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Cragin Watershed Protection Project

Final Environmental Assessment

Lead Agency

U.S. Department of Agriculture, Forest Service, Coconino National Forest, Mogollon Rim Ranger District

Cooperating Agencies

U.S. Department of Interior, Bureau of Reclamation, Phoenix Office
U.S. Department of Interior, Fish and Wildlife Service, Arizona Ecological Services Office
State of Arizona, Game and Fish Department
Salt River Project
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Cover Photo: C.C. Cragin Reservoir, formerly Blue Ridge Reservoir as seen from Forest Road 751.

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List of Abbreviations

4FRI – Four Forests Restoration Initiative
ADEQ – Arizona Department of Environmental Quality
ALERT – Automated Local Evaluation in Real Time
AMZ – Aquatic Management Zone
AZGFD – Arizona Game and Fish Department
AZPDES- Arizona Pollutant Discharge Elimination System
AZNST – Arizona National Scenic Trail
BA – Basal area
BMP – Best management practice
CBH– Crown Base Height
CCF – Hundred Cubic Feet
CEQ – Council on Environmental Quality
CFR – Code of Federal Regulations
CL – concern level
CNF – Coconino National Forest
CWD – Course Woody Debris
CWPP –Cragin Watershed Protection Project
Dbh – Diameter at breast height
DEIS – Draft Environmental Impact Statement
Drc – Diameter at Root Collar
EA– Environmental Assessment
EIS – Environmental Impact Statement
ERI – Ecological Restoration Institute
FEIS – Final Environmental Impact Statement
FOFEM – First-Order Fire Effects Model
FRCC – Fire Regime Condition Class
FSH – Forest Service Handbook
FSM – Forest Service Manual
FVS – Forest Vegetation Simulator
GHG –Greenhouse gas
FR – Forest road
FRCC – Fire regime condition class
FSVeg – Field Sampled Vegetation, a national database
FVS – Forest Vegetation Simulator
GCNRT – General Crook National Recreation Trail
GIS – Geographic Information Systems
GMU – Game Management Unit
HUC – Hydrologic Unit Code
IBA – Important Bird Area
IDT – Interdisciplinary Team
LEARN – Long-term Ecological Assessment and Restoration Network
LiDAR – Light Detection and Ranging.
MA – Management area
MIS – Management Indicator Species
ML – Maintenance Level
MSGP – Multi-sector General Permit
MSO – Mexican spotted owl
NAAQS – National Ambient Air Quality Standards
NCGU –Non-commercial Group Use
NEPA – National Environmental Policy Act
NF – National Forest
NFMA – National Forest Management Act
NHPA – National Historic Preservation Act
NOGO – Northern Goshawk
NRCS – Natural Resources Conservation Services
NRHP – National Register of Historic Places
NRV – Natural Range of Variability
OHV – Off highway vehicle
ORV –Outstanding remarkable values
PAC – Protected activity center (Mexican spotted owl)
PCE – primary constituent elements
PFA – Post-fledging family area (Northern Goshawk)
PM – Particulate Matter
QMD – Quadratic Mean Diameter
RFSS – Regional Forester's Sensitive Species
ROS- Recreation Opportunity Spectrum
ROD- Record of Decision
ROS – Recreation Opportunity Spectrum

- P-Primitive
- SPNM-Semi-primitive non-motorized
- SPM –Semi-primitive motorized
- RN –Roaded Natural
- U- Urban

SDI – Stand density index
SHPO – State Historic Preservation Office
SIO – Scenery integrity objectives
SMS – Scenery Management System
SNOTEL –Snow Telemetry
SPCC – Spill Prevention, Countermeasures and Contingency
SOPA-Schedule of Proposed Actions

SRP– Salt River Project
SWCP – Soil and Water Conservation Practice
SWPPP – Site specific pollution prevention plan
TCP – Traditional cultural property
TES – Terrestrial ecosystem survey
TES – Threatened, endangered and sensitive
TMDL – Total Maximum Daily Load
TMR – Travel Management Rule
TPA – Trees per acre
UEA – Uneven Aged
USDA – U.S. Department of Agriculture
USDOI – U.S. Department of the Interior
USFWS – U.S. Fish and Wildlife Service
VQO – Visual quality objective
VSS – Vegetative structural stages
WEPP – Water Erosion Prediction Project
W&SR – Wild and Scenic River
WUI – Wildland-urban interface

Introduction

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. This document is organized into five main parts and additional appendices.

Chapter 1: Purpose and Need: The section includes information on the purpose of and need for the project, a description of the existing and desired conditions, needs for change, opportunities to move the project area towards desired conditions, and a brief summary of the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal, and how the public responded.

Chapter 2: Comparison of Alternatives, including the Proposed Action: This section provides a more detailed description of how the agency developed the Proposed Action, alternatives considered and those alternatives that were eliminated from detailed analysis. Design features of the Proposed Action are summarized, and mitigation measures and monitoring are described. This section also presents a comparison of alternatives based on how they meet the project's objectives and units of measure described in Chapter 1.

Chapter 3: Affected Environment and Environmental Consequences: This section describes the affected environment and the environmental effects of implementing the Proposed Action and other alternatives.

Chapter 4: Consultation and Coordination: This section provides lists of individuals involved in the environmental assessment, agencies consulted during the development of the environmental assessment, and individuals and groups that responded during public involvement phases of the project.

Appendices: The following appendices provide more detailed information to support the analyses presented in the environmental assessment.

Appendix A: Large and Old Tree Implementation Plans

Appendix B: Proposed Action Design Features

Appendix C: Forest Plan Compliance

Additional documentation, including more detailed analyses of project-area resources, is available upon request or may be found in the project planning record located at the Coconino National Forest Supervisor's Office.

CHAPTER 1: Purpose and Need

Background

The Mogollon Rim Ranger District of the Coconino National Forest has prepared an Environmental Assessment (EA) under the Healthy Forest Restoration Act (HFRA) authority to document the environmental effects of the Cragin Watershed Protection Project (CWPP). The analysis evaluates and discloses the effects of vegetation treatments using mechanical and hand thinning and prescribed burning on the National Forest to reduce the risk of uncharacteristic wildfire[1] to the wildland urban interface[2] (WUI), critical developments, infrastructure and drinking water watersheds in and adjacent to the project area. Mechanical and hand vegetation treatments are proposed over about 37,764 acres and prescribed burning treatments are proposed over about 63,634 acres within the project area. A recent example of an uncharacteristic wildfire on the Coconino National Forest includes the Schultz Fire in 2010, which encompassed thousands of acres and burned at high severity[3] over 39% of the fire area. This fire caused large stands of trees to be killed and resulted in soils becoming hydrophobic (a condition where soils repel water). The conditions resulted in post-fire erosion and flooding in sub-watersheds within and downstream of the burned area.

The HFRA of 2003, as amended, provides improved statutory processes to reduce delays and the complexity of administrative processes for hazardous fuel reduction projects on National Forest System Lands. The delays not only put communities and infrastructure at risk to uncharacteristic fire, they allow the conditions of key watersheds to continue to degrade. While the focus of the CWPP is fuels reduction, the proposed treatments benefit ecological processes that promote healthy resilient ecosystems and healthy human communities.

The CWPP qualifies under the HFRA authority in the following ways:

- The entire project area is covered by the Blue Ridge Area, Mogollon Rim Ranger District Community Wildfire Protection Plan (Gatewood, 2010).
- 26% of the project area consists of WUI values at risk and surrounding buffers consisting of private lands, critical communications sites, high voltage transmission lines, water

[1] Uncharacteristic wildfire means fire severity outside the historic fire regime, which was a low severity/high frequency fire regime.

[2] The WUI definition used in this project comes from Southwestern Region (R3) Supplement No. 5100-2010-2, September 7, 2010, FSM 5100, Fire Management, Chapter 5140, section 5140.5. The WUI includes those areas of resident populations at imminent risk from wildfire and human developments having special significance. These areas in CWPP include critical communications sites, municipal watersheds, high voltage transmission lines, water pipelines, campgrounds, weather stations, fire towers, historical cabins and Forest Service administrative sites that if destroyed by fire would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites regardless of the distance involved. Generally all private property, developments and infrastructure was buffered by a half mile in all directions to denote the WUI boundary surrounding the values at risk. In the Blue Ridge, Mogollon Rim Ranger District Community Wildfire Protection Plan (Gatewood, 2010) all private lands are buffered by a half mile in all directions and up to 4 miles on the upwind side of predominant winds. This does not necessarily mean that WUI areas will be treated any differently than other areas in the project area but is a way to prioritize treatments.

[3] Severity (Keeley, 2009) is used to describe the effects of wildfire on soil (sometimes called "burn severity") or on fuels and vegetation (sometimes called "fire severity"). Fire severity descriptors may include characterization of fuel consumption (what is burned), vegetation mortality and measures such as bark char and foliage scorch. These are indicators of how the fire behaved and are often related to mortality. Intensity is reserved for fire-line intensity and the important physical characteristics of fire such as residence time, rate of spread, depth and duration of soil heating which all help to explain the severity and secondary ecosystem effects of the fire.

pipelines, campgrounds, weather stations, fire towers, historical cabins and Forest Service administrative sites that, if destroyed by fire, would result in hardship to communities.

- 71% of the project area is within watersheds that drain into the C.C. Cragin Reservoir which is a municipal water supply to the Town of Payson and other northern Gila County communities. The water from the reservoir also supplies water to the Phoenix Metropolitan Area served by SRP. The municipal water supply watersheds are a WUI value at risk.
- Post-fire flooding following an uncharacteristic wildland fire would result in erosion that would have an adverse effect on water quality of the C.C. Cragin Reservoir and maintenance of the municipal water supply.
- Approximately 100 % of the project area is in Vegetation Condition Class 2 and 3 where the vegetation is highly to moderately departed from historical reference conditions.
- Threatened and endangered (T&E) species and habitat is present. The project's purpose is to provide enhanced protection to T&E species habitat from post-fire effects following an uncharacteristic wildfire. The proposed action alternative 2 complies with applicable guidelines in the revised 2018 Land and Resource Management Plan for the Coconino National Forest (USDA Forest Service 2018), and the revised Mexican Spotted Owl Recovery Plan 2012 (USDI Fish and Wildlife Service, 2012).
- Old growth vegetation and large trees are present within the project area and the proposed vegetation treatments satisfy the old growth and large tree retention requirements in the Healthy forest Restoration Act. The project incorporates a project specific Old Tree Implementation Plan and a Large Tree Implementation Plan which specifically identifies limited circumstances in which old or large trees may be removed. .
- Collaboration with stakeholders and interested publics occurred during project proposal development and was key to the development of this Proposed Action.

Project Location

The CWPP area encompasses about 64,433 acres and is located about 55 miles south of Flagstaff on the Mogollon Rim Ranger District of the Coconino National Forest in Coconino County, Arizona. The project legal location is listed on Figure 1. The CWPP area mainly includes the three sub-watersheds that drain into the C.C. Cragin Reservoir (formerly Blue Ridge Reservoir): East Clear Creek-Blue Ridge Reservoir, Bear Canyon and Miller Canyon. Together these sub-watersheds comprise about 45,485 acres or 71 percent of the project area. When full, the C.C. Cragin Reservoir impounds 15,000 acre feet with a water depth of 100 feet across about 280 surface acres. Additional areas (18,948 acres) surrounding the three sub-watersheds are included in the project area because the forest has a high crown fire hazard and includes various WUI sites and values at risk (see Figure 2) such as private lands, Forest Service administrative sites, recreation sites and other critical infrastructure. The CWPP area lies within the 2.4 million acre Four Forest Restoration Initiative.

Local Community and Values at Risk

The project area serves as a source area for a large municipal water supply and includes many WUI sites and values at risk (Figure 3). The Cragin sub-watersheds comprise a municipal water supply source area for the Town of Payson and several Northern Gila County communities which

are situated below the Mogollon Rim surrounded by the Tonto National Forest. Water supplies from the watershed and reservoir are intended for use in outstanding water rights settlements, including the settlement of the Tonto Apache Tribe. The sub-watersheds are also a water supply source area for cities and water users who receive water from the Salt River Project. Water deliveries provided from the C.C. Cragin reservoir are delivered by a pipeline to the East Verde River, which is a tributary to the Verde River. The Lower Verde River and its reservoirs provide municipal water deliveries in the Phoenix Metropolitan area. The project area includes various C.C. Cragin Project facilities owned by the U.S. Bureau of Reclamation and operated by the Salt River Project: the dam, pumping facility, water pipeline, electric power line, priming reservoir and surge tank. There are 557 acres of developed and undeveloped private lands in small blocks consisting of Goddard, Dick Hart, Little Springs and the Reservoir. Numerous Forest Service administrative sites, facilities and infrastructure are located within the project area including the Blue Ridge Ranger Station, Moqui and Baker Butte lookout towers, Long Valley, Moqui, Kehl, and Blue Ridge Campgrounds.

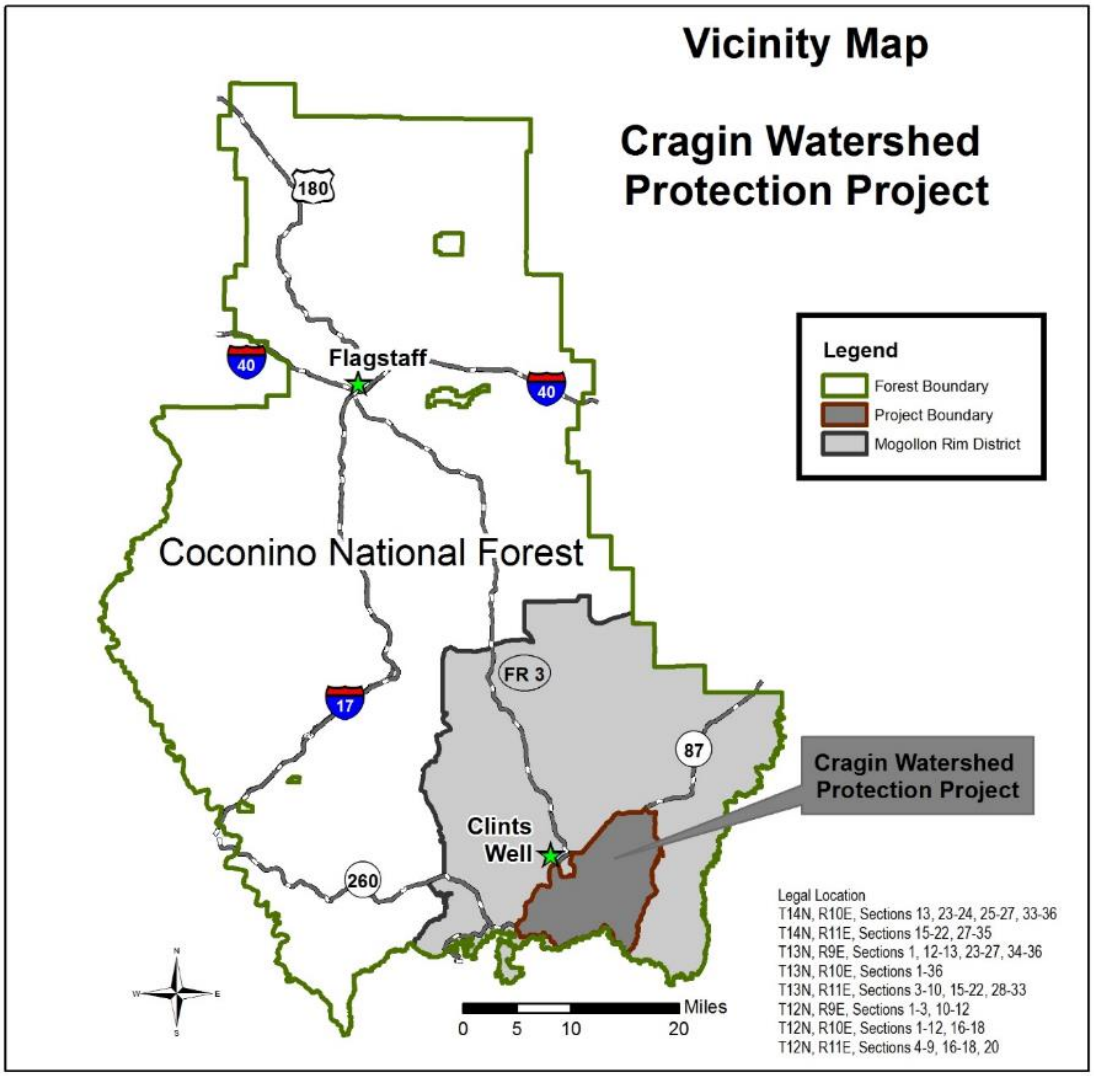


Figure 1. Vicinity Map for the CWPP

Several historical cabins are in the project area: Pinchot Cabin, Baker Butte Cabin and Barn, General Springs Cabin and various cabins and structures at Long Valley Campground. Three permitted recreational residences at Forty Four Springs are WUI sites. There are numerous facilities under special use authorizations including electric power lines, telephone and fiber optic cable lines, radio repeaters, communication towers and weather stations. The State Highway Route 87 right-of-way is in the project area and is another value at risk. The designated WUI area for private lands, facilities and infrastructure comprises about 17,000 acres (26% of the project area).

The Blue Ridge Community Wildfire Protection Plan (Gatewood, 2010) includes all of the project area as well as the entire Mogollon Rim Ranger District. Community Wildfire Protection Plans were authorized by the Healthy Forests Restoration Act of 2003. The Blue Ridge Community Wildfire Protection Plan evaluated the local conditions and risks from fire, and designed a plan to address all aspects of community protection and wildfire mitigation that can be implemented by the community and forest.

The CWPP area contains parts of two National Trails, the Arizona National Scenic Trail (11.6 miles) and the General Crook National Recreational Trail (14.1 miles). In addition, the project area contains parts of several national forest system trails including the Barbershop, Rock Crossing, Houston Brothers, Fred Haught and U Bar trails (18.0 miles) (Figure 3). The national and system trails feature outstanding recreational, natural resource, cultural, historical and scenic values and are considered a value at risk from uncharacteristic wildfire.

The CWPP area contains habitat for several important protected and sensitive wildlife species. The project area provides important habitat for the threatened Mexican spotted owl (MSO). All or parts of 32 Mexican spotted owl Protected Activity Centers (PACs) are found in the project area and comprise about 30 percent of the project area (19,471 acres). An additional six PACs occur along the eastern boundary of the project area. About 26 miles of streams provide critical for the threatened Little Colorado spinedace, and candidate conservation agreement species roundtail chub, bluehead sucker and Little Colorado River sucker *spp*. Four northern goshawk Post Fledging Areas (NOGO PFAs) occur in the project area and comprise about 4% of the project area (2,484 acres). The northern goshawk is a Southwest Region Forest Service Sensitive species. The project area also contains potential habitat for the northern leopard frog (sensitive) and Chiricahua leopard frog (listed as threatened). The steep canyons in the project area provide the bulk of the habitat for nesting and breeding for these terrestrial and aquatic wildlife species. An uncharacteristic wildfire in the project area would modify forested habitat important to the birds and could result in post-fire hill slope erosion that would supply unnatural amounts of sediment ash into streams that would degrade water quality for aquatic species.

The Salt River Project (SRP) manages a series of dams and reservoirs on the Salt River, the Verde River, and East Clear Creek, having a total functional capacity of 2.3 million acre-feet of water. These central Arizona reservoirs are a key water supply to the Phoenix Metropolitan Area. The C.C. Cragin reservoir is one of seven reservoirs within SRP's reservoir system. SRP and municipal water providers in the Phoenix Metropolitan area have realized impacts to water supplies following wildfires in the Salt and Verde River systems. Monsoonal rain events following fires such as the Rodeo-Chediski Fire, Cave Creek Complex Fire, Willow, Sunflower and Wallow Fire have washed sediment, debris and ash into rivers and reservoirs negatively impacting water quality and reservoir capacity. Runoff from wildfires contains heightened levels of nitrates, phosphates, heavy metals, total organics, and turbidity. Inflows into reservoirs

following uncharacteristic wildfire reduce storage capacity through sedimentation and increase water treatment costs due to increases in chemical constituents.

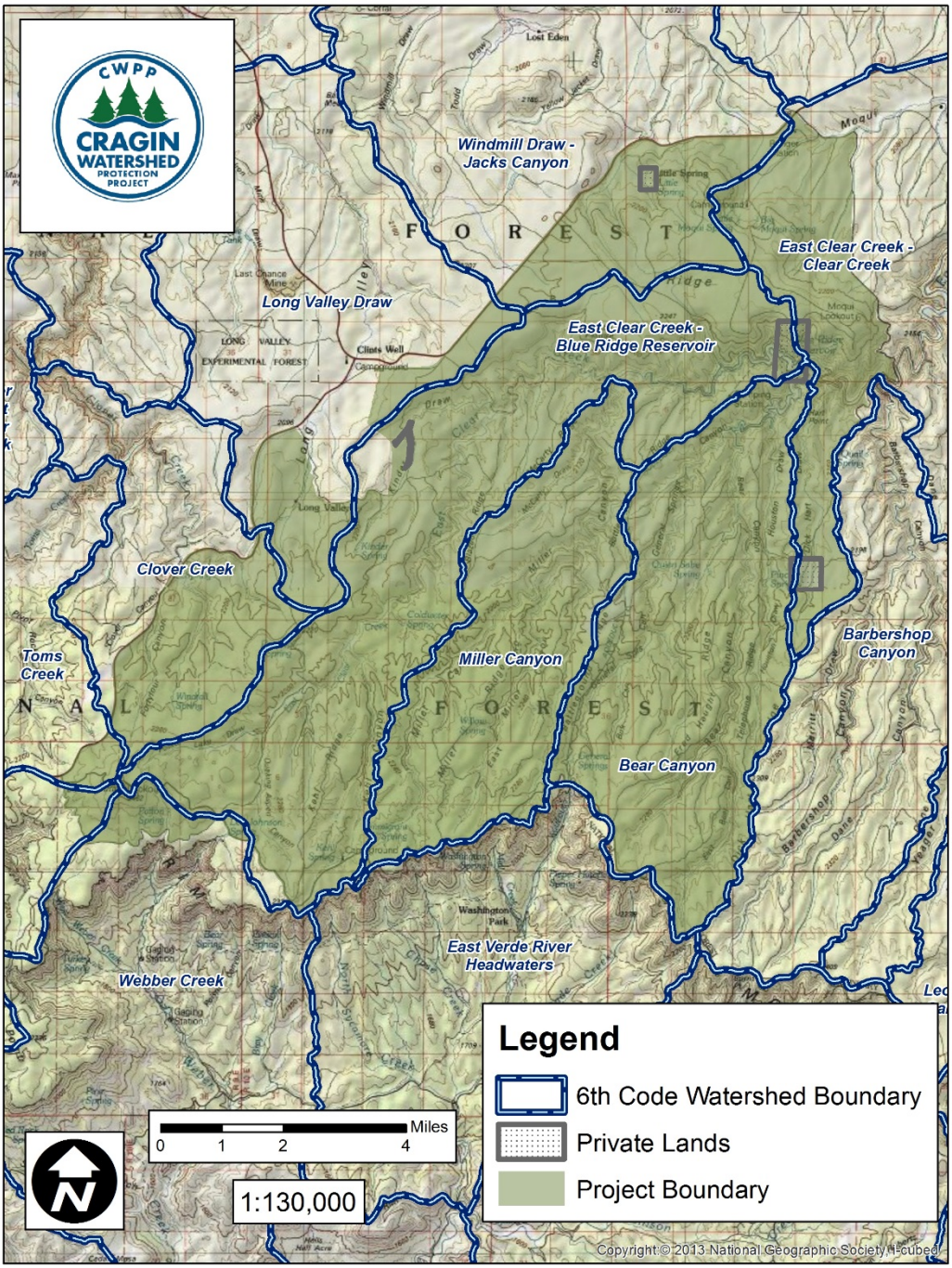


Figure 2. Location and Boundary Map for the CWPP

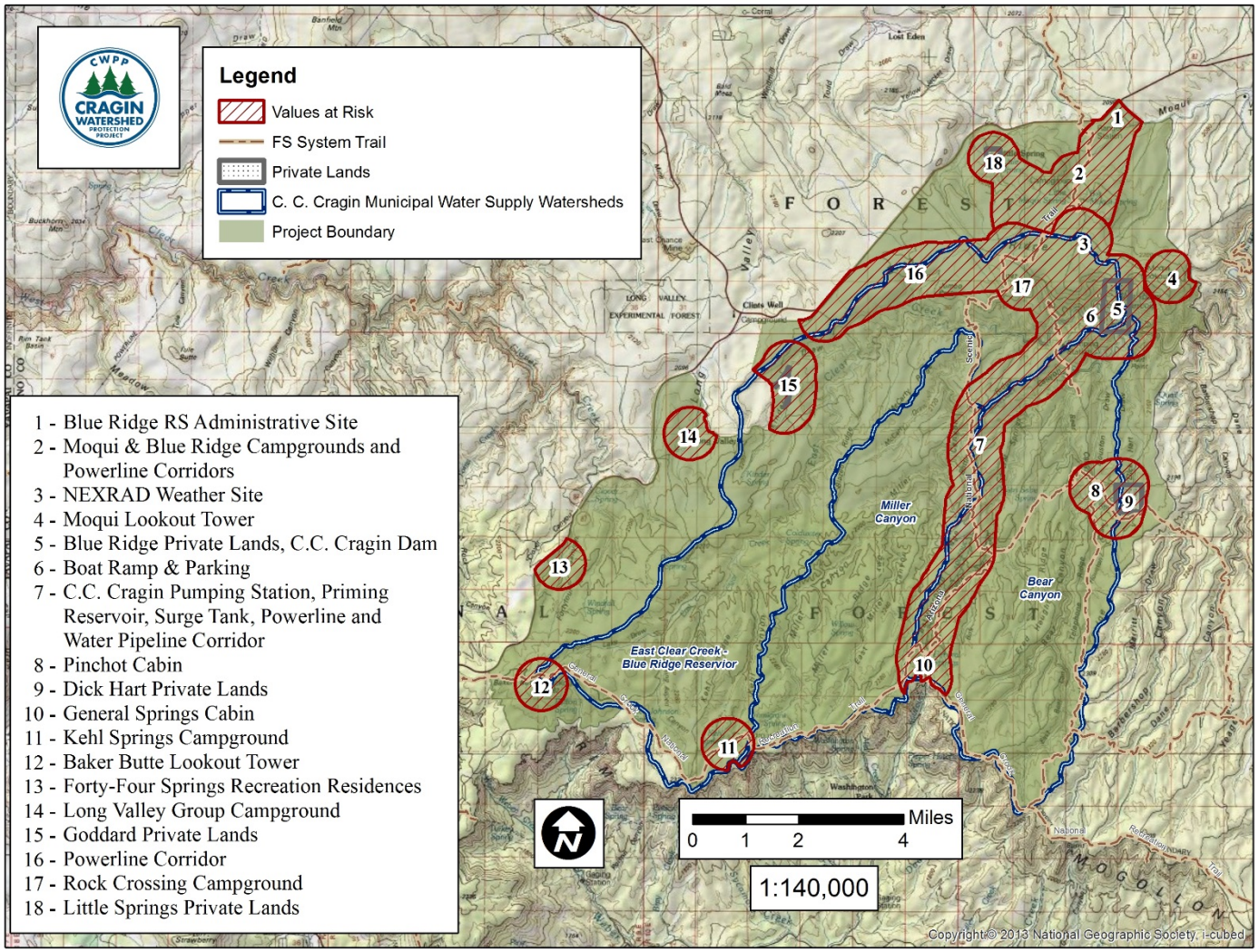


Figure 3. Municipal Watershed, WUI Sites and Boundaries, Critical Infrastructure and Values at Risk

Why Here – Why Now?

The purpose of the Cragin Watershed Protection Project (CWPP) is to reduce the risk of uncharacteristic wildfire and subsequent flooding and sedimentation within and adjacent to the three sub-watersheds that drain into C.C. Cragin Reservoir by diversifying forest structure, reducing tree densities, and reducing ground and ladder fuels. The Forest Service proposes to use a combination of mechanical and hand thinning and prescribed burning to reduce these risks.

Under the 2004 Arizona Water Settlements Act (Act) (Public Law 108-451, 43 USC 1501), title to the Blue Ridge dam, reservoir, and associated water diversion infrastructure was transferred from the Salt River Project Agricultural Improvement and Power District (Salt River Project or SRP) to the U.S. Department of Interior, Bureau of Reclamation, for the exclusive use and benefit of the Salt River Federal Reclamation Project. In addition, the reservoir and dam were re-named the C.C. Cragin Project and SRP and the Salt River Valley Water Users' Association were assigned responsibility for the care, operation, and maintenance of the reservoir, dam, and associated water diversion infrastructure. The Act allows use of up to 3,500 acre-feet/year of water for municipal and domestic uses in Northern Gila County, Arizona. Currently, the Town of Payson relies exclusively on groundwater to meet its demand for potable water. In 2011, the Land Withdrawal and Reservation was enacted which clarified the jurisdiction of the Secretary of Interior with respect to the C.C. Cragin Dam and Reservoir and administrative jurisdiction of the Secretary of Agriculture over various land management activities on the covered land (Public Law 112-45).

Through collaborative efforts that include the Forest Service, Salt River Project (SRP), Bureau of Reclamation (BOR) and the Town of Payson, a pipeline and water treatment facility have been constructed by the Town of Payson that will allow Payson to use water from the reservoir. The Town will have access up to 3,000 acre feet – approximately 1 billion gallons – of water for its drinking water supply per year. Water delivery from the reservoir to the Town of Payson was expected to begin in 2018, but has been deferred due to abnormal drought conditions. When the pipeline is fully operational, surface water from C.C. Cragin reservoir will become the primary source of potable water for the Town of Payson, allowing this municipality to meet its projected build-out demand for water resources. Water from the reservoir is used by SRP and is actively being used for water rights resolution agreements between SRP and various communities in Northern Gila County, and as a potential source of supply for the Tonto Apache Indian Community. The build-out of the Payson C.C. Cragin project includes modernization of C.C. Cragin Reservoir pumping and transmission facilities and construction by the Town of Payson of new raw water and finished water pipelines, a hydroelectric facility and a water treatment plant. Total cost of the Payson C.C. Cragin Project is estimated to be approximately 52 million dollars. More information on the Town of Payson, C.C. Cragin Project, and the pipeline and water treatment facility can be found at this website:
http://www.paysonaz.gov/Departments/water/Cragin.html

The potential threat of wildfire to the use of C.C. Cragin Reservoir as a domestic and municipal water supply is exemplified by the 2002 Hayman Fire in Colorado. This wildfire burned over 137,000 acres impacting watersheds that provide domestic and municipal water to several cities along Colorado's Rocky Mountain Front Range including the City of Denver. Over a two year period following the fire, water providers spent $25 million removing sediment from a reservoir that serves as a source of potable water with additional costs due to slope re-stabilization efforts. This web site, (https://www.planning.org/research/postdisaster/casestudies/haymanfire.htm) provides information on the post-fire impacts of the Hayman Fire. The Hayman post-fire erosion

response is typical of high-severity fire-impacted watersheds with reports of increases in sediment yield of over 1,400 times greater than pre-fire conditions. In addition to increased erosion and its impact on suspended sediment concentrations in surface waters, high-severity wildfires can result in an increase in nutrient loading (i.e., nitrogen and phosphorus) to water bodies resulting in an increase in algal growth and reduction in dissolved oxygen leading to fish kill (Lyon & O'Connor, 2008). The Cragin project facilities, which include the extensive infrastructure required to divert water from the reservoir, 11 miles of pipeline and power lines, water pumps, priming tank and the hydropower generating unit, are all susceptible to direct fire damage. Fire damage could leave the communities which depend on C.C. Cragin water supplies without water.

At the end of April 2018, the Tinder Fire ignited in the East Clear Creek drainage within the CWPP project area. The fire quickly grew to over 8,000 acres in the first few days under dry conditions and high winds, and burnt several structures within the Blue Ride WUI. Previous mechanical and prescribed fire treatments completed within the project area illustrated a clear decrease in fire severity (MacDonald 2018). This illustrates the need to act as soon as possible to reduce the risk of high severity wildfire within the project area. While the models are expected to provide helpful information regarding likely fire risk under recently observed similar conditions, the increasing frequency and intensity of drought and high winds means that high severity crown fires and the effects of those fires (loss of private property, tree mortality, and post-fire flooding) are likely more intense than predicted by current models.

Partnerships and the Cragin Watershed Protection Project

The three watersheds that feed C.C. Cragin Reservoir were identified as priority watersheds in the Western Watershed Enhancement Partnership between the U.S. Department of Agriculture and the Department of Interior. The partnership between the two agencies seeks to accomplish common goals and interests in water supply, quality, conservation and watershed function. The Cragin Watershed Protection Project is one of six pilot projects in the nation. These pilot projects are designed to improve watershed functions and reduce the risk of uncharacteristically severe wildfire across jurisdictional boundaries.

The Coconino National Forest, the Salt River Project, Bureau of Reclamation, National Forest Foundation and the Town of Payson signed a Memorandum of Understanding (MOU) intended to establish a joint program to proactively improve the health of the three watersheds in July of 2014. A proclamation was signed in September, 2014, between the partners and local and state officials codifying the efforts to reduce wildfire hazard in the watersheds under the Western Watershed Enhancement Partnership.

This project is one of the many projects within the Four Forest Restoration Initiative (4FRI) footprint, and the Rim Country Environmental Impact Statement (EIS) (second 4FRI EIS) project area which initiated the proposal development phase of planning in 2015. The goal of 4FRI is to increase the pace and scale of forest restoration efforts in the forests of northern Arizona. The goal of the CWPP is to expeditiously reduce hazardous fuels in the project area to protect the water supply of the Town of Payson and other water users. The Coconino NF and partners are working toward this goal by accelerating the CWPP planning efforts. To meet this timeline, the CWPP does not include restoration projects beyond restoring forest structure and restoring low-intensity fire to the landscape. The anticipated completion of the Rim Country EIS is estimated to be in 2019 or later. The CWPP EA is scheduled for completion in 2018. The rapid completion of CWPP planning efforts will enable the Forest Service to begin implementation as soon as possible

which is important to protect the C.C. Cragin reservoir and water supply from the damaging effects of a future uncharacteristic wildfire.

Ongoing and Future Foreseeable Projects Watershed Health Project

The CWPP partially overlaps with the East Clear Creek (ECC) Watershed Health Project NEPA Decisions (2006); the overlap comprises about 30,445 acres (47 percent of the CWPP project area). Past thinning over 1,020 acres (thin from below treatments[4]) and prescribed burning over about 3,176 acres from 2007 to 2016 as part of the ECC project have been completed within and adjacent to the CWPP project area. About 4,295 acres of forest (2,753 acres within the CWPP boundary) are targeted for thinning as part of the East Clear Creek 4FRI task order which was issued in 2014. The CWPP proposes to analyze these stands in the Proposed Action alternative because treatment under CWPP would allow MSO PAC treatments that are aligned with the 2012 MSO Revised Recovery Plan (USDI Fish and Wildlife Service, 2012) and would more completely meet fuels reduction objectives and reduce threats to owl habitat. The task order could still be implemented with modifications as programmed or could be implemented as part of the CWPP Proposed Action alternative 2. Watershed restoration opportunities that would improve conditions in the CWPP project area have been identified in the East Clear Creek Watershed Health Project (ECC) decision and include but are not limited to thinning of conifers in meadows, stabilization of incised stream channels, and protection of riparian areas by fencing out access by elk and deer. All forest stands identified for treatment within the ECC project are within the scope of the CWPP proposed action to trend forest vegetation towards desired conditions. Vegetation thinning and prescribed burning activities completed through ECC may be re-treated through the CWPP depending on site conditions at time of implementation.

Long-Term Ecological Assessment and Restoration Network Research Project

One treatment block (56 acres) of the Long-Term Ecological Assessment and Restoration Network (LEARN) research project to study dry mixed conifer treatments on the Mogollon Rim is within the CWPP area. Research treatments in dry mixed conifer stands were analyzed in the East Creek Watershed Health Improvement Project EA and approved in the Decision Notice (2006). Vegetation thinning and prescribed burning treatments in the LEARN blocks are presently undergoing post-decisional review according to Forest Service Handbook 1909.15, Section 18.1, and may be implemented in 2018. A detailed listing of past, ongoing and future foreseeable actions such as vegetation treatments, wildfires, prescribed burning and watershed restoration treatments is found in Chapter 3 as part of the cumulative effects analysis. All forest stands within the LEARN study are within the scope of the CWPP proposed action to trend vegetation towards desired conditions. Activities proposed through CWPP will defer to the LEARN Study's proposed treatments for the designated research stands.

Four Forest Restoration Initiative (4FRI) Rim Country Project

The entire project area of the CWPP is within in the 4FRI Rim Country project area. Rim Country has a broader purpose of overall forest restoration than the more focused purpose of CWPP, which is to reduce fuels in such a way as to decrease the chance of an uncharacteristic wildfire affecting critical infrastructure and values at risk within the project area. However, fuels reduction and thinning treatment to reduce crown fire potential are intended to put the forests in CWPP on a

[4] Thin from below is a treatment description where the smallest diameter or shortest trees are removed until the desired stocking level is reached.

trajectory towards restoration even though the primary focus is hazardous fuels reduction. The Rim Country EIS analysis will consider other types of restoration activities in the CWPP area including wildlife habitat improvement, stream channel restoration, aspen regeneration, and restoration of meadows and springs. Tree harvesting, thinning and prescribed burning activities completed through CWPP will not be intensified or further analyzed for treatment in 4FRI Rim Country; rather 4FRI activities will complement CWPP by focusing on other restoration objectives.

Historic Conditions

Historically, fire was an integral component of the ecosystem. Prior to human-influenced changes to the characteristic fire regime, the composition, structure, and spatial pattern in frequent-fire forests were maintained by frequent, low-severity fire through a functional relationship between pattern and process; that is, frequent low-severity fires resulted in forest structures that facilitated continued low-severity fire (Fitzgerald, 2005) (Graham, McCaffrey, & Jain, 2004) (Hiers, O'Brien, Mitchell, Grego, & Loudermilk, 2009) (Thaxton & Platt, 2006) (Mitchell, Harmon, & O'Connell, 2009).

Recent research from a small group of scientists has concluded that historic data demonstrates the region surrounding the project area experienced mixed severity fire, and that high-fire severity was not an uncommon phenomena (Odion, et al., 2014) (Williams & Baker, 2012). While there may have been many areas in the southwest region that historically supported naturally greater numbers of trees, which may have supported mixed severity fire or even high-severity fire, the overwhelming majority of research from a great number of studies which have occurred near the project area, supports the reduction of tree densities (Sánchez Meador, Parysow, & Moore, 2010) (Ffolliott, Barger, & Martin, 1967) (Fulé, Covington, & Moore, 1997). Recent research of mixed conifer forest on the Mogollon Rim found that historical high-severity fires were very unlikely, and "the historical fire regime on this landscape was one of high-frequency, low-severity fires." (Huffman, Zegler, & Fulé, 2015).

Much research has been done in the past several decades to determine reference conditions (pre-European settlement approximately 1870) for ponderosa pine in Arizona. The studies referenced below are from forest soils developed from basalt, limestone and sandstone bedrock as the CWPP area has these bedrock types. Tree stocking levels, stand density and tree age and diameter have been studied. Data collected around Camp Navajo near Flagstaff determined that approximately 60 trees per acre were present in 1883 (Fulé, Covington, & Moore, 1997). Also, on the Coconino National Forest near Flagstaff, research studies found evidence that trees per acre historically ranged from 20 – 87 (Moore, Huffman, Fulé, Covington, & Crouse, 2004). An inventory of the Long Valley Experimental Forest, which is located near the project area, was completed around the time of its establishment in 1936. Data from that inventory shows that the average tree diameter for ponderosa pine was around 20 inches. Forest stand densities ranged from 73 to 181 trees per acre (average of 100 tpa) and basal areas ranging from 61 to 102 ft^2 per acre (average of 90 ft^2) (Ffolliott, Barger, & Martin, 1967). These stocking levels indicate a relatively open forest with less than full site occupancy, and low competition among trees.

Dry mixed conifer forests occur throughout the project area and are similar to ponderosa pine forests in general stand structure, but Douglas-fir, white fir, southwestern white pine, and, occasionally, spruce are also important components of these forests (Reynolds, et al., 2013). They intergrade with the cool/moist ponderosa pine types on warmer/drier sites at the lower end of the mixed-conifer zone and with wet mixed-conifer forests on the cooler/moister sites at the upper

end of the zone. Dry mixed-conifer forests intergrade with or are adjacent to pure ponderosa pine forest and experience similar site conditions and ecological disturbances (Reynolds, et al., 2013).

Mixed Conifer with infrequent fire is also present in the project area and referred to as wet mixed conifer. Within the Cragin WPP, wet mixed conifer can be found on microsites within the canyons and drainages and are so intermingled with other forest cover, making it difficult to delineate separate stands of vegetation that can be classified as wet mixed conifer vegetation type.

Due to its frequent fire regime, historical fine-scale structure and spatial pattern of dry mixed-conifer forests were similar to ponderosa pine in having a more open structure and similar aggregated arrangement of trees in some stands. Historical species composition was dominated by fire-resistant, shade-intolerant conifers such as ponderosa pine, southwestern white pine, and Douglas-fir. Consequently, species composition in dry mixed-conifer forests was historically regulated by the balance between climate and disturbance agents, such as fire. Shade tolerant, less fire-resistant species were historically minor components on drier sites, such as ridge tops and southwest-facing slopes, and likely more frequent on cooler and/or more mesic sites in frequent-fire forests, such as drainages and north-facing slopes. Empirical evidence also indicates that historically, dry mixed-conifer forests had lower tree densities and a more open structure comprised of a higher proportion of old and large trees, were more spatially heterogeneous (having groups and patches of trees) and were more uneven-aged compared to current conditions. Mean tree densities and basal areas were similar to those in ponderosa pine stands but with slight increases at the fine scale (Reynolds, et al., 2013).

Existing Conditions

Forest Cover and Habitat Types

The CWPP area consists of dense stands of ponderosa pine and mixed conifer, with tree densities ranging from 500 to 6,000 trees per acre for about 65 percent of the project area. Average tree density for trees greater than 5 inches in diameter ranges from about 121 to 500 trees per acre on about 59 percent of the project area (Figure 5). In terms of basal area, 71 percent of the project area exceeds 120 ft^2 of basal area per acre.

Within the mixed conifer stands there is a shift toward more shade tolerant species within the younger tree classes and regeneration. The current stocking levels indicates high competition among trees, resulting in competition-induced mortality and growth stagnation. Historical data suggest that historical tree densities for trees greater than 5 inches ranged from 73 to 181 trees per acre (average of 100 tpa) and basal areas ranged from 61 to 102 ft^2 per acre (average of 90 ft^2) (Ffolliott, Barger, & Martin, 1967). These historic stocking levels indicated a relatively open forest with less than full site occupancy, and low competition among trees. In terms of spatial pattern, homogenous conditions exist where continuous tree canopies over large landscapes are at risk of high-intensity, severe fire behavior (Reynolds, et al., 2013).

Forest vegetation within the project area is variable and changes by factors such as topography, aspect, and elevation. As shown in Table 1, the analysis area is dominated by the ponderosa pine cover type with 66 percent of the area and mixed conifer with 33 percent of the analysis area.

Table 1. Forest cover types within the CWPP analysis area

Forest Cover Type	Acres	Percent of Land Area
Ponderosa Pine	19,552	30%
Ponderosa Pine-Gambel Oak	23,256	36%
Mixed Conifer	21,068	33%
Private Land	557	<1%
Total	64,433	100%

The three forest cover types incorporate small inclusions of other types such as aspen, grassland, other non-forested lands and w ater bodies totaling less than 1 percent of the project area.

While wildfire has begun to be managed and prescribed burning has occurred across the project area and over the ranger district over the last two decades, the century-long exclusion of frequent, low-intensity fires prior to this has led to striking and rapid changes in ecosystems that evolved under frequent disturbance. For example forest conditions have resulted in: increased tree stocking, increased tree biomass, both live and dead, resulting in increased susceptibility to insect and disease epidemics, and supporting a shift from frequent, low-intensity surface fires to increasingly larger crown fires (Cooper, 1960) (Swetnam T. W., 1990) (Covington & Moore, 1994) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996).

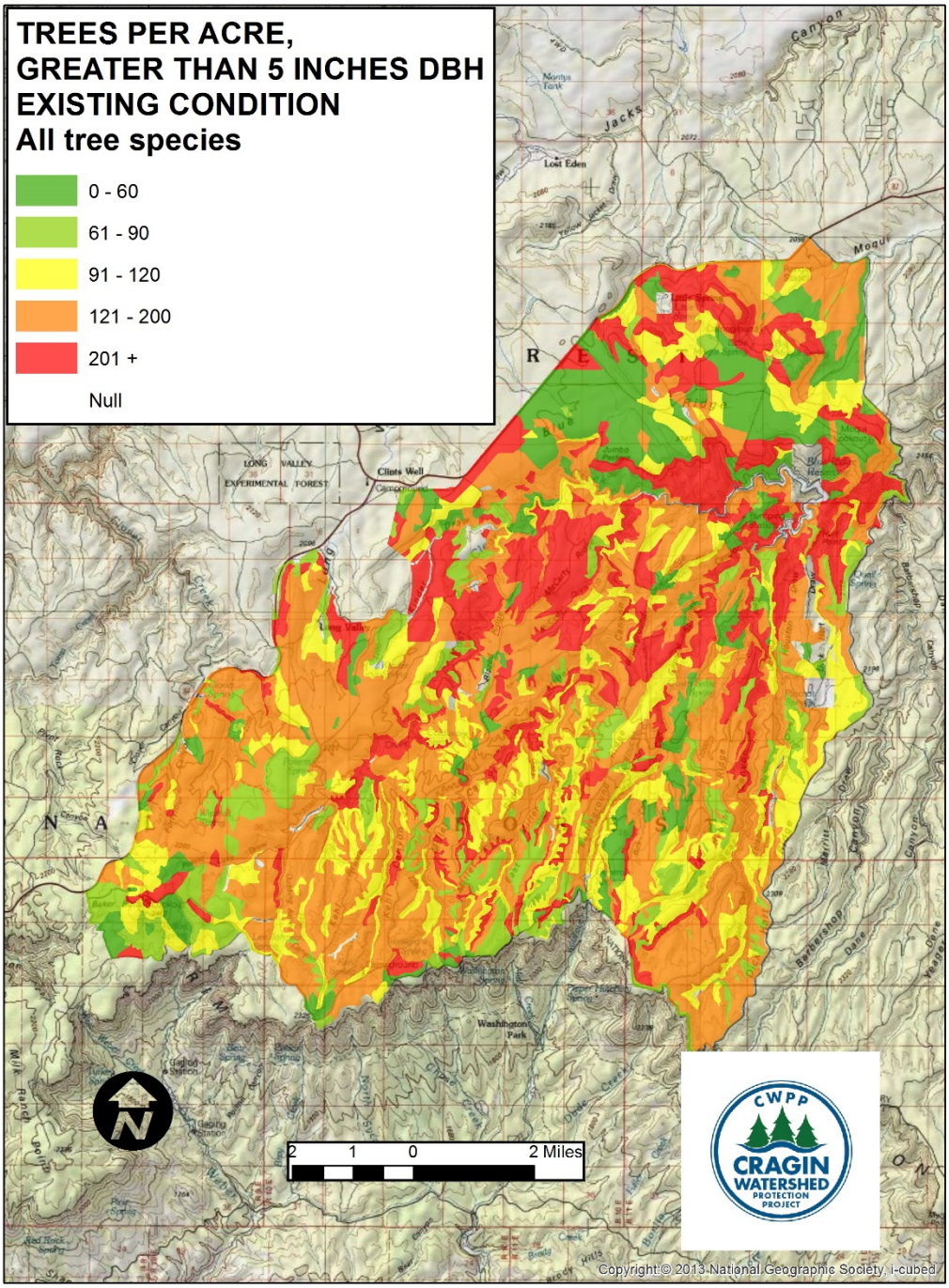


Figure 4. Existing condition of trees per acre, all tree species and size classes, excluding trees less than 5 inches

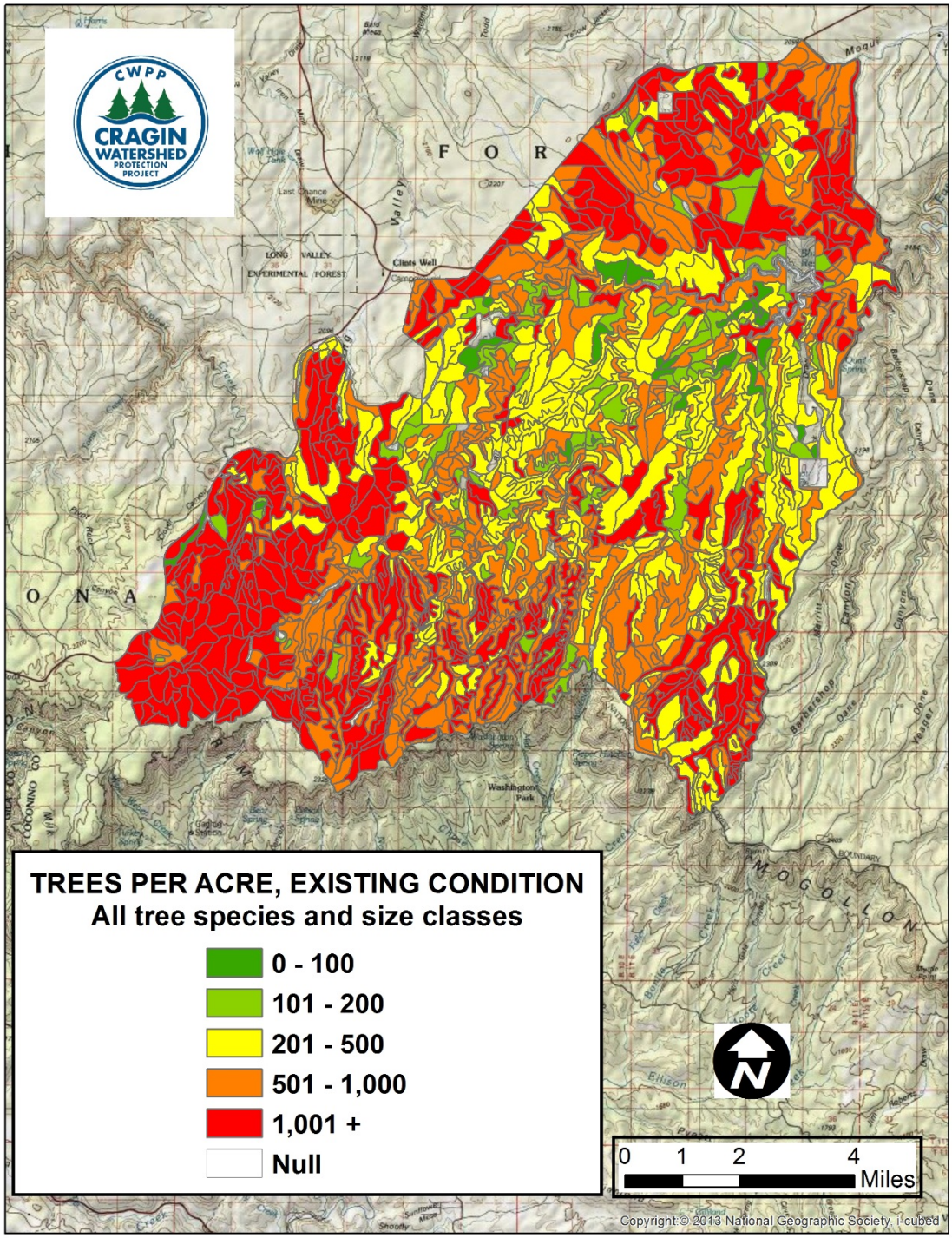


Figure 5. Trees per acre, for the existing condition. Average tree density for trees greater than 5 inches in diameter ranges from about 121 to 500 trees per acre on about 59 percent of the project area.

Of major importance within the project area is both the Mexican spotted owl (*Strix occidentalis)* specifically protected or managed around Protected Activity Centers (PACs), which includes nest/core areas, and has specified recovery and foraging areas. Northern goshawk habitat is specifically protected or managed around Post Fledging Family Areas (PFAs), which include nest stands, and foraging habitat. There are 32 MSO protected activity centers (PACs) in the project area. In addition, seven PACs are located within 0.5 mile of the project boundary.

As shown in Figure 7, the ponderosa pine and dry mixed conifer cover types were stratified into forest types based on the habitat structure and composition goals of the Mexican spotted owl and the northern goshawk. This categorization was done in order to meet analysis requirements, desired conditions, guidelines contained within the 2018 Forest Plan and the 2012 MSO Recovery Plan.

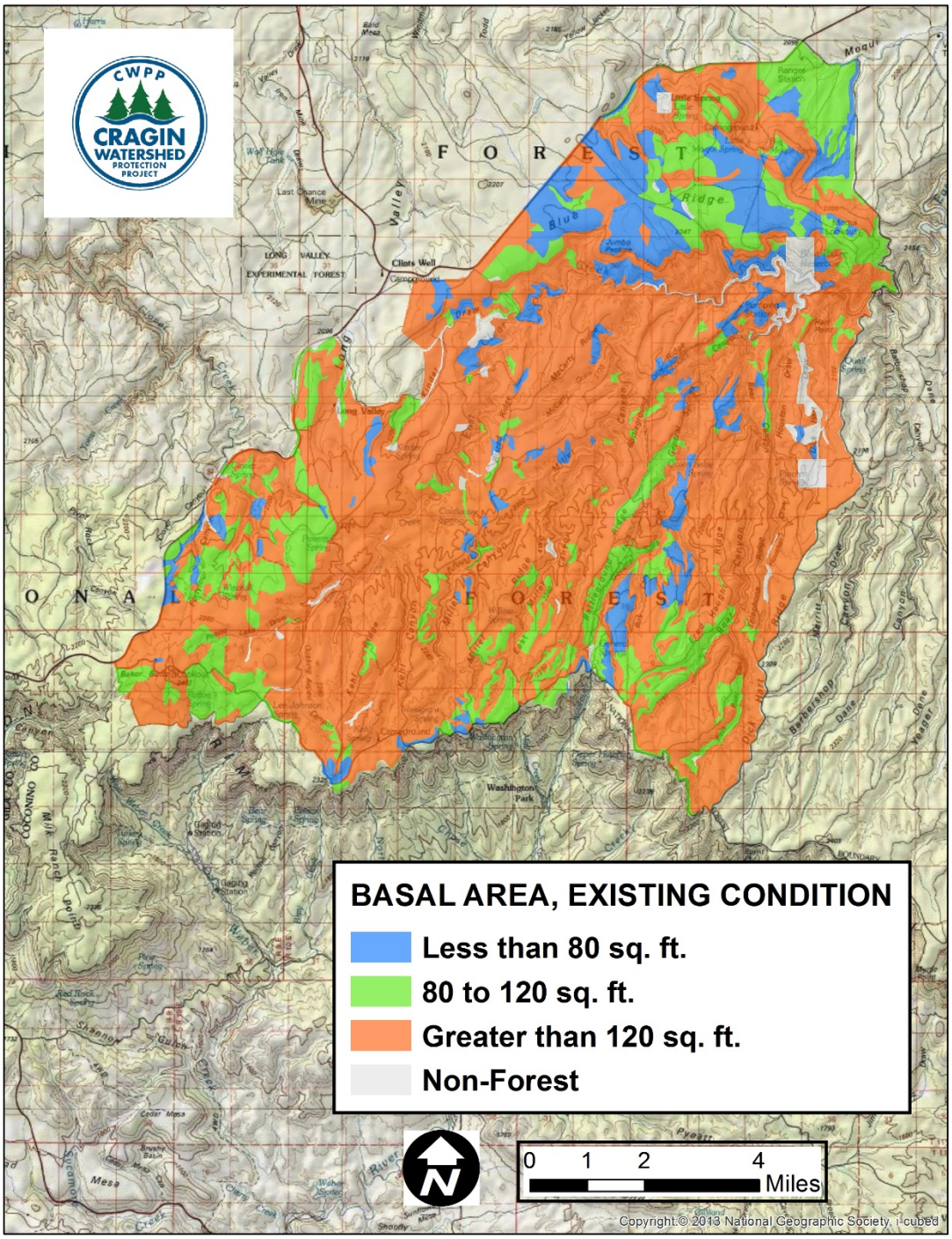


Figure 6. Existing condition of basal area for the CWPP area. Map displays that the majority of project area exceeds 120 square feet of basal area. Canyons and associated MSO habitat are areas of particularly high basal area

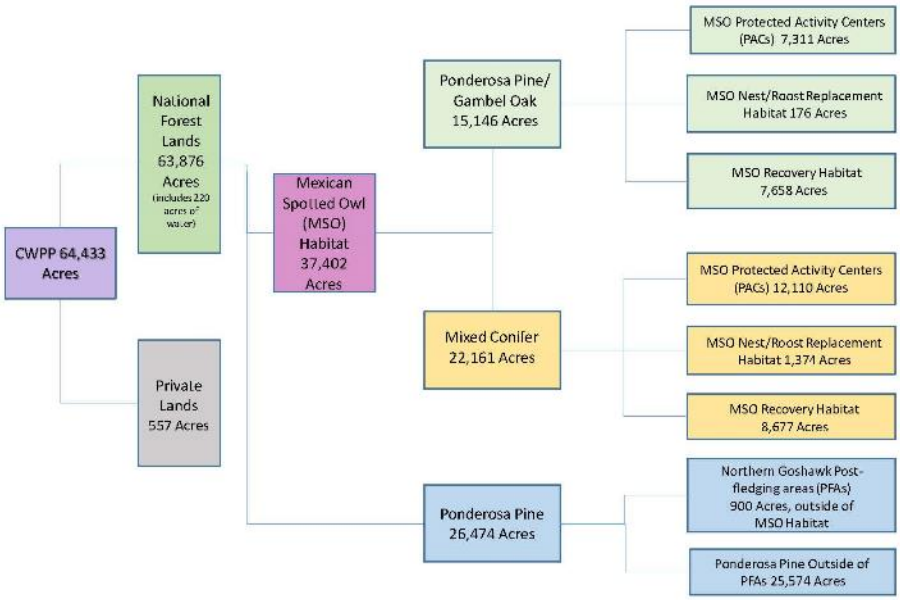


Figure 7: Stratification of forested lands by vegetation cover and wildlife habitat type within the CWPP.

Vegetation Condition Class

Vegetation Condition Class (VCC) uses vegetation departure from historic conditions. VCC gives a coarse assessment of vegetation conditions as it relates to ecosystem processes and functions. Both the current project's LANDFIRE assessment and the Blue Ridge, Mogollon Rim Ranger District Community Wildfire Protection Plan shows that almost 100% of the CWPP area has a condition class rating of two or three, meaning that vegetation components are moderate to highly departed from historic conditions (Table 2 and Figure 8). Previously, LANDFIRE Fire Regime Condition Class (FRCC) deliverables included both classed and continuous metrics of departure for vegetation and were called FRCC. According to the FRCC Guidebook, FRCC is a combination of vegetation departure and fire frequency and severity departure. The layers previously referred to as Fire Regime Condition Class (FRCC) were measures of vegetation departure, hence the name change. For more information on VCC please visit the web site at http://www.landfire.gov/.

Table 2. Summary of the existing condition for vegetation condition class by acres and percent of acres. Current vegetation is moderate to highly departed from the historic range of variability.

Vegetation Condition Class					
Class 1 low vegetation departure		**Class 2 moderate vegetation departure**		**Class 3 high vegetation departure**	
Acres	*Percent of area*	*Acres*	*Percent of area*	*Acres*	*Percent of area*
179	Less than 1%	26,987	42%	37,267	58%

Fire Behavior Type

As part of the fire modeling for the CWPP project area, weather conditions for nine large wildfires (greater than 100 acres) on the Mogollon Rim District were compared to look for common factors of large fire growth. Parameters from the Clover (2000) fire were used for crown fire potential modeling and output validation. The existing conditions of the project area show that a large proportion of the area is currently susceptible to forms of crown fire (Figure 9). Over 90% over the project area would demonstrate some form of crown fire under 97% percentile weather. About 76% of the forested area has the potential for **active crown fire** where the entire tree canopy is lost to fire. About 18% of the area has the potential for **passive crown fire** in which individual or small groups of trees torch out, but solid flaming in the canopy is not likely to be maintained except for short periods. The remaining 6% of the forested area has the potential for a **surface fire** only. The FLAMMAP modeling run chosen to represent existing crown fire potential may show slightly higher values than reality, primarily due to the inability of LANDFIRE data to account for recent vegetation treatments and wildfire that has occurred in the recent past. Over the last 10 years about 21,250 acres within the CWPP project area burned in wildfires managed for resource objectives. Another 4,736 acres of prescribed burning has occurred and 1,565 acres has been under various prescriptions in the project boundary. There is no consistent or feasible way to account for all vegetation and fuel changes to date. The modeling run chosen (97th percentile weather conditions, along with live fuel moistures and high wind conditions of the Clover Fire) represents a high fire danger or "worst case" scenario.

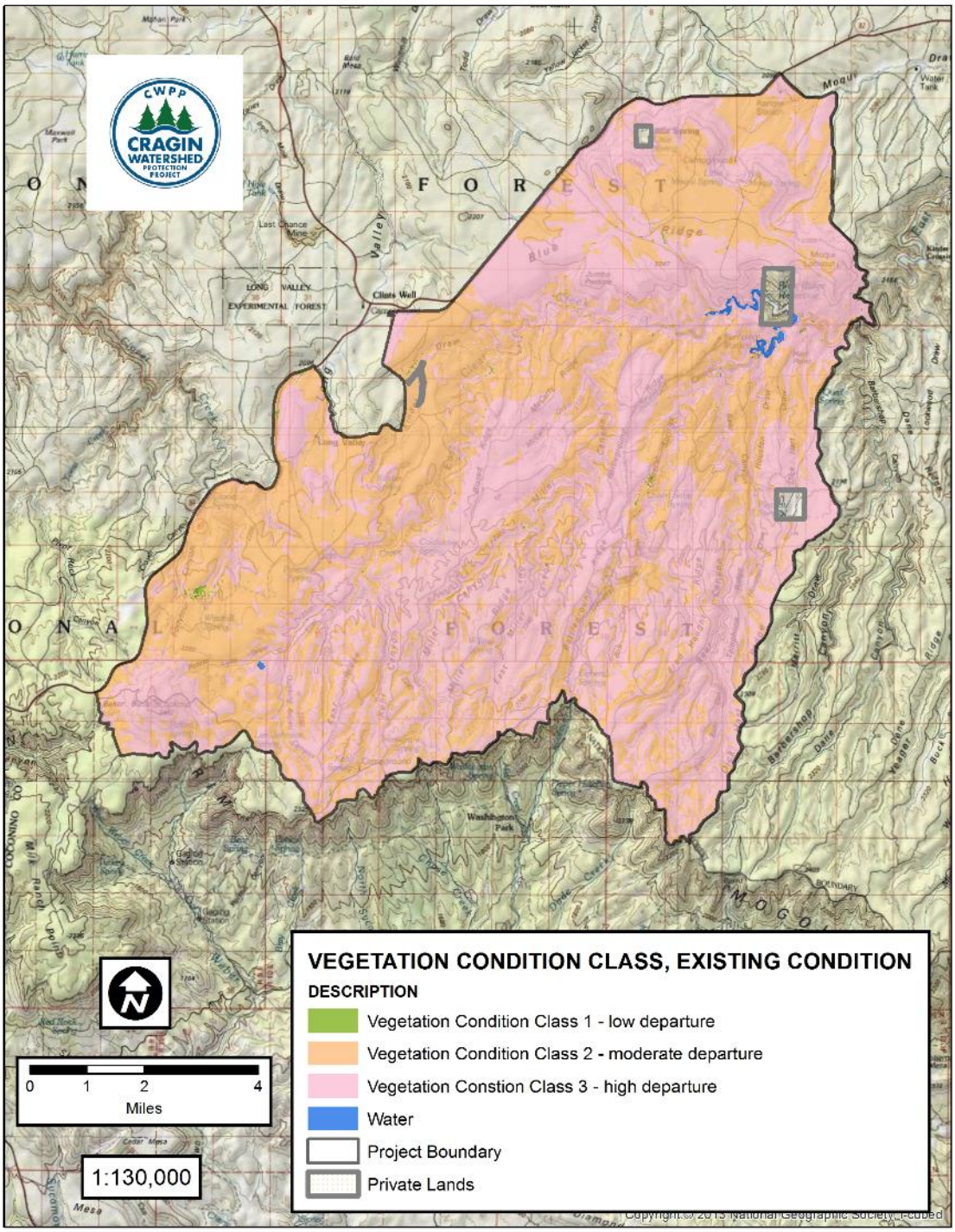


Figure 8. Vegetation condition class for the CWPP area. Current vegetation is moderate to highly departed from the historic range of variability.

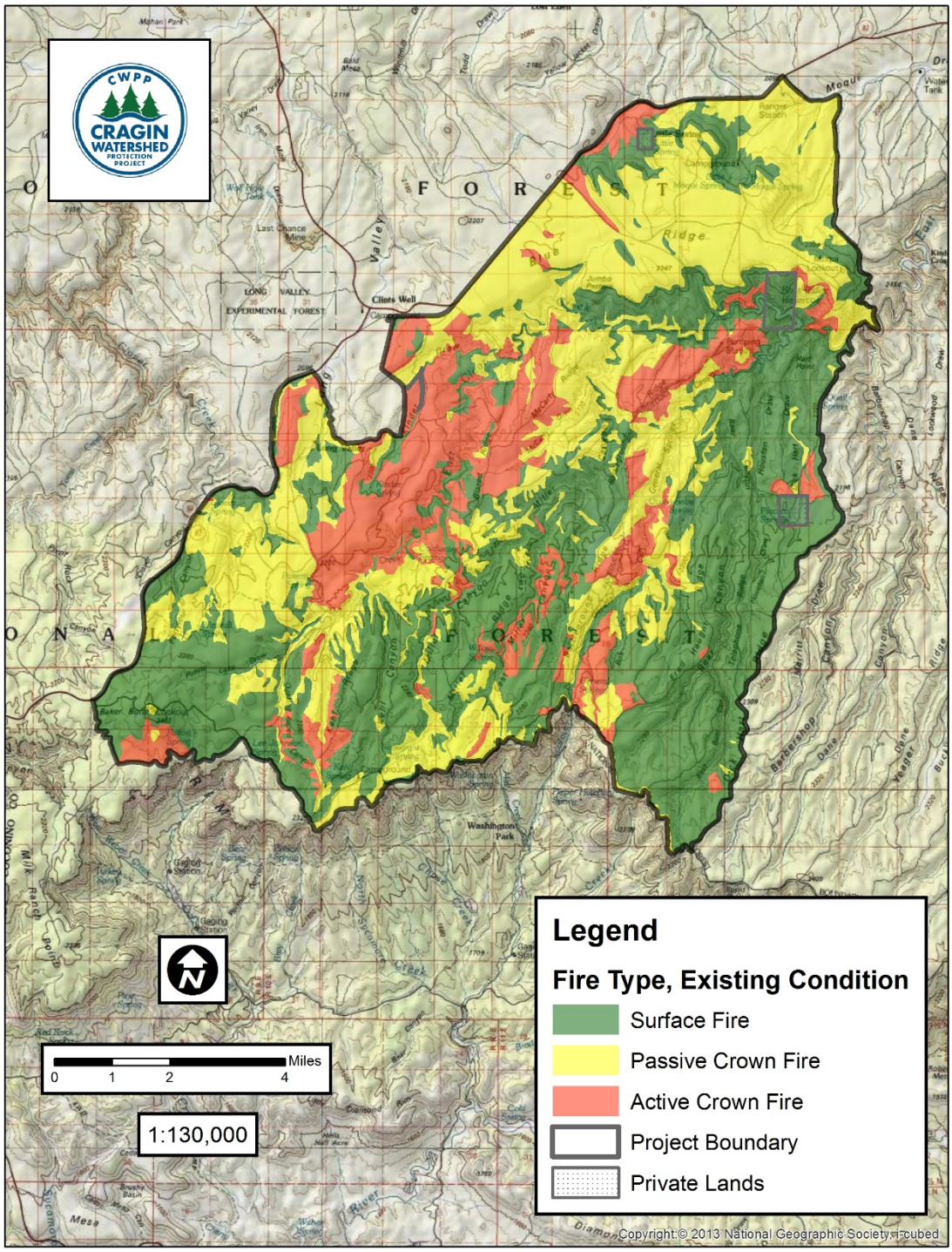


Figure 9. Fire Behavior Type Map for the CWPP. Existing conditions show more than half of the project area is conducive to crown fire.

Table 3. Existing condition for fire behavior type by acres and percent of area. Currently vegetation conditions support active crown fire for the majority of the project area.

Fire Type					
Surface Fire		**Passive Crown Fire**		**Active Crown Fire**	
Acres	*Percent of area*	*Acres*	*Percent of area*	*Acres*	*Percent of area*
29,908	47%	22,908	36%	10,818	17%

Current forest conditions in the area also limit the effectiveness of fire-fighting infrastructure within the project area such as the Baker Butte Lookout Tower. Currently, a variety of trees have grown up and around the tower obscuring the view from the lookout, which is decreasing efficiency in spotting fires and has created a dangerous situation, as the early detection of wildfires in the project area and surrounding areas is compromised.

Desired Conditions

Forest Cover and Habitat Types

Desired conditions for the following forest cover and habitat types is based on a synthesis of management direction as found in the 2018 Land and Resource Management Plan for the Coconino National Forest (Forest Plan), Management Recommendations for the Northern Goshawk in the Southwestern United States (1992), Mexican Spotted Owl Recovery Plan, First Revision (2012), and best science such as the general technical report entitled Restoring Composition and Structure in Southwestern Frequent-Fire Forests (2013).

General

A variety of forest conditions (composition, structure and pattern) would exist across the landscape, comparable to historic conditions. Forested landscapes would be diverse with groups and patches of variable tree densities, including groups with dense, closed canopies (interlocking crowns) and small areas of scattered individual trees; well shaded soil beneath tree groups; dead, deformed and diseased trees; large logs and woody debris; and old, large oaks, junipers and aspen. Canopy openings within the forest would be common and support a diverse species composition and productive grass/forb/shrub community. Forest habitats would contain a forest overstory dominated by ponderosa pine, mixed where appropriate with pinyon and juniper species, oaks, aspen, Douglas fir, limber pine or white fir. Large old alligator junipers would continue to exist where they currently occur.

In areas with mixed conifer habitat canopy openings would be smaller and tree groups would be at finer scales with aggregates and individual large trees separated by small openings.

Overall, the project area would be comprised of forest conditions that are resilient to disturbance (insects, disease, fire, climate change) and sustainable through at least several generations of trees. Forest habitats would generally be vigorous, with endemic levels of native insect and disease occurrences. Dwarf mistletoe would be an element of the forest landscape. There would be a varied level of mistletoe across the landscape, comparable to historic conditions. Forest structure and density would impede spread and reduces

impacts associated with infection. Dwarf mistletoe infections would be irregularly distributed among tree groups, such that effects are limited to the forest group and patch scale.

The ponderosa pine and dry mixed conifer forest would contain uneven-aged stands composed of a distribution of age classes that comprise a sustainable balance of structural stages. Old trees and old forest structure would be sustained over time across the landscape.

Table 4. Summary of existing and desired tree density in terms of basal area for CWPP forest habitat types.

Forest Cover and Habitat Type	Purpose	Existing Basal Area	Desired Basal Area (stand-level)
		Square feet per acre	*Square feet per acre*
Ponderosa Pine - outside of PFAs and MSO habitat	Reduce the threat of an uncharacteristic wildfire, develop uneven-aged stand characteristics and maintain goshawk foraging habitat.	110	40 to 80
Ponderosa Pine - northern Goshawk PFAs outside of MSO habitat	Protect the PFA from uncharacteristic wildfire, while retaining goshawk PFA and nesting habitat characteristics.	154	60 to 80
Ponderosa Pine – northern Goshawk Nest Area	Protect the nest areas from uncharacteristic wildfire, while retaining goshawk nest area habitat characteristics.	167	Minimum of 115
MSO Recovery Habitat- Pine- Oak	Reduce crown fire hazard while developing uneven-aged conditions and retaining key MSO habitat elements	137	60 to 90
MSO Recovery Habitat- Mixed Conifer	Reduce crown fire hazard while developing uneven-aged conditions and retaining key MSO habitat elements.	136	60 to 120
MSO Protected Activity Center- Pine-Oak	Reduce crown fire hazard and maintain uneven-aged habitat conditions and maintain existing nest/roost habitat.	132	Nest Core: 100 to 125 PAC: 80 to 140
MSO Protected Activity Center- Mixed Conifer	Reduce crown fire hazard and maintain uneven-aged habitat conditions and maintain existing nest/roost habitat.	140	Nest Core: 115 to 135 PAC: 90 to 150
Mexican Spotted Owl Nest/Roost Replacement- Pine-oak	Reduce crown fire hazard while developing uneven-aged conditions and retaining key MSO habitat elements.	187	100 to 125

Forest Cover and Habitat Type	Purpose	Existing Basal Area	Desired Basal Area (stand-level)
Mexican Spotted Owl Nest/Roost Replacement- Mixed Conifer	Reduce crown fire hazard while developing uneven-aged conditions and retaining key MSO habitat elements.	148	115 to 135
Baker Butte Treatment	Fuel reduction and removing trees that block the view of the landscape from the tower, reducing the ability of personnel to detect new fires	172	60

Ponderosa Pine Outside of PFAs

Desired future conditions include increased diversity in age and size classes, uneven-aged stand structure, and improved successional dynamics. A balanced distribution of vegetative structural stages (VSS) formed as groups separated by interspace is desired. The desired distribution of size age classes is defined within Table 5. It is desired to have groups of 2 to 40 trees ranging in size from 0.1 acre to 0.7 acre, with interspaces between groups. Within ponderosa pine forests outside of PFAs, canopy cover for mid-aged forest tree groups (VSS 4-6) should average 40% or greater (Proposed Forest Plan Amendment 2, this EA). At the stand level, basal areas would range from 40 ft^2 to 80 ft^2 per acre.

All snags greater than 12 inches diameter would be retained, 3 downed logs greater than 12 inches diameter and at least 8 ft. long, and 5 to 7 tons of woody debris greater than 3 inches in diameter would be retained per acre.

Table 5. Desired vegetation structural stage distribution for uneven-aged stands, by age and tree size class

Percentage of Land Area	Age and Tree Size Class	Vegetation Structural Stage (VSS)
10%	grass/forb/shrub (openings)	1
10%	seedling sapling (1-5” dbh)	2
20%	young forest (5-12” dbh)	3
20%	mid-age forest (12-18” dbh)	4
20%	mature forest (18-24” dbh)	5
20%	old forest (24”+ dbh)	6

DBH- diameter breast height, the diameter of a tree measured at 4.5 feet above the ground. The target VSS distribution would not likely be achieved in one entry; and, due to the even-aged structure of many stands, it may take a century or more. The percentages are a guide and may vary up to 3%.

Northern Goshawk Post-Fledging Family Area (PFA)

The desired condition is to provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-

fledging family area. Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Coconino NF Forest Plan, p. 65-10). At the stand level, basal areas would range from 60 ft^2 to 80 ft^2 per acre.

All snags greater than 12 inches diameter would be retained, 3 downed logs greater than 12 inches diameter and at least 8 ft. long, and 5 to 7 tons of woody debris greater than 3 inches in diameter would be retained per acre.

Northern Goshawk Nesting Area

This forest type provides unique nesting habitat conditions for goshawks. Important features include trees of mature to old age with high canopy cover. The nesting area contains only mature to old forest (VSS 5 & 6) having a canopy cover (measured vertically) between 50-70% with mid-aged VSS 6 trees 200-300 years old. Non-uniform spacing of trees and clumpiness is desirable (Forest Plan, Desired conditions for ponderosa pine, FW-TerrERU-PP-DC-4 and 13). At the stand level, basal areas would have a minimum basal area of 115 ft^2 per acre.

Mexican Spotted Owl - Protected Activity Center, Mixed Conifer

Desired future conditions for stands of mixed conifer inside MSO PACs is to maintain key habitat components (e.g., large trees, large snags, large logs, hardwoods) as specified in the revised MSO Recovery Plan (USDI Fish and Wildlife Service, 2012) and to reduce the potential for crown fire to burn up the PAC by reducing the fuels hazard. The desired conditions listed in the recovery plan call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size, maintain canopy cover of 60 percent, and maintain 50 percent of basal area in trees greater than 16 inches dbh. At the stand level, PAC basal areas would range from 90 ft^2 to 150 ft^2 per acre. Nest core basal areas would range from 115 ft^2 to 135 ft^2.

Mexican Spotted Owl Protected Activity Center, Ponderosa pine-oak

Desired future conditions for stands of ponderosa pine inside MSO PACs is to maintain key habitat components (e.g., large trees, large snags, large logs, hardwoods) as specified in the revised MSO Recovery Plan (USDI Fish and Wildlife Service, 2012) and to reduce the potential for high intensity wildfire from burning up the PAC by reducing the fuels hazard. The desired conditions listed in the recovery plan call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size, maintain canopy cover of 40 percent, and maintain 50 percent of basal area in trees greater than 16 inches dbh. At the stand level, PAC basal areas would range from 80 ft^2 to 140 ft^2 per acre. Nest core basal areas would range from 100 ft^2 to 125 ft^2.

Mexican Spotted Owl - Recovery Habitat, Mixed Conifer

Within MSO recovery habitat, desired conditions include treatments that mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Stand structure should be uneven-aged. Provide for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in

size. Stand basal area should range from 60 ft^2 to 120 ft^2. Maintain key habitat components (e.g., large trees, large snags, large logs, hardwoods).

Mexican Spotted Owl - Recovery Habitat, Ponderosa pine-oak

Within MSO recovery habitat, desired conditions include treatments that mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Stand structure should be uneven-aged. Provide for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size. Stand basal area should range from 60 ft^2 to 90 ft^2. Maintain key habitat components (e.g., large trees, large snags, large logs, hardwoods).

Mexican Spotted Owl - Nest/Roost Replacement Habitat, Mixed Conifer

Nest/roost replacement habitat are areas managed towards the desired conditions of nest/roost habitat. These are areas intended to eventually replace nest/roost habitat lost to disturbance or aging and death and to provide new nest/roost habitat for a recovering owl population (USDI Fish and Wildlife Service, 2012, p. 386).

Within MSO nest/roost recovery habitat, desired conditions include basal area ranging from 115 to 135 ft^2 per acre. Trees from 12-18 inches dbh would comprise thirty percent of stand basal area and an additional 30 percent of basal area would come from trees greater than 18 inches dbh. The desired conditions for nest roost recovery also call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size and maintain canopy cover of 60 percent.

Desired conditions include treatments that mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Stand structure should be uneven-aged. Treatments would foster retention of trees greater than 18 inches dbh, yellow pines, mixed conifer trees with fire scars, snags greater than 18 inches, down logs greater than 12 inches mid-point diameter, and large hardwoods.

Mexican Spotted Owl - Nest/Roost Replacement Habitat, Ponderosa pine-oak

Management objectives are the same as for mixed conifer. Within MSO nest/roost recovery habitat, desired conditions include basal area ranging from 100 to 125 ft^2 per acre. Trees from 12-18 inches dbh would comprise thirty percent of stand basal area and an additional 30 percent of basal area would come from trees greater than 18 inches dbh. The desired conditions for nest roost recovery also call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size, and maintain canopy cover of 60 percent.

Desired conditions include treatments that mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Stand structure should be uneven-aged. Treatments would foster retention of trees greater than 18 inches dbh, yellow pines, mixed conifer trees with fire scars, snags greater than 18 inches, down logs greater than 12 inches mid-point diameter, and large hardwoods.

Vegetation Condition Class and Fuels

The desired condition for the project area is to have vegetation that allows for frequent low severity surface fires that approach the historical fire regime for the vegetation types in the project area. The desired condition would be to shift the project area from mostly Condition Class 3 (highly departed) to predominately Condition Class 1 (low departure) with a minor part of the area in Condition Class 2 (moderate departure).

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 (Fire Regime I) 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.

Vegetation and coarse woody debris levels would be altered to change fire type in the project area that would shift from dominantly active and passive crown fire to mostly surface fire. Vegetation attributes that would shift fire type from active and passive crown fire to surface include reducing the trees per acre which in turn reduces canopy bulk density (mass per unit volume of available canopy fuels) so that the forest attains a more open horizontal and vertical structure more similar to historical conditions and which would better support surface fire. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites for ponderosa pine. While in mixed conifer, openings typically range from 10 percent in more productive sites to 50 percent in the less productive sites. Reducing small diameter trees and raising canopy base height (height of lowest live limbs) would also contribute to reducing crown fire potential.

Thinning will reduce smaller trees while fire can kill lower live limbs of live trees to increase canopy base heights. Woody debris consisting of surface litter, dead and down logs, and small trees that comprise the fuel load on the forest floor would be maintained at 3-10 tons per acre in ponderosa pine, pine-oak and 5-15 tons per acre in mixed conifer in the project area. Forest structure surrounding values at risk and WUI sites would have smaller and more widely spaced groups of trees and fuel treatments would focus on spatial distribution that does not pose a threat to infrastructure or firefighters. Shifting to a predominantly surface fire regime would reduce overall burn severity resulting in less impacts to soils and potential for erosion. FLAMMAP was used to demonstrate changes in fire type with FVS outputs used to derive change in forest vegetation.

The following scales of desired conditions (USDA Forest Service, 2014) are consistent with the Forest Plan and have been used as a guide in developing the proposed action (Table 6).

Table 6. Existing and Desired Conditions for Vegetation Condition Class and Fuel Parameters

Measure	Existing	Desired
Canopy Base Height	Ranges from 0-60 feet, average = 12 feet	Averaging 18 + feet in ponderosa pine and dry mixed conifer (Agee & Skinner, 2005)
Canopy Bulk Density	Ranges from 0 - 0.35, average = 0.10 kg/m^3	Averaging 0.05 kg/m^3 in ponderosa pine and mixed conifer (Stratton, 2009)
Woody Debris	0.1-50 tons per acre	3-7 tons/acre in ponderosa pine, pine-oak; 10-15 tons/acre in mixed conifer. (Forest Plan new page 65-10). Spatially distribute coarse woody debris in WUI to lessen threat to infrastructure and firefighters.
Trees per acre	10-6000 trees per acre	< 120 in ponderosa pine and mixed conifer. Excluding Gambel oak and aspen.

Purpose and Need for Action

The purpose of the CWPP is to:

- Reduce the risk of uncharacteristic wildfire to the WUI and municipal water supply watersheds in and adjacent to the project area.
- Reduce the risk of post-fire erosion and/or flooding that could impact reservoir operations and storage which could affect the water supply for the Town of Payson, the community of Mesa del Caballo, the Salt River Project, Native American Indian tribes and other northern Gila County water users.
- Move the forest on a positive trajectory of restoring forest structure, composition and function and initiate the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem.

The following needs would be met as part of achieving the purpose of the project:

- Reduction of active and passive crown fire in the municipal water supply watersheds and in the WUI and to increase the ability of fire suppression crews to control a wildfire within the project area.
- Reduction of the crown fire potential in Mexican spotted owl protected and recovery habitats.
- Create and maintain an adequate 360 degree viewshed for fire-start detection at Baker Butte Tower by removal of tall trees that obscure views of the watersheds on the Coconino and Tonto National Forests. There is also a need to reduce the crown fire potential and fuels buildup around the tower that comprises a safety risk to safe escape from the tower by the fire lookout employee. This is referred to as the Baker Butte Treatment.

- Reduction of fuels and dense thickets of small young trees adjacent to State Highway 87 and other identified values at risk to reduce crown fire potential and to maintain safe travel ways and access.
- Provide in-forest processing, drying and/or sort yard locations to facilitate mechanized thinning and biomass removal and to make timber harvesting operations more economically efficient.

Proposed Action

The proposed action is designed to achieve the purpose and need within a twenty-year period or until objectives are met. Hazard fuel reduction and forest restoration activities proposed for the Cragin Watershed Protection Project area consist of mechanical vegetation treatments on approximately 37,764 acres and prescribed burning treatments are proposed over about 63,634 acres within the project area. Multiple prescribed fire treatments would be conducted over the next two decades on all acres proposed for treatment to mimic natural fire return intervals. Treatments in Mexican spotted owl (MSO) habitats would be designed to meet guidelines outlined within the Revised Mexican Spotted Owl Recovery Plan (USDI Fish and Wildlife Service, 2012) for Protected Activity Centers and Forested Recovery Habitat and are being developed in conjunction with the U.S. Fish and Wildlife Service a cooperating agency.

A complete description of Alternative 2, the Proposed Action can be found in Chapter 2.

Coconino Forest Plan Direction

Relationship to the Forest Plan

A revised plan for the Coconino National Forest was approved in April 2018. As a result, the management direction in the revised Forest Plan is the relevant management direction applicable to this project. The desired conditions for the project are based on Forest Plan desired conditions, and each resource area has reviewed Forest Plan guidelines, standards, and management approaches to determine compliance of the proposed project with the Forest Plan.

Two project specific Forest Plan amendments were discussed in the Preliminary EA under the 1987 Forest Plan. These project-specific amendments would be one-time adjustments to the 1987 Forest Plan, however, based on the approval of the revised Forest Plan, these amendments are no longer necessary. The proposed action has been closely evaluated and has been determined to be consistent with all current management direction in the revised Forest Plan.

More information on compliance with the current Forest Plan is included in each specialist report for the resource being analyzed. This information is available on the project website under the “Analysis” tab: https://www.fs.usda.gov/project/?project=46075.

Management Area Direction

Table 7. Current Forest Plan Management Area, Description and Forest Plan Emphasis

Forest Plan Management Area	Acres	Forest Plan Emphasis	Pages in the Forest Plan
C.C. Cragin Watersheds	44,903	Should be managed to reduce the threat of uncharacteristic wildfires, flooding, and sedimentation, and to maintain water quality and quantity. The canyons in this management area should be managed for solitude and more primitive non-motorized recreation opportunities with low-disturbance to wildlife. Roads and trails should be maintained to prevent erosion and sedimentation.	167-168
Long Valley	18,556	This management area provides semiprimitive and rural settings for motorized dispersed camping and associated recreation uses. Recreation is to be managed to result in low-disturbance to wildlife by minimizing camping and motorized recreation in the vicinity of meadows and riparian areas.	164-165
East Clear Creek	974	Should be managed to provide mainly semiprimitive recreational opportunities. Recreation is to be managed to result in low-disturbance to wildlife by minimizing camping and motorized recreation in the vicinity of meadows and riparian areas.	165-166
Total Acres	64,433		

Decision to be made

The Coconino Forest Supervisor is the Responsible Official for this project. The decision to be made is whether or not to approve the Proposed Action, another alternative, or develop an alternative design that meets the purpose and need and moves the area towards the desired condition, or to not implement a project at this time. The Responsible Official may also determine that the proposal or alternatives will result in significant effects requiring analysis through an Environmental Impact Statement.

Collaboration and Public Involvement

During project proposal development and prior to public scoping, collaboration was initiated with a group of stakeholders that expressed interest in the project. Participation in the collaborative process included local landowners and representatives from municipal and local governments, land and water management agencies, academia, environmental and recreational organizations and forest products industries. Four stakeholder meetings were held and facilitated by the National Forest Foundation and their contractor, Southwest Decision Resources. Information that came from these meetings was used to help develop and refine the proposed action. Stakeholder information is contained at the following web site developed and maintained by the National Forest Foundation, https://www.nationalforests.org/who-we-are/regional-offices/southernrockies/cragin.

The first stakeholder meeting was held on September 9, 2015 at the Blue Ridge Community Church facility in Happy Jack, AZ. In October 21, 2015, a second

stakeholder meeting was held in the field and various field trip stops were made within the project area. At that meeting, the Forest Service presented draft project vegetation and prescribed burning treatment scenarios that provided a basis for discussions by the stakeholders. On February 11, 2016 the third stakeholder meeting was held at Gila Community College in Payson, AZ. At that meeting, stakeholders provided comments to the Forest Service on a pre-scoping CWPP Draft Proposed Action document (dated February 4, 2016). On December 6, 2016 the fourth stakeholder meeting was held at the Blue Ridge Ranger Station in Happy Jack, AZ.

Throughout the stakeholder engagement process, long transportation distances from the project area to existing lumber mills was discussed as an economic impediment to implementing the proposed fuels reduction treatments. Cooperating agency SRP asked the Forest Service IDT to consider options of using processing sites within the project area as a means to create transportation efficiencies for implementing the project. At the fourth stakeholder meeting on December 6, 2016, the Forest Service presented updated treatment descriptions and information on processing sites. The group went on a field trip to a nearby proposed processing site location and discussed various aspects of processing, sorting and drying sites.

Figure 10. Fire and Fuels Specialist, Jeff Thumm, discussing fuels in the CWPP area from Baker Butte Lookout Tower during a public field trip in 2016

A public information letter dated September 3, 2015, was mailed out to 190 individuals, tribes, agencies and groups. The letter provided background information on the project location, partners, and project purpose. A project website also was developed in September, 2015, to provide public information on the project, http://www.fs.usda.gov/goto/coconino/CWPP. The project has been listed on the Coconino National Forest Schedule of Proposed Actions since January 1, 2015, http://www.fs.usda.gov/project/?project=46075.

On February 24, 2016, public scoping on the Proposed Action was initiated. A scoping letter describing how to submit comments and a detailed Proposed Action document was

sent out via post and email to 217 individuals and groups. Information on the project was also sent out to the Mogollon Rim Ranger District email list which has more than 600 addresses. Recipients included federal and state agencies, businesses, interest groups, and local landowners. The Proposed Action was also posted on the Coconino National Forest public web site at that time, and an article describing the Proposed Action and public meetings was published in the High Country Informant in the March 2016 issue.

Two public meetings were held in March: one in the evening on March 2, 2016, at the Payson Unified School District Boardroom, and one in the morning on March 5, 2016, at the Starlight Pines Community Center in Happy Jack. Both meetings were facilitated by personnel from Southwest Decision Resources. A field trip to three locations within the project area occurred on May 5, 2016. Field trip participants included three personnel from the Center for Biological Diversity, one staff member from the USFWS, and seven staff, including the District Ranger, from the Mogollon Rim RD.

During scoping of the Proposed Action from February 24 2016 to April 11, 2016, the Forest received 26 submissions from the public, containing a total of 110 specific comments.

A preliminary Environmental Assessment was released in May of 2017, with a legal notice announcing a 30-day public comment period published on June 1, 2017 in the Arizona Daily Sun. Two public meetings were held in conjunction of the release of the preliminary EA including a meeting on June 6, 2017 in Payson and a meeting on June 7, 2017 in Happy Jack at the Starlight Pines Community Center. Approximately 6 comment letters or e-mails were received from individuals or organizations during the 30-day public comment period.

Public comments identified a number of issues or concerns regarding the proposed action and analysis in the preliminary EA. For example, there were a number of comments regarding the need for better data to improve the proposed treatments, especially in Mexican spotted owl habitat so that the treatments would be more strategic. The inter-disciplinary team responded to this comment by completing a series of field surveys with Fish and Wildlife Service personnel to identify were treatments were necessary to meet desired conditions in MSO PACs and to identify vegetation types and treatment needs in MSO recovery habitat. This ground-based data collection resulted in changes to vegetation classification within the project area, and a substantial decrease in proposed treatments in Mexican spotted owl habitat throughout the project area. Examples of changes to the proposed treatments since the preliminary EA include:

- Mechanical treatment in owl PACs went from 4,809 acres to 1,631 acres
- Mechanical treatments in nest/roost replacement habitat were reduced to zero
- The number of estimated temporary roads were decreased and all proposed temporary roads were removed in MSO PACs
- Much greater limitations on mechanical treatments and prescribed fire were included during the MSO breeding season

Another comment focused on the unlikely fire modeling results in the preliminary EA that showed proposed treatments would reduce fire risk from crown fire to surface fire in 96% of the project area. Similar comments requested more information on past wildfires over the past two decades and how these affected current conditions in the project area.

To address comments about fire modeling, both vegetation modeling and fire and fuels modeling were re-done with the updated proposed treatments to provide a much more realistic assessment of fire risk for both the existing condition and alternatives, the results of which have been included in this EA. In addition, the inter-disciplinary team reviewed past wildfires over the past twenty years to determine the extent of high-severity fire that has occurred within the project area, and has used this information to update the existing condition used for this analysis.

The inter-disciplinary team also received comments regarding the large and old tree implementation plans. Specifically, the comments requested that the large and old tree implementation plans more closely mirror those in the 4FRI Environmental Impact Statement, and that the plans include language to address "stands with a preponderance of large, young trees" (SPLYT) as has been discussed and drafted by the Rim Country EIS stakeholder group. These changes have been made based on public input and are reflected in Appendix A of this EA.

These and other changes from public comments were shared with participating stakeholders during a meeting in November 2017. This meeting was followed with a field trip to further discuss project treatments in various forest conditions on November 8, 2017. Another field trip occurred with a representative of the Center for Biological Diversity at a later date since they were unable to attend the November 2017 field trip.

The CWPP inter-disciplinary team has continued to work with stakeholders and cooperating agencies since late 2017 to answer questions and keep them informed on progress with the project. Beginning in February 2018, final specialist reports started to be published to the project website as they were completed. In late April and early May 2018 all specialist reports used to inform the analysis in this document were posted to the project website along with pre-publication versions of the first two chapters of the Final EA. Also in May 2018, the inter-disciplinary team held a public meeting and informed all individuals and organizations that commented during any public comment period. During this public meeting, inter-disciplinary team members shared updates on the NEPA planning process, answered questions, and shared the most current mechanical thinning and prescribed fire plans for implementation once a decision has been signed.

No additional concerns regarding the proposed treatments were identified during these events in late 2017 or in 2018.

Tribal Consultation

Tribal consultation regarding the CWPP initially began by notifying the tribes by postal mail sending them the Schedule of Proposed Actions (SOPA) in January 2015. The Coconino Forest SOPA is sent quarterly to all 12 tribes. On January 27, 2015 a letter was sent from the Forest Supervisor to the Tonto Apache Nation formally inviting them to be a Cooperating Agency. On September 14, 2015 a letter from the Mogollon Rim District Ranger was sent to Tonto Apache Nation, Hopi, Ft. McDowell Yavapai, White Mountain Apache, Yavapai-Apache and Yavapai-Prescott tribes providing information on the CWPP project and initiation of the planning process. On September 30, 2015 the Hopi tribe replied back in a letter and expressed their desire to consult on this project through information sharing of the cultural resources report and the preliminary environmental analysis. On February 25, 2016 a letter from the Forest Supervisor was sent to the Tonto

Apache Nation, Hopi, and Ft. McDowell Yavapai tribes describing the Proposed Action Alternative. This letter was also emailed to the San Carlos Apache, White Mountain Apache and the Yavapai-Apache. The Hopi tribe replied back in a letter dated March 7, 2016 and asserted their cultural affiliation to prehistoric archaeological sites in the project area and their desire to continue consultation and review of the cultural resources survey. During an April 20, 2016 SOPA consultation meeting with Hopi, the Mogollon Rim District archaeologist provided maps depicting the area of the CWPP heritage survey. The Hopi's concerns are for the pipeline which carries the water from the reservoir to the city of Payson, which has a right-of-way across the Tonto National Forest. But for the portion of the pipeline on the CNF, the Hopi deferred comment. On the January 17, 2017 during the SOPA consultation meeting with the Hopi the Forest Tribal Liaison and the Mogollon Rim Deputy District Ranger presented maps and current information on the status of archeological surveys in the project areas. On February 8, 2017 the Mogollon Rim District archaeologist met with the Yavapai Apache Nation and shared information on the project. The Yavapai Apache Nation is interested in the sites recorded and in particular, the area of the Battle of Big Dry Wash. Tribal consultation is ongoing and will continue through the NEPA process.

Through tribal consultation we have learned that tribes generally support forest fuels reduction and restoration projects. This is evident because the desired conditions are an attempt to return the forest to conditions prior to the industrial age of intensive logging and subsequent timber industry growth and fire suppression that lasted for decades. Beyond the legal requirements for tribal consultation the Forest seeks tribal involvement on restoration because of their aboriginal ties to the land. Additionally the tribes have traditionally used the land and resources in the past and many plants and resources are currently used by tribes with aboriginal ties. One measure of success of the CWPP after treatments are implemented will be the proliferation and collection of native plants traditionally used by native peoples.

Cooperating Agencies

The CEQ regulations define "Cooperating agency" as any Federal, State or local agency and Federally recognized Indian Tribe which has jurisdiction by law or has special expertise with respect to any environmental impact involved in a proposal or major Federal action affecting the quality of the human environment (40 CFR 1508.5). The following groups are cooperating agencies for the CWPP.

The Bureau of Reclamation Phoenix Area Office (Reclamation) has jurisdiction by law for the withdrawn areas (covered lands) of the C.C. Cragin Project under Public Law 112-45 enacted November 7, 2011. Reclamation also has special expertise in water management and water management facilities in the Western United States, including the C.C. Cragin facilities and the federal standards that apply to Federal Reclamation projects.

The Salt River Project is responsible for the care, operation and maintenance of the C.C. Cragin Dam and Reservoir under Public Law 108-451, the Arizona Water Settlements Act of December 10, 2004. Salt River Project has special expertise in water measurement, precipitation, snow measurement and monitoring, reservoir and water system operations, watershed monitoring and management, water rights analysis, environmental permitting, fisheries biology, and power corridor and system management. Salt River Project is

engaged in the CWPP with the interest of improving the health and function of the forest lands adjacent and within the watersheds that feed C.C. Cragin reservoir.

The Town of Payson has acquired rights to water from the C.C. Cragin Dam, Reservoir and water pipeline system. The Town of Payson has special expertise in the subjects of reservoir and water system operations, water quality chemistry, water sampling and analysis, water transmission operations and management, water quality management and road development and surface water drainage planning.

The U.S. Fish and Wildlife Service Arizona Ecological Services Office (FWS) has jurisdiction and special expertise as the lead agency for threatened and endangered species in the project area which includes threatened Mexican spotted owls and critical habitat, threatened Little Colorado spinedace and candidate conservation agreement species roundtail chub, bluehead sucker and Little Colorado River sucker *spp*.

The Arizona Game and Fish Department, (AZGFD) under the authority of the Arizona Game and Fish Commission, and pursuant to Title 17 of the Arizona Revised Statutes, has jurisdiction over wildlife (and fish) in the State of Arizona. AZGFD jointly manages federally endangered and threatened wildlife species with the US Fish and Wildlife Service. The Department has special expertise in wildlife and fisheries management covering the C.C. Cragin Watersheds.

Issues

Scoping and public involvement activities are used to identify issues about effects of the Proposed Action. Issues are statements of problems to be solved or problems that may be created by the proposed action.

The public, interdisciplinary team and stakeholders also brought forward a number of concerns regarding the proposed project. The following issues and concerns that were raised internally or were stated in public or stakeholder comments are addressed through the No Action Alternative, the Proposed Action Alternative and the various project design features, monitoring, effects analyses presented in Chapters 2 and 3 and in Appendices of the EA and in the project record.

Primary issues identified as relevant include:

- ✓ *Impacts of the project to utilities' infrastructure*. See the Lands, Recreation, Special Uses and Wild and Scenic Rivers section in Chapter 3 and the Project Design Features in Appendix B.
- ✓ *Impacts to air quality from smoke*. See the Air Quality section in Chapter 3.
- ✓ *Sedimentation of waterways*. See the Water Quality and Riparian Resources section in Chapter 3.
- ✓ *Evaluation of effects of treatment prescriptions based on a less severe fire weather scenario*. See the Fire and Fuels section in Chapter 3.

- ✓ *Conflict of the proposed fuel treatments with the 4FRI old growth protection and large tree retention strategy.* See the Large and Old Tree Retention Plan discussions in Chapter 2 of the EA.
- ✓ *Effectiveness of fuel reduction treatments in reducing the risk of severe wildfire (in the forest and in the WUI).* See the Fire and Fuels section in Chapter 3.
- ✓ *Impacts of thinning and temporary road construction on the ecosystem and recreational experiences of forest users.* See the Soils, Water Quality and Riparian Resources, Recreation and Scenery sections in Chapter 3.
- ✓ *Construction of temporary roads on soils and wildlife.* See the Soils, Water Quality and Riparian Resources section in Chapter 3. The proposed action was modified after the publication of the preliminary EA so that no new temporary roads are proposed in MSO PACs.
- ✓ *Impacts of logging, biomass removal and activity fuels treatments to soil, the down woody debris component and the overall impacts of various slash treatments to fire hazard, fuels reduction and air quality and emissions.* See the Fire and Fuels section and the Soils section in Chapter 3.
- ✓ *Consideration of the distance of the project area to businesses and mills that can process woody biomass and timber and methods that could be used, such as processing sites, to increase the utilization of forest products and transportation efficiencies.* See the Processing Sites section of the Proposed Action in Chapter 2.

After consideration of the public input received, the District Ranger and the Forest Supervisor determined that three alternatives are to be considered but not analyzed in detail in the Preliminary Environmental Analysis. These alternatives are:

- A No Forest Plan Amendment Alternative
- A No Temporary Roads Alternative
- No Treatment During the MSO Breeding Season

The alternatives that will be analyzed in detail are the No Action Alternative and the Proposed Action Alternative. Clarifications and refinements to the Proposed Action have been made as needed in response to internal and public comments received during scoping and the 30-day comment period.

Changes between the Preliminary and Final EA

Six comment letters were received in response to the Preliminary EA published in May 2017. While this is a very small number of comment letters for such an extensive project, several of the letters included a number of issues that resulted in changes to the Proposed Action Alternative and the analyses. This section includes a brief summary of changes from the comments received on the Preliminary EA. A more detailed response to each

comment is included in the Response to Comments document in the project file and on the project webpage.

Issue: Improved data/information is needed to identify which areas of MSO habitat will be treated so that there is a strategic effort to reduce fire risk reduction to MSO per the 2012 Recovery Plan

- This issue was addressed through field visits with Fish and Wildlife Service personnel to MSO PACs proposed for treatment. Each PAC was visited to consider a number of factors from likely effectiveness of treatments, need for mechanical treatments to move conditions toward desired conditions, to feasibility of treatments. As a result the proposed action went from treatment of 4,809 acres in PACs to 1,631 acres, which makes up approximately 13% of PACs in the project area. This change is to reduce treatments in PACs to only those areas where treatments are necessary to modify forest structure to reduce the risk of high-intensity fire and severity of effects in PAC habitat based on-site assessments.

- Treatments in recovery habitat were also reviewed and updated based on new information from on-site assessments. Mechanical treatments in MSO recovery habitat identified in the preliminary EA on 17,872 acre was reduced to 13,238 acres based on more specific data.

Issue: Information in desired and existing conditions are generalized and should be refined to provide more information for other vegetation types in the project area besides ponderosa pine. There should be more discussion of wet mixed conifer vegetation types and desired conditions for mixed conifer vegetation types should include the retention of large hardwood trees.

- The vegetation analysis was updated to include more information in both the existing conditions and desired conditions for vegetation types other than ponderosa pine forest. The vegetation analysis includes more discussion of wet mixed conifer vegetation, and desired conditions now include the retention of large hardwood trees, such as oak.

Issue: The preliminary EA does not address concerns brought up in scoping regarding proposed road construction in MSO PACs

- Site visits were made to proposed temporary roads that would require new construction. As a result, the proposed action was modified to reduce the number of proposed new temporary roads. All proposed temporary roads in PACs were removed from the proposed action, because either the proposed treatments in PACs were dropped, or the surveys determined that road construction was not necessary for access for proposed treatments.

Issue: There should be limitations on mechanical treatments in and adjacent to MSO habitat during the breeding season to reduce potential adverse effects on the owl.

- Substantial changes were made to the proposed action to restrict treatments in MSO PACs and within ¼ mile of MSO PACs except in key priority mechanical treatment areas. This is expected to minimize the potential for adverse effects to

nesting MSO pairs from disturbance during the breeding season. Priority mechanical treatment areas provide an exception to allow treatment within ¼ mile of MSO PACs. Treatment of these priority acres would protect key infrastructure, watershed areas, and habitat for federally listed species. These areas would be the main focus of mechanical treatments and hand thinning at the beginning of implementation. To facilitate the implementation of mechanical treatments and hand thinning, the preferred alternative would allow for treatments to occur without a breeding season timing restriction on the approximately 3,134 acres that are within 0.25 miles of 12 different PACs in three of the five priority areas. Without this exception, mechanical treatment operators would likely be required to move in and out of any given priority area several times over several years to complete each treatment. This would result in extended treatment timelines, substantial increases of treatment costs and an increased risk of effects to values at risk in these areas from uncharacteristic, stand-replacing wildfires.

Issue: Fire modeling results are not realistic and show an over-optimistic outlook of treatment effects.

- After the publication of the preliminary EA, project area field trips resulted in changes to the proposed action, and changes to some of the cover type information used as inputs to the fire modeling. In addition, both the vegetation model and fire model were re-run and re-calibrated for more realistic results. This was an iterative process that involved input from regional fire modeling experts to ensure the model was run correctly. Post-modeling results included in this analysis were reviewed by local and reginal fire and fuels specialists and determined to be accurate.

Issue: The analysis should include information on how past wildfire over approximately a third of the project area in the last 10 years has effected current vegetation. In particular, there should be a determination if these wildfires have changed forest structure across a significant portion of the project area or if they have reduced fuels effectively enough to reduce fire risk.

- An analysis was completed on how wildfire within the project area over the last decade may have affected forest structure and fuels. We determined that very little of the wildfire over the last decade was high-severity, and thus there was little or an insignificant change to forest structure from wildfire in the project area. Fuels were reduced in areas affected by wildfire, but only temporarily, and thus fire risk has not been substantially changed. This information has been added to this EA, and more detailed information is in the Fire and Fuels Specialist Report.

Issue: Impacts to non-motorized recreation, especially along the Arizona Trail should be avoided or minimized.

- Design features were added or modified to avoid or minimize effects to non-motorized recreation along the Arizona National Scenic Trail.

Issue: The Old and Large Tree Implementation Plans include language that appears to allow the removal of more large trees. The plans should be revised to reflect the

stakeholder agreement from the 4FRI decision, and to include updated information about stands with a preponderance of large, young trees (SPLYT), which is a new area of agreement identified by 4FRI stakeholders.

- The Old and Large Tree Retention Plans were modified to more closely match those included in the 4FRI Record of Decision. Since the CWPP and 4FRI have different project purposes, there are some inherent differences with respect to exception categories for where old and large trees can be cut. Also, because the CWPP includes mixed conifer vegetation, some wording was modified to apply to forest types other than ponderosa pine. Information on SPLYT stands was also added as an exception category to mirror the information developed for the Rim Country Restoration EIS.

Issue: the preliminary EA lacks clarity on the differences between interspace and openings.

- More information was added to this analysis to clarify and define these two terms.

Issue: The analysis of the No Action Alternative does not recognize that wildfire may still be managed for resource benefit.

- The potential for management of wildfire for resource benefit was discussed in the effects of the No Action Alternative, where relevant.

Issue: The Coconino National Forest has approved a new Forest Plan, which includes management direction that must be considered rather than the 1987 Forest Plan considered and documented in the Preliminary EA.

- A new Forest Plan for the Coconino National Forest was signed in April 2018. This EA incorporates new management direction from this revised plan, including desired conditions, standards, and guidelines. The new plan language removes the need for the two project-specific forest plan amendments included in the preliminary EA. Information on how the proposed action complies with the 2018 Forest Plan is included in Appendix C.

Project Record Availability

The project record for the CWPP includes all project-specific information, including records of public involvement, resource reports, inter-disciplinary team (IDT) meeting notes and records, and results of field investigations. Key points from these documents are summarized throughout the EA and referenced by title. The project record is located at the Coconino National Forest Supervisor's Office in Flagstaff, Arizona. The project record, which includes all project-related supporting documentation is available for review upon request.

The Public Involvement section of the project record for the CWPP contains the scoping letters, mailing lists, and all comments on the project received from the public. It also includes documentation of other public involvement efforts such as legal notices and community newspaper articles. The public comments on scoping and the Forest Service

responses to these comments are disclosed in two documents: Initial Public Scoping Comments and Disposition, and the Issues Analysis.

CHAPTER 2: Comparison of Alternatives

This chapter describes alternative development, alternatives considered in detail, design features, resource protection measures, and provides a summary comparison of the alternatives considered by the Forest Service for the Cragin Watershed Protection Project.

Alternative Development

The Proposed Action was developed to meet the purpose and need for action. It was modified and perfected based on public input and additional data collection since the release of the preliminary EA. The Interdisciplinary Team designed the proposal with consideration of cooperating agency and stakeholder collaboration, to minimize effects on resources, and to address issues identified during project scoping and collaboration. The IDT and line officers have reviewed all of the comments made by the public and stakeholders from scoping and from other comments received during the environmental analysis and determined that no other alternatives would be fully analyzed.

Alternatives Considered but Not Analyzed in Detail

Federal agencies are required by the NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). In developing the proposed action the interdisciplinary team (IDT) considered a number of alternative ways to manage the project area. In addition, public comments received in response to the proposed action provided suggestions for alternate methods for achieving the purpose and need.

No Forest Plan Amendment Alternative

An alternative that did not require forest plan amendments under the previous 1987 Forest Plan was considered but dropped from detailed analysis since it would not meet the CWPP's purpose and need. Due to the need to define and manage for interspace, which allows for treatments to meet desired conditions with groups of trees, and in order to be consistent with the current MSO Recovery Plan, an alternative that abided by the previous 1987 Forest Plan including outdated language and management direction was not included for detailed analysis. The Coconino National Forest recently approved a new Forest Plan, which includes updated language consistent with the 2012 Mexican spotted owl Recovery Plan, and the updated proposed action has been determined to be consistent with the management direction in these documents. Under the 2018 Forest Plan, project-specific or programmatic amendments would not be needed for this project.

No New Temporary Roads Alternative

Construction of temporary roads on sensitive soils was brought forward by the commenter from the Center for Biological Diversity, who requested a detailed study of an action alternative that foregoes road building on steep slopes and sensitive soils where it may increase erosion or impair productivity. Another commenter is opposed to use and construction of any temporary roads at all. The proposed action includes construction of

about 22 miles of new temporary roads and opening of another 23 miles of non-system roads (these were likely previously decommissioned) that have existing road prisms. This is a decrease of approximately 25 miles of temporary roads included in the initial proposed action in the preliminary EA. This change was made in response to public input and additional field work to determine how temporary roads could be minimized, while still providing for access needed for proposed treatments.

These roads would be used to haul thinned materials that would not otherwise be accessible. These temporary roads are proposed in areas outside of steep slopes as defined by the Forest Plan and outside of sensitive soils where there is a risk for accelerated erosion. The Proposed Action also includes a number of "Soil and Watershed Protection" design features to avoid, minimize, and mitigate impacts from temporary road construction (SW1-SW23). The EA and Soil and Water Resource Report includes analysis of the specific soil types affected from all road use, temporary road construction, and logging activities on soil productivity and impacts to streams and water quality to disclose the potential effects to the public and inform the decision-making process.

No Treatments During the MSO Breeding Season

The proposed action allows for treatments and hauling activities during MSO breeding season in certain areas under certain circumstances. For example, when there is survey data showing no breeding owls are present, the proposed action would allow for treatments in PACs and other MSO habitat, because there is no indication that breeding owl pairs would be disturbed by treatment activities. While the proposed action does not allow treatment activities in PACs during the breeding season, the proposed action would allow for mechanical treatments and hand thinning within a 0.25 mile buffer of PACs in three of five priority areas (General Springs, Kinder Springs, and McCarty Ridge) for up to two consecutive breeding seasons. This language meets recommendations in the MSO Recover Plan to avoid disturbance in PACs during the breeding season when owls are present, but allows flexibility in areas that are a high priority for treatment to reduce the risk of crown fire adjacent to PACs. This was determined necessary to meet the purpose and need based on an analysis that concluded treatments in each priority area can take up to 7 years (which would mean that all mechanical treatments in the project area could take 30-40 years or more). Since there are 5 priority mechanical treatment areas identified and these only make-up approximately a quarter of the project area, it was determined that providing some flexibility in areas adjacent to MSO PACs to expedite mechanical treatments in the most at-risk areas was necessary to meet the purpose and need in a strategic manner.

In addition to the flexibility included for mechanical treatments, the proposed action would allow hauling along main transportation corridors forest roads 95, 123, and 139 during the breeding season. These roads occur alongside Mexican spotted owl PACs, and based on information that has shown noise causing disturbance to owls within a quarter mile from nests, it is technically possible that hauling on these roads during the breeding season could cause disturbance to breeding owls that nest on the edge of a PAC. However, for these roads, vegetation and topography features would minimize noise disturbance to any potential nesting location, and as a result hauling on these routes would be allowed during the breeding season.

The proposed action includes these modifications to allow management direction for the MSO to be applied in a flexible manner that limits the potential disturbance to nesting owls to greatest degree possible while still allowing for flexibility that will facilitate project implementation in a way to meet the purpose and need of reducing the risk of crown fires. If the management direction were interpreted broadly and applied blindly so that any possible effects to MSO were definitively avoided, the project purpose and need would not be met as mechanical treatments would take an estimated 30-60 years to complete.

Alternatives Considered in Detail

The alternatives that will be analyzed in detail are Alternative 1 No Action Alternative and Alternative 2 the Proposed Action Alternative.

All treatment acreages and other quantitative measurements were derived from a number of sources including field measurements and estimations, and remote sensing techniques using the Forest Geographic Information System (GIS). Stands proposed for treatment, acre estimates and other quantitative measurements have been refined since the scoping letter was mailed, and then refined again based on field-based data collection in 2017. It is expected that as each stand proposed for mechanical treatment is visited new information will continue to be used refined specific treatment, and may further vary after unit layout and when project design features and other resource protection measures would be applied.

The interdisciplinary team has already identified some minor instances where new information can be used to better characterize cover types. For example, based on field visits in 2017, one stand identified as Ponderosa pine treatment type was determined more accurately classified as mixed conifer vegetation. This recent information resulting in a cover type change to one stand has been integrated into treatment prescriptions, along with a minor changes to Mexican spotted owl PAC habitat to change several acres from forested to meadow vegetation type. This recent information has not been integrated into analyses such as this Environmental Assessment, because it would require the re-analysis and re-modeling for a number of resources that would not result in changes to the conclusions for any resource. These changes have been discussed with Fish and Wildlife Service and to this point, affect approximately 60 acres or approximately 0.1% of the project area.

It is also possible that there may be future changes to cover type or habitat type in the project area that may result in changes of treatment type applied to an area during implementation. For example, a future wildfire may change a stand or a small number of stands to an extent that the treatment type would need to be modified to address the new stand conditions so that they can move toward desired conditions. It is also likely that changes in wildlife habitat, such as the identification of one or more owl nests or identification of a new owl pair in the project area could result in a change in treatment type compared to what was analyzed in the environmental analysis.

These changes are expected to be relatively limited in scope throughout the next decade during project implementation. A large wildfire that substantially alters vegetation throughout the project area may require a complete post-decisional review, however, the aforementioned vegetation cover type changes are expected to be part of project

implementation. The environmental analysis included herein includes information on the effects of each treatment type, when relevant, to illustrate the effects caused by the range of treatments applied to each vegetation type. Given the small extent of the project area affected by updated information and the level of analysis on each treatment type, the flexibility to use updated information to slightly modify treatments during implementation in these cases is not expected to result in effects beyond those analyzed for each resource in the Environmental Assessment.

Alternative 1: No Action Alternative

The No Action alternative is required to be considered and assessed in an environmental assessment under HFRA (Sec. 104(c)(1)(B). A full no action alternative is not required to be developed; however, the effects of failing to implement the project should be evaluated (USDA Forest Service; USDI Bureau of Land Management, 2004). Under the No Action alternative, current management plans would continue to guide management of the project area. No new mechanical or hand tree, thinning or prescribed burning would be implemented. However, managing lightening-ignited fires for resource benefits would still be possible under this alternative. The No Action alternative serves as a benchmark against which to compare the environmental effects of the action alternatives.

Alternative 2: Proposed Action Alternative

The proposed action is designed to achieve the purpose and need over twenty year period or until objectives are met. Hazard fuel reduction and forest restoration activities proposed for the Cragin Watershed Protection Project area consist of prescribed tree cutting treatments on approximately 37,764 acres and prescribed fire on approximately 63,634 acres (Table 8 and Table 9). Multiple prescribed fires would be conducted on all acres proposed for treatment to mimic natural fire return intervals. Treatments in Mexican spotted owl (MSO) habitats would be designed to meet guidelines outlined within the 2012 MSO Recovery Plan (USDI Fish and Wildlife Service, 2012) for Protected Activity Centers and forested Recovery Habitat and were developed in conjunction with the U.S. Fish and Wildlife Service.

Hazard fuel reduction and forest restoration actions would include:

- Mechanically cut trees on approximately 22,326 acres within the ponderosa pine forest cover type.
- Mechanically cut trees on approximately 434 acres within three northern goshawk post-fledging family area (PFA) habitat areas.
- Mechanically cut trees on approximately 13,238 acres within Mexican spotted owl (MSO) recovery habitat.
- Mechanically cut trees on approximately 1,354 acres within 12 Mexican spotted owl protected activity centers (PACs). Prescribed fire alone is proposed for nest/roost core areas.
- Mechanically thin trees on 27 acres surrounding the Baker Butte Fire Lookout Tower.

- Precommercial thin by hand young trees on 109 acres within the ponderosa pine forest cover type and on 277 acres in 4 MSO PACs.
- Apply prescribed fire on approximately 37,766 acres where mechanical treatments occur.
- Use prescribed fire alone on 25,868 acres.

All the fuel reduction and restoration treatments except the Baker Butte Treatment (for which there is more detailed data) described in the proposed action are based on the best available data used to determine forest cover and associated wildlife habitat. The CWPP is a large landscape-level fuel reduction and forest restoration project encompassing over 64,000 acres of National Forest System Lands for potential treatment. We do not have complete information on the conditions found on every acre, but we do have enough data to make an informed decisions about what types of treatments work best in certain conditions. For the treatments proposed, Vegetation cover and habitat type are the primary characteristics used to determine the treatment. Adjustments to the various treatments, acres treated and the treatment type tool used may change during implementation based on actual site conditions and new information. Adjustments to treatments used within MSO habitat will be performed in coordination with the U.S. Fish and Wildlife Service.

Table 8. Summary of mechanical vegetation treatments proposed by Alternative 2

Treatment	Acres
Ponderosa Pine Treatments outside of PFAs	22,326
Ponderosa Pine Treatments within Northern Goshawk PFAs	434
Precommercial Thinning	109
MSO Recovery Habitat– Ponderosa Pine-Gambel Oak	6,172
MSO Recovery Habitat– Mixed Conifer	7,066
MSO PAC Treatments– Ponderosa Pine-Gambel Oak	1,084
MSO PAC Treatments– Mixed Conifer	270
MSO PAC Treatments – Precommercial Thinning	277
Baker Butte Treatment	27
Total Mechanical Vegetation Treatments	**37,764**
Percent of Project Area	**59%**
No Mechanical Vegetation Treatments	25,869
No Treatment Water	242
Private Lands	557
Total Acres	**64,433**

*Acreage adds up to one acre less than total as a result of rounding

Table 9. Summary of prescribed fire treatments proposed by Alternative 2 for the CWPP

Prescribed Burning Treatment Type	Acres
Activity Fuels Treatment, Broadcast Burn, Maintenance Burn	37,766
Broadcast Burn, Maintenance Burn	25,868
Total Prescribed Fire Treatments	**63,634**
Percent of Project Area	**98.8%**
No Treatment Water	220
Private Lands	557
Total Acres In Project Footprint	**64,433**

Treatment Descriptions

The CWPP proposes vegetation treatments utilizing prescribed cutting and prescribed fire to reduce the risk of catastrophic fire and infrastructure damage within the wildland urban interface and surrounding values at risk. Treatment prescriptions are designed to move forest vegetation on a positive trend towards the desired conditions. The main silvicultural tool used is uneven-aged selection cutting, which is described as the combination of group and single tree selection systems with reserve trees left in all structural stages, and is recommended for creating clumpy and irregular stand structure that is desired for resilient and sustainable southwestern ponderosa pine and mixed conifer forests (Graham & Jain, 2005), (Reynolds, et al., 2013).

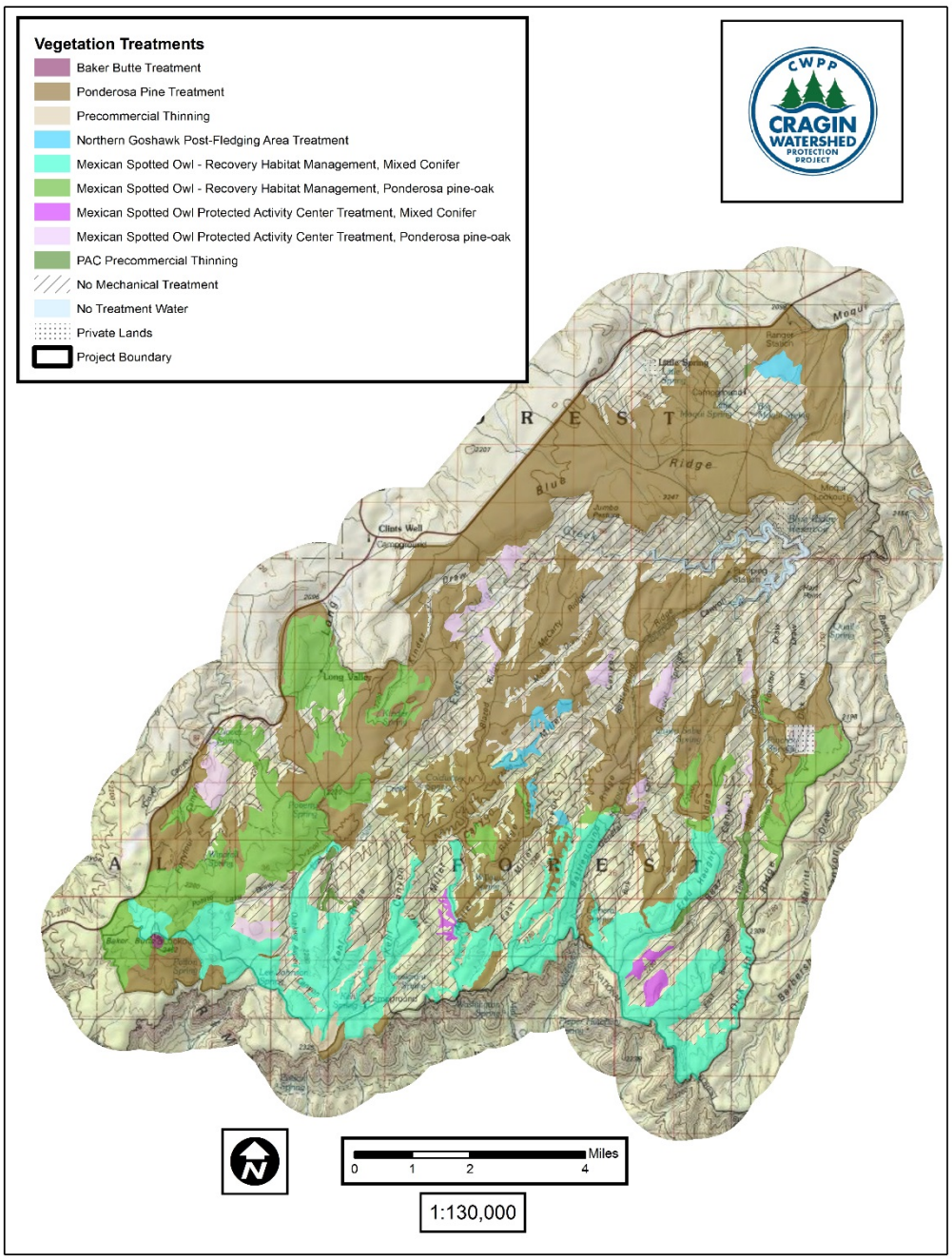


Figure 11. Mechanical treatments included in the Proposed Action

- Mechanical treatments include: the use of chainsaws or feller-bunchers to cut trees and lop slash, skidders to move material to landings along forest service approved skid trails, and bulldozers to pile or rearrange slash for burning or erosion control. Other specialized equipment may be used to cut, chop, break, lop or treat the fuels to meet resource objectives.

- Landings created for treatments would range in size from ¼ to 1 acre with an average of one landing every 20 acres.

- Several products could result from treatments such as biomass, fuelwood, posts and poles, and sawtimber, which could be sold through personal use and commercial wood product contracts.

- Within the treatment units identified for prescribed cutting, post-settlement ponderosa pines (in VSS class 5 or 6) may be removed following the project's large and old tree implementation plans. The creation of openings and interspace and the majority of tree cutting would be primarily focused in VSS 2, 3 and 4 tree size classes.

- Prescribed burning or tree thinning may be the initial treatment during implementation depending on the current conditions as compared to desired conditions. Where very dense forest conditions exist with an abundance of ladder fuels, thinning would need to occur prior to prescribed burning treatments. Tree harvest methods may include traditional methods of felling trees by hand within the unit or using mechanical harvester equipment.

- The growth of additional large oaks would be promoted by thinning of ponderosa pine and prescribed burning (2018 Forest Plan, FW-TerrERU-PP-G-4; FW-TerrERU-MC-All-DC-3 and USFWS 2012, p. 276). Oak and other species may also be removed for temporary roads and landings; however every attempt would be made to avoid cutting Gambel oak particularly oak greater than 10" diameter at root collar (drc).

Ponderosa Pine Treatment outside of PFAs

This treatment is within the ponderosa pine cover type outside of northern goshawk PFAs. Possible treatment tools include single tree and group selection tree regeneration methods, intermediate thinning, stand improvement thinning, and prescribed fire. The treatments are designed to reduce existing surface and ladder fuels and trend vegetation to the forest plan's desired future condition for the ponderosa pine vegetation community. The desired or target stand condition is to develop a balanced uneven-aged structure, and a mosaic of openings and tree groups of varying sizes at both the stand and landscape scale. Tree groups should consist of 2 to 40 trees ranging in size from 0.1 acre to 0.7 acre, with grass-forb-shrub interspaces between groups. Canopy cover within VSS 4-5-6 groups would vary from 40 percent to 70 percent. At the stand level, basal areas would range from 40 to 80 ft^2 per acre

Yellow pines would be retained based on the old tree implementation plan. Snags greater than 12 inches diameter would be retained. Three downed logs greater than 12 inches diameter and at least 8 ft. long, and 5 to 7 tons of woody debris greater than 3 inches in diameter would be retained per acre. Regeneration openings from 0.1 to four acres would be created across 20 percent of each stand. Regeneration openings up to four acres with a

maximum width of 200 feet may be created; however openings should rarely be greater than two acres and the average opening size would be approximately one acre. Three to five trees per acre would be retained in openings greater than one acre. Mechanical treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule.

Ponderosa Pine Treatment within Northern Goshawk PFAs

This treatment is proposed within northern goshawk post-fledging family habitat. The treatment is designed to reduce surface and ladder fuels and follow forest plan direction for northern goshawk habitat management for PFAs. This treatment is the same as the ponderosa pine treatment with the exception that trees would be thinned to a residual basal area range from 60 to 80 ft^2 per acre to promote denser tree and canopy cover conditions for goshawk nesting. Mechanical treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule. No mechanical or hand thinning would occur within northern goshawk nest sites. These nest sites would be treated with prescribed fire.

Precommercial Thinning

The purpose of precommercial thinning (PCT) is to thin young ponderosa pine forest stands and plantations to improve growth and vigor and reduce the effects of wildfire by reducing ladder fuels. The proposed treatment consists of hand or mechanical thinning conifers generally less than 9 inches dbh that act as ladder fuels underneath the canopy of larger trees. The trees would be thinned at a varied spacing to provide species diversity and horizontal structure with an average spacing of 15 feet. The treatment would mimic natural disturbance patterns (to the extent possible) by incorporating natural variation, such as irregular tree spacing into the prescription. Biomass or other material may be sold or removed from the site as a byproduct of the PCT activity or hand piling and burning. Thinning treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule.

MSO - Recovery Habitat Treatment, Ponderosa Pine- Gambel Oak

Within MSO recovery pine-oak habitat, treatments would be designed to reduce surface and ladder fuels while enhancing and maintaining forest health and key habitat components for the spotted owl. Possible treatment tools include single tree and group selection tree regeneration methods, intermediate thinning, stand improvement thinning, and prescribed fire. Trees would be thinned to an average residual basal area per acre between 60 to 90 ft^2 in ponderosa pine - Gambel oak habitat. Openings ranging from 0.1 to 2.5 acres in size would be implemented across 10 to 20 percent of the treatment area. Trees greater than 24.0 inches dbh would be retained. Tree groups would vary in shape, size, density, and number: generally less than one acre in size and 2-50 trees per group. Mechanical treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule. The focus would be to retain healthy fire-resistant ponderosa pine while promoting the retention and growth of hardwoods.

MSO - Recovery Habitat Treatment, Mixed Conifer

Within MSO recovery mixed conifer habitat, treatments would be designed to reduce surface and ladder fuels while enhancing and maintaining forest health and key habitat

components for the spotted owl. The treatment is similar to the pine-oak recovery habitat treatment except that trees would be thinned to an average residual basal area per acre between 60 to 120 ft^2 in mixed conifer habitats. The focus would be to retain healthy fire-resistant, shade-intolerant conifers (ponderosa pine, Douglas fir, and Southwestern white pine) and promote hardwoods.

MSO - PAC Treatment, Ponderosa Pine – Gambel Oak

Within MSO PACSs proposed for treatment, mechanical treatments would be designed to reduce surface and ladder fuels while enhancing and maintaining forest health and key habitat components for the spotted owl. Possible treatment tools include single tree and group selection tree regeneration methods, intermediate thinning, stand improvement thinning, and prescribed fire. The treatments would mimic natural disturbance patterns by incorporating irregular tree spacing and various opening sizes into the treatment design. Mechanical treatments would create a diversity of patch sizes with a minimum patch size of 2.5 acres. No trees greater than 18 inches dbh would be removed. The tree stocking would range from 80 to 140 ft^2 per acre in pine-oak forest. Trees greater than 16 inches dbh would contribute more than 50 percent of the stand basal area and maintain a minimum of 40 percent canopy cover in pine-oak per the 2012 MSO Recovery Plan. Openings ranging from 0.1 to 2.5 acres in size would be implemented across 10 to 15 percent of the treatment acres. Treatments would retain trees greater than 18 inches dbh, woody debris larger than 12 inches in diameter, all snags, to the extent practicable, and hard wood trees. Mechanical treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule. No mechanical or hand thinning treatments would occur within any PAC nest core.

MSO - PAC Treatment, Mixed Conifer

Within MSO dry mixed conifer PAC habitat, treatments would be designed to reduce surface and ladder fuels while enhancing and maintaining forest health and key habitat components for the spotted owl. The treatment is similar to the pine-oak PAC treatment with a focus on retaining fire-resistant, shade-intolerant conifers (ponderosa pine, Douglas fir, Southwestern white pine). The tree stocking would range from 90 to 140 ft^2. Trees greater than 16 inches dbh would contribute more than 50 percent of the stand basal area and a minimum canopy cover of 60 percent would be maintained throughout the stand as per the 2012 MSO Recovery Plan. Mechanical treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule. No mechanical or hand thinning treatments would occur within any PAC nest core.

MSO PAC Precommercial Thin

The purpose of the precommercial thin (PCT) is reduce the potential effects of wildfire and provide for increased protection for nest cores within MSO PACs by reducing ladder fuels. The proposed treatment consists of hand thinning conifers generally less than 9 inches dbh that act as ladder fuels underneath the canopy of larger trees. The trees would be thinned at varied spacing to provide species diversity and horizontal structure with the average spacing being 15 feet. This treatment would mimic natural disturbance patterns (to the extent possible) by incorporating natural variation, such as irregular tree spacing into the prescription. Biomass or other material may be sold or removed from the site as a byproduct of the PCT activity or piled and burned. Thinning treatments would be either

preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule.

Baker Butte Treatment

This treatment includes three acres of the administrative site that includes the tower and associated facilities and 24 acres of forest surrounding the administrative site. Treatment within this 27 acres is in the ponderosa pine cover type outside of MSO and northern goshawk PFA habitat. The treatment consists of thinning to raise the average crown base height and reduce the number of taller trees that affect the view from the tower. Possible treatment tools include intermediate thinning, stand improvement thinning, and prescribed fire. This treatment would allow for an exception in the large and old tree implementation plans to remove approximately 38 trees than 16 inches dbh that directly obscure the view from the tower. Any hardwood trees that block the view would be topped or cut. Locust stands in the area exhibit characteristics of being in the oldest age classes for that species and would be retained for scenery values where possible. The residual basal area would be about 60 to 100 ft^2 per acre. Mechanical treatments would be either preceded by or followed by an initial entry or maintenance prescribed burn, depending on the implementation schedule.

This treatment includes periodic maintenance focused on removal of trees that grow and obstruct the view over time. A post-decisional NEPA review (FSH 1909.15, Chapter 10, §18.1) would be conducted at any time in the future prior to the maintenance treatment to determine whether effects of maintenance treatments are within the context and intensity of effects disclosed in this analysis.

Prescribed Burning Treatment

The proposed treatment consists of using prescribed fire to treat natural fuels and fuels generated from timber sales or thinning activities across the entire project area (Figure 12). Prescribed burning would consist of three different stages or types of burning that depends on the location within the project area. In some locations, all three stages may occur in the same area over a number of years. Generally an “initial entry” burn would take place first in a given area to consume naturally accumulated fuels and old logging debris. The next treatment may be a “pile” burn which would consume slash from thinning activities. The next burn would be a “maintenance” burn which would re-occur in previously burned areas to keep fuel accumulations at a level that reduces the threat of an uncharacteristic wildfire. Maintenance burns would be implemented to mimic natural return intervals every 2-10 years depending on fuel accumulations. Both initial entry and maintenance burns would consist of low to moderate intensity fire that would result in the consumption of surface litter, logs and mortality of smaller diameter trees. Pile burning would burn slash generated from logging and would generally be confined to activity fuels such as limbs, tops of trees and needles (activity fuels). All stages of burning could occur at any time of the year as long as conditions are favorable to meet objectives safely and are within constraints defined by resource specialists.

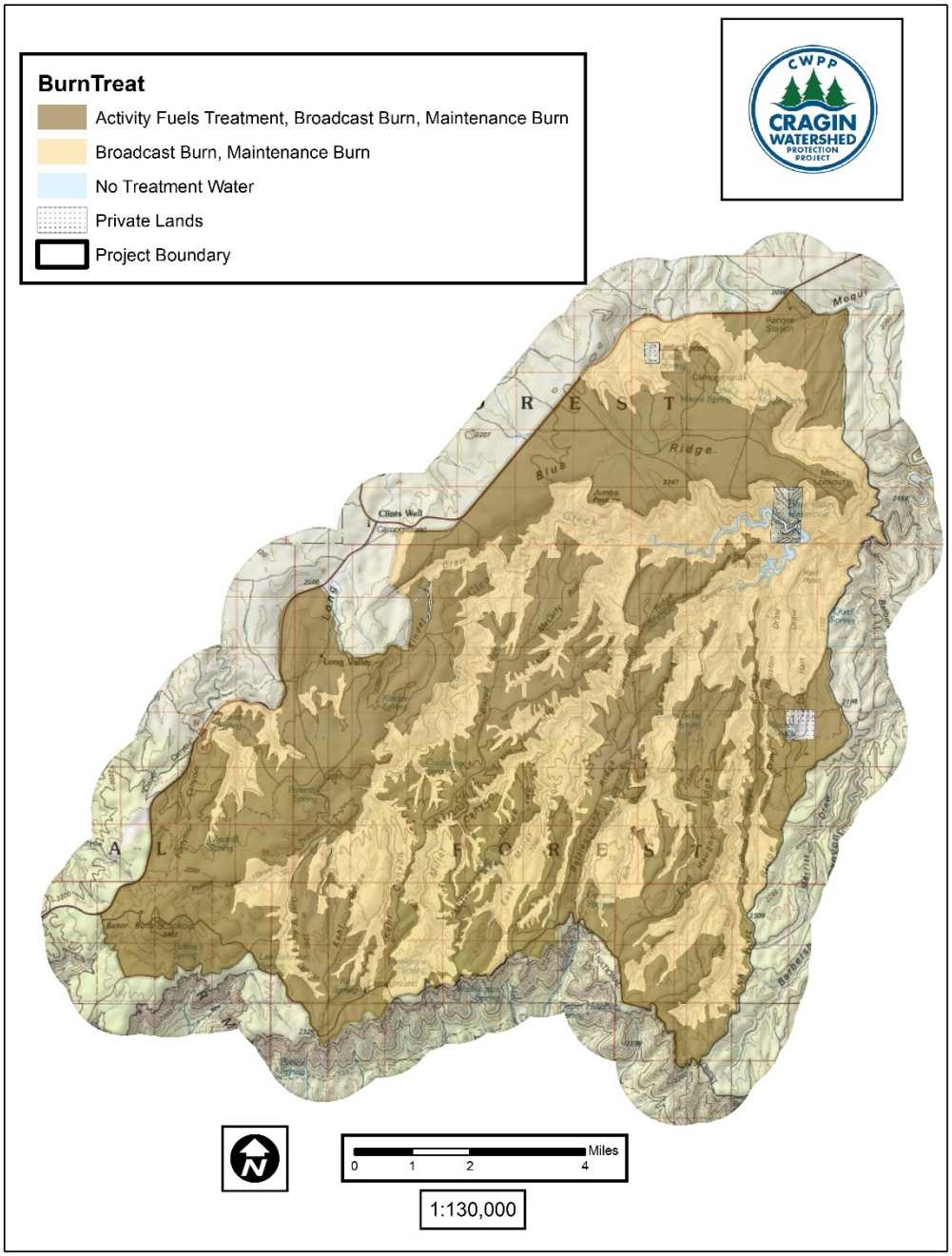


Figure 12. Prescribed fire treatments included in the proposed action alternative

MSO PAC Nest Core Area, and Nest/Roost Replacement Habitat

Within nest core areas of MSO PACs and nest/roost replacement habitat, prescribed burning treatments would be designed to reduce surface and some ladder fuels, while enhancing and maintaining key nesting or replacement habitat components, including large, old trees, hardwoods, snags, and downed wood.

Northern Goshawk Nest Sites

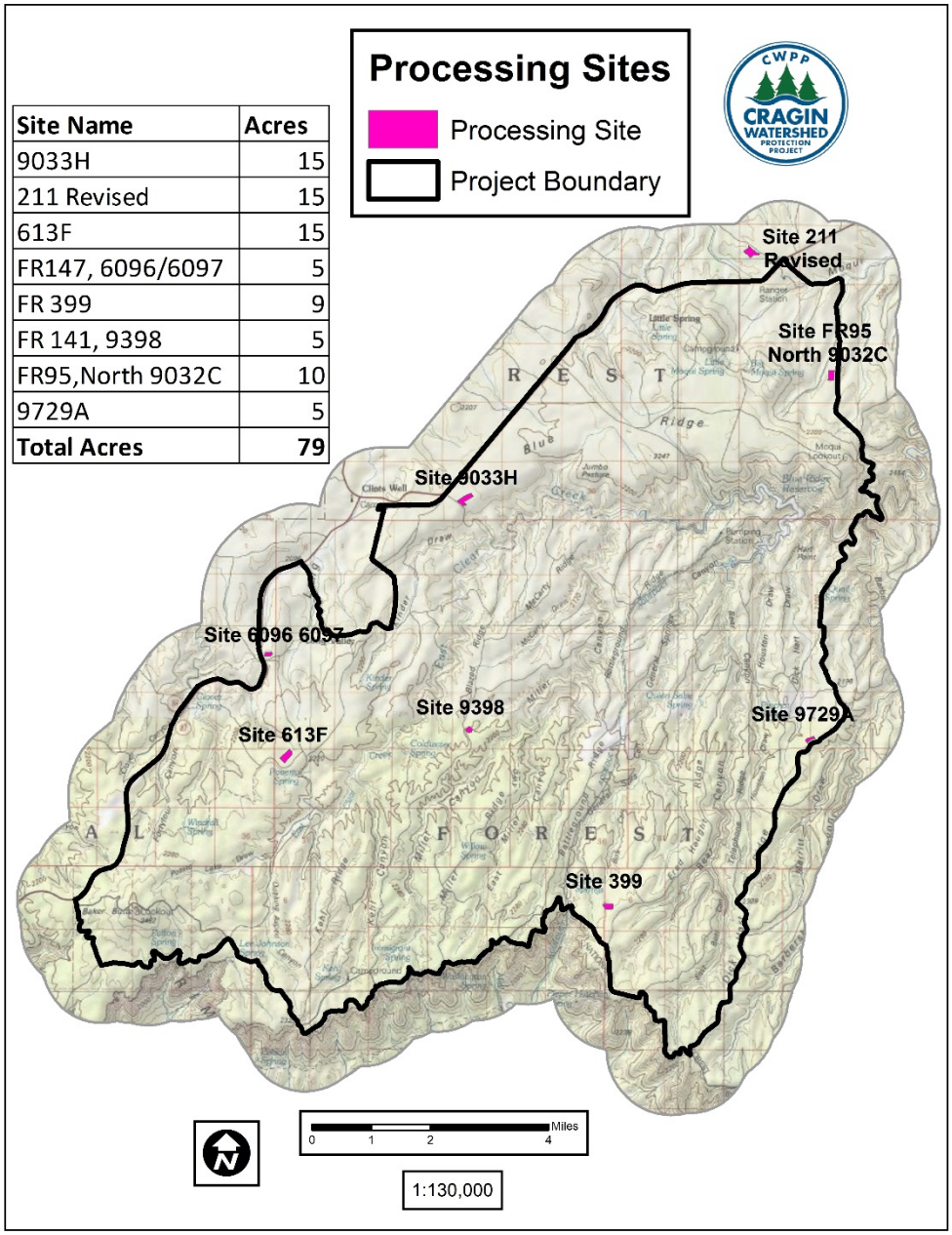
Within nest stands in the northern goshawk PFAs, prescribed burning treatments would be designed to reduce surface and some ladder fuels, while enhancing and maintaining key nesting habitat conditions, including mature trees and high canopy cover.

Processing Sites

The distance of the CWPP from businesses that can process woody biomass and timber prompted the identification of potential processing sites on the forest, within and adjacent to the project boundary. Preliminary economic analysis identified that if minimal primary processing or drying of logs could be accomplished close to the project area, it would facilitate more utilization of the forest resource and increase transportation efficiencies. Tasks carried out at processing sites may include drying, debarking, chipping stems and bark, cutting logs, manufacturing and sorting logs to size, producing wood cants[5], scaling and weighing logs and creating poles from suitable sized logs. Equipment types commonly used at processing sites include circular or band saws, various sizes and types of front-end loaders, log loaders and chippers of several types and may include timber processors, planers and mechanized cut to length systems, associated conveyers and log sorting bunks for accumulation and storage of logs. Electric motors and gas or diesel generators are also used to provide power. Large processing sites are typically greater than 10 acres in size. Large sized sites allow for more flexibility in their design and allow for more area to process, grade, scale and sort logs and manufacture cants and poles and chip and haul products. Medium sized processing sites are 5 to 10 acres in size and log processing, equipment use and storage is more limited (Dramm, Jackson, & Wong, 2002). Landings at the timber sale area are considerably smaller than log sort yards and typically are about 0.33 acre.

Eight processing sites are proposed for use in the CWPP (Figure 13). Processing site location and siting considerations included the following: flat uplands less than 5% slope; more than 200 feet distant ephemeral and intermittent stream channels (except for two sites), more than 300 feet from meadows, springs and karst features; more than 0.25 miles from MSO PACs and outside of NOGO PFAs, more than 0.25 miles from system hiking trails, campgrounds and group event recreation sites; and more than 0.25 miles from private lands, residences or offices. Processing sites were located to provide for a buffer of 100 or 300 feet from Forest roads and state highways to provide for visual screening from Concern Level 1 and 2 travel ways. Site boundaries are approximate and may be further modified during implementation and layout.

[5] A **cant** is a piece of **wood** usually over 2" thick and sawn flat on one to three sides. Most pallet shops want cants to re-saw into pallet parts because they have more options on what sizes they can cut from them.



Site Name	Acres
9033H	15
211 Revised	15
613F	15
FR147, 6096/6097	5
FR 399	9
FR 141, 9398	5
FR95,North 9032C	10
9729A	5
Total Acres	**79**

Figure 13. Processing sites and acreage included in the proposed action

The eight processing site areas may be used as part of the CWPP project over its implementation period from up to 20 years. Continuous use processing sites are those where use is expected to be continuous on a regular basis for 10-20 years. These sites typically consist of the larger sites 10-15 acres in area that are located close to major highways. Sites originally developed and operated as continuous use will frequently change to intermittent use or occasional use following initial harvest activities in the area. Intermittent use processing sites are those sites that are smaller in area, 5-10 acres, where

use is expected to be shorter term and used for one or multiple timber sale or stewardship contract periods lasting from 3-10 years.

Bonding or other methods will be included in the permitting of processing sites to facilitate appropriate reclamation is completed after use. Performance bonding provisions may be included as part of timber sale contracts to ensure that all obligations are fulfilled by the contractor and would be used if needed to clean up and rehabilitate processing sites. The standard rights and responsibilities clause and optional bonding provisions may be included in the permitting for processing sites authorized under a special use permit. These clauses would ensure that all structures and improvements would be removed and that the site would be fully rehabilitated.

Design features for processing sites including: allowed operations and facilities, authorization, construction, operation, maintenance, rehabilitation, closure and monitoring are found in Appendix B.

Transportation System, Road Management, Maintenance and Use

The 2018 Forest Plan directs the forest to have a road system that "provides access to areas on the Coconino NF including private land, recreational opportunities, research sites, facilities and to support forest and resource management". In addition, "The transportation system expands and contracts commensurate with use and needs, and it balances the desire for access with management activities and ecological impacts" (FW-RdsFac-DC-1).

To achieve the objectives of the CWPP, a transportation system is needed to access the area with log trucks, chip vans and other equipment needed to perform the required fuel reduction and timber removal work. Access is also needed for work such as non-commercial tree thinning and prescribed burning and to access the eight proposed processing sites.

The transportation system proposed for use under alternative 2 utilizes a combination of existing Forest Service system roads, closed system roads that would be used during project implementation, and decommissioned and new temporary roads, some of which would be placed on existing road beds (Table 10). No new permanent roads are proposed.

Table 10. CWPP transportation system by road status and number of miles

Road Type		Operational Maintenance Level	Miles
Existing MVUM open		ML-2, 3, 4, and 5	61
Existing MVUM open haul route		ML-2, 3, 4, and 5	173
Administrative use only, not on MVUM, haul route		ML-1	6
Administrative use only, not on MVUM		ML-1, 2	162
Temporary Roads			
Decommissioned Roads		ML-1, 2	22
	Existing Road Bed	ML-1, 2	*16*
	No Existing Road Bed	ML-1	*6*

New (total)		Not classified	23
	Existing road bed (LiDAR)	Not classified	*7*
	No existing road bed	Not classified	*14*
	Processing Sites Access	Not classified	*2*

Haul Routes

Alternative 2 will utilize about 179 miles of primary haul routes for log trucks and chip vans (Table 11).

Table 11. CWPP Haul Routes and Mileage

Route Number	Road Status	Miles
123	Existing MVUM open	8
139	Existing MVUM open	9
139A	Existing MVUM open	4
141	Existing MVUM open	12
141C	Existing MVUM open	3
141H	Existing MVUM open	5
147	Existing MVUM open	6
211	Existing MVUM open	1
218	Existing MVUM open	3
218A	Existing MVUM open	1
300	Existing MVUM open	25
308	Existing MVUM open	5
320	Administrative Use, not on MVUM	3
320A	Existing MVUM open	1
501	Administrative Use, not on MVUM	3
612	Existing MVUM open	2
613	Existing MVUM open	5
701	Existing MVUM open	3
751	Existing MVUM open	3
9033H	Existing MVUM open	1
95	Existing MVUM open	18
AZ-87	Existing MVUM open	56
Total		*179*

Forest Roads 211 and 9033H are considered haul routes because they provide access to proposed processing sites and there would be greater than normal logging truck traffic on them.

Use of Public Roads by Forest Service Contractors

Forest Service contractors have the right to legally use public roads, such as state highways or county roads, within and outside of the project area, subject to regulation by the public entity charged with jurisdiction of that roadway. In order to move timber from

the project area to processing facilities, heavy trucks will need to use public roads through surrounding cities such as Camp Verde, Winslow, Flagstaff, and others. The Forest Service may restrict haul routes or timing of routes used by contractors on the National Forest in order to provide for public safety. The Forest Service cannot dictate the routes the contractors use once they leave the National Forest.

Administrative Use Roads

Alternative 2 will utilize about 167 miles of Forest Service Administrative Use (closed) roads that are not designated for public motorized use. These include Maintenance Level 1 and 2 roads that are either occasionally used for administrative purposes or closed and managed for long term storage. Following completion of work in the area they serve, these administrative use roads will be rehabilitated back to the condition they were prior to timber operations and closed to public motorized use.

Temporary Roads

Temporary roads include new road construction for purposes related to project implementation or use of non-system roads. Roads that are identified as decommissioned and are proposed for use in this project are also considered temporary roads. While temporary roads may not be recorded in the Forest System roads database, some of these roads are well-established routes that receive regular motor vehicle use by the public for camping or recreation.

In order to support fuels reduction activities and access the project area for timber removal, temporary roads need to be used or constructed (FW-RdsFac-DC3). A new temporary road is a primitive road created or used during vegetation treatment activities for the specific purpose of transporting woody material from the project area. Based on the analysis of potential treatment areas, an estimated 45 miles of temporary roads are required in alternative 2. Temporary roads are designed to serve as short term access to a specific area for timber removal and follow up treatments such as prescribed burning. About 2 miles of temporary roads are needed to access the proposed processing sites. When the new temporary road is no longer needed for the project, the road will be rehabilitated. This rehabilitation may include outsloping, re-contouring and scarifying the road surface lopping and scattering of slash, ripping and seeding, installing adequate drainage structures such as water bars and effectively blocking the road to normal vehicular traffic where feasible pursuant with standard timber contract provision BT6.63 regarding temporary roads (USDA Forest Service, 2006).

About 23 of the 45 miles of temporary roads are on existing road prisms, which are either non-system roads or are roads that have been documented as closed from past management activities. Seven miles of roads were identified using Light Detection and Ranging remote sensing techniques (LiDAR). Old road prisms clearly show up on LiDAR imagery. Field verification of the roads that show up on LiDAR may reduce the total mileage of new construction upon project implementation.

It is likely that road prisms of temporary roads may remain partially visible after rehabilitation work is completed. The term “rehabilitation” is used in this document to describe the post project work done on these roads, rather than the term “decommission,” in order to avoid potential confusion. Road decommissioning includes activities that remove the road from the Forest Service road system and result in restoration of unneeded roads to a more natural state (FSM 7734).

The temporary road locations and mileages are approximate and may vary somewhat when they are actually constructed. A very limited number of additional temporary roads not listed in this analysis may be constructed and rehabilitated.

No new temporary road construction would occur within Mexican spotted owl Protected Activity Centers (PACs) that are proposed for timber harvest. All roads in PACs that would be used are existing roads in the forest transportation system database and are open to public use, are administrative use roads or are decommissioned (temporary) roads with an existing road bed. All temporary roads, landings, and skid trails to be used will be pre-approved by the Forest Service Timber Sale Administrator prior to harvesting and will be constructed and located in compliance with project design features. Existing roads would be used to the extent possible for hauling harvested trees and biomass.

Road Maintenance

Road maintenance on roads that receive substantial use by the public are maintained by the Forest Service as funding allows. When there is a substantial increase in use of a road by a Forest Service contractor for uses such as log hauling, the associated contractor is usually required to perform maintenance both during and after their use of the road commensurate with their use. This maintenance is often blading and reshaping of the road surface, culvert maintenance and possible adding road surfacing material. The logging contractor will be required to maintain roads used for timber transport that are closed to the public.

Rock Pit Use

Existing rock pits nearby the project area that have current authorization through the NEPA process would be used for pit run or crushed aggregate material for spot rocking and other road maintenance needs during project implementation. There are no rock pits within the project area.

There are three existing rock sources outside of the project area that may be used if needed: Lockwood Pit (T13N, R11E, Section 11) on FR 96; and Cinch Hook Pit (T12N, R9E, Section 6) at the junction of State Route 87 and State Route 260 and Park Knoll Pit, (T14N, R10E, Sec. 27) off of FR 698. Rock material would be extracted by following an approved development and operating plan as specified in the timber sale contract. During and after use, rock pit working areas would be water-barred and shaped for proper drainage. Access roads used to haul rock materials would also be maintained by the contractor or other user during and after use.

Conservation of Old Trees and Large Trees

The issue of conserving large and old trees has been identified by stakeholders and the public and has been similarly identified and addressed in every single large-scale fire risk reduction or restoration project on the Coconino National Forest in recent years. In response to this issue, two implementation plans have been developed and would be integrated into the decision to conserve old trees and large trees. The principles of this strategy have already been integrated into the proposed action. These plans are also included to meet management direction in the Healthy Forest Restoration Act to protect old growth stands and retain large trees. The plans identify ecological conditions where old pre-settlement and large, post-settlement trees may be removed to move toward or

meet desired conditions. Below is a summary of each implementation plan. The complete Old and Large Tree Implementation plans are included in Appendix A.

Old Tree Implementation Plan

Old trees (approximately over 150 years old) would be retained, with few exceptions, regardless of their diameter and condition, within the project area. Removal of old trees would be rare. Exceptions would be made for threats to human health and safety and to provide for community protection goals (such as in the Baker Butte Treatment), and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation. Old trees would not be cut for forest health issues or to balance age or size class distributions.

Large Tree Implementation Plan

The large tree implementation plan is designed to reflect the Healthy Forest Restoration Act's intent to focus on forest restoration through fire risk reduction rather than large tree removal by clarifying the intent to focus treatments on small and intermediate-diameter tree thinning, to retain large trees whenever possible, and to more specifically design treatments so that large trees would be retained unless they must be cut to meet the desired conditions listed in the categories below. The plan's desired conditions are consistent with the summarized desired conditions found in the project's purpose and need and the plan provides additional citations that support the desired conditions. It incorporates the old tree implementation plan by reference.

For the purpose of this document, large post-settlement trees, as defined by the socio-political process, are those that are 16 inches dbh or larger. Trees greater than or equal to 18 inches dbh represent VSS 5 and 6. VSS 5 and 6 represent the largest and (sometimes) oldest trees. These size classes best correspond with the successional age classification system that was developed to address the forest dynamics of southwestern ponderosa pine, which is also relevant to dry mixed conifer where it occurs in the project area.

The plan may not include every instance where large post-settlement trees may be cut. There may be additional areas and/or circumstances where large post-settlement trees need to be removed in order to achieve restoration objectives. During implementation (prescription development), if a condition exists that does not the meet the desired conditions included in this strategy, no large trees would be cut until the NEPA decision is reviewed by the Forest Service implementation team. The team would decide whether the action is consistent with the analysis and the decision made.

Exceptions to the large tree implementation plan include ecological conditions where large, post settlement trees may (or should) be removed to move toward or meet desired conditions. Since the Cragin Watershed Protection Project has a purpose and need based on fire risk reduction and watershed protection, many of the exception categories included in the Four Forest Restoration Initiative (such as exceptions to cut large trees in Seeps and Springs, Riparian areas, Wet Meadows, Encroached Grasslands, and Aspen Forest and Woodland) do not apply to this project. Exceptions where large or old trees may be cut include the following for the CWPP:

- Where necessary to meet protection of facilities and structures, public and operational safety goals, and other community protection needs.

- To remove large trees within the ponderosa pine cover type that obstruct the viewsheds from the Baker Butte Lookout Tower.
- Ponderosa Pine/Gambel Oak Forest (Pine-Oak PIPO/QUGA)
- Within Stand Openings
- Heavily-Stocked Stands (with High Basal Area)
  Generated by a Preponderance of Large, Young Trees (SPLYT)

More detailed information on the Large and Old Tree Implementation plans is included in Appendix A.

Project Design Features and Resource Protection Measures

Design features are part of the proposed action and would be incorporated into the project to protect soil, water, scenery values, wildlife and aquatic species and habitat, facilities, infrastructure and rare plants. Mitigation measures and best management practices would be implemented during the project to minimize watershed impacts, prevent the introduction and spread of invasive plants, to reduce impacts to wildlife, to protect heritage and cave and karst resources and to protect public health and safety. A listing of design features and resource protection measures is found in Appendix B.

Other NFMA consistency requirements (16 USC 1604)

The proposed action alternative 2 is consistent with the National Forest Management Act requirements under 16 USC 1604 (g) (3) (E).

1) No soil, slope, or other watershed conditions will be irreversibly damaged by implementing the proposed action. No permanent system roads or processing areas will be built during this project, so the project will not create any permanent impairment. The proposed action protects the organic matter, soil porosity, and topsoil through the use of BMPs and design features. Localized and limited losses will occur on landings, skid trails, temporary roads, and processing areas. However, over the majority of a unit and the landscape, the processes that contribute to productive soils will be preserved. BMPs and mitigations assure that no irreversible damage to the watershed or stream channel conditions would occur.

2) The proposed action provides protection for streams, stream banks, springs, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment through implementation of the Forest Plan standards and guidelines and project resource protection measures.

3) The mechanical treatments identified in the proposed action were not selected primarily to generate the greatest dollar return or the greatest unit output of timber. Rather, they were selected to appropriately balance treatment efficiency with minimizing resource impacts. Factors such as: reducing risk of uncharacteristic fire and its effects to forest resources; re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem; and improving wildlife habitat within the CWPP area were the primary factors used to determine the timber harvesting system.

4) The proposed action alternative 2 is consistent with the NFMA requirements under 16 USC 1604 (g) (3) (F) which concerns even-aged management and clearcutting. The cutting of live trees to create an even-aged system is not proposed. The CWPP proposes the use of individual tree and group selection regeneration methods which are both uneven-aged management methods.

Project Needs for Action and Units of Measure

Table 12. List of project needs and the associated unit of measure for comparison of how the alternative meets the purpose and need.

Needs For Action	Units of Measure
Reduce the risk of uncharacteristic wildfire to the WUI and drinking water watersheds in and adjacent to the project area.	• Fire Type: acres of active, passive and surface fire • Vegetation Condition Class: acres of condition class 1, 2, and 3
Reduce the risk of post-fire erosion and/or flooding that could impact reservoir operations and storage which could affect the water supply for the Town of Payson and other water users.	• Fire Type: acres of active, passive and surface fire • Vegetation Condition Class: acres of condition class 1, 2, and 3
Move the forest on a positive trajectory of restoring forest structure, composition and function and initiate the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem.	• Basal Area per Acre • Forest Stand Structure • Fire Type: acres of active, passive and surface fire • Vegetation Condition Class: acres of condition class 1, 2, and 3
Other Project Needs	
Reduction of active and passive crown fire in the drinking water watersheds and in the WUI and to increase the ability of fire suppression crews to control a wildfire within the project area.	• Fire Type • Fire Arrival Time and Fire Size
Reduction of the crown fire potential in and adjacent to Mexican spotted owl PACs.	• Fire Type in PACs
Baker Butte Treatment	• Degrees of viewshed improved • Fire Type

Comparison of Alternatives and How They Meet Purpose and Need for Action

Table 13. Comparison of alternatives by project purpose and need's unit of measures.

Management Practice or Activity	Alternative 1	Alternative 2
Mechanical Thinning in PACs	0 acres	1,631 acres
Mechanical Thinning in PFAs	0 acres	434 acres
Other Thinning Treatments (MSO Recovery, Ponderosa Pine, and Baker Butte)	0 acres	35,699 acres
Prescribed Burning	0 acres	37,766 acres

Management Practice or Activity	Alternative 1	Alternative 2
Activity fuels treatment, initial prescribed burning and maintenance burning		
Prescribed Burning (not accompanied with any mechanical thinning)	0 acres	25,868 acres
Temporary Road Construction on Existing Road Prisms (all roads would be decommissioned after use)	0 miles	23 miles
New Temporary Road Construction	0 miles	22 miles
SR 87 Highway ROW Thinning	0 acres	~200 acres
Hand thinning burn preparation treatment on steep slopes adjacent to some private lands and campgrounds	0 acres	~77 acres
Baker Butte Tower Viewshed	90 degrees of viewshed impaired	0 degrees of viewshed impaired
Baker Butte Tower Fire Behavior Type on 27 acres	Active Crown Fire	Surface Fire

Comparison of Fire Behavior Type between Alternatives

The three fire types are active crown fire, passive crown fire, and surface fire. An active crown fire type is a crown fire that would be self-sustaining though a stand resulting in mortality of most trees, shrubs and surface vegetation. A passive fire type would be the possibility of individual or group tree torching but due to openings and interspaces between tree groups may not be sustained crown fire. Surface fire would be fire restricted to the forest floor due to the removal of most surface and ladder fuels through prescribed cutting and fire treatments. More information regarding fire types is included in the Fire and Fuels Environmental Consequences section in Chapter 3.

The following tables compares the change in fire behavior type between Alternative 1's No Action and Alternative 2's Proposed Action. Table 14 compares fire behavior for the CWPP analysis area as a whole. Within MSO PACS and within the project area, Alternative 2's proposed treatments reduce the risk of active crown fire by 92 percent promoting fire-adapted, resilient, diverse and sustainable forest ecosystems.

Table 14. Fire behavior comparison by alternative after first decade. After implementation of Alternative 2, uncharacteristic active crown fire behavior is reduced by 98 percent within the CWPP area from Alternative 1's existing condition.

Fire Behavior Type	Alternative 1		Alternative 2		
	Acres	*Percent of area (%)*	*Acres*	*Percent of area (%)*	*Percent Change (%)*
Active Crown Fire	22,552	35	644	1	- 97
Passive Crown Fire	34,794	54	9,665	15	- 72
Surface Fire	7,088	11	54,124	84	663
Total	64,433	100	64,433	100	–

Table 15. Fire behavior comparison by alternative after first decade within Mexican spotted owl Protected Activity Centers. After implementation of Alternative 2, uncharacteristic active crown fire behavior is reduced by almost 100 percent within the CWPP area from the existing condition.

Fire Behavior Type	Existing Condition		Alternative 2		
	Acres	*Percent of area (%)*	*Acres*	*Percent of area (%)*	*Percent Change (%)*
Active Crown Fire	2,531	13	195	1	- 92
Passive Crown Fire	5,452	28	2,921	15	- 46
Surface Fire	11,488	59	16,356	84	42
Total	19,471	100	19,471	100	–

Vegetation Condition Class

After thinning and burning treatments, the Vegetation Condition Class 3 which is associated with vegetation conditions highly departed from desired conditions is improved by 32 percent (see Table 16). Alternative 2 meets the project's purpose and need better than Alternative 1 at initiating steps toward restoring a fire-adapted, resilient, diverse and sustainable forest ecosystem as defined by vegetation condition class.

Table 16. Comparison of the alternatives to Vegetation Condition Class by change in total acres.

Alternative	Vegetation Condition Class			
	1	**2**	**3**	**Total**
	Acres	*Acres*	*Acres*	*Acres*
Alternative 1	175	26,881	37,377	64,433
Alternative 2	23,195	15,466	25,773	64,433
Percent Change	13,154%	- 42%	- 32%	–

Arrival Time and Fire Size Simulation

Alternative 2's vegetation thinning and prescribed burning treatments have reduced surface and ladder fuels and diversified forest structure. Alternative 2 would improve the ability of fire suppression crews to control a wildfire within the project area which reduces the risk of damage to infrastructure and water resources.

FlamMap, a fire behavior computer model, was used to simulate a wildfire for both alternatives, based on a June 20th start date at 10 am with eight hours of burning until nightfall. With no action, with the existing vegetation conditions, the modelled fire growth was estimated at about 5,400 acres. After implementation of Alternative 2's thinning and prescribed burning treatments and under the same conditions, the modeled fire growth was estimated at 700 acres (Figure 14).

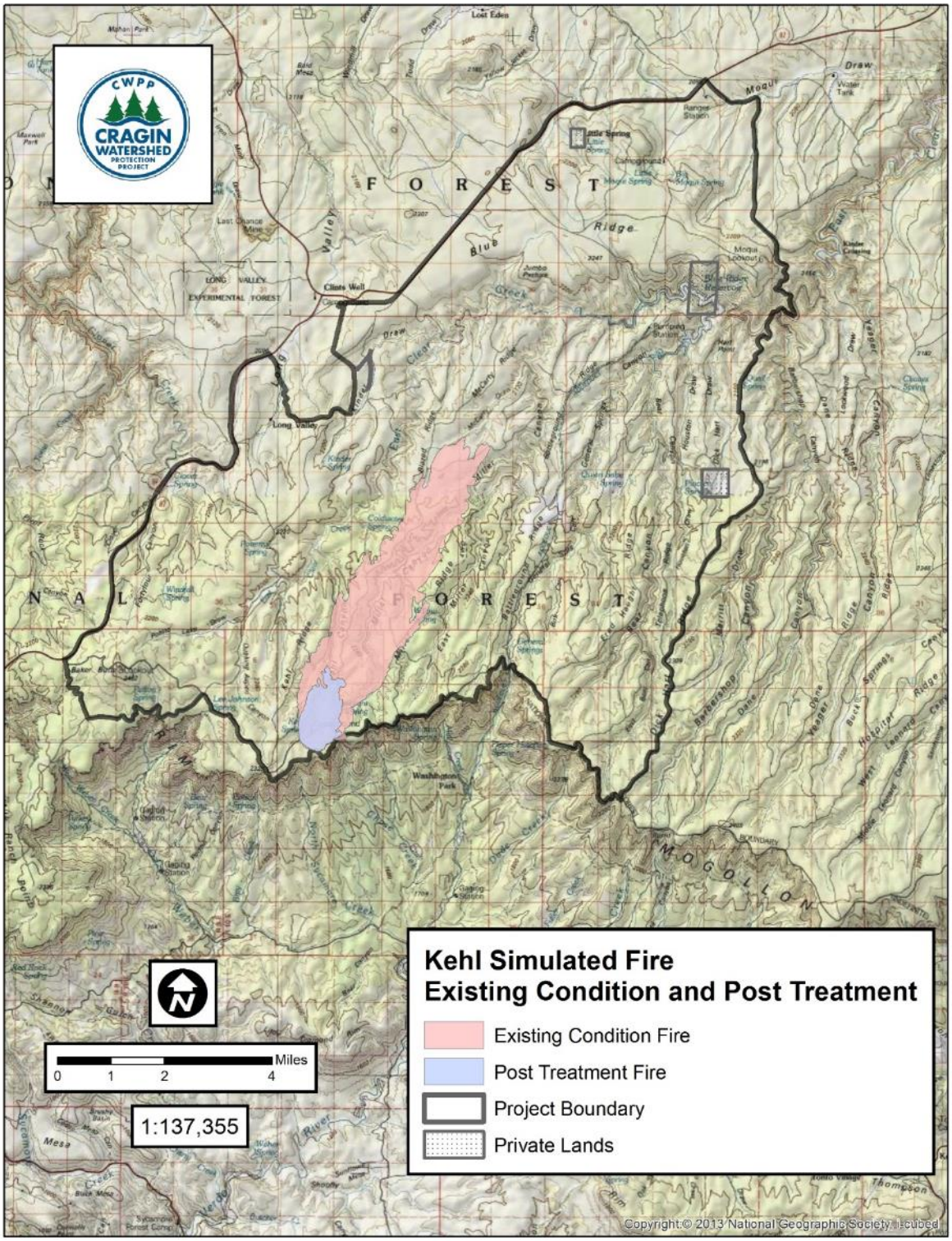


Figure 14. Modeled wildfire in the vicinity of Kehl Springs after 8 hours of burning based on the Existing Condition and Proposed Action scenarios

Comparison of Vegetative Conditions by Alternative

The following is a comparison of how Alternative 1 (No Action) and Alternative 2 (Proposed Action) address the project's purpose and need of restoring a fire-adapted, resilient, diverse and sustainable forest ecosystem.

Information in the tables below is focused on activities and measurable effects that can be distinguished quantitatively or qualitatively among alternatives. Values presented are the result of modeled outputs from the Forest Vegetation Simulator (FVS) from stands that are proposed for mechanical or hand thinning. Cells shaded in green either move toward or achieve the desired condition for each evaluation criteria the year after treatment.

Table 17. Comparison matrix for vegetation resources in terms of basal area per acre by treatment type one year after treatment.

COMPARISON MATRIX FOR VEGETATION RESOURCES					
Basal Area per Acre (BA)					
Desired Condition: (+/- 1) of the reference condition.					
		Alternative 1		Alternative 2	
Treatment Type	Desired Condition	BA	Meets DC?	BA	Meets DC?
Ponderosa Pine Treatment outside of PFAs	40- 80	128	No	59	Yes
Ponderosa Pine Treatment within Northern Goshawk PFAs	60-80	120	No	54	No
MSO PAC Mixed Conifer	80-150	148	Yes	123	Yes
MSO PAC Pine-Oak	80-140	145	No	88	Yes
MSO Recovery Habitat Mixed-Conifer	60-120	150	No	89	Yes
MSO Recovery Habitat Pine-Oak	60-90	145	No	89	Yes
Baker Butte Treatment	60	193	No	61	Yes

Table 17 illustrates that Alternative 2 trends tree density better than Alternative 1 toward desired conditions. In situations, such as in Northern Goshawk PFA stands where the post-treatment density does not meet desired conditions immediately, it is expected to move toward these desired conditions so that they are within the desired range for basal area in one or two years after mechanical treatments. Desired conditions promote fire-adapted, resilient, diverse and sustainable forest ecosystems and reduced risk of uncharacteristic wildfire.

1. Basal area (BA) is important to analyze whether forest densities fall within the natural range of variability (NRV). NRV is based on the ground assessment and recommendations found within the report *Restoring Composition and Structure in Southwestern Frequent-Fire Forests* (Reynolds, et al., 2013). Desired condition is a balance of natural range of variability, habitat needs, species composition and cover type.

2. Regeneration on the various soil types (limestone, sandstone, basalt flows, etc.) is going to be variable based on site productivity and habitat type. Uneven-aged management is more successful under the proposed action because it introduces areas to regenerate trees while providing adequate protection from uncharacteristic wildfire. The use of prescribed burning would function to reduce regeneration and overall densities of shade tolerant species. In mixed conifer habitats basal area per acre is correlated with higher canopy cover. These

conditions promote more shade tolerant species such as white fir. More open tree stocking (lower basal area per acre) would promote shade intolerant species such as ponderosa pine, Douglas-fir and aspen. Historical distributions of species composition is based on topographical factors such as elevation, drainages and slope aspect. White fir is represented in wet mixed conifer areas that are identified upon silviculture prescription preparation. Wet mixed conifer, which would be treated with prescribed fire, is identified by legacy and reference condition of large white fir trees, mixed with other indicator plants such as aspen, maple and low levels of bunch grasses and higher representation of sedge grasses. These areas are typically found in drainages and north facing slopes in the project area.

3. The proposed action improves forest health at the landscape levels by reducing tree densities to decrease bark beetle risk. Treatment would also reduce the severity of dwarf mistletoe by limiting the disease to its current location and reducing the overall abundance by removing infected trees.

4. Baker Butte treatment does not fall within the reference condition due to the need to reduce densities in the proximity of the lookout tower to protect infrastructure and views. However the treatment meets the purpose and need for action to improve the viewshed from the tower.

Table 18. Comparison of the alternative's success in meeting the desired condition in terms of stand structure one year post treatment.

COMPARISON MATRIX FOR VEGETATION RESOURCES					
Stand Structure					
Desired Condition: Move toward increased acres of uneven-aged (UEA) structure.					
Treatment Type	Desired Condition (structure)	Alternative 1		Alternative 2	
		Structure	Meets DC?	Structure	Meets DC?
Ponderosa Pine Treatment outside of PFAs	Uneven	Uneven	Yes	Uneven	Yes
Ponderosa Pine Treatment within Northern Goshawk PFAs	Uneven	Even	No	Uneven	Yes
MSO PAC Mixed-Conifer	Uneven	Even	No	Even	No
MSO PAC Pine-Oak	Uneven	Uneven	Yes	Uneven	Yes
MSO Recovery Habitat Mixed-Conifer	Uneven	Uneven	Yes	Uneven	Yes
MSO Recovery Habitat Pine-Oak	Uneven	Uneven	Yes	Uneven	Yes
Baker Butte Treatment	Uneven	Uneven	Yes	Uneven	Yes

Table 18 illustrates that the group selection with free thinning mechanical treatments proposed with Alternative 2 trends stand structure towards the desired uneven-aged structure better than Alternative 1 - No Action.

1. Uneven-aged forest conditions are desired to create forest resiliencies to disturbances such as fire, insects and diseases. Forest sustainability, ensuring forest conditions into the future, is important for conservation of habitat and forest uses. Uneven-aged silviculture management is appropriate because this practice would move the project area within natural range of variability. Even-aged patches at sizes less than stand level, were historically tied to moist drainages and north-facing slopes and will continue to occur as micro sites within the project area.

2. Most of the treatments, create uneven-aged structures, which promote forest resiliencies to disturbances. At the stand level, single-storied stands would become two-storied (even-aged) over the next decade. Stands that are currently 2-storied would move toward uneven-aged structure. At the landscape level, treatments move the forest conditions toward uneven-aged structure.

CHAPTER 3: Affected Environment and Environmental Consequences

Vegetation

The following section describes the affected environment and effects of the alternatives on vegetation. The analysis presented is summarized from the Silviculture Specialist Report for the Cragin Watershed Protection Project.

All ponderosa pine and mixed conifer forested habitat within the CWPP analysis area was stratified to meet analysis requirements in the forest plan and the revised recovery plan for the Mexican spotted owl. Stratification of acres by habitat and forest type is displayed in Figure 7. The discussion of the Affected Environment and Environmental Consequences will be by forest habitat type.

Forest Composition

The Cragin Watershed Protection Project proposed action is based on forest cover information and habitat type to identify different treatment types. Forest cover information was primarily based on plot measurements, however, other sources of data were used such as field visits and LANDFIRE, to fill-in and enhance information on forest cover and fuels type throughout the project area.

During the 30-day comment period on the preliminary Environmental Assessment, the Fish and Wildlife Service requested information on just forest cover type throughout the project area for more clear information on forest composition. This information is different than the forest data used for the proposed action, because the proposed action is based on forest cover and habitat type to develop different treatment types. Data on forest composition cover type is included here to help further inform and disclose information about forest composition within the project area.

In the case of the Cragin Watershed Protection Project, the forest cover data from LANDFIRE differs slightly from data used to derive treatment types. For example, LANDFIRE data illustrates slightly lesser amounts of Ponderosa pine, mixed conifer, and ponderosa-pine Gambel oak and has additional forest cover categories of juniper and other woodlands, grasslands, non-forest and water, aspen, and mixed hardwoods. In other words the forest cover data used for treatment types lumps smaller categories of other vegetation types into one of the three main cover types. This is helpful for identifying treatments across the project area, but is not as detailed and can obscure information about small but important cover types such as aspen or mixed hardwood (maple stands).

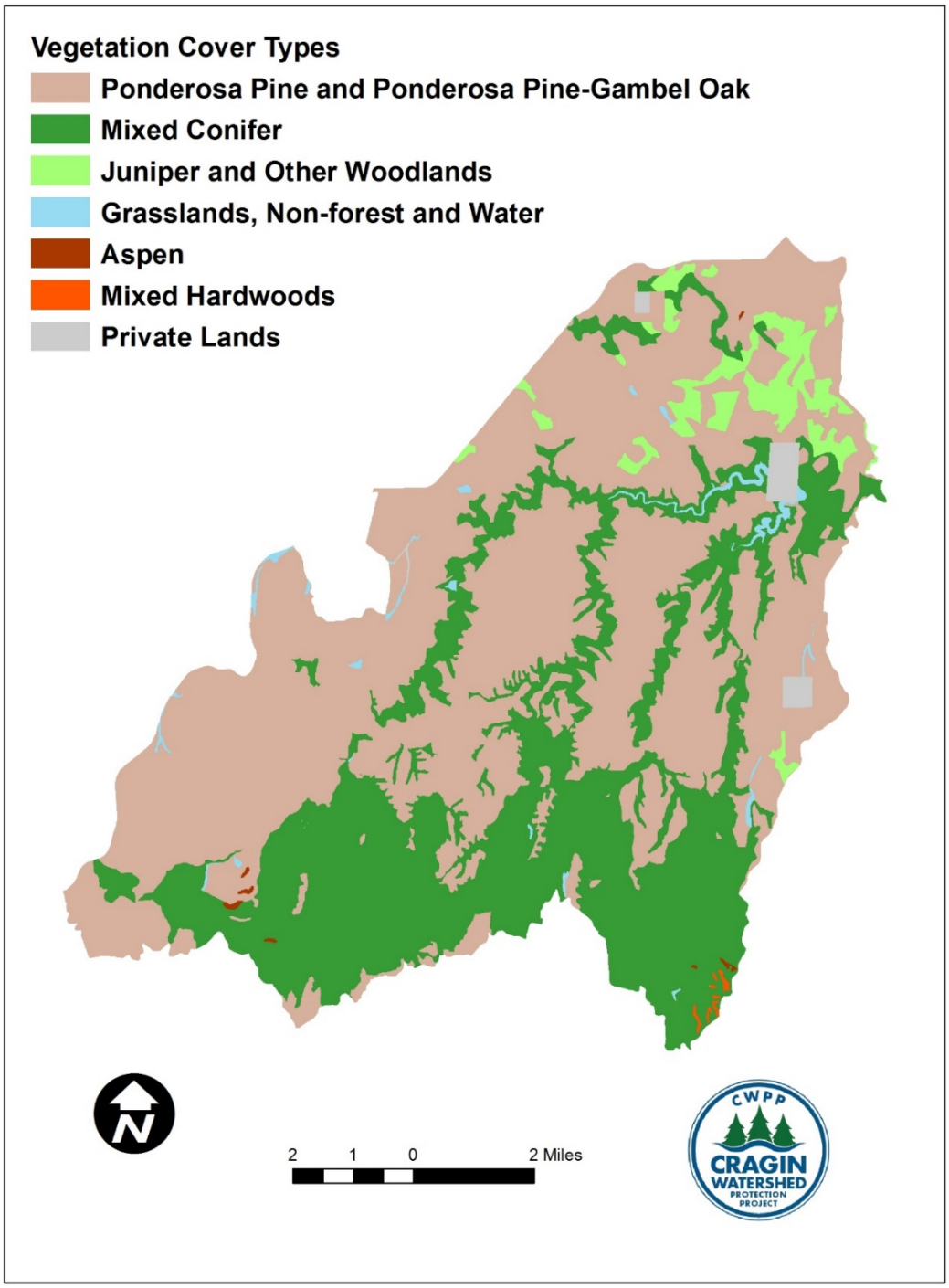


Figure 15. Vegetation cover types within the CWPP analysis area

Forest vegetation within the project area is variable and changes by factors such as topography, aspect, and elevation. As shown in Figure 15 and Table 19, the analysis area is dominated by the ponderosa pine cover types with 38 percent of the area and mixed conifer with 34 percent of the analysis area and pine-oak with 23 percent of the area. Limited cover types (making up less than 1%

of the project area) such as aspen and mixed hardwood are primarily located near the rim at the south end of the project area in drainages and on north-facing slopes.

Table 19. Vegetation cover types within the CWPP analysis area

Vegetation Cover Type	Acres	Percent of Land Area
Ponderosa Pine	24,589	38%
Mixed Conifer	21,940	34%
Ponderosa Pine-Gambel Oak	14,582	23%
Juniper and Other Woodlands	2,113	3%
Grasslands, Non-forest and Water	524	1%
Aspen	64	<1%
Mixed Hardwood	64	<1%
Private Lands	557	1%
Total	64,433	100%

Forest Structure

Vegetation Structural Stage

Vegetation structural stage (VSS) is a method of describing the development stages of a stand of living trees and is a generalized description of forest age and tree size from seedling to old forests. It is an integrative approach, combining vegetation and forest growth, to describe southwestern forests. Six vegetation structural stages (VSS) have been defined primarily on tree diameters and are based on the time it takes seedlings to become established and subsequent growth rates. Life expectancy of trees determines how long the oldest VSS can be maintained (Reynolds et al. 1992). These stages are: VSS 1, forests dominated by grasses, forbs and shrubs; VSS 2, forests dominated by seedlings and saplings; VSS 3, young forests; VSS 4, mid-aged forests; VSS 5, mature forests; VSS 6, old forests (Reynolds et al. 1992). The VSS classification is based on the tree size class with the highest square foot of basal area. Basal area includes all tree species. For this analysis it will be used to describe variability of size and age classes, old forest structure and determine the effects to sustainability of large trees within the ponderosa pine cover type.

Table 20. Description of Vegetation Structural Stages (VSS)

Vegetation Structural Stage	DBH Size Class (inches)	Vegetation Structural Stage	Stage/DBH Size Class (inches)
1- Grass/Forb/Shrub	0-.9	4- Mid-age Forest	12.0-17.9
2- Seedling/Sapling	1.0-4.9	5- Mature Forest	18-23.9
3- Young Forest	5.0-11.9	6- Old Forest	24.0 +

Uneven-aged Structure

Even-aged forests are forests that are comprised of one or two distinct age classes of trees. Uneven-aged forests are forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups (Reynolds, et al., 2013). The Coconino Forest Plan and the 2012 revised Mexican Spotted Owl (MSO) Recovery Plan *(*USDI Fish and Wildlife Service, 2012*)* both promote the desired condition of forests composed of an uneven-aged structure where groups and clumps of trees of different size and age classes are spatially arranged across the landscape

Density

Stand density is a measure of the degree of crowding of trees within stocked areas (Helms, 1998). One of the major factors affecting forest structure and development, specifically the rate at which individual trees grow and advance through successional stages, is inter-tree competition. "Competition" refers to density-related scarcity of one or more environmental factors necessary for growth, such as moisture, nutrients, and sunlight. Early in stand development and prior to closure of the crown canopy, individual trees are growing at their full potential due to a lack of competition with other trees. As stand development advances, relative densities increase as the size of individual trees increase and the crown canopy begins to close. Individual trees begin to experience some competitive interaction with other trees and self-pruning of lower branches begins. At this stage in stand development, individual trees begin to exhibit height growth differentiation due to genetics, microsite differences, and damage caused by biotic and abiotic factors. As stands continue to develop, competition between trees continues to increase as trees increase in size. Growth rates for individual trees decrease as competition increases. Eventually, stands near the point of full site occupancy and self-thinning occurs due to competition-based mortality. At this stage of stand development, trees are growing at much less than full potential.

High forest densities result in increased inter-tree competition, decreased tree health, growth and vigor, decreased regeneration of shade intolerant species, stagnation of structural stage progression, increased insect and disease-related mortality especially in older age classes, decreased horizontal heterogeneity, decreased understory productivity and diversity, and increased fire hazard.

Measures of stand density used in this analysis are basal area, trees per acre, and stand density index (SDI). Basal area (BA) is the cross-sectional area of all trees, measured in square feet per acre and trees per acre (TPA) is simply a count of the total number of trees on an acre. These simple measures of stocking do not give an indication of tree sizes and therefore can be biased when used alone to determine how site resources are being used.

Basal Area

Basal area is the cross-sectional area of all stems of a species or all stems in a stand measured at breast height (4.5 ft. above the ground) and expressed per unit of land area. The larger the circumference of a tree the more basal area it has. Basal area will be used to quantify the density of the tree overstory in general terms. Higher basal areas generally over 120 ft^2 can indicate increased risk to insect outbreaks, increased inter-tree competition for resources as well as more closed forest structure (Chojnacky, Bentz, & Logan, 2000) (Schmid, Mata, & Obedzinski, 1994). While the Forest Plan provides a density desired condition with a range of basal areas ranging from 20 to 180 ft^2 depending on cover type, for this analysis, at the project level, and for ease of comparison of effects between alternatives, 120 ft^2 is the breakpoint used for the resource measure. For both mixed conifer and ponderosa pine cover types it is desired to maintain basal area at less than 120 ft^2 though exceptions exist along steep slopes or for specific wildlife needs for dense and closed canopy forest conditions.

Stand Density Index

Stand Density Index (SDI) – An expression of relative stand density based on the predictable relationship between average tree size and trees per unit area in dense stands. This relationship, independent of both stand age and site quality, provides a basis from which to develop an understanding of the competitive interactions between individuals in a population (Long J. N., 1985, p. 24) (see Table 21). For this analysis 450 is the SDImax for ponderosa pine and ponderosa pine-oak forests and 560 is the SDImax for mixed conifer forest stands (Shaw, 2013).

Table 21. The competitive interactions for vegetation based on the percent of maximum stand density index.

Percent Maximum SDI	Competitive Interactions
0 – 24% Low density	Less than full site occupancy, maximum understory forage production. No competition between trees, little crown differentiation. Maximum individual tree diameter growth. Minimum whole stand volume growth.
25-34% Moderate density	Less than full site occupancy, intermediate forage production. Onset of competition among trees, onset of crown differentiation. Intermediate individual tree diameter growth. Intermediate whole stand volume growth.
35-55% High density	Full site occupancy, minimum forage production. Active competition among trees, active crown differentiation. Declining individual tree diameter growth. Maximum whole stand volume growth. Upper range of zone marks the threshold for the onset of density-related mortality.
56%+ Extremely high density	Full site occupancy, minimum to no forage production. Severe competition among trees, active competition-induced mortality. Minimum individual tree diameter and growth, stagnation. Declining whole stand volume growth due to mortality

Crown Cover and Openness

Interspaces and Openings

A key characteristic of historical ponderosa pine forests was the grass-forb-shrub open areas interspersed among tree groups; defined as the interspace[6]. This interspace typically comprised a large portion of the landscape and are areas capable of supporting tree growth but, at a given point in time, are absent of tree canopy (typically created and maintained by low severity disturbances, such as frequent fire). Figure 16 provides an example of an interspace between groups and clumps of trees. Openings[7], another term used throughout this report are generally larger than interspaces and are

6 Interspaces includes areas not currently under the vertical projection of the outermost perimeter of tree canopies. They are generally composed of grass-forb-shrub communities, but could also be areas with scattered rock or exposed mineral soil. Interspaces do not include meadows, grasslands, rock outcroppings, and wetlands (that is, exclusions adjacent to and sometimes within forested landscapes).

7 Openings are areas greater than 0.10 acre generally devoid of trees because they either: (1) preclude tree growth (such as rock outcroppings, wetlands [natural openings] or (2) were the site of a complete stand-clearing disturbance event (also natural openings) or (3) currently have less than 10 percent canopy cover and have the site capacity but an insufficient number of established seedlings to sustain at least 10 percent tree canopy cover at maturity.

generally discussed in association with creating areas for tree regeneration as part of an uneven-aged forest management system. Openings are limited in size according to each treatment type. Figure 17 provides an example of an opening created by a stand-clearing fire disturbance.

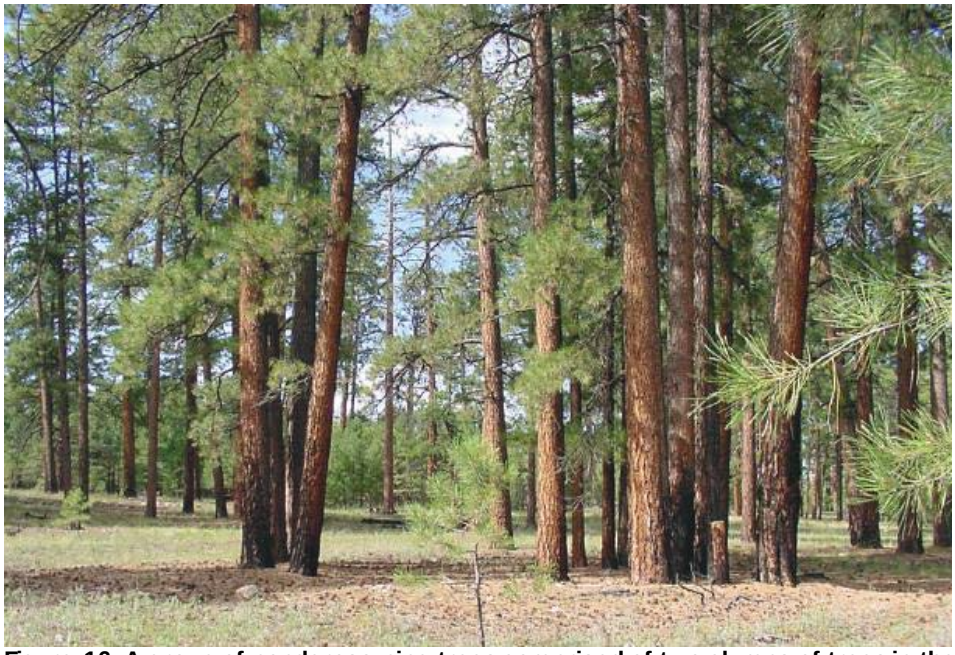


Figure 16. A group of ponderosa pine trees comprised of two clumps of trees in the foreground. The grass-forb-shrub meadow interspersed among the tree groups and single young trees is defined as the interspace.

Figure 17. An example of an opening, approximately 1 acres in size, created by fire and naturally regenerated by windblown seed with ponderosa pine.

Openness

The term openness as used in this analysis conveys the percentage of the forested area that is grass-forb-shrub interspace and additional open areas, such as meadows, grasslands, rock outcroppings, wetlands, and small openings created to support growth of new trees. As defined by the Forest Plan, openness is the estimated inverse of forest canopy cover for a given area. For example a forest with 70 percent canopy cover would have an openness of 30 percent. The Forest Plan desires interspaces within ponderosa pine forests to range from 30 to 60 percent. For mixed conifer, denser conditions are desired with interspaces ranging from 10 to 50 percent of the area. Stands managed for specific wildlife habitat needs may be managed for the less open side of the spectrum according to management direction appropriate for that species.

Large Trees and Old Forest Structure

The 2012 MSO Recovery plan outlines the minimum desired conditions for mixed conifer and pine-oak forest areas managed for recovery nesting/roosting habitat and protected activity center (PAC) habitat. The desired condition for large trees and old forest structure within MSO PAC habitat is a minimum of 12 trees per acre that are 18 inches in diameter or larger and for the basal area within the 12 to 18 inch and 18 inch and greater size classes average 30 percent of total basal area each.

Table 22. Desired condition for MSO size class distribution and other attributes for PACs - mixed conifer habitat

Condition	Trees per Acre 18"+	% Basal Area by Size Class	
		12 to 18" DBH	18" + DBH
		(Feet^2)	(Feet^2)
Desired Condition	12	30 +	30 +

Within the ponderosa pine cover type outside of MSO recovery habitat, the desired condition for large and old trees is characterized by having 40 percent of the stand tree density within the VSS 5 and 6 size classes (18 inches and greater) (Reynolds, et al., 1992). However, based on larger landscape conditions that show a lack of large and old trees, stakeholder input urging protections on large and old trees, and language in the Healthy Forest Restoration Act to retain large trees, the desired condition is to maintain as many large and old trees as possible given the project purpose and need can be met.

Methodology

Information Sources

Common Stand Exam Data

The basic unit for characterizing of vegetation conditions is the stand. All lands within the Coconino National Forest are delineated into stands based on similar characteristics such as vegetation type, slope, aspect, tree density, species composition and management history. Stands vary in size depending upon their uniformity; usually from 10 acres up to several hundred acres.

Comprehensive tree data has been collected on a subset of the stands within the project area between 1993 and 2015. A special effort was made to update data within forest stands impacted by wildfire through 2015. Within each sampled stand, tree characteristics were measured at sample points, using both variable basal area factor plot and fixed plot designs. Specific tree data collected includes

species, class, diameter, height, age, growth, damage and disease. Other data sometimes collected depending on design included surface fuels and understory plant species. This stand data is currently stored in the Field Sampled Vegetation (FSVeg) database which is a Forest Service database used to store field sampled data in a common format. A thorough review of the stand data was done for the project area to ensure validity.

FSVeg Spatial Data Analyzer

The FSVeg Spatial Data Analyzer (DA) program is an analysis tool to help forest managers understand vegetation data through the use of the Forest Vegetation Simulator linked with Geographical Information System (GIS) software (ArcGIS) (USDA Forest Service, 2016a). The DA was used to create a vegetation data set for the entire project area using various nearest neighbor imputations, create alternatives and model vegetation treatments for this assessment.

Nearest Neighbor Analysis

Data used for this analysis has come from intensive stand exam data, walk-through examinations and a Nearest Neighbor (NN) dataset. The FSVeg Spatial Data Analyzer uses Nearest Neighbor imputation[8] methods to fill in the missing vegetation data with imputed data that is based on existing vegetation data from similar stands (USDA Forest Service, 2016a).

Approximately 23 percent of the project area had stand data and the NN analysis was used to provide data for the rest of the analysis area. Areas sampled included ridge-tops and previously treated areas. Steep slopes were not included in the samples, due to access issues. The r-squared value for the NN data is .88, which is considered dependable for modeling environmental assessments. NN analysis uses satellite imagery (Landsat 8, June 2016), spatial relationships, and topographic information to match a target site (a stand without data) to the nearest reference site (a stand with data) with the greatest similarity in vegetative characteristics. Tree data from the reference site is then assigned to the target site. All of the stand exam data was first run through a tree growth model, the Forest Vegetation Simulator (FVS), to equalize all stand data to the year 2016 (Year 1).

Forest Vegetation Simulator

The Forest Vegetation Simulator (FVS) is a computer model used for predicting forest stand dynamics (Dixon, 2002). FVS is the standard tree growth and yield model used by the USDA Forest Service. FVS with use of the Central Rockies Variant (Keyser & Dixon, 2008) was used to summarize current forest stand conditions, and predict future stand conditions under various management alternatives. FVS was used to estimate direct effects to forest stands and to consider how management practices affect stand structure and composition and estimate hazard ratings for wildfires.

Canopy Cover Measurements

Canopy cover is defined as "the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage" (Reynolds et al. 1992). Canopy cover is often viewed as a meaningful expression of stand conditions relating to habitat suitability as well as tree overstory/herbaceous understory relationships. In the southwest, canopy cover estimates figure in management recommendations for both the Mexican spotted owl (USDI Fish and Wildlife Service 2012) and the northern goshawk (Reynolds et al. 1992).

Canopy cover is time consuming to measure and difficult to standardize to obtain consistent results with different observers. Percent canopy cover for all the analysis within this document was

[8] Imputation is a process of 'filling in' missing data with plausible values.

determined by stand using the average basal area (BA) as calculated by FVS. A study by Shepperd et al. (2002) used vertical crown projection to develop an algorithmic relationship to estimate canopy cover based on the average stand basal area. Average percent canopy cover for each stand was calculated using the following formula developed by this study: *Canopy cover = -57.44 + 25.5047 * LN (BA)*

Incomplete and Unavailable Information

Older stand exam data collected in the 1990s captured stand conditions immediately post-harvest from commercial thinning and regeneration harvests utilizing shelterwood and selection methods conducted in the late 1980s and early 1990s. This older data provides a good estimate of the existing forest overstory even despite wildfires that have occurred in the project area since this data was collecyed, however, it is lacking in information regarding the abundant pine regeneration that has established on many sites following the exams. These older exams also did not collect fuels data such as Brown's transects and as a result, forest managers used default values or data from other sources such as the LandFire Project (https://www.landfire.gov/) for vegetation modeling purposes.

As noted above stand exams were used to update stand conditions within wildfire areas through the year 2015. Landsat imagery dated June, 2016 was used to perform the remote sensing analysis, capturing and performing imputations of changed conditions to that date. Prescribed fire and wildfires occurring after June of 2016 were reviewed and it was determined that the fire effects to forest stands were mostly of a low intensity and would have had a negligible effect to forest structure or composition at the stand or landscape scale.

Stand exam data is an average characterization of the forested area within the stand boundaries. It is limited by sampling intensity and the variability within the sampled area.

Dwarf mistletoe infections are difficult to detect from satellite imagery. Therefore, the MSN imputation process may have imputed stand data showing mistletoe infections to stands that are not infected and vice-versa. This error is expected to have little effect on conclusions of the modeling with regards to basal area or other measurements besides mistletoe.

FVS is not spatially explicit and cannot model tree groups and interspaces together. The modeling results are an average approximation of forested structure.

Results from the FVS model depend upon sample data, validity of the model itself and assumptions made by the modeler. Detailed information about the FVS model and assumptions applied during FVS modeling for this analysis are included in the project record.

Affected Environment

This section details the affected environment for the vegetation resources within the analysis area. We will define the existing condition and the desired condition. The existing condition establishes the baseline against which the decision maker and the public can compare the effects of the alternatives towards meeting the desired conditions for vegetation resources depending on the forest ecosystem and associated wildlife habitat.

Historical Context

Historically, fire was an integral component of the ecosystem. Prior to human-influenced changes to the characteristic fire regime, the composition, structure, and spatial pattern in frequent-fire forests were maintained by frequent, low-severity fire through a functional relationship between pattern and process; that is, frequent low-severity fires resulted in forest structures that facilitated continued low-

severity fire (Fitzgerald, 2005) (Graham, McCaffrey, & Jain, 2004) (Hiers, O'Brien, Mitchell, Grego, & Loudermilk, 2009) (Thaxton & Platt, 2006) (Mitchell, Harmon, & O'Connell, 2009).

Recent research from a small group of scientists has concluded that historic data demonstrates the region surrounding the project area experienced mixed severity fire, and that high-fire severity was not an uncommon phenomena (Odion, et al., 2014) (Williams & Baker, 2012). While there may have been many areas in the southwest region that historically supported naturally greater numbers of trees, which may have supported mixed severity fire or even high-severity fire, the overwhelming majority of research from a great number of studies which have occurred near the project area, supports the reduction of tree densities (Sánchez Meador, Parysow, & Moore, 2010) (Ffolliott, Barger, & Martin, 1967) (Fulé, Covington, & Moore, 1997). While some of the mixed conifer forest types in the project area may have historically supported a mixed fire regime, recent research of mixed conifer forest on the Mogollon Rim found that historical high-severity fires were very unlikely, and "the historical fire regime on this landscape was one of high-frequency, low-severity fires." (Huffman, Zegler, & Fulé, 2015).

Much research has been done in the past several decades to determine reference conditions (pre-European settlement approximately 1870) for ponderosa pine in Arizona. The studies referenced below are from forest soils developed from basalt, limestone and sandstone bedrock as the CWPP area has these bedrock types. Tree stocking levels, stand density and tree age and diameter have been studied. Data collected around Camp Navajo near Flagstaff determined that approximately 60 trees per acre were present in 1883 (Fulé, Covington, & Moore, 1997). Also, on the Coconino National Forest near Flagstaff, research studies found evidence that trees per acre historically ranged from 20 – 87 (Moore, Huffman, Fulé, Covington, & Crouse, 2004). An inventory of the Long Valley Experimental Forest, which is located near the project area, was completed around the time of its establishment in 1936. Data from that inventory shows that the average tree diameter for ponderosa pine was around 20 inches. Forest stand densities ranged from 73 to 181 trees per acre (average of 100 tpa) and basal areas ranging from 61 to 102 ft^2 per acre (average of 90 ft^2) (Ffolliott, Barger, & Martin, 1967). These stocking levels indicate a relatively open forest with large trees, less than full site occupancy, and low competition among trees.

Dry mixed conifer forests occur throughout the project area and are similar to ponderosa pine forests in general stand structure, but Douglas-fir, white fir, white pine, and, occasionally, blue spruce are also important components of these forests. They intergrade with the cool/moist ponderosa pine types on warmer/drier sites at the lower end of the mixed-conifer zone and with wet mixed-conifer forests on the cooler/moister sites at the upper end of the zone. Dry mixed-conifer forests intergrade with or are adjacent to pure ponderosa pine forest and experience similar site conditions and ecological disturbances (Reynolds, et al., 2013).

Due to its frequent fire regime, historical fine-scale structure and spatial pattern of dry mixed-conifer forests were similar to ponderosa pine in having a more open structure and similar aggregated arrangement of trees in some stands. Historical species composition was dominated by fire-resistant, shade-intolerant conifers such as ponderosa pine, southwestern white pine, and Douglas-fir. Consequently, species composition in dry mixed-conifer forests was historically regulated by the balance between climate and disturbance agents, such as fire. Shade tolerant, less fire-resistant species were historically minor components on drier sites, such as ridge tops and southwest-facing slopes, and likely more frequent on cooler and/or more mesic sites in frequent-fire forests, such as drainages and north-facing slopes. Empirical evidence also indicates that historically, dry mixed-conifer forests had lower tree densities and a more open structure comprised of a higher proportion of old and large trees, were more spatially heterogeneous (having groups and patches of trees) and were

more uneven-aged compared to current conditions. Mean tree densities and basal areas were similar to those in ponderosa pine stands but with slight increases at the fine scale (Reynolds, et al., 2013).

Forest Composition

Forest vegetation within the project area is variable and changes by factors such as topography, aspect, and elevation. As shown in Table 19, the analysis area is dominated by the ponderosa pine cover types with 38 - 41 percent[9] of the area and mixed conifer with 34 percent of the analysis area and pine-oak with 24 percent of the area. Small portions of aspen and mixed hardwood vegetation (maple) were grouped with mixed conifer vegetation to identify treatment types. These small patches of aspen and mixed hardwood vegetation are unique on the landscape and would be treated to move toward desired conditions described for them in the Forest Plan.

Table 23. Vegetation cover types within the CWPP analysis area

Vegetation Cover Type	Acres	Percent of Land Area
Ponderosa Pine	26,474	41%
Mixed Conifer	22,161	34%
Ponderosa Pine-Gambel Oak	15,146	24%
Juniper and Other Woodlands*	-	-
Grasslands	-	-
Aspen*	-	-
Mixed Hardwood*	-	-
Private Lands and Non-forest and Water*	652	1%
Total	64,433	100%

*These vegetation types are very limited across the project area and were grouped into the ponderosa pine or mixed conifer vegetation types for purposes of identifying treatment types. Information on all vegetation cover types in the project area is included in Appendix C of the Silvicultural Specialist Report.

As shown in the figures below, the ponderosa pine and mixed conifer cover types were further stratified into eight wildlife habitat treatment types based on the needs of the Mexican spotted owl and the northern goshawk. This categorization was done in order to meet analysis requirements, desired conditions and guidelines contained within the 2018 Forest Plan and the 2012 MSO Recovery Plan.

[9] Depending on how stands are classified, the amount of the project area in ponderosa pine vegetation type varies a few percentage points. Table 19 shows project area vegetation types when vegetation types that are limited were not grouped into ponderosa pine vegetation type.

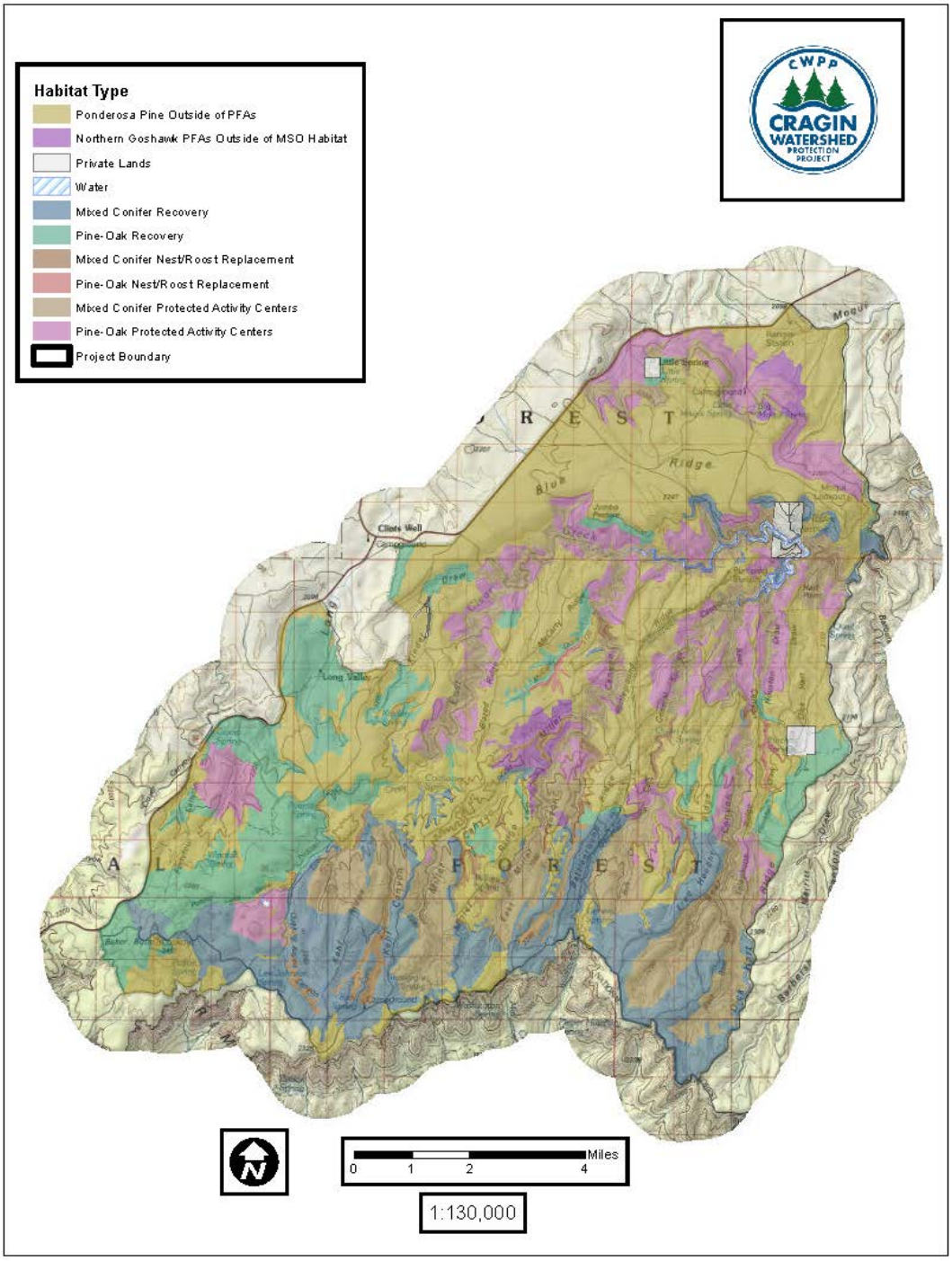


Figure 18. Habitat types within the CWPP analysis area.

A summary description of the forest cover types of interest are discussed below. The discussion is drawn from the Ecological Response Unit (ERU) descriptions found in the Coconino Forest Plan.

Ponderosa Pine and Ponderosa Pine Gambel Oak

The vast majority of the Ponderosa Pine ERU is made up of two subtypes: Ponderosa Pine Bunchgrass and Ponderosa Pine Gambel Oak. For this analysis we will simply use Ponderosa Pine

and Ponderosa Pine Gambel Oak. Ponderosa pine is the dominant species. In some areas, Gambel oaks or evergreen oaks (such as Emory oak, Arizona white oak, silverleaf oak, and grey oak) may be well represented. Other species may include aspen, Douglas-fir, juniper species, pinyon pine species, and white fir). The understory varies depending on site-specific conditions and may include perennial grasses, forbs, and shrubs, or evergreen shrubs (manzanita, turbinella oak, sumac species, and mountain mahogany species). Fire is the primary natural disturbance.

Ponderosa Pine Gambel Oak is particularly important to many wildlife species, including Mexican spotted owls. Higher wildlife species richness has been correlated with higher densities of Gambel oak. This subtype provides important nesting and foraging habitat for wildlife. For the Cragin Project, the Ponderosa Pine Gambel Oak is considered recovery habitat for Mexican spotted owls and recommendations for MSO habitat contained within the MSO Recovery Plan along with the Forest Plan will be used to define desired conditions and provide direction for management.

Mixed Conifer

As defined in the Coconino Forest Plan, Mixed Conifer with Frequent Fire is also known as Dry Mixed Conifer. It covers approximately 21,940 acres within the CWPP analysis area. Mixed Conifer with Infrequent Fire is also present in the project area and referred to as wet mixed conifer. Within the Cragin WPP, wet mixed conifer can be found on microsites within the canyons and drainages and are so intermingled with other forest cover, making it difficult to delineate separate stands of vegetation that can be classified as wet mixed conifer vegetation type.

Dry mixed conifer primarily occurs on mountain slopes, canyons, and north-facing slopes. This cover type occupies the warmer and drier sites of the mixed conifer life zone and is characterized by a relatively open structure and a historic fire regime of frequent, low-severity fires and infrequent, mixed-severity fires. These conifer forests are dominated by mainly shade-intolerant trees such as: ponderosa pine, southwestern white pine, limber pine, and Gambel oak, with a lesser presence of New Mexican locust and maple. Shade-tolerant species such as Douglas-fir and white fir tend to increase when lack of fire or other disturbances facilitate development in older stages of succession. Aspen may occur as small groups in north-facing slopes, drainages, and other microsites where cooler, moister conditions prevail. This cover type typically occurs with an understory of graminoids, forbs, and shrubs. The understory is similar to Ponderosa Pine, but it generally has more sedges, mosses, and liverworts.

Within the wet mixed conifer, tree species composition varies depending on seral stage, elevation, and moisture availability. This forest type can be composed of dominant and codominant species such as: Douglas-fir, New Mexico locust, southwestern white pine and limber pine, and late seral species such as maple, and white fir. Ponderosa pine may be present in minor proportions.

For the Cragin Project, the Mixed Conifer cover type is considered recovery habitat for Mexican spotted owls and recommendations for MSO habitat contained within the MSO Recovery Plan along with the Forest Plan will be used to define desired conditions and provide direction for management.

Aspen and Maple

Within the analysis area, aspen and maple are generally found within cool moist locations, such as canyon bottoms or draws, in the Mixed Conifer and Ponderosa Pine cover types and generally do not dominate stand composition. Aspen is an early seral shade-intolerant species that occurs as groups or clones. Its distribution can vary in space and time and is influenced by soil type, soil moisture, low temperatures, and disturbances (primarily wildfires, but occasionally flooding) that stimulate root sprouting and colonization. Due to lack of disturbance events to stimulate new growth, chronic

browsing by ungulates and competition from conifers, aspen is declining in composition within the CWPP analysis area.

Maple is a shade-tolerant later seral species generally found in wetter and cooler sites, canyons, and draws. It is currently more abundant in the bottom than in the top of snow-melt drainages on the Mogollon Rim. Bigtooth maple can be a deciduous tree or shrub and its form is dependent on the moisture regime. It is generally fire-tolerant, sprouting from root crowns after low to moderate severity burns.

Forest Structure

Uneven-Aged Structure

At the landscape scale, Ponderosa Pine is composed of trees in structural stages that range from young to old and are dominated by ponderosa pine trees. Forest appearance is variable, but generally uneven-aged and open; occasional areas of even-aged structure are present. Forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. It is desired that uneven-aged forest structure occurs on the majority of the acres by cover type. The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages, including old growth. Groups of seedlings and saplings are maintained at sufficient levels to provide a reliable source of replacement as trees grow and progress into succeeding size and age classes.

Currently 57 to 65 percent of forest stands by cover type are in an uneven-aged condition. The arrangement of the tree cohorts or size classes though are in conditions conducive to crown fire with continuous overstory canopies in a closed condition and understory canopies acting as ladder fuels supporting crown fire behavior. It is desired to have a forest arrangement in individual trees, small clumps, and groups of trees interspersed within small, variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns and discourage crown fire behavior.

Table 24. Even and uneven-aged forest structure by cover type. The forest plan's desired condition is for mixed conifer and ponderosa pine forests to be dominated by uneven-aged forest structure.

Cover Type	Uneven-Aged Structure
	% of Cover Type
Ponderosa Pine	57%
Ponderosa Pine-Gambel Oak	61%
Mixed Conifer	65%

Vegetation Structural Stage

Table 25 below displays the acres by existing dominant VSS class for the ponderosa pine cover type within the analysis area. Much of the landscape has a closed tree canopy, dominated by a single overstory canopy layer and one or more understory layers developed from past thinnings and even-aged regeneration harvests. The young and mid-age structural stages account for approximately 69 percent of the ponderosa pine analysis area while the grass/forb and seedling saplings stages are seven percent, the mature tree stage is 15 percent and the old forest stage is 9 percent. The low representation in the seedling/sapling, mature and old classes indicates limited structural stage diversity across the landscape within the ponderosa pine cover type.

Table 25. Existing Condition- Vegetation structural stage for the ponderosa pine cover type, percent of cover type area by the dominant VSS class.

Vegetation Structural Stage Class (Percent of Total Acres for the Ponderosa Pine Cover Type)					
1 Grass/Forb/Seedlings	2 Seedlings/Sapling	3 Young Forest	4 Mid-Aged Forest	5 Mature Forest	6 Old Forest
1%	6%	29%	40%	15%	9%

Density

The existing condition for the density measures (trees per acre, basal area, and stand density index) indicates high competition among trees for water, light, growing space, and soil nutrients, resulting in competition-induced mortality and growth stagnation with increased susceptibility to insect and disease outbreaks. The current conditions support a shift away from frequent, low-intensity surface fires to increasingly larger high intensity crown fires (Cooper, 1960) (Swetnam, 1990) (Covington & Moore, 1994) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996). The current conditions do not meet the CWPP's purpose and need for fire-adapted, resilient, diverse and sustainable forest ecosystems that primarily support low-intensity wildfire.

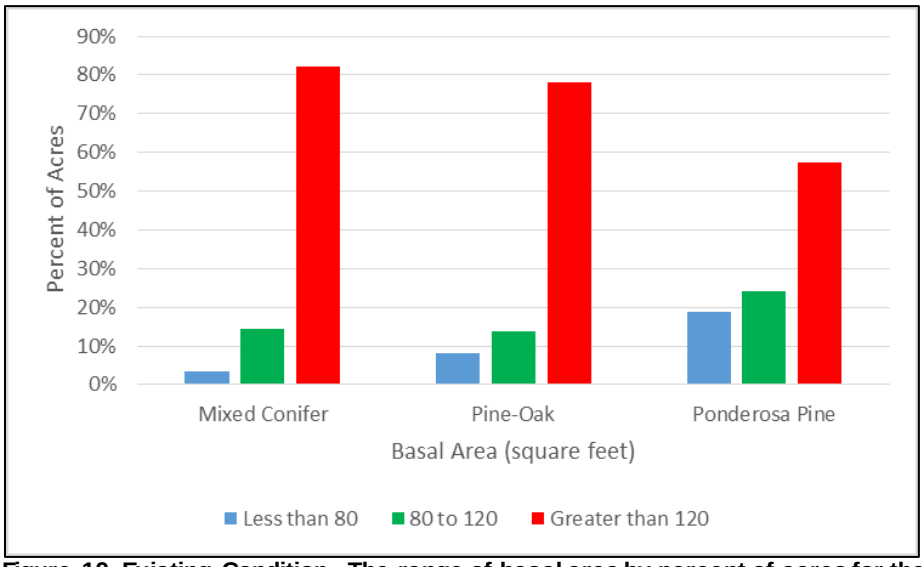


Figure 19. Existing Condition: The range of basal area by percent of acres for the mixed conifer, pine-oak, and ponderosa pine cover types.

For basal area (see Figure 19), 82% of the acres within the mixed conifer cover type exceed 120 ft^2. Within the pine-oak cover type, 78% of the acres, and within the ponderosa pine cover type, 57% of the acres exceed 120 ft^2.

Crown Cover and Openness

Current conditions have the mixed conifer cover type, outside of PACs and nest/roost replacement habitat, meeting the desired openness conditions defined by the Forest Plan of 10% to 50%. This equates to a desired range of canopy cover from 50% to 90%. Currently mixed conifer stands average 69% canopy cover, which equate to dense stand conditions conducive to crown fire behavior.

Within the ponderosa pine and pine-oak cover types, openness meets the desired condition on 57% of the area within the pine-oak cover type, and 62% of the area within ponderosa pine stands (see Figure 20). The acreage outside the desired range typically are dense stands with little to no interspaces between tree groups. This may be the case in areas with little fire disturbance where the interspaces have filled in, or past silviculture treatments have encouraged tree regeneration within the interspaces. Average canopy cover averages 67% for the pine-oak cover type

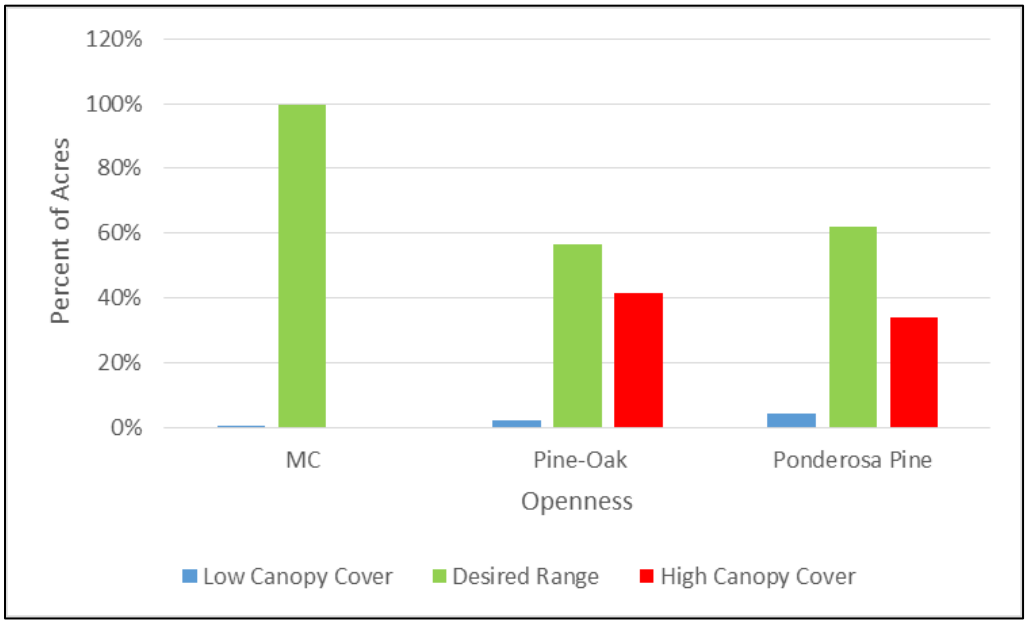


Figure 20. Existing Condition: The area within and outside the Forest Plan's desired range of area covered by interspaces defined as openness by percent of acres for the mixed conifer, pine-oak, and ponderosa pine cover types.

Large Trees and MSO Old Forest Structure

Large trees within the project area meet the desired density within MSO protected and recovery habitat on 78 percent of the acres within the mixed conifer cover type and 64 percent of the acres within the pine-oak cover type (see Figure 21). The density of large trees average 14 TPA in ponderosa pine, 17 TPA in pine-oak, and 20 TPA in the mixed conifer cover type. It must be noted that while large trees are present in densities sufficient to meet desired conditions for MSO habitat as defined in the recovery plan, the densities of the largest size classes are still deficient in terms of age and size class distribution as defined by the Forest Plan.

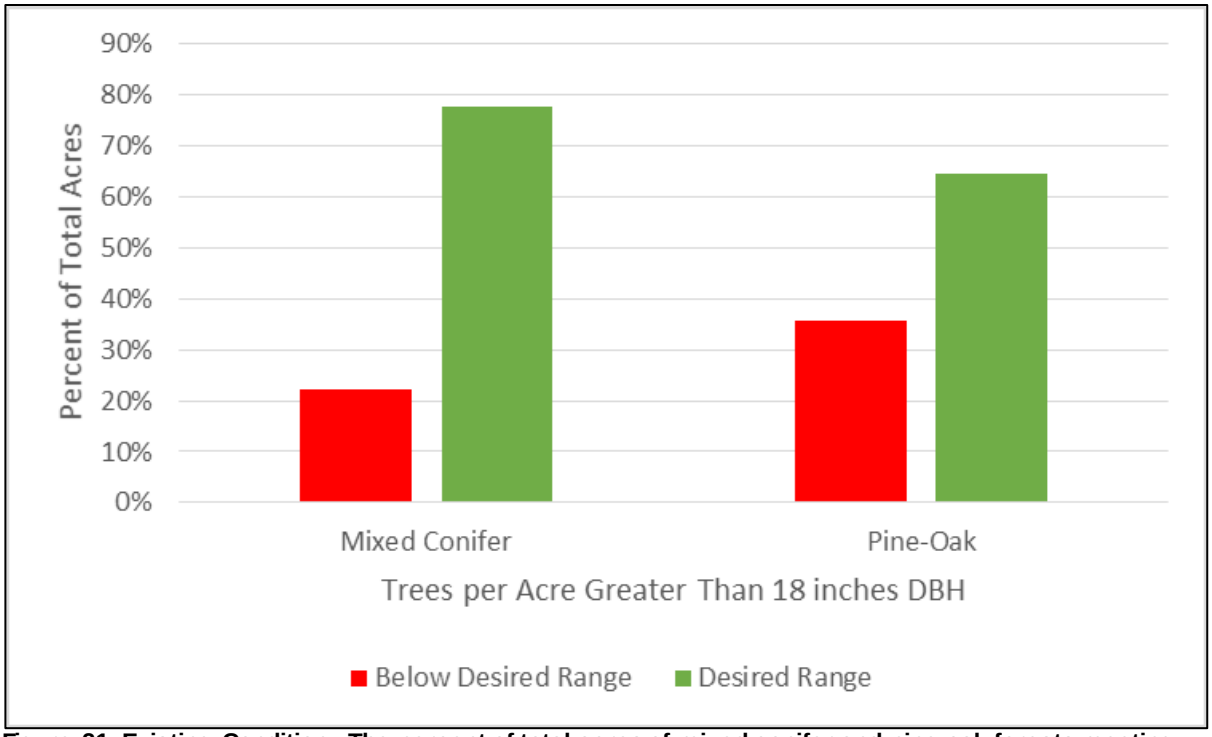


Figure 21. Existing Condition: The percent of total acres of mixed conifer and pine-oak forests meeting the desired range of 12 or more trees per acre that are 18 inches in diameter within MSO recovery habitat.

For MSO old forest structure, trees 12- 18 inches and trees greater than 18 inches in diameter average 32% and 33% of the total basal area on average within pine-oak stands, meeting desired conditions on around 60 percent of the acres within the mixed conifer cover type and around 50% of the acres within the pine-oak cover type. For Gambel oak, 11% of the acres meet the desired density within pine-oak forest stands, and only 5% meet the desired density within mixed conifer stands.

Table 26. Existing Condition- Percent of total acres and percent of total basal area for trees 12 inch dbh and greater by cover type and the percent of total basal area of the Gambel oak component.

Cover Type	% Total Acres Meeting MSO Forest Structure Desired Conditions		Basal Area by Size Class (% Total BA)		% Total Acres Meeting Gambel Oak Structure Desired Conditions	Gambel Oak BA (% Total BA)
	12.0 – 17.9”	>18.0”	12.0 – 17.9”	>18.0”		
Pine-Oak	50%	48%	32%	33%	11%	11%
Mixed Conifer	60%	62%	33%	36%	5%	5%
Desired	–	–	30% +	30% +	–	20%

Forest Function

Fire

From observations based on site visits and aerial insect and disease surveys, the majority of tree mortality since 2016 is fire-related mortality (USDA Forest Service, 2016b). Fires within the project

area in recent times were mostly low intensity, causing mortality in groups or small patches or in individual trees. These low intensity fires had the greatest effect of reducing fuels on the forest floor and did not change forest structure or measurably reduce tree density. Over the last twenty years, there has been 26,121 acres affected by wildfires in the project area from fires that were over 100 acres in size. The primary effects from these past wildfires have been to temporarily reduce understory fuels, and kill very young trees. These past wildfires have been overwhelmingly low-severity and have not changed forest composition, structure, or age classes. For this project a review of over 30 fires from 1979 to 2017's Highline Fire have identified 447 acres of high intensity fire across the 64,433 acre project area ranging from less than an acre to 72 acres with an average patch size of 3 acres. Given high intensity fire has effected 0.7% of the project area in the last 38 years, the effects of these fires combined is expected to be relatively small and inconsequential on forest structure and density at the scale of the project.

Insects

Forest insects appear to be at endemic levels throughout the project area based on annual aerial insect and disease surveys and site visits (USDA Forest Service, 2017). For bark beetles, Douglas-fir bark beetle *(Dendroctonus pseudotsuqae)*, western pine beetle (*Dendroctonus brevicomis*) and the pine engraver *(Ips species)* are present in the project area in low populations, infesting individual trees and creating small pockets of mortality ranging from two to 15 trees. The beetles are maintaining themselves in windthrown or injured trees, fire scorched trees, or in those stressed by root disease or dwarf mistletoe. Where such susceptible trees are abundant, once they have been infested and killed, beetle populations can build up rapidly and spread to adjacent green, standing trees (Negrón, Allen, Cook, & Withrow, 2008). Damage would be expected to be greatest in dense (greater than 120 ft^2 BA) even-aged stands of mature trees (USDA Forest Service, 1996) (Olsen, Schmid, & Mata, 1996) (Chojnacky, Bentz, & Logan, 2000).

Dwarf Mistletoe

Dwarf mistletoe is a prevalent natural disturbance agent in forested stands of the project area. "Dwarf mistletoes (*Arceuthobium* spp.) are parasitic flowering plants which depend almost entirely on their host trees for water and nutrients. They are considered to be pathogens (disease-causing agents) of trees because of their damaging effects, which include growth reduction, deformities (notably the characteristic witches' brooms), and decreased longevity. Essentially, these plants re-allocate growth to infected portions of the tree at the expense of the rest of the tree (Conklin & Fairweather, 2010, p. 1)." In beneficial terms, the dwarf mistletoes provides food and cover for wildlife; and tree mortality caused by mistletoe is an important factor in recruiting snags that provide habitat for cavity-nesting birds and other species (Hawksworth & Wiens, 1996). Surveys from some of the proposed treatment stands indicate dwarf mistletoe infection ranges from low to high, but overall across the project area incidence is common to abundant in both ponderosa pine and Douglas-fir. Research by Hoffman et al. has concluded that wildfire can transition from a low-intensity surface fire to a passive or active crown fire more easily in stands with severe mistletoe infestation due to the effect of mistletoe on forest fuels. Use of prescribed fire has been shown to effectively manage dwarf mistletoe to low to moderate levels by up to a decade where there is adequate crown scorch from treatments (Conklin and Geils 2008).

Table 27. Summary table comparing desired condition by the existing condition by resource indicator measure

Measure	Desired Condition	Existing Condition
Uneven-aged Forest Structure	Forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	Currently 57 to 65% of forest stands by cover type are in an uneven-aged condition. Forest structure is made up of two or more tree stories that are intermingled with few openings. This is departed from historic conditions consisting of tree groups arranged in a clumpy fashion with interspaces. Current conditions predispose stands to crown fire behavior.
% of Area by VSS Class	Outside of MSO habitat, a balanced distribution of VSS classes with 10% grass/forb/shrub (VSS1), 10% seedling-sapling (VSS2), 20% young forest (VSS 3), 20% mid-aged forest (VSS4), 20% mature forest (VSS 5), 20% old forest (VSS6)	Deficit in VSS 1, 2, 5 and 6 classes VSS1 averages 1% VSS2 averages 6% VSS3 averages 29% VSS4 averages 40% VSS5 averages 15% VSS6 averages 9%
Basal Area per Acre	Generally less than 120 ft2/acre to meet forest resilience goals while maintaining wildlife habitat desired conditions. For MSO protected and nest/roost replacement habitat 110 to 120 ft2/acre is the minimum.	For basal area (see Figure 6), 82% of the acres within the mixed conifer cover type exceed 120 ft2. Within the pine-oak cover type, 78% of the acres, and within the ponderosa pine cover type, 57% of the acres exceed 120 ft2. High densities in terms of basal area make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Stand Density Index	Maintain forest density at less than 35% of SDImax to maintain tree growth and vigor.	The existing condition for the mixed conifer cover type is that 88% of the acreage have high (36 to 55%) to extremely high (56% +) tree densities. Within the pine-oak cover type, 93% of the acreage has high to extremely high tree densities. Within the ponderosa pine cover type 79% of the acreage has high to extremely high tree densities, High densities in terms of stand density index make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Crown Cover (%)	Greater than 40% for pine/oak MSO protected activity centers (PACs) and nest/roost replacement habitat, and 60% for mixed conifer	Average canopy cover averages 67% canopy cover for the pine-oak cover type, and mixed conifer stands averages 69% canopy cover.
Openness	Ranges from 30 to 60% in ponderosa pine and pine-oak. Ranges from 10 to 50% in mixed conifer outside of PACs and nest/roost replacement habitat	Within the ponderosa pine and pine-oak cover types, openness meets the desired condition on 57% of the area within the pine-oak cover type, and 62% of the area within ponderosa pine stands. Most acres within the mixed conifer cover type meet the desired condition for openness. See Figure 20.
Trees per Acre 18"+	A minimum of 12 trees per acre	Currently 78% and 64% of the acres within the mixed conifer and pine-oak

Measure	Desired Condition	Existing Condition
		forests, respectively, meet the desired large tree density of at least 12 TPA (See Figure 21), though forest stands still lack enough large trees to achieve a balance of size classes for a resilient forest ecosystem.
% Basal Area by Size Class (For MSO PACs and nest/roost replacement habitat only)	30% basal area in 12 to 18 inch size class 30% basal area in 18 inch and greater size class. 20% basal area in Gambel oak.	Currently around 50% of the total acres within pine-oak meet desired conditions and about 60% meet desired conditions in the mixed conifer cover type. For Gambel oak, 11% of the acres meet the desired density within pine-oak forest stands, and only 5% meet the desired density within mixed conifer stands.

Environmental Consequences

The following information includes direct effects to the indicator measures as modeled by the Forest Vegetation Simulator for the existing condition (2017), immediately post cutting and first prescribed burn (2018) and year 2037 following the second prescribed burn. Three scales of analysis were completed, including the project area scale, the cover type scale and the treatment type scale.

The project area scale where the indicator measures are averaged by cover type for the project area. At this scale, the general trends for changes in vegetation within the project area over time are shown, but due to aggregation of treatments (averaging burn only acreage with cutting and burning acreage) the effects are somewhat muted. This scale is used to summarize and compare the effects of the activities proposed with the CWPP to forest vegetation by alternative.

The cover type scale where the indicator measures area averaged by cover type and by whether the forest stands are receiving prescribed cutting and burning treatments, or prescribed fire only. At this scale, effects are more pronounced and highlight effects to the indicator measures by prescribed cutting and burning treatments or prescribed burning only.

The treatment type scale where the forest stands are sorted by the specific treatment proposed. At this scale, direct effects are most pronounced depending on the intensity of the treatment. For instance, stands within the ponderosa pine treatment are being thinned more intensely to a target density of 40 ft^2 of basal area with interspaces created, while a ponderosa pine-oak stand with a PAC treatment may only be thinned to 80 ft^2, with no interspaces developed.

Data for all three scales of analysis are included in the Silviculture specialist report, located on the project webpage and in the project file. For purposes of this environmental assessment, only the treatment type scale are included as it most clearly shows the effects of the proposed treatments or lack of treatments.

Alternative 1

Direct/Indirect Effects

Under Alternative 1 no acres would be receive either prescribed cutting or prescribe fire treatment. Although this alternative does appear to meet some of the desired conditions identified in the Forest Plan and MSO recommendations concerning forest structure, it does not move the forest forward in

initiating the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem. For example, based on a broad array of research, current stand conditions would continue to develop so that the overabundance of VSS 3 and 4 stands would slowly transition to VSS 5 and 6 stands at the landscape scale, but they would likely develop at a slower rate due to increased competition and water stress. At the same time, the slow transition of intermediate and mature forests would lead to an increasing lack of young, developing forests; or, in the case of one or more large disturbance events (e.g. wildfire, drought) that result in an over-abundance of young forests. Without treatment, stands in the project area would be much less resilient to disturbances such as multi-year drought, pests and disease such as bark beetle and mistletoe, and wildfire (Abella, et al., 2007). Increased drought stress and insect attacks are often associated with increased tree density, altered tree spatial arrangement, and shifted forest composition that have resulted from fire exclusion, grazing, and past logging. These changes in forest structure may exacerbate tree mortality due to increased competition among trees (Kane, Kolb, & McMillin, 2014, p. 171). At the fine scale, these disturbances would likely result in a greater mortality rate for areas with dense forest, which include groups and clumps of large trees (Zhang, Ritchie, Maguire, & Oliver, 2013).

Under the no action alternative, it is possible for naturally caused wildfires to be managed for resource benefits across the project area. Management of naturally caused fires for resource benefit could result in changes to forest structure or reductions in small trees that would move some areas toward desired conditions for density, and in some rare circumstances could improve forest structure. However, management of naturally ignited fires on the landscape for resource benefits would be difficult over large areas given the current condition of the landscape can more easily facilitate a fire growing from low-intensity to high-intensity. Thus, under this alternative the use of this tool to move vegetation conditions toward desired conditions by killing small trees and creating small openings would be limited to unique circumstances where the risk of high-intensity fire is low and there are few or no values at risk.

Forest Composition

Forest composition is not expected to change under this alternative given there is no large-scale high-intensity wildfire. Ponderosa pine (including Ponderosa Pine- Gambel Oak) will still be the dominant cover type within the project area. Mixed conifer will make up a moderate proportion of the project area. Juniper, grasslands, and other hardwoods will continue to make up a minor part of the project area. Without wildfire or other types disturbance, aspen would continue to decline, and possibly eventually disappear from the project area, as current conifer encroachment has resulted in greater inter-tree competition and overtopping. This continued encroachment may result in the loss of aspen within the project area. Climatic models for the southwestern U.S. predict continued warming, greater variability in precipitation, and increased drought. These climatic changes likely will contribute to continued and perhaps increasing tree mortality, which may lead to large shifts and contractions in the range of dominant trees throughout much of the region (Kane, Kolb, & McMillin, 2014).

Forest Structure

Uneven-Aged Structure

Per the Forest Plan, it is desired that uneven-aged forest structure occurs on the majority of the acres by cover type. The effects described here are broken out by cover type.

Across the project area, the current percentage of uneven-aged forest structure has been defined by vegetation cover type (See Table 24). For the ponderosa pine cover type that percentage ranges from 57 (ponderosa pine) to 61 (ponderosa pine-oak) percent. Within the mixed conifer cover, uneven-aged structure accounts for 65 percent of the cover type area.

Assuming that no major disturbance events were to occur, within twenty years, uneven-aged structure rises slightly to 63 to 67 percent in the ponderosa pine cover type, which includes the pine-oak. Within the mixed conifer cover type, uneven-aged structure increases to 72 percent of the cover type area.

While this does meet the Forest Plan, this does not account for the possibility of an uncharacteristic wildfire or other potentially transformational event, such as a beetle outbreak or long-term drought. There are an abundance of small diameter trees, far above historic conditions. Because of the current structure, including overstocked forests and ladder fuels created when smaller trees grow directly beneath the canopy of larger, the current landscape would be less resilient if a catastrophic event were to occur. Many, if not most, of the trees would be killed, resulting in large areas lacking live trees. In order to reforest these areas, trees would need to be planted. That would create large even-aged, young forest, with little structural diversity for the next several decades.

VSS

Under this alternative, there would no change to vegetation structural stages in the immediate future, as the area would not be treated. Vegetation structural stage (VSS) is a method of describing the development stages of a stand of living trees and is a generalized description of forest age and tree size from seedling to old forests. It can be used to help determine whether a stand is even-aged or uneven-aged. Uneven-aged stands would have a more VSS stages well represented. Over the next two decades, there would be growth and development of forested stands in the project area but these changes would not move conditions towards the desired conditions. Most of the VSS structure, approximately 62%, would still be found in VSS3/4. VSS1, 2, and 6 would continue to be underrepresented. VSS1 is almost non-existent, as the density of trees prevents sunlight from reaching the forest thereby, inhibiting the establishment of a younger cohort. With no prescribed cutting or burning treatments, the distribution of size classes remain static, with only small shifts in VSS caused by tree growth and mortality over time. Without cutting or fire disturbances, tree regeneration is inhibited and the trend is a shift to the larger size classes maintaining conditions that are not resilient to disturbances such as fire, insects, and climate.

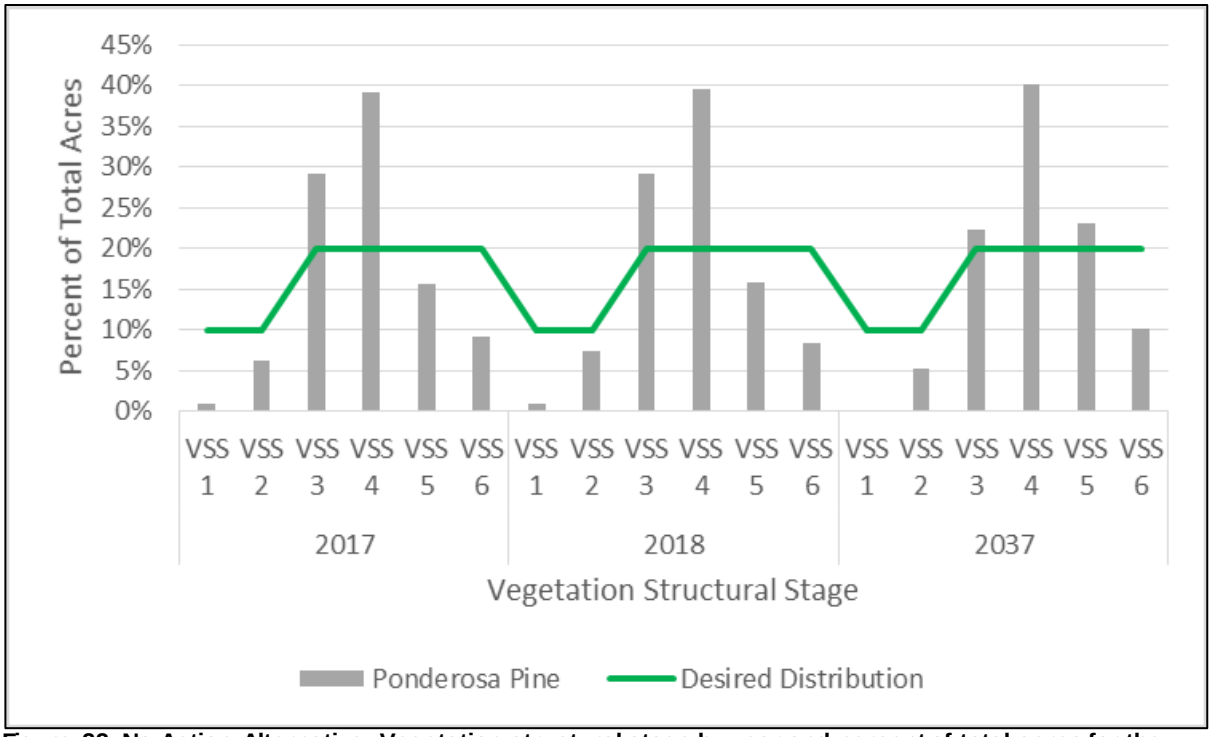


Figure 22. No Action Alternative: Vegetation structural stage by year and percent of total acres for the ponderosa pine cover type.

Without treatments forest conditions would continue to increase canopy cover well above the 60 percent identified in the desired conditions. High canopy cover and high tree densities would likely limit the development of tree growth, recruitment of new trees, and result in greater likelihood of mortality to mature trees. Tree density, structure, spatial pattern, and ecological functions in today's ponderosa pine forests of the Southwest are greatly altered from their historical conditions (Reynolds, et al., 2013). Tree densities will continue to remain higher than desired and outside of the range of natural variability.

As crown cover increases, ponderosa pine litter increases in depth and percent soil cover. Natural regeneration will continue to decline. Less sunlight and precipitation reaches the forest floor due to crown interception and the increasing pine litter and duff layer intercepts some of the moisture that reaches the forest floor. Shading of the forest floor and pine litter accumulation reduces herbaceous understory growth, presence, and establishment and reduces available soil moisture and nutrients to nearly all plants and soil organisms (Naumburg, DeWald, & Deiter, 2001)

Stand structure does not change much in either the short or long term (1-5 years), but over the next several decades, the trend will move toward slightly more uneven-aged structure unless there is a major disturbance event (e.g. wildfire), which could effectively move large portions of the project area to even-aged conditions.

Density (including Basal Area, SDI, Trees per acre)

The overall tree density continues to increase or remain very high under this alternative, with well over 1,000 trees per acre through much of the area. Many of these trees are less than 5" dbh, and their spatial pattern on the landscape has resulted in dense thickets of "dog-haired" pine. While there is some density related mortality in the smaller trees as time goes by, this trend of "dog-haired" thickets of pine is expected to continue into the foreseeable future under this alternative. Within both the

ponderosa pine and mixed conifer cover types, forested stands will continue to be dominated by small diameter trees into the future. This tree density results is reduced tree growth and increased mortality, especially in older trees, stagnated nutrient cycles, decreased herbaceous and shrub forage quality and quantity (Covington & Moore, 1994).

Basal Area

The desired condition is to retain a basal area per acre of less than 120ft^2 per acre across most habitat types, including mixed conifer cover types outside of MSO protected activity centers. Within MSO PACs, the objective is to retain 120ft^2 in mixed conifer and 110 ft^2 in ponderosa pine-oak (US Fish and Wildlife Sercice 2012). While the Forest Plan provides a density desired condition with a range of basal areas ranging from 20 to 180 ft^2 depending on cover type, for this analysis, at the project level, for ease of comparison of effects between alternatives, 120 ft^2 is the breakpoint for the resource measure, especially for those areas on ridges and gentle slopes that historically included less dense conditions. For both mixed conifer and ponderosa pine cover types it is desired to maintain basal area at less than 120 ft^2 though exceptions exist along steep slopes or for specific wildlife needs for dense and closed canopy forest conditions.

Under the No Action alternative, the majority of the current basal area is over 120 ft^2 for all cover types, with a range from 57 percent in ponderosa pine to 82 percent in mixed conifer. This excessive stocking is expected to increase for the foreseeable future. Continuous tree growth will allow for forest stand densities to average 120 ft^2 or greater on the majority of acres by cover type. Twenty years from now, the percentages of acres with over 120 ft^2 basal area will range from 79 percent to in the ponderosa pine to 94 percent in both the mixed conifer and Ponderosa Pine-Gambel Oak cover types (see Figure 24). This will result in increasing competition for limited resources (water, light, growing space, and soil nutrients). Competition-induced mortality and growth stagnation will continue to increase, along with susceptibility to potential insect and disease outbreaks. The current conditions and effects of no action over the next twenty years support a shift away from frequent, low-intensity surface fires to increasingly larger high intensity crown fires (Cooper, 1960) (Swetnam, 1990) (Covington & Moore, 1994) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996). These conditions will not meet the CWPP's purpose and need for fire-adapted, resilient, diverse and sustainable forest ecosystems.

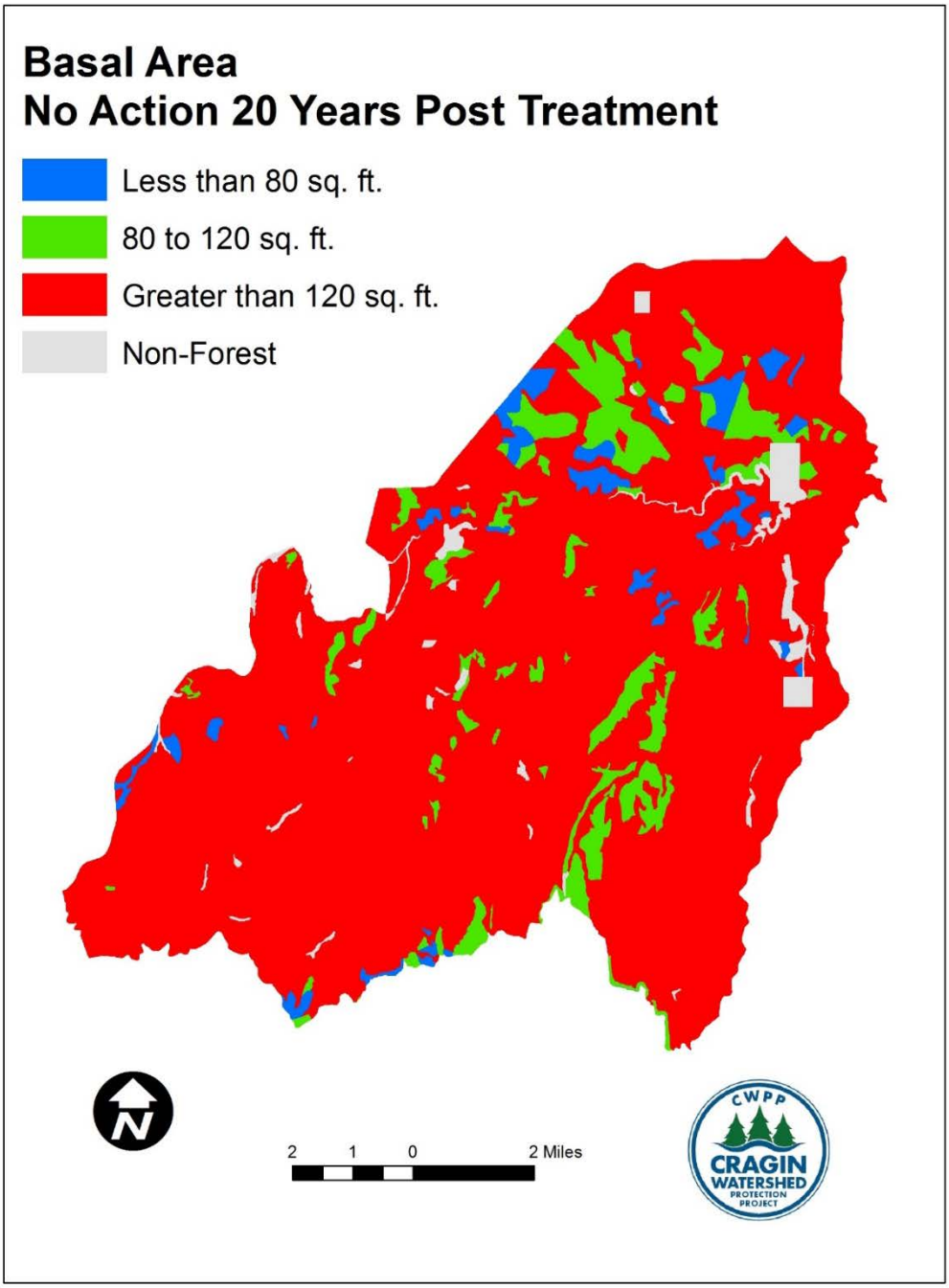


Figure 23. No Action Alternative- Basal area 20 year post treatment

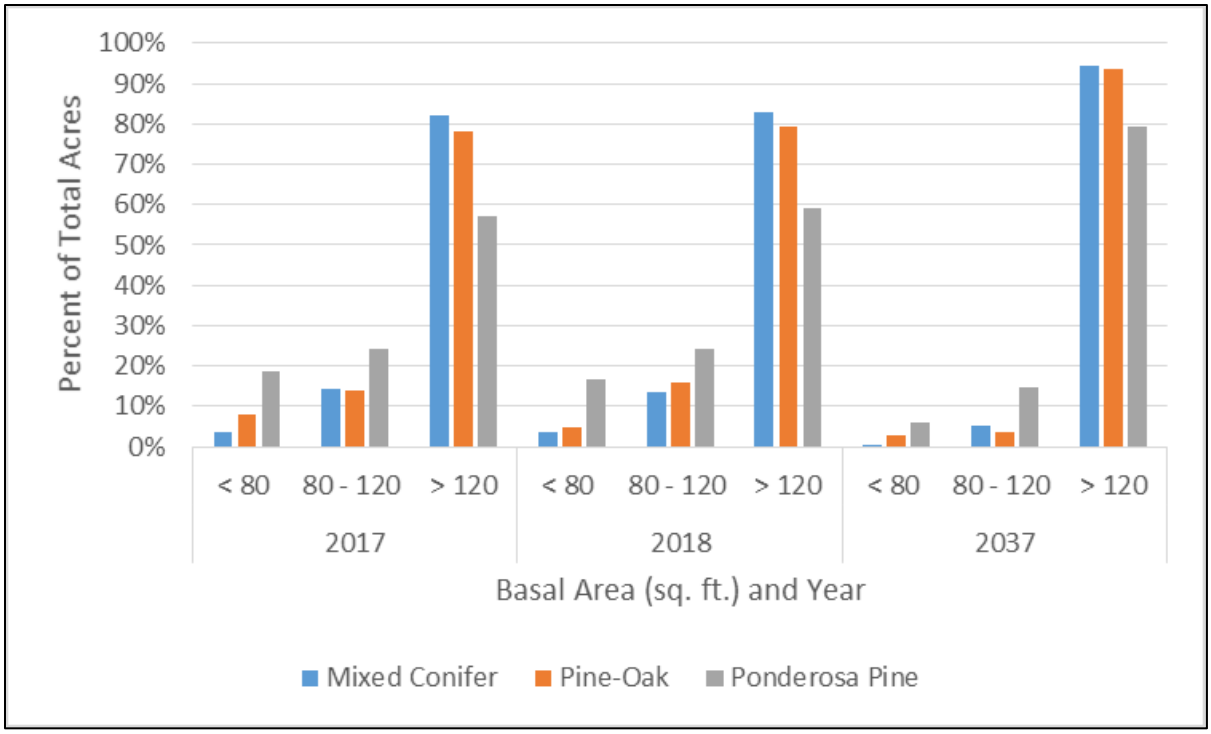


Figure 24. No Action Alternative- Basal area by year and percent of total acres for the mixed conifer, pine-oak, and ponderosa pine cover types.

Stand Density Index

SDImax represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type. The SDImax for ponderosa pine and ponderosa pine-oak cover type was defined as 450. The SDImax used for mixed conifer cover type was 570, because this cover type includes species that are more shade tolerant than ponderosa and have evolved to grow in conditions with higher overall tree densities.

Within the all cover types, overall SDI and it relation to SDImax continues to increase. Over time, with no action, continuous tree growth will allow forest stand densities to remain high and extremely high on the majority of acres; almost 90% of the area has a high to extremely high SDI. Within twenty years, almost 95 percent of the area has a high to extremely high SDI. Within the ponderosa cover types, including ponderosa pine-Gambel oak, between 80 and 90% of the area has a high to extremely high SDI. Within 20 years, that percentage increases to approximately 95%. This will result in increased susceptibility to insect epidemics, particularly bark beetles and competition-induced mortality.

Canopy Cover and Openness

Current conditions have the mixed conifer cover type (outside of MSO PACs) meeting the desired openness conditions defined by the Forest Plan. Within the ponderosa pine and pine-oak cover types, openness meets the desired condition on 57% of the area within the pine-oak cover type, and 62 percent of the area within ponderosa pine stands (see Figure 20). The acreage outside the desired range typically are dense stands with little to no interspaces between tree groups, and few openings. This may be the case in areas with little fire disturbance where the interspaces and openings have filled in, or past silviculture treatments have encouraged tree regeneration within the interspaces and openings.

Over the next 20 years, canopy cover conditions within the mixed conifer cover type will continue to exceed the desired conditions outlined in the Forest Plan. Within the ponderosa pine cover type, only 37% of the area will meet desired conditions for openness (the inverse of canopy cover), a reduction of 25 percentage points, which is a substantial move away from desired conditions. Sixty two percent will have high cover, resulting in little openness. This high canopy cover will reduce understory vegetation richness, reduce regeneration of seral species, transition toward shade tolerant species (white fir), and sustain conditions for susceptibility to crown fires.

Large and Old Tree Structure

Under this alternative, no trees would be removed through cutting. Therefore, all large and old trees are expected to remain, except they are likely to be more susceptible to mortality from drought, pests and disease as well as wildfire (Das et al. 2011, Ritchie et al, 2008). Currently, 78% of the mixed conifer and 64% of the pine-oak are meeting the desired range, which is a minimum of 12 trees per acre larger than 18.0" dbh. Over the next twenty years, the amount of acreage meeting the desired condition is expected to increase to 89 percent within the mixed conifer cover type, and 83% within the pine-oak cover type. This is the result of current trees continuing to increase in diameter growth.

This alternative would also result in higher risk of mortality, especially for larger trees, because of an increasing risk of infection from pests or disease (Fischer M. J., Waring, Hofstetter, & and Kolb, 2010), high-intensity or uncharacteristic wildfire (Coop, Parks, McClernan, & Holsinger, 2016) (Fiedler, Metlen, & Dodson, 2010) or increased drought stress from competition (Erickson & Waring, 2014). A number of studies have found that higher forest density leaves large and old trees more susceptible to mortality. Erickson and Waring (2014) concluded that, "treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA." Modifying forest conditions to facilitate low-intensity fire on the landscape has been identified as a key condition to preventing increased mortality of large and old trees over the next several decades (Fiedler et al. 2007, Kolb et. al. 2007, Ritchie et. al. 2008). Thus while this alternative may increase the amount of large and old trees based on model results, these results do not account for the likely substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire), which would decrease the amount of old and large trees in the project area so as not to meet desired conditions.

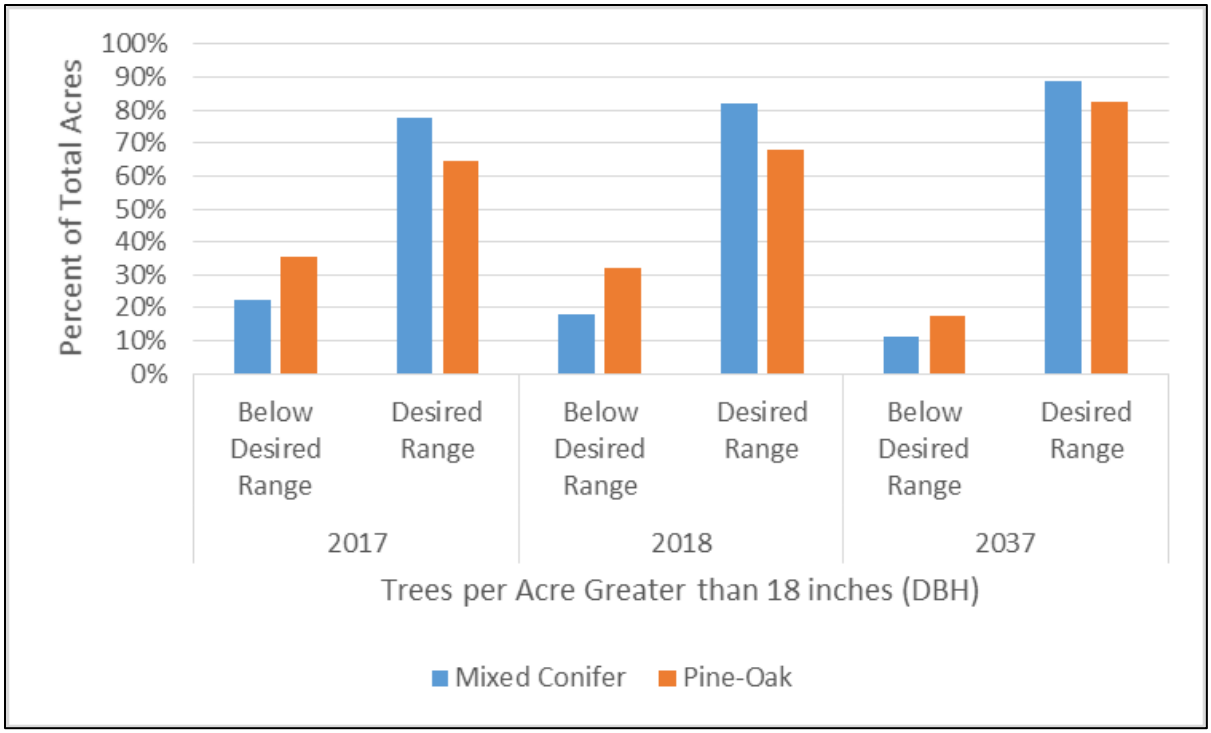


Figure 25. Large and Old Tree Structure. Over time, within the MSO habitat, most of the area will be within the desired range as trees grow into the larger size classes.

Under this alternative it is possible that one or more naturally caused wildfires will be managed to benefit forest resources. Depending on the ability to manage one or more naturally caused fires based on values at risk, fuel, and weather conditions, management of naturally caused fires under this alternative could result in small openings that decrease areas of intermediate aged trees, which would then contribute to establishment of a new young cohort of trees. Management of naturally caused fires under this alternative may also have the effect of reducing basal area and SDI by killing small trees or groups of small and/or intermediate aged trees. These fires could also result in mortality of some large and old trees. Based on recent wildfires managed for resource benefits, this effect would be very limited across the landscape. Especially considering the current condition of the Forest would limit the ability to manage naturally occurring wildfires in the project area at low to moderate intensity levels without potential unacceptable impacts to values at risk.

Function (Forest health, insects and disease, fire adaptation)

This alternative does not support the CWPP's purpose and need to develop or return to a forest ecosystem that is fire-adapted, resilient, diverse and sustainable. This alternative will continue to support the current shift away from frequent, low-intensity surface fires to conditions that are more likely to support increasingly larger high intensity crown fires (Cooper, 1960) (Swetnam, 1990) (Covington & Moore, 1994) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996). The current forest structure is quite different from conditions from the natural range of variability of the native microbes, plants, and animals living in western ponderosa forests (Covington & Moore, 1994). As a result, this project area will remain susceptible to uncharacteristic wildfires and increase in vulnerability to crown fire (see fire and fuels analysis report) and other disturbance agents, such as bark beetles and disease, over time.

High inter-tree competition for limited resources, including sunlight, soil nutrients, water, and growing space will continue, resulting in a potential increase in competition-induced mortality,

continued tree growth stagnation, and decreased vigor. Increased tree density is responsible for decreased growth rates and decreased vigor, which increases susceptibility to bark beetle attack and other agents of mortality (Covington & Moore, 1994). Trees of all sizes in untreated stands will show signs of stress with poor vigor and reduced growth rates (Sackett, Haase, & Harrington, 1996). Growth of individual trees will continue to decline as this competition for limited resources continues to grow. Low growth caused by high tree density may negatively affect the ability of the tree to mobilize carbohydrates for defense, such as the production of resin for withstanding beetle attacks (Christiansen, Warning, & Berryman, 1987). With climate change, warmer temperatures and more frequent and severe drought could result increasing tree mortality (Kane, Kolb, & McMillin, 2014). Combined, these effects will limit the ability of and rate at which small trees grow into intermediate trees, and at which intermediate aged-trees to grow into mature trees, and will continue to drive unbalanced aged classes of trees and lack of mature trees across the project area. In addition, recent studies have shown that between 2000 and 2015 there has been increasingly unfavorable post-fire growing conditions, especially for dry forest types, resulting in a greater likelihood of vegetation type conversions of forests to non-forests after wildfires (Stevens-Rumann et al. 2017).

Drought, coupled with high tree densities, can lower resistance to beetle attacks. Bark beetle population dynamics suggests that homogenous, dense, even-aged stands are highly susceptible to beetle outbreaks. Susceptibility to western pine beetle would slowly increase over time. Areas with the greatest likelihood of infestation are those stands with densities greater than 120 BA and average stand diameters greater than 12” DBH. Susceptibility to Ips would continue to increase with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris. Dwarf mistletoe infections will not be reduced and may intensify in infected trees and the surrounding trees, reducing the growth, vigor and longevity of ponderosa pine.

Overstory density has increased and understory species richness has declined significantly (Korb & Springer, 2003). Without treatment, understory grass vigor would be expected to be reduced. Less of the sunlight would reach the forest floor. As a result, understory diversity would decrease, which would reduce the overall biodiversity found in frequent-fire forests.

Summary of Direct/Indirect Effects for Alternative 1

At the treatment type scale, a trend towards desired conditions, as growth in terms of diameter, height, and crowns continues unabated with no management actions. What the tables don’t show is a continued shift from a frequent surface fire regime to stand-replacing fire regimes because of forest structure and continuous canopy cover that facilitates the transition of a surface fire to a crown fire (Covington & Moore, 1994, pp. 160-161). With no action, forest stands and existing old growth trees will exhibit signs of growth stagnation due to decreased tree vigor, and an increased susceptibility to insects and disease outbreaks as well as crown fire risk (Abella, et al., 2007). Abundance of fire-intolerant tree species such as white fir and juniper species will continue to increase resulting in an increase in uneven-aged forest conditions, but also more ladder fuels. For all indicator measures except trees per acre, with no action, tree growth in diameter, height and crowns increases tree densities in terms of basal area and stand density index. Trees per acres decline overtime due to competition-induced mortality. With no action forest stands will continue to exhibit signs of growth stagnation due to decreased tree vigor, and susceptibility to insects and disease outbreaks as well as crown fire risk. These future conditions do not meet the purpose and need to create forest stands resilient to fire nor trend vegetation to the forest plan desired conditions.

Under the no action alternative, it is possible for lightening ignited wildfires to be managed for resource benefits across the project area. Management of naturally caused fires for resource benefit could result in changes to forest structure or reductions in small trees that would move some areas to

desired conditions for density, and in some rare circumstances could burn at moderate or high severity to improve forest structure in some patches. However, management of naturally ignited fires on the landscape for resource benefits would be difficult over large areas given the current condition of the landscape can more easily facilitate a fire growing from low-intensity to high-intensity. Thus, the use of this tool to move vegetation conditions toward desired conditions by killing small trees and creating small openings would be limited to circumstances where the risk of high-intensity fire is low.

Table 28. Alternative 1- Averages of the indicator measures for forest stands proposed by treatment and by year: 2017 existing condition, 2018 post-treatment, and 2037, 20 years post treatment.

Year	Treatment	Uneven-Aged (% of Area)	Basal Area (Feet^2)	Trees per Acre	Percent of SDImax	Canopy Cover (% of Area)	Open-ness (% of Area)	Trees per Acre 18"+
2017	Ponderosa Pine	57%	126	914	48%	64%	36%	14
	NOGO PFA	40%	119	1286	47%	64%	36%	19
	Baker Butte	100%	192	2298	71%	77%	23%	30
	MSO Recovery Mixed Conifer	63%	149	1307	45%	69%	–	22
	MSO Recovery Pine-Oak	66%	144	1637	55%	69%	–	21
	MSO PAC Mixed Conifer	34%	147	1261	43%	70%	–	25
	MSO PAC pine-Oak	68%	144	1148	55%	67%	–	15
	PAC Precom. Thinning	58%	149	1057	46%	70%	–	19
	Precom. Thinning	16%	63	1126	23%	48%	52%	9
	No Mechanical Treatment	64%	146	888	48%	69%	31%	18
2018	Ponderosa Pine	60%	128	901	49%	64%	36%	15
	NOGO PFA	40%	120	1246	48%	64%	36%	20
	Baker Butte	100%	193	2254	71%	77%	23%	29
	MSO Recovery Mixed Conifer	62%	150	1281	45%	69%	–	23
	MSO Recovery Pine-Oak	66%	145	1607	55%	69%	–	21
	MSO PAC Mixed Conifer	39%	148	1226	43%	70%	–	25

Year	Treatment	Uneven-Aged (% of Area)	Basal Area (Feet^2)	Trees per Acre	Percent of SDImax	Canopy Cover (% of Area)	Open-ness (% of Area)	Trees per Acre 18"+
	MSO PAC pine-Oak	80%	145	1123	56%	67%	–	16
	PAC Precom, Thinning	58%	150	1039	47%	70%	–	20
	Precom. Thinning	0%	64	1124	23%	48%	52%	9
	No Mechanical Treatment	65%	147	874	49%	69%	31%	18
2037	Ponderosa Pine	62%	152	701	58%	69%	31%	20
	NOGO PFA	54%	148	749	59%	69%	31%	24
	Baker Butte	100%	204	1644	76%	78%	22%	32
	MSO Recovery Mixed Conifer	73%	170	937	50%	73%	–	28
	MSO Recovery Pine-Oak	74%	166	1188	63%	73%	–	28
	MSO PAC Mixed Conifer	55%	173	869	51%	74%	–	29
	MSO PAC pine-Oak	82%	165	802	62%	72%	–	20
	PAC Precom. Thinning	72%	171	777	52%	74%	–	28
	Precom. Thinning	100%	87	1032	34%	56%	44%	13
	No Mechanical Treatment	67%	168	693	54%	73%	27%	24

Cumulative Effects – No Action

Cumulative effects to the no action alternative would be relevant to the project area over the next several decades. This alternative would result in increasing inter-tree competition, with likely increasing risk of high-intensity wildfire, mortality as a result of drought, and mortality as a result of pests and disease.

Many ongoing activities and planned activities would result in effects that combine cumulatively with those of the no action alternative. The Four Forest Restoration Initiative Rim Country project would is expected to include a number of restoration-based activities that could occur in CWPP project area. Restoration activities such as meadow restoration, which involves removing trees in areas that show evidence of grassland-type soils, could include creation of openings that reduce the potential impacts

of increased density in these specific areas where the treatment occur, which would likely make up a very small proportion of the project area.

The CWPP partially overlaps with the East Clear Creek (ECC) Watershed Health Project NEPA Decisions (2006). The ECC decision also authorized treatment of up to 460 acres with mechanical thinning and prescribed burning treatments as part of the Long-Term Ecological Assessment and Restoration Network (LEARN) research project to study dry mixed conifer treatments on the Mogollon Rim, 56 acres of which is planned for thinning activities in the CWPP project area. Past thinning over 1,020 acres (thin from below treatments[10]) and prescribed burning over about 3,181 acres from 2009 to 2016 as part of the ECC project have been completed within the CWPP project area. About 4,295 acres of forest (2,753 acres within the CWPP boundary) are targeted for thinning as part of the East Clear Creek 4FRI task order which was issued in 2014. These treatments would reduce the risks associated with the no action alternative where they occur in the CWPP project area. The combined 3,995 acres of mechanical treatments authorized through the ECC project in addition to the 530 acres treated under the Blazed Ridge/Little Spring Tornado Recovery Stewardship contract would continue to have the effect of reducing the risk associated with the impacts of increasing density associated with the no action alternative on approximately 6% of the project area over the next 5-20 years. The 3,181 acres of prescribed fire treatments to occur through the ECC project in the CWPP project area would have less of an effect and would last approximately 1-10 years on approximately 9.5 percent of the CWPP project area.

Both the 4FRI Rim Country proposed project and the ECC project would combine to counteract the effects of the no action alternative, but only within approximately 10% of the project area. Since these treatments are not specifically designed to decrease risk of high intensity wildfire, these effects would be limited at reducing the post-fire effects of a high-intensity wildfire even within the treatment footprint.

Other activities including dispersed recreation, motor vehicle use, vegetation treatments for utility right-of-way maintenance, and road maintenance would have little effect of forest vegetation due to their relatively small spatial footprint at the landscape scale and are likely to have little cumulative effect on vegetation density, composition, and large trees within the project area that would combine with the effects of the no action alternative.

The primary cumulative impact would come from the effects of climate change, which would result in a higher likelihood of high-intensity wildfire and widespread tree mortality triggered by drought and temperature stress (Anderegg, Kane, & Anderegg, 2012). Current forest conditions that are outside or on the edge of natural variability would be pushed farther toward or possibly through critical thresholds, and as a result may not recover to their previous state following disturbance (Anderson-Teixeira et al. 2013). As a result it is likely that this alternative would result in a long-term move away from desired conditions punctuated by disturbance events that would drastically change forest structure and composition from being able to meet the elements of desired conditions in the future.

[10] Thin from below is a treatment description where the smallest diameter or shortest trees are removed until the desired stocking level is reached.

Alternative 2 – Proposed Action

Hazardous fuels reduction and forest restoration activities proposed for the CWPP area consist of prescribed tree cutting treatments and prescribed fire. Multiple prescribed fires would be conducted over the next several decades on all acres proposed for treatment to mimic natural fire return intervals. Treatments in MSO habitats have been designed to meet guidelines outlined within the 2012 MSO Recovery Plan for PACs and Forested Recovery Habitat and were developed in conjunction with the U.S. Fish and Wildlife Service. Snags would only be cut for operational or safety reasons, therefore the impact to snag numbers should be minimal.

Direct/Indirect Effects

Forest Composition

Forest composition would not change under this alternative. Ponderosa pine (including Ponderosa Pine- Gambel Oak) will still be the dominant cover type within the project area. Mixed conifer will make up a moderate proportion of the vegetation composition. Aspen, juniper, grasslands, and other hardwoods will continue to make up a minor part of the vegetation composition. Hardwood representation (aspen, Gambel oak, maple) may increase slightly, as the emphasis would be to reduce competing conifers around these trees. Reducing competition from conifers and returning fire to the landscape may improve aspen and other hardwood over the next several decades.

Forest Structure

Uneven-Aged Structure

Under the current Forest Plan, it is desired that uneven-aged forest structure occurs on the majority of the acres by cover type. Uneven-aged forest are defined as forests composed of three or more distinct age classes of trees, either intimately mixed or in small groups.

Across the project area, one year post treatment, the percentage of uneven-aged structure within the various cover types changes. Within all cover types the percentage of uneven-aged structure increases one year post treatment. Within the ponderosa pine cover type, uneven structure ranges from 68 percent in ponderosa pine to 75% in ponderosa pine-Gambel oak. Within the mixed conifer cover type, uneven-aged structure accounts for approximately 67% of the acres.

Within twenty years, uneven-aged structure rises to 74% and 76% in the Ponderosa Pine- Gambel Oak cover type and ponderosa pine cover type, respectively. Within the mixed conifer cover type, uneven-aged structure increases to 72% of the cover type area. The effects of the treatments over the next two or three decades is to facilitate a greater amount of the project area toward desired conditions of uneven aged cover type.

Vegetation Structural Stage

This alternative, shows a shift in the VSS structure towards the desired condition, which is a balanced range of tree class sizes. One year post treatment, there is an increase in the representation of VSS 1 (grass, forbs, and shrubs) as a result of the reduction of primarily VSS 3 and 4 trees and the creation of small openings. Treatments would result in a large increase in the representation of VSS 6 stands. This is because most of the larger trees will remain, regardless of health or vigor, unless they meet the criteria defined in the Large Tree Implementation Strategy for removal. Because the large trees remain while intermediate aged trees are removed from mechanical thinning, the proportion of VSS 6 stands is shown to substantially increase. Furthermore, over time, treatments would result in

conditions that improve health and vigor of large trees so that fewer die prematurely, and the rate of VSS 4 and VSS 5 trees transitioning to VSS 6 trees accelerates.

Immediately following the prescribed cutting and burning treatments in 2018, while not at the desired distribution, the project area would be trending towards a balanced range of tree size classes. With a restriction on cutting VSS 6 size trees, this size class appears to be over-represented within the project area, which would contribute to evening out deficits of this tree size class in the larger landscape. By 2037 with natural tree growth and mortality along with tree regeneration, the VSS 3 size begins share dominance with the VSS 6 class. The representation of VSS 2 appears to decrease with treatment. This is because smaller trees will be removed from beneath the canopy of larger trees. Patches of smaller trees located near roadways will also be thinned as part of precommercial thinning treatments included in this alternative to promote the safe introduction of prescribed burning.

Over the next two decades, the trend towards a more balanced range of tree sizes continues, especially in the larger structure classes. VSS 3 and VSS 6, at 36% and 29% respectively, meet or exceed the desired range. VSS1 and VSS2 continue to be underrepresented, as trees that were formally in those structure class have grown into to larger structure classes and younger trees are not being recruited. VSS 1 structural class appears to disappear after twenty years. This is, in part, a product of the FVS program. Seedlings were not added to the program after the second prescribed burn. And regeneration accounted for has grown into VSS2 structure class. However, with the potential for creating small opening the torching of individual trees or clumps of trees, VSS 1 trees will continue to be a part of the overall structure.

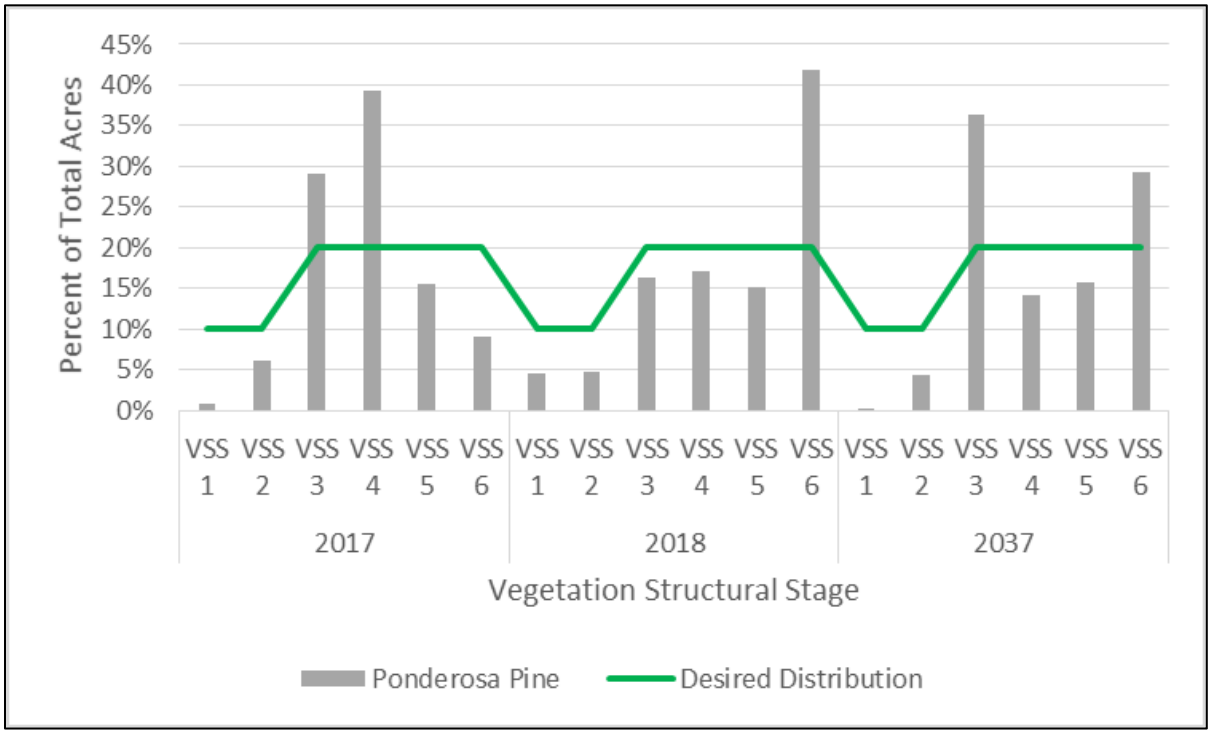


Figure 26. Proposed Action Alternative: Vegetation structural stage by year and percent of total acres for the ponderosa pine cover type.

Density (including BA, and SDI)

Basal Area

Under this alternative, the direct effects include a reduction of the basal area per acre across most of the project area, specifically in areas receiving mechanical treatments. There would be trend of an overall increase in the proportion of the project area that falls within the desired basal area per acre identified.

One year post treatment, approximately 44% of the mixed conifer cover type would meet the desired basal area per acre of 120 ft^2 or less, an increase of 144%. Within the ponderosa pine cover type, approximately 96% would meet the desired basal per acre, an increase of 118%. Within the pine-oak cover type, approximately 57% would meet the desired condition, an increase of 160%. See Figure 27 for a graphical representation of post-treatment basal area across the project area.

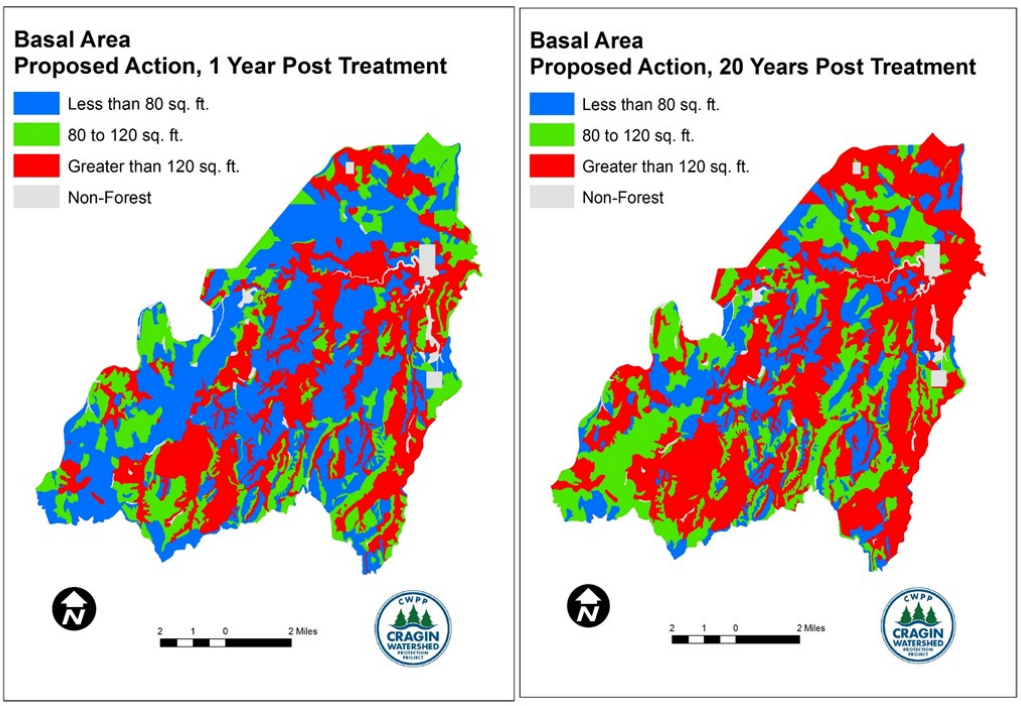


Figure 27. Proposed Action- Basal area, 1 Year and 20 Years Post Treatment

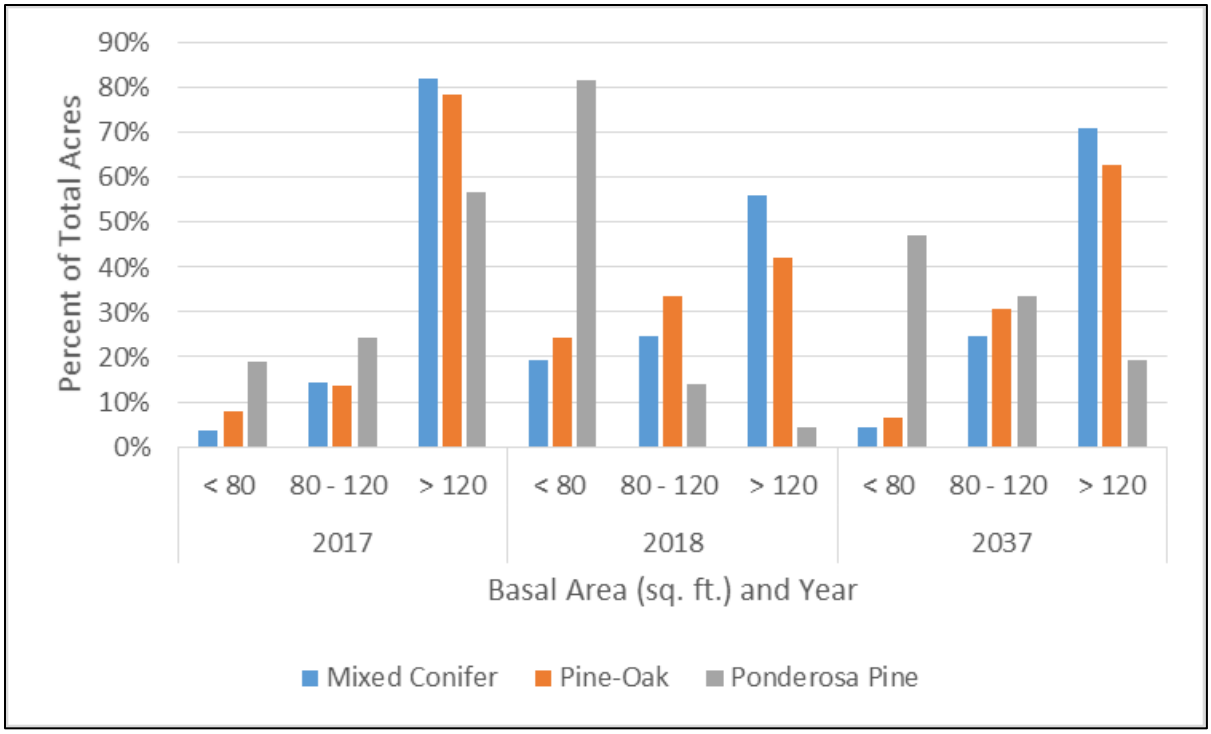


Figure 28. Proposed Action Alternative- Basal area by year and percent of total acres for the mixed conifer, pine-oak, and ponderosa pine cover types.

Within twenty years this trend begins to wane, especially in the mixed conifer and pine-oak cover types. This is because the retention of higher tree densities within these cover types to meet wildlife habitat needs. Due to higher retained tree densities within the mixed conifer and pine-oak following cutting to meet wildlife habitat needs, in 20 years, tree densities are approaching pre-treatment conditions due to tree growth and tree infill. However, the effects of the treatment are still apparent in that they result in forest conditions that are closer to meeting desired conditions than no treatment, and the structural changes to the forest are also present. Within the mixed conifer cover type, 29% of the acres would continue to meet the desired basal area per acre, a reduction of 34% from one year post treatment. Within the ponderosa pine cover type, 81% would continue to meet the desired condition, a 15% reduction. Within the pine-oak cover type, 37% would continue to meet the desired condition, a 35% reduction.

Stand Density Index

The desired condition is to obtain stand densities that are less than 35% of SDImax for each cover type (low to moderate) after treatment has been completed. To retain levels of tree growth similar to reference conditions, the SDI should be generally less than 35% after treatment. Forest stands maintained at this density are considered to be less than fully occupied, resulting in reduced inter-tree competition for limited site resources. This allows for tree growth similar to reference conditions for approximately 20 years. Once SDIs have reached between 50% and 60% of maximum, trees are within what is called the zone of imminent mortality. In this zone, competition-induced mortality begins to occur.

One year post treatment, within the mixed conifer cover type, the acreage within the low to moderate densities rise from 12% to 41%, an increase of 242%. Within the ponderosa pine cover type, these densities are rise from 21% to 84%, an increase of 300%. Within the pine-oak cover type, the acreage within the low to moderate stand density rise from 7% to 38%, an increase of 442%.

Twenty years post treatment, stocking densities begin shifting back to the high to extremely high categories within the mixed conifer and pine-oak cover types due to the densities of retained trees and tree regeneration. Within the mixed conifer cover type approximately 29% continues to meet the desired condition. Within the pine-oak cover type, approximately 16% continues to meet the desired condition. In the ponderosa pine cover type approximately 56% of the acreage continues to meet low to moderate stand densities. This increase in tree stocking could be mitigated or reduced by continual use of prescribed fire and managed fires to reduce both surface and ladder fuels.

Canopy Cover and Openness

Immediately following cutting and burning treatments, acres with low canopy cover increase due to small openings created for tree regeneration in all cover types and additional interspaces created within the ponderosa pine cover type. This results in a reduction of acres within the desired canopy cover range within the mixed conifer cover type. Within both the ponderosa pine and pine-oak cover types, there is a significant reduction in the amount of area with high canopy cover.

Within one year of treatment, the amount of canopy cover within the desired range within the mixed conifer cover type is 93%, a 7% reduction from current condition, and still meeting desired conditions. Within the ponderosa pine cover type, the amount of area within the desired range for canopy cover remains the same as current condition. What changes is the amount of area within the high canopy cover. High canopy cover is reduced from 34% to 2%, a 94% change. This change is because of the reduction of overall tree stocking and the introduction of openings for regeneration. Within the pine-oak cover type, the amount of canopy cover within the desired ranges increases from 57% to 79%, an increase of 39%.

Within twenty years most of acres are within the desired range for tree canopy cover and openness, particularly within both the mixed conifer and ponderosa pine cover types. Within the pine-oak cover type, the majority of the area is within the desired canopy cover. However, about 39% of the area has high canopy, close to the current condition.

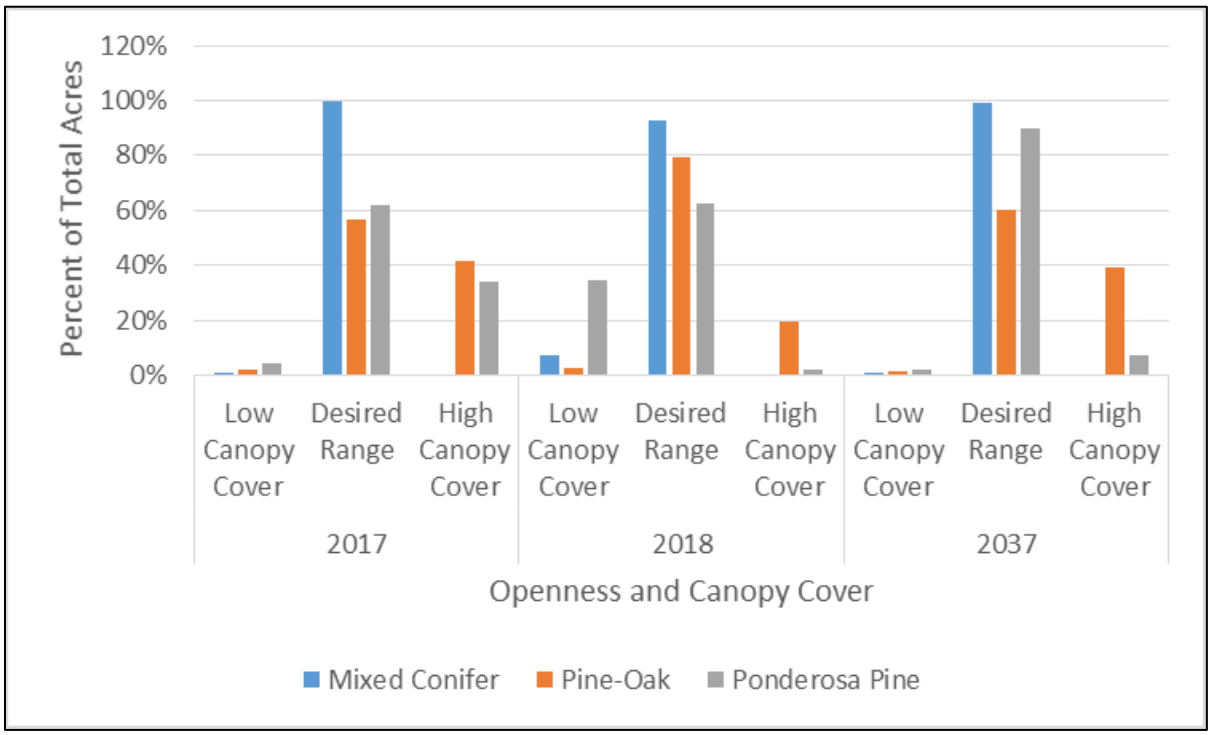


Figure 29. Proposed Action: Desired range of canopy cover by year and percent of total acres for the mixed conifer, pine-oak, and ponderosa pine cover types.

Large and old tree Structure

The large and old tree implementation plans do allow for the removal of trees between 18 inches and 24 inches under certain circumstances such as where it is necessary to meet fuels reduction, community protection, or forest restoration objectives. These include removing these to protect facilities structures, to improve the viewshed around Baker Butte, within heavily stocked stands with a preponderance of large young trees, and in other clearly defined circumstances.

It is incredibly difficult to model situations on the landscape where the exception categories (to remove large trees) apply, so the effects of this alternative on large trees were modeled without incorporating these restrictions. As a result, this alternative does show an initial reduction on the amount of area that meets the desired condition for large trees. The amount of acreage meeting the desired condition would be reduced from 78% to 72% in the mixed conifer cover type, a reduction of approximately 8 percent. Within the pine-oak cover type, the amount of acreage meeting the desired condition will be reduced from 64% to 55%, a reduction of 14%.

This reduction is the result of computer models based on the proposed actions without the large and old tree implementation plans, which would limit cutting of trees >16 inches dbh. The model would allow for cutting of trees up to 24 inches DBH in the mixed conifer and ponderosa pine-oak recovery habitat and simulated fire caused mortality in all size classes to estimate potential effect to large tree density. With the large and old tree implementation plans applied during project implementation, potential effects to densities of existing large trees would be expected to be much less. The reduction of large trees will be very limited during project implementation and is not likely to reflect the modeled reductions because of the use of the large and old tree implementation plan. As a result, it is expected that this alternative will mostly maintain existing large and old trees while also supporting conditions for intermediate aged trees to more quickly develop into large trees, thus moving toward desired conditions.

Over the long-term models show that conditions will continue to move toward desired conditions for old and large trees. Within twenty years, because of the expected tree growth, there is an upward trend in the number trees greater than 18.0” across these cover types. In mixed conifer, approximately 86% of the area is expected to meet or exceed the desired condition, an increase of 19 percent. Within pine-oak, up to 81% of the area is expected to meet or exceed the desired condition, an increase of 47%.

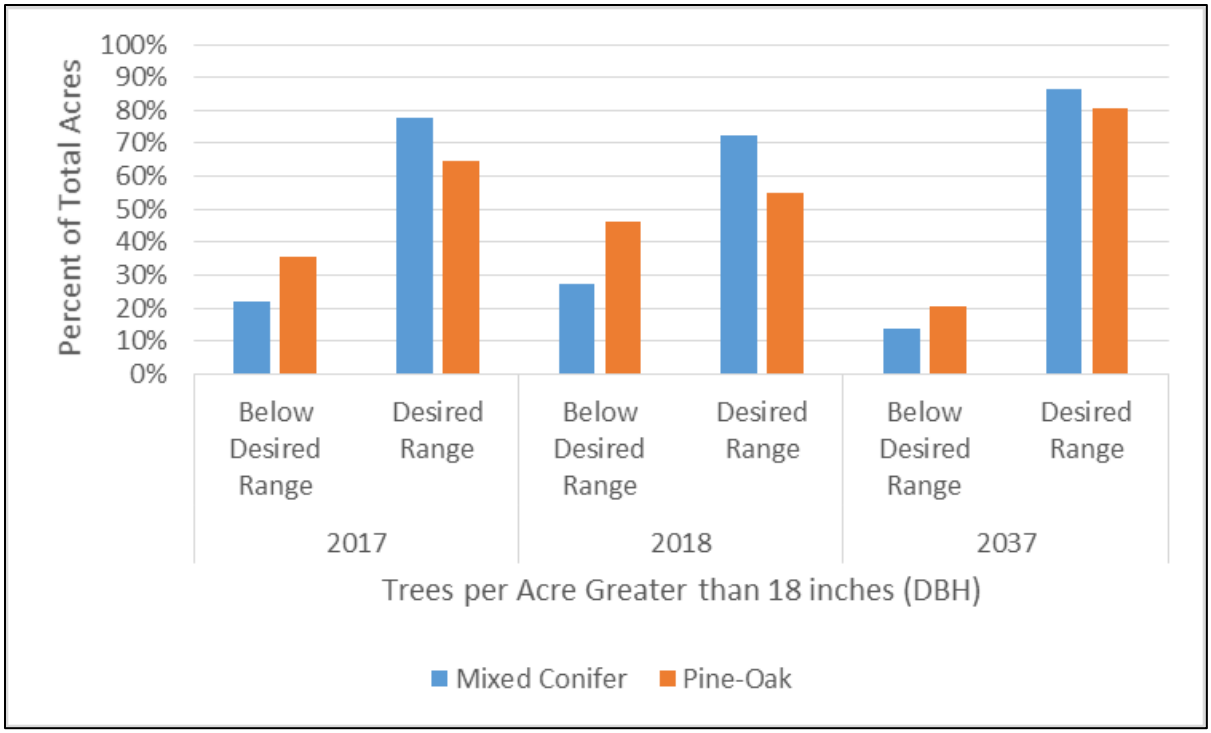


Figure 30. Proposed Action: Large trees per acre by in or below desired range of tree density by year and percent of total acres for the mixed conifer and pine-oak cover types (MSO habitat).

Stands will be opened up through thinning, along with the creation of small openings and interspaces, as treatments will ease stocking by mostly removing trees in overrepresented size classes such as VSS4 trees. This will reduce inter-tree competition for resources such as light, water, soil nutrients, growing space, resulting in increased diameter growth and improved vigor of the remaining trees. Treatment would be effective in reducing drought- and insect-induced tree mortality in southwestern mixed conifer forests because improved vigor will increase the tree's ability to respond to insect attacks and reduce the potential for epidemic loss bark beetles such as the western bark beetle. Dwarf mistletoe will be reduced in intensity and confined to its current locations. Higher forest density desirable in MSO habitat will be sustained to ensure that vegetation conditions meet the needs of the Mexican spotted owl habitat. Stand structure will move more of the landscape towards the desired uneven-aged structure.

The group selection and interspaces created from mechanical thinning treatments will create and maintain more uneven-aged stand structure, particularly in the ponderosa pine cover type. Canopy gap openings, if large enough, should naturally regenerate with ponderosa pine and Douglas fir seedlings (in the mixed conifer areas) within 10 years, allowing for the introduction and maintenance of a younger age class. Openings will vary in size and locations.

Indirect effects of all thinning silvicultural treatments could include some potentially negative effects. Downed slash can create increased breeding sites for Ips beetles. This negative effect is mitigated through the design feature that allowed implementers to adaptively manage green slash creation to July to December. Mechanized logging equipment can decrease on-site soil productivity through compaction, which could affect growth of new trees or reduction in growth rates of remaining un-cut trees. Goodwin (2005) noted that compaction is having an effect on ponderosa pine regeneration and growth throughout the Coconino National Forest. Results from a study by Bolding et al (2009) indicate that fuel reduction operations did not contribute to either statistically or biologically

significant soil disturbance effects. Design features of controlling skid trail location, timing to avoid wet conditions, and felling to the lead will minimize soil compaction and thus limit potential effects on tree regeneration in the project area.

Stands with Preponderance of Large Young Trees

Within these areas, as defined in the large and old tree implementation plans, treatments will be designed to retain a higher basal area. The overall effects of the treatment would not change. However, the stocking would be left at the higher end of the desired range. This would still allow for reduced competition and increased tree growth within these areas, but the time frame to grow back to existing conditions would be shorter. These areas would reach the point of competition induced mortality faster than those areas with less stocking.

Function (fire, insects/disease, Forest health, vertical and horizontal diversity)

Mechanical treatments and prescribed fire will improve forest health and resiliency by creating small openings and interspaces between groups of trees in ponderosa pine cover type, reducing inter-tree competition in all cover types, and improving tree growth and vigor. Targeted thinning may be effective in reducing drought- and insect-induced tree mortality in southwestern mixed conifer and ponderosa pine forests.

Within the ponderosa pine cover type, groups of trees will be variable in shape and size and surrounded by grassy interspaces. Groups and interspaces located in the ponderosa pine cover type will be within the natural range of variability. Interspaces provide rooting space to support grouped trees (Reynolds, et al., 2013). Treatments are expected to create and maintain both horizontal and vertical diversity throughout the project area. Stand structure will move toward becoming and maintaining a more uneven-aged structure. Dwarf mistletoe will be reduced where possible or isolated to reduce the potential for spread. The potential for bark beetle attacks would remain at endemic levels.

Maintaining structural, age class, and community composition diversity at a landscape level helps to reduce the risks from uncharacteristic fire and insect epidemics (Nyland, 2002). Reintroduction of fire whether associated with mechanical treatment or not, is expected to decrease the current level of departure from the historic fire regime. Past and present research results suggest mechanical aerial fuel reduction (i.e., reduced canopy bulk density) followed by frequent prescribed fire is well suited as a management tool to restore and sustain entire watersheds and their ecological functions, particularly in pine-grassland forests (Cram et al. 2006). Additionally, they observed that mechanical treatment followed by prescribed fire (including pile burning) had the greatest influence toward mitigating fire severity for at least a decade and in some cases up to several decades (Omi & Martinson, 2002) (Strom & Fulé, 2007). Specifically, as density and basal area decrease and mean tree diameter increase, fire severity decreases. A similar pattern was reported by McHugh and Kolb (2003) in terms of decreased tree mortality (three years following fire) as tree diameters increased from small to intermediate trees.

Treatments are expected to increase understory grass vigor and prescribed fire may reduce conifer regeneration especially where Arizona fescue resides (Sabo, Sieg, & Bailey, 2008). Historically the composition of the grass-forb-shrub community in ponderosa pine forests is typically diverse, especially in the open interspaces between trees. Understory composition includes various combinations of grasses, forbs, shrubs, ferns, and cacti depending upon plant associations (Reynolds, et al., 2013), all of which contribute to the biodiversity found in frequent-fire forests.

Gambel oak is a fire-adapted species that responds to fire by vegetative sprouting from the lignotuber and rhizomes. Brown and Smith (2000) report that Gambel oak has low fire resistance at maturity and at any size, although it resprouts vigorously the first growing season following fire. If successive fires occur at this stage, Gambel oak stands may be reduced to a grass-forb stage. Prescribed burning can be used to manipulate oak directly (for example, to change stem density) or to meet other management objectives, such as fuel reduction. Abella and Fulé (2008) found that oak survival was diameter specific 5 years after fall or spring prescribed burning. Survival of oaks greater than 6 inches (15 cm) in diameter exceeded 66% at both sites, while survival was low (11% to 20%) for small stems less than 2 inches (5 cm) in diameter. Survival may vary depending on operational aspects of burns, such as burn timing or whether oak clumps are deliberately lit. Nonetheless, these data support the findings of Fulé and others that large oaks can be maintained during burns and are consistent with oak's persistence in frequent-fire presettlement forests (Abella and Fulé 2008).

Prescribed burning or thinning-and-burning projects often experience less encroachment by non-natives than wildfires, frequently due to the decreased severity of the fires. As with wildfire, the severity of disturbances in conjunction with prescribed burning can influence the level of nonnative establishment in the post-burn community. This is of particular concern when the site is thinned prior to burning. While non-native species continue to be a major cause for concern in post-fire ponderosa pine forests, their impact in these ecosystems has been limited so far, especially when compared to the situation in lower-elevation ecosystems (McGlone & Egan 2009).

Processing Sites

Alternative 2 proposes the use of wood processing sites for wood storage, log merchandising, and chipping in order to improve the costs of removing wood and biomass from the CWPP's analysis area (Crandall, Adams, Montgomery, & Smith, 2017). Eight sites ranging from 5 to 15 acres have been identified for the potential use as processing sites for the CWPP. Sites can be found in all cover types. Sites were proposed base on terrain, road access, utilities, and potential impacts to resources.

Table 29. Processing Sites by cover type, name and total acres along with total impact to cover types

Cover Type	Processing Site Name	Acres
Ponderosa Pine	Site 6096 6097	5
	Site 613F	15
	Site 9033H	15
	Site 9398	5
	Total Ponderosa Pine Acres	40
Ponderosa Pine-Gambel Oak	Site 211 Revised	15
	Site 9032C	10
	Site 9729A	5
	Total Pine-Oak Acres	30
Mixed Conifer	Site 399	9
Grand Total		79

On these sites, most existing trees other than those that meet the large and old tree implementation plan would be removed. There will be a short term loss of productivity of forest resources such as tree volume, and forage, for about 20 years until wood processing operations are ended and sites are reclaimed and returned to timber production via natural and artificial reforestation. The processing

sites have populations of merchantable timber and fuelwood species, but with the small acreage affected and with design features in place; effects to forest product resources would be negligible.

Temporary Roads

Under this alternative, up to 46 miles of temporary roads would be constructed or where already existing, they would be used to access mechanical treatment areas and potential processing sites. Temporary roads are expected to have a negligible effect on forest productivity since created routes are returned to forest resource production within 1 to 2 years after treatment has been completed. It is anticipated that after decommissioning, grass, forbs and shrubs will quickly re-establish and tree species will seed within 5-10 years. Temporary road sites are at an increased risk of non-native plant species establishment. With adherence to project design features effects of non-native plant establishment should have a very limited effect at the project scale.

Summary of Direct/Indirect Effects for Alternative 1

With prescribed cutting and burning treatments, uneven-aged acreage increases due to the creation of openings and initiation of a new tree age class. All density measures drop due to the removal of trees. Large trees per acre drops as well since the model was allowed to thin trees indiscriminately for all trees less than 24 inches in diameter. With the large and old tree implementation plans being implemented, large trees not meeting the large and old growth tree implementation plan categories would be retained, resulting in more large trees being left at the expense of smaller tree sizes. At this scale, forest stands are trending toward or meeting the project's purpose and need and the desired conditions for the various cover types, indicating improved resilience to inter-tree competition, and disturbance such as fire drought, or insects.

By year 20, basal area is generally approaching conditions similar to the existing condition, due to diameter growth of retained trees, With the increased heterogeneity of the forest structure created from the proposed action within the forest stands, (i.e., reduced tree densities, more uneven-aged conditions, more acreage of trees configured into groups and clumps), resilience to fire, drought, and insects are still improved over the existing condition and meeting the project purpose and need and trending towards desired conditions. The trend is that the more intense the prescribed cutting and burning treatments, the better efficacy of the treatment for meeting the desired conditions and the project's purpose and need over time.

Table 30. Alternative 2- Averages of the indicator measures for forest stands proposed <u>by treatment</u> and by year: 2017 existing condition, 2018 post-treatment, and 2037, 20 years post treatment.

Year	Treatment	Uneven-Aged (% of Area)	Basal Area (Feet^2)	Trees per Acre	Percent of SDImax	Canopy Cover (% of Area)	Open-ness (% of Area)	Trees per Acre 18"+
2017	Ponderosa Pine	57%	126	914	48%	64%	36%	14
	NOGO PFA	40%	119	1,286	47%	64%	36%	19
	Baker Butte	100%	192	2,298	71%	77%	23%	30
	MSO Recovery Mixed Conifer	63%	149	1,307	45%	69%	–	22

Year	Treatment	Uneven-Aged (% of Area)	Basal Area (Feet^2)	Trees per Acre	Percent of SDImax	Canopy Cover (% of Area)	Open-ness (% of Area)	Trees per Acre 18"+
	MSO Recovery Pine-Oak	66%	144	1,637	55%	69%	–	21
	MSO PAC Mixed Conifer	34%	147	1,261	43%	70%	–	25
	MSO PAC pine-Oak	68%	144	1,148	55%	67%	–	15
	PAC Precom. Thinning	58%	149	1,057	46%	70%	–	19
	Precom. Thinning	16%	63	1,126	23%	48%	52%	9
	No Mechanical Treatment	64%	146	888	48%	69%	31%	18
2018	Ponderosa Pine	76%	59	471	23%	44%	56%	8
	NOGO PFA	94%	54	241	19%	43%	57%	9
	Baker Butte	100%	61	81	21%	47%	53%	10
	MSO Recovery Mixed Conifer	73%	89	495	26%	56%	–	15
	MSO Recovery Pine-Oak	77%	89	565	32%	56%	–	15
	MSO PAC Mixed Conifer	34%	123	359	34%	65%	–	25
	MSO PAC pine-Oak	83%	88	392	31%	55%	–	16
	PAC Precom, Thinning	44%	137	333	39%	68%	–	20
	Precom. Thinning	0%	62	254	22%	47%	53%	9
	No Mechanical Treatment	64%	139	420	44%	67%	33%	18
2037	Ponderosa Pine	76%	89	490	35%	55%	45%	11
	NOGO PFA	97%	84	292	31%	54%	46%	12
	Baker Butte	100%	82	464	29%	55%	45%	15
	MSO Recovery Mixed Conifer	84%	115	510	33%	63%	–	19

Year	Treatment	Uneven-Aged (% of Area)	Basal Area (Feet^2)	Trees per Acre	Percent of SDImax	Canopy Cover (% of Area)	Open-ness (% of Area)	Trees per Acre 18"+
	MSO Recovery Pine-Oak	92%	116	566	42%	63%	–	20
	MSO PAC Mixed Conifer	60%	145	392	40%	69%	–	29
	MSO PAC pine-Oak	90%	117	437	41%	63%	–	18
	PAC Precom. Thinning	58%	159	357	44%	71%	–	–
	Precom. Thinning	16%	75	237	26%	52%	48%	15
	No Mechanical Treatment	65%	163	439	51%	71%	29%	24

Cumulative Effects – Proposed Action

Cumulative effects for the proposed CWPP to vegetation includes past timber sales, timber stand improvement thinning, prescribed burning, wild and domestic grazing, recreational activities, vegetation management for utility right-of-ways, and riparian improvement projects. The geographic setting for the cumulative effects vegetation analysis consists of the project area. The timeframe for past actions, along with future, foreseeable projects is 10 years. These timeframes were chosen because harvested sites have normally grown back to pre-treatment conditions within 10 to 20 years, and planning beyond 10 years is speculative.

Table 31. Past, present and reasonably foreseeable activities projects used for the CWPP cumulative effects analysis for vegetation

Project Name	Year	Description	Acres
East Clear Creek Watershed Health	2009	Precommercial Thinning, 5-9" dbh	1,020
Blazed Ridge/Little Spring Tornado Recovery Stewardship IRTC	2012	Sanitation Cut, and Yarding – Removal of Fuels	530
Blue Ridge Urban Interface	2010	Prescribed Fire- Maintenance Burning	603
Blue Ridge Urban Interface	2011	Prescribed Fire- Maintenance Burning	957
East Clear Creek Watershed Health	2007	Prescribed Fire- Broadcast Burn	748
East Clear Creek Watershed Health	2010	Prescribed Fire- Broadcast Burn	1,238
East Clear Creek Watershed Health	2011	Prescribed Fire- Broadcast Burn	1,190
East Clear Creek Watershed Health	2017	Prescribed Fire- Broadcast Burn	2,000
LEARN Research Project	2017	Thinning and Prescribed Fire	56
Dude Lake	2009	Wildfire	19
Independence*	2009	Wildfire	1,371
July 4th Complex*	2009	Wildfire	3,084
Reservoir	2009	Wildfire	170
Rim*	2009	Wildfire	276

Project Name	Year	Description	Acres
Bravo*	2010	Wildfire	3,285
Ranger*	2010	Wildfire	2,138
Kehl*	2011	Wildfire	187
Scout*	2011	Wildfire	803
Hart	2013	Wildfire	38
General*	2014	Wildfire	2,086
Kinder*	2014	Wildfire	451
General*	2015	Wildfire	2,690
Reservoir	2016	Wildfire	124
Poverty*	2016	Wildfire	300
Crackerbox*	2016	Wildfire	922
Pinchot*	2016	Wildfire	3,864
Wolfman*	2016	Wildfire	59
Highline/Bear	2017	Wildfire	4,400
Noxious and Invasive Weed Treatments, SR 87	2015	Pesticide Application	922
Noxious and Invasive Weed Treatments, SR 87	2016	Pesticide Application	200
		Total Acres	35,731

* Several of the activities in this table include overlapping acreage

The analysis area has a network of roads built by federal, state and private interests to provide access for resource management and recreation beginning in the 19th century. The cumulative effects area contains 362 miles of roads open to the public and for administrative use. This equates to 1,235 acres of forest land converted to a non-forest use as roads. Establishment of roads inhibit forest resource productivity for the life of the road.

The analysis area has a network of buried and overhead telephone and power lines and associated right-of-ways built by several utilities. The cumulative effects area contains 57 miles of utility line which equates to an estimated 93 acres of forest land that has been cleared of trees. This activity removes the impacted area from the productive timber base for the life of the utility lines. The activity does not impact vegetation cover. The area remain in production for grass, forbs, and shrubs as forest resources.

Past vegetation and fuels projects in addition to wildfires have occurred on about 31,527 acres within the CWPP area (some of this acreage is overlapping). Most, if not all, of these past activities have occurred on the same acres being proposed for treatment with the CWPP and their effects to vegetation have been incorporated into the existing condition and so are not considered a cumulative effect in addition to the direct and indirect effects analysis. These activities involved pre-commercial and commercial thinning reducing densities of trees and removing ladder fuels from forest stands. Prescribed and wildfire activities were mostly low to mixed severity, removing surface fuels and smaller ladder fuels (see Fire and Fuels report for more information on fire severity of past fires). The effects of these activities have been variable, especially with regard to previous wildfires. However, in general they have resulted in a slight and temporary improved resistance to disease through stocking control, reduced crown fire potential through removal of ladder fuels and a reduction of interconnected canopies that carry crown fires, as well as a reduction of canopy cover for improved understory vegetative response. However, even with these effects of previous activities, existing conditions are still trending away from desired conditions.

Many ongoing activities and planned activities would result in effects that combine cumulatively with those of the proposed action alternative. The Four Forest Restoration Initiative Rim Country project would is expected to include a number of restoration-based activities that could occur in CWPP project area over the next two decades. Restoration activities such as meadow restoration included in Rim Country and other proposed projects including the Long Valley Meadow Restoration and Long Valley Workstation Restoration Project, involve removing small trees in areas that show evidence of grassland-type soils. These efforts could include creation of openings that reduce the potential impacts of increased density in these specific areas where the treatment occur, which would likely make up a very small proportion of the project area. This could combine with the effects of the proposed action to cumulatively increase the amount of openings within the project area, which would result in a cumulative decrease in canopy cover. The meadow restoration projects in long valley would include thinning of small trees in meadows on less than 50 acres. There is currently no final proposal for the Rim Country project the amount of this cumulative impact is not known. Regardless, any proposed meadow restoration treatments under the Rim Country project or other treatments that affect canopy cover in the CWPP area would be analyzed in the Rim Country EIS and include CWPP treatments in cumulative effects analysis.

The CWPP partially overlaps with the East Clear Creek (ECC) Watershed Health Project NEPA Decisions (2006). The ECC decision also authorized treatment of up to 460 acres with mechanical thinning and prescribed burning treatments as part of a Long-Term Ecological Assessment and Restoration Network (LEARN) research project to study dry mixed conifer treatments on the Mogollon Rim, 56 acres of which is planned for thinning activities in the CWPP project area. Past thinning of approximately 1,565 acres (thin from below treatments) and prescribed burning over about 3,181 acres from 2009 to 2016 as part of the Blazed Ridge/Little Spring Tornado Recovery and ECC project have been completed within the CWPP project area. About 4,295 acres of forest (2,753 acres within the CWPP boundary) are targeted for thinning as part of the East Clear Creek 4FRI task order which was issued in 2014. About 4,295 acres of forest (2,753 acres within the CWPP boundary) are targeted for thinning as part of the East Clear Creek 4FRI task order which was issued in 2014. These treatments would result in similar effects to those disclosed in the CWPP and would cumulatively combine with the treatments in the CWPP area. The combined 3,773 acres of mechanical treatments authorized through the ECC project would cumulatively add to the effects of the CWPP to reduce the risk associated with the impacts of increasing density of vegetation within the project area by adding treatment on an additional 6% of the project area over the next 5-20 years.

The prescribed fire treatments to occur through the ECC project in the CWPP project area would have less of an effect and would last approximately 1-10 years on approximately 9.5 percent of the CWPP project area. These effects are not expected to cumulatively combine with the effects of the CWPP, because the CWPP proposed action assesses the effects of prescribed fire treatments on the entire project area.

Natural fires that occur over the next two decades within the CWPP area could be managed for resource benefits given appropriate conditions that allow for low and moderate severity of fire effects. In some instances these may result in cumulative effects from mechanical and prescribed fire treatments implemented as part of this alternative. It is unlikely these cumulative effects would result in combined effects that change forest structure, composition, or productivity beyond the desired conditions because of processes such as biological consultation, which would limit effects that would result in conditions that would not support Mexican spotted owl habitat recommendations, which are integrated into the project desired conditions.

Other activities including dispersed recreation, motor vehicle use, vegetation treatments for utility right-of-way maintenance, and road maintenance would have little effect of forest vegetation due to their relatively small spatial footprint at the landscape scale and are likely to have little cumulative effect on vegetation density, composition, and large trees within the project area that would combine with the effects of the proposed action alternative. In some circumstances it is possible that vegetation impacts from dispersed camping, vegetation maintenance for utilities, or other activities could result in cumulative effects by removing additional trees in areas where treatments have occurred or where processing sites or temporary roads resulted in localized reduction in vegetation. These effects would localized to the dispersed campsites, or utility right-of-way where the vegetation impacts occurred, and are not expected to result in measurable cumulative effects at the level of the project area.

The primary cumulative impact would come from the effects of climate change, which would result in a higher likelihood of high-intensity wildfire and widespread tree mortality triggered by increasing frequency and intensity of drought and temperature stress (Anderegg, Kane, & Anderegg, 2012). Current forest conditions that are outside or on the edge of natural variability would be pushed farther toward or possibly through critical thresholds, and as a result may not recover to their previous state following disturbance (Anderson-Teixeira et al. 2013). The proposed action alternative would help address these forces associated with increasing environmental stressors from climate change by alleviating elements such as water stress, risk of high-intensity wildfire, and drought. Several studies have found that reducing density of forest vegetation is expected to moderate the effects of drought and ultimately reduce mortality or changes in composition of vegetation (D'Amato A. W., Bradford, Fraver, & Palik, 2013). In addition, research indicates forest management strategies similar to those in the proposed action as necessary to sustain large trees and mature trees under increasing cumulative stressors associated with the expected effects of climate change (Kerhoulas, Kolb, Hurteau, & Koch, 2013).

The cumulative effects of Alternative 2 will continue to move the forest within the project area on a positive trajectory of reducing surface and ladder fuels, restoring forest structure, composition and function and will facilitate the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem. The most substantial effect of this alternative would be to counteract the effects of cumulative environmental stressors caused by climate change by reducing the effects of existing environmental stressors such as water stress from drought, pest and disease infestation, inter-tree competition, and high-intensity wildfire.

Fire and Fuels

The following section describes the affected environment and effects of the alternatives relating to fire and fuels.

Resource Indicators and Measures

Crown Fire Potential

Crown fire potential is the unit of measure for existing condition and post-treatment condition. It was modeled using FlamMap, an interagency fire behavior mapping and analysis program that computes potential fire behavior characteristics. The tool uses eight spatial input data layers to represent biophysical conditions and weather parameters to simulate wind and fuel moisture conditions. The spatial input layers were created by LANDFIRE and include elevation, slope, aspect, canopy closure, fuel model, canopy base height, and canopy bulk density. FlamMap was also used to show change in crown fire potential after treatment with data from Forest Vegetation Simulator.

Three different types of crown fire potential were used to describe conditions in the project area;

Active crown fire: An active crown fire presents a solid wall of flame from the surface of the forest floor through the canopy fuel layers. Flames appear to emanate from the canopy as a whole rather than from individual trees within the canopy

Passive crown fire: Passive crown fire encompasses a wide range of crown fire behavior, from occasional torching of isolated trees to nearly active crown fire . Passive crown fire is also called torching or candling.

Surface Fire: A fire which spread with a flaming front and burn leaf litter, fallen branches and other fuels located at ground level.

For existing condition, we began by identifying existing, baseline, fire behavior potential. For this effort we compared weather conditions for large fires (>100 acres) over the past 22 years in the general area to look for common denominators of large fire growth. The Clover Fire, 2000, was chosen to use for modeling and output validation due to its proximity to the project location and fire effects observed. This fire included average wind speeds of 13 mph, which is not considered a "worst case scenario", and is generally an average value observed for wind speeds for fires considered for modeling purposes. As the 2018 Tinder Fire illustrated, high winds can be the driving force of crown fire, yet fuels also play an important role especially in the initial phases of a wildfire when wind may not be the driving factor. Please refer to the Fire, Fuels, and Air Quality Specialist Report for specific information on the parameters used in association with the Clover Fire for fire modeling purposes and how they compared to other fires considered for this purpose.

Weather used is based on the worst case scenario of the 97 percentile weather. These are the weather conditions where wildfires effects are most likely undesirable and escape initial attack. More moderate weather conditions usually allow for unwanted wildfires to be caught and suppressed effectively. We look for natural occurring wildfires under more moderate weather conditions to be managed for resource benefit where conditions allow. It is possible that even weather conditions at the 85-90 percentile weather may benefit the landscape by removing more dead and live fuels to achieve objectives

LANDFIRE existing condition data was compared to existing condition FVS outputs to create a LCP file that was then used to create fire modeling in FlamMap. Landscape files are multi-band raster format used by wildland fire behavior and fire effects simulation models such as FlamMap.

For post treatment crown fire potential, percentile change from the Forest Vegetation Simulator was used based on crown base height, (CBH), crown bulk density (CBD), stand height, and canopy cover to create fuel model changes. Then a new Landscape file was created and run through FlamMap again to model post treatment crown fire results.

FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics (spread rate, flame length, fireline intensity, etc.).

The FlamMap fire mapping and analysis system (Finney 2006; Stratton 2006) is a PC-based program that describes potential fire behavior for constant environmental conditions (weather and fuel moisture). Fire behavior is calculated for each pixel within the landscape file independently, so FlamMap does not calculate fire spread across a landscape. Potential fire behavior calculations include surface fire spread (Rothermel 1972), crown fire initiation (Van Wagner 1977), and crown fire spread (Rothermel 1991). Dead fuel moisture is calculated using the Nelson model (Nelson 2000) and

FlamMap permits conditioning of dead fuels in each pixel based on slope, shading, elevation, aspect, and weather.

Because environmental conditions remain constant, FlamMap will not simulate temporal variations in fire behavior caused by weather and diurnal fluctuations as FARSITE does. Nor will it display spatial variations caused by backing or flanking fire behavior. These limitations need to be considered when viewing FlamMap output in an absolute rather than relative sense. However, outputs are well-suited for landscape level comparisons of fuel treatment effectiveness because fuel is the only variable that changes. Outputs and comparisons can be used to identify combinations of hazardous fuel and topography, aiding in prioritizing fuel treatments.

The FlamMap software creates raster maps of potential fire behavior characteristics (for example, spread rate, flame length, crown fire activity) and environmental conditions (dead fuel moistures, mid-flame wind speeds, and solar irradiance) over an entire planning level landscape. These raster maps can be viewed in FlamMap or exported for use in a GIS, image, or word processor.

FlamMap is not a replacement for FARSITE[11] or a complete fire growth simulation model. There is no temporal component in FlamMap. It uses spatial information on topography and fuels to calculate fire behavior characteristics for a single set of environmental conditions. FlamMap uses the same spatial and tabular data and incorporates the same fire behavior models as FARSITE. FlamMap is widely used by the U.S. Forest Service, National Park Service, and other federal and state land management agencies in support of fire management activities. It is designed for use by users familiar with fuels, weather, topography, wildfire situations and the associated terminology. Because of its complexity, only users with the proper fire behavior training and experience should use FlamMap where the outputs are to be used for making fire and land management decisions

Vegetative Condition Class

Vegetation Condition Class (VCC) represents a simple categorization of the associated Vegetation Departure (VDEP) layer and indicates the general level to which current vegetation is different from the simulated historical vegetation reference conditions. VDEP and VCC are based upon methods originally described in Interagency Fire Regime Condition Class Guidebook, but are not identical to those methods.

LANDFIRE data was used to demonstrate Vegetative Condition Class for existing condition. For post treatment effects the areas that are proposed to be thinned were used to show changes based on percentage change from crown bulk height, CBD, stand height and canopy cover.

Affected Environment

Dead and Down Fuels

Dead and down fuel loadings (surface fuels) range across the analysis area from a low of 1 ton per acre to a high of 50+ tons per acre. Two hundred random plots were placed throughout the project area. Within these plots average fuel loading was 23 tons per acre of dead and down fuels, average

[11] *FARSITE* is a spatially-explicit fire growth simulation modeling system. It uses spatial information on topography and fuels along with weather and wind files. It incorporates existing models for surface fire, crown fire, spotting, post-frontal combustion, and fire acceleration into a 2-dimensional fire growth model.

logs per plot were eight and two snags per plot. Surface fuels are comprised of slash from past forest management activities (logging, pulping, and pre-commercial thinning), and from normal annual fuel accumulation (tree blow-downs, tree breakage, conifer needle loss, and herbaceous litter, etc.). A small portion of the project area was affected by a tornado in 2011, which created a line of dead trees through the project area, and is one of the portions of the project area with the highest concentration of dead and down fuels.

Live Fuels

Live fuels are primarily comprised of conifer tree crowns, shrubs and grasses. Historically, most of the analysis area consisted of stands of generally large diameter ponderosa pine (likely averaging 30-50 basal area per acre), with scattered large Gambel oak, and a well-developed herbaceous under story. Wetter sites contain Doulgas fir, white fir, white pine, aspen and big tooth maple. While drier sites contain juniper and Gambel oak. Today, the overstory in places contains large diameter trees, but there is a much greater amount of small to medium sized trees, on average, across the landscape. More importantly, the spatial arrangement of the forest is much different than based on pre-European conditions, with a much greater amount of overall canopy cover, a homogenous arrangement of trees lacking small openings, a greater amount of ladder fuels, and an overabundance of small trees in the understory of most stands. Fine fuels such as grasses that have been documented as abundant in pre-European southwestern forests and that are important for facilitating low-intensity surface fire is very sparse in areas because of heavy canopy cover and dense needles cast.

Figure 31. Ponderosa pine stand in project area with heavy needle cast and lack of grasses and forbs

Fire History

Mean fire return intervals of 3-14 years in the ponderosa pine and 9-33 years in dry mixed conifer have been reported for the Southwest (Fulé et al. 2003, Brown and Wu 2005, Heinlein et al. 2005, Fulé et al. 2009). These fire regimes are the result of a complex feedback- promoted by and perpetuating the historic structure (Reynolds et al. 2013). One research site located at Long Valley Experimental Forest on the Mogollon Rim Ranger District has a demonstrated historic median return interval of every 4 years (Swetnam and Baisan, 1996). Within the analysis area, fire has been excluded for the past approximately 100 years in many areas with the exception of pile burning on timber sales, and prescribed burning within the East Clear Creek, Blue Ridge Urban Interface and Pocket/Baker Projects. Prescribed burns have burned approximately 4,500 acres within the analysis area since 2004 (Table 33).

Since 2009 wildfires have been managed for resource objectives within the CWPP project area totaling over 20,000 acres (Table 32). While many of these fires have altered dead and down fuel components and CBH they have not altered stand structure significantly. Because of the high volume of live trees within much of the project area, dead and down fuel accumulates very rapidly after fire crosses the landscape. As a result, these past fires have likely resulted in short-year effects to fuel accumulations (1-5 years).

Fire is also a coarse tool when it comes to changing stand structure. Fire does not follow thresholds or divisions identified by classification tools used for vegetation analysis such as VSS distribution, "clumpy/groupy" descriptions or uneven age management. If fuels, weather and topography align it will make changes; if all of these factors do not align results can be short in duration and in effectiveness. While some areas may have more long lasting effects, other past wildfires have had very minimal effects that lasted a year or less with regards to fuel loads. In some instances, where wildfires reached moderate or high fire severity we have observed changes to small areas of stand structure that caused increases in fuels, such as when those trees that are killed then become areas of higher dead and down fuel loading that can add to increased fire behavior.

As described in a recent paper, (Huffman et al. 2017) about 85% of managed fires within the fires sampled had low to unburned severity which show little change in long term efficacy. As managing wildfires is a new tool, we learn with each one what is effective and acceptable from the many different stakeholders of forest service lands. Any fire is not a "one and done" treatment, it takes numerous entries with fire over time to make long term changes in stand structure and fuel loadings. Research of fire variability on the Mogollon Rim indicates the historical fire regime on this landscape was one of high frequency, low-severity fires. Current conditions call for restoration of forest structure and function, which will require a return to this pattern. (Huffman et al. 2015).

Within the CWPP area over the last 10 years there have been a total of 17 fires intersecting and within the project area totaling 29,401 acres of which 26,267 acres are in the CWPP Boundary (Table 32, Figure 32).

Table 32. Past Wildfires for Last 10 Years larger than 100 acres Fires with an asterisk * are those that have been managed for resource objectives.

Fire Name	Years	Acres	Acres in Project Boundary
4th of July Complex*	2009	3,084	3,084
Independence*	2009	1,370	1,371
Reservoir	2009	170	170
Rim*	2009	600	276
Ranger*	2010	2,138	2,138
Bravo*	2010	3,285	3,285
Kinder*	2014	451	451
Kehl*	2011	187	187
Scout*	2011	803	803
Reservoir*	2013	124	124
General*	2014	2,086	2,086
General*	2015	2,690	2,690
Reservoir	2016	128	128
Crackerbox*	2016	921	922
Pinchot*	2016	3,864	3,864
Poverty*	2016	300	300
Bear/Highline*	2017	7,200	4,388
Total Acres		29,401	26,267

Table 33. Past Prescribed Burning Projects in the Analysis Area Watersheds and Project Area

Project Name	Years	Acres	Acres in Project Area
Blue Ridge Urban Interface	2004, 2010, 2011	1560	1,560
East Clear Creek Watershed Health	2007, 2010, 2011, 2017	3176	3,176
Total Acres		4,736	4,736

Past Wildfire Severity

To respond to internal and stakeholder comments, we reviewed past wildfires and fires managed for resource objectives to determine the amount of high severity burns in the fire areas using Burned Area Reflectance Classification (BARC) data[12]. As shown by Figure 33 the occurrence of high severity fire effects throughout the project area over the last 10 years is very limited, only affecting a small fraction of the project area. The largest acreage for high severity was 72 acres and that was within the Bray fire from 1990 which since has filled in with dense growth of young, small trees. The largest high severity area within a wildfire managed for resource objectives is 22 acres. While these photos show that wildfires within the project area have caused total mortality of entire tree stands from high-intensity wildfire, the data shows that these types of effects have been extremely limited in the CWPP boundary equaling near 1% of the project area. Changes from these high-intensity fires was incorporated to the degree possible for fire effects modeling.

The photos below (Figure 34 and Figure 35) depict some of the changes in the vegetation that wildfire has altered. The photos for each fire were taken within 50 feet of each other and demonstrate the wide range of fire effects that occur within the same fire.

Past wildfires and prescribed burning alter dead and down fuels primarily. Measurement plots have been placed in previous wildfires managed for resource benefit and prescribed fires. For example, the 2010 Ranger fire (within CWPP) had five random plots placed within the perimeter. Browns transects were done at these plots and dead and down fuels were measured before and after fire crossed the plot. Results after the fire burned through the plots had an average reduction of 69% for dead and down fuels, going from an average of over 20 tons/acre to just over 7 tons/acre following fire. Additionally a 1/20 acre plot was done to sample trees within the area. Post fire results only showed an average of 6% reduction in mid-sized and large trees (trees over 5” dbh). Figure 33 depicts this very well in that it shows no high severity within the Ranger fire but at the same time dead and down fuels were altered substantially.

Although the dead and downed fuels were reduced, the moment after the fire is extinguished dead and downed fuels begin to accumulate. How quickly they accumulate depends on a number of factors but the density of the live trees is the main contributor. On average fuels accumulate at a rate of 1-3.5 tons/acre (Sackett 1996) per year. Within the Ranger fire, fuels accumulation over the past 8 years means the plots could be back up to over 20 tons/acre, meaning the stands have mostly fully recovered or surpassed the fuels levels from 2010. There are also other events that have occurred in the project area that have affected fuel levels in limited areas. As an extreme example with the Ranger fire, soon after the fire was out a tornado swept through the fire and what was close to 7 tons/acre of dead and down fuels is now 50 tons/acre within the path of the tornado.

[12] Comparable BARC data within the project area is only available for fires prior to 2016.

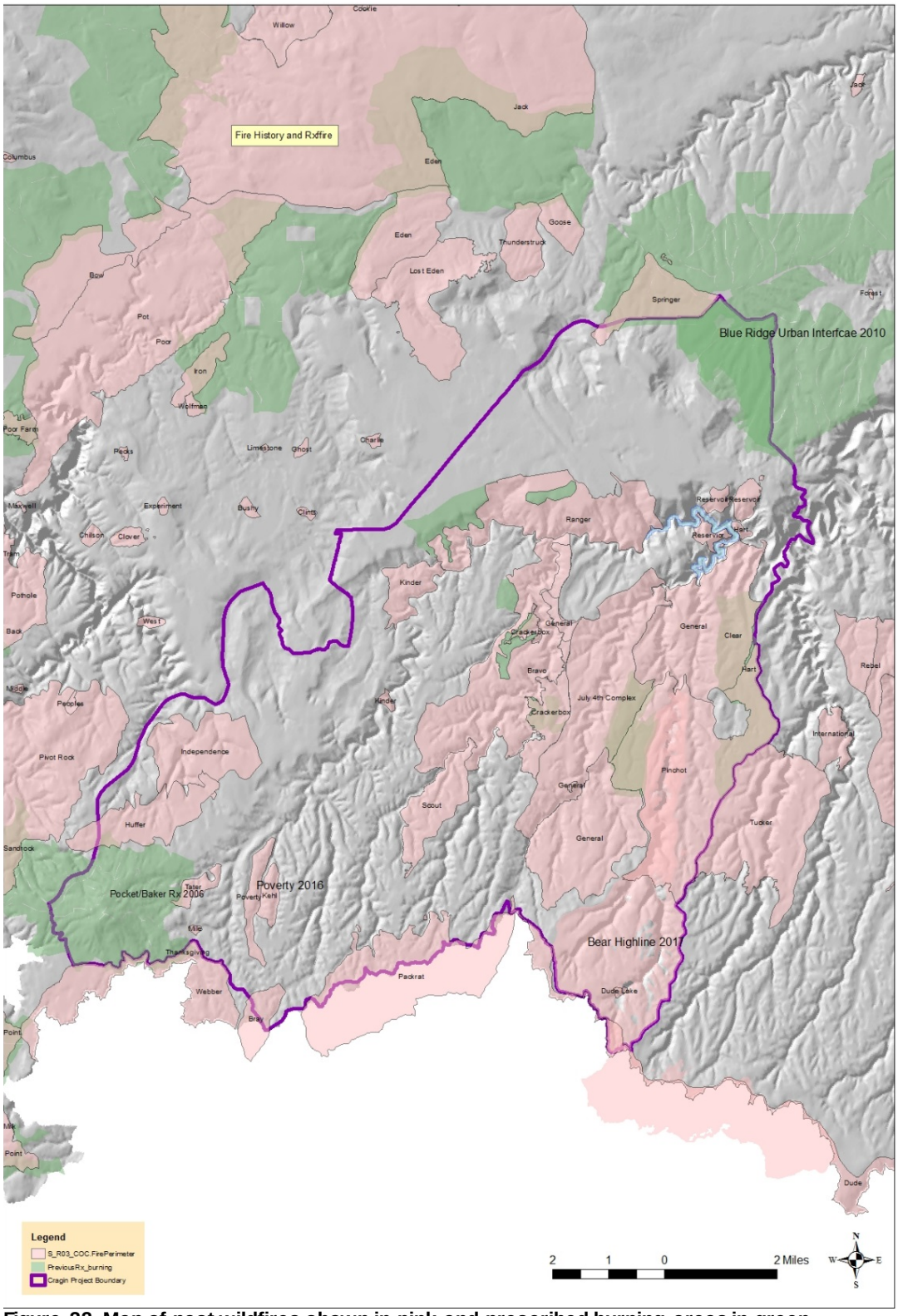


Figure 32. Map of past wildfires shown in pink and prescribed burning areas in green.

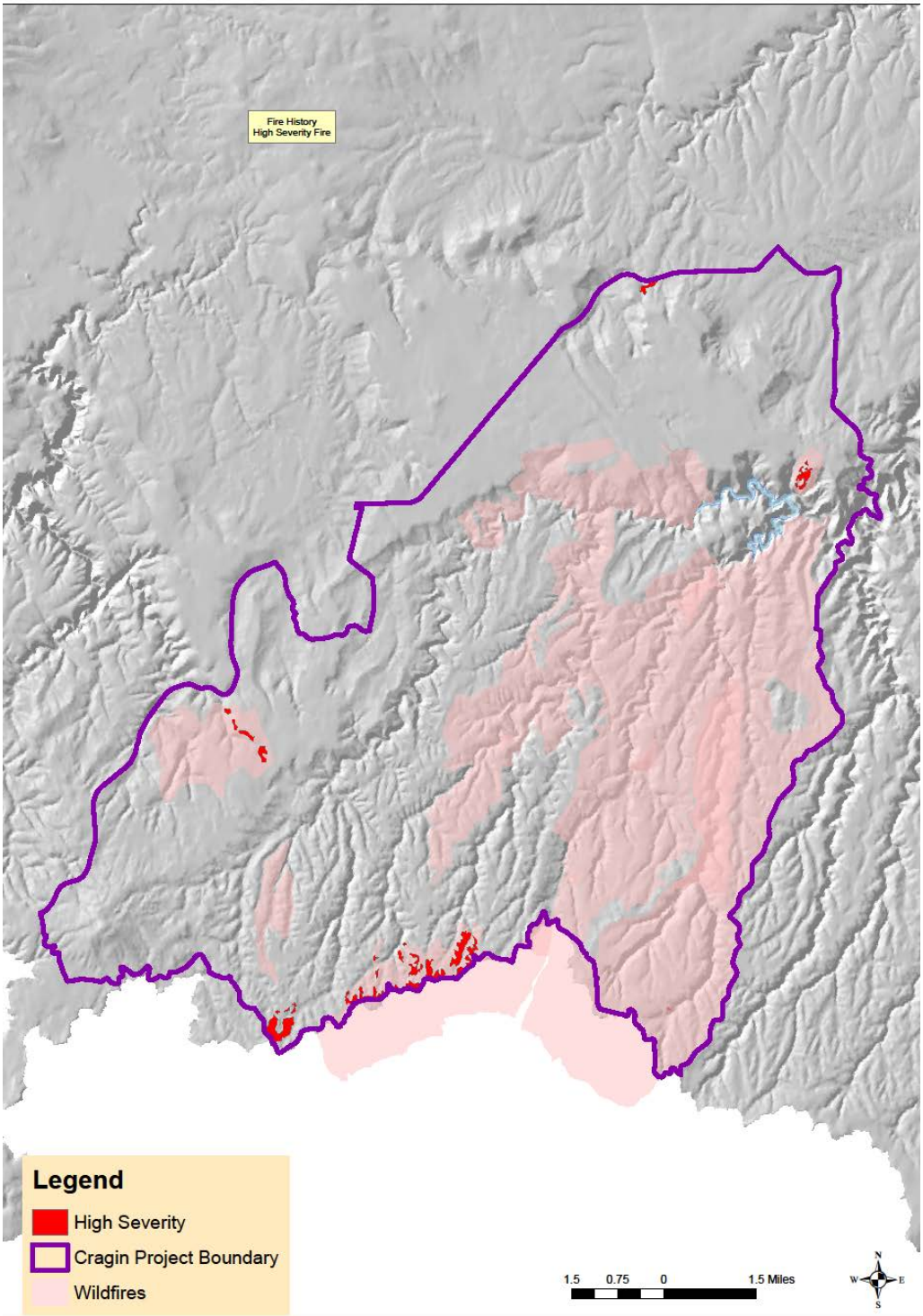


Figure 33. Locations of high severity burns within past wildfire areas.

Figure 34. Fire effects within the Pinchot Fire of 2016. The photos display a mosaic of fire severity including heavily scorched understory trees with the needles still on and overstory trees that are lightly scorched and burned at low severity.

Figure 35. Fire effects within the Fourth of July Complex Fire of 2009 along a road. Not all managed fires achieve desired objectives in all portions of the treated area. In the photo on the left there was high severity fire conditions where most all of the trees died over about 50 acres. In the photo on the right, across from the road there were minimal fire effects. The fire did not kill the lower branches of the pine trees. The two photos were taken 10 feet from each other.

The CWPP area also has a high occurrence of wildfire starts. Beginning in 2013 the Coconino National Forest began recording the number and location of abandoned campfires. Over a seven year period from 2006-2013 the CWPP area had 123 starts with about 70% started by lightning. The area also has seasonally high recreational use within and around the C.C. Cragin Reservoir. In 2016, a geospatial assessment was created to document relative risk of human caused wildfire starts across the Coconino National Forest (Hall, Wesley, Coconino National Forest Prevention Geospatial Assessment). Within this analysis a large portion of CWPP area shows as high risk for human caused wildfires (Figure 36).

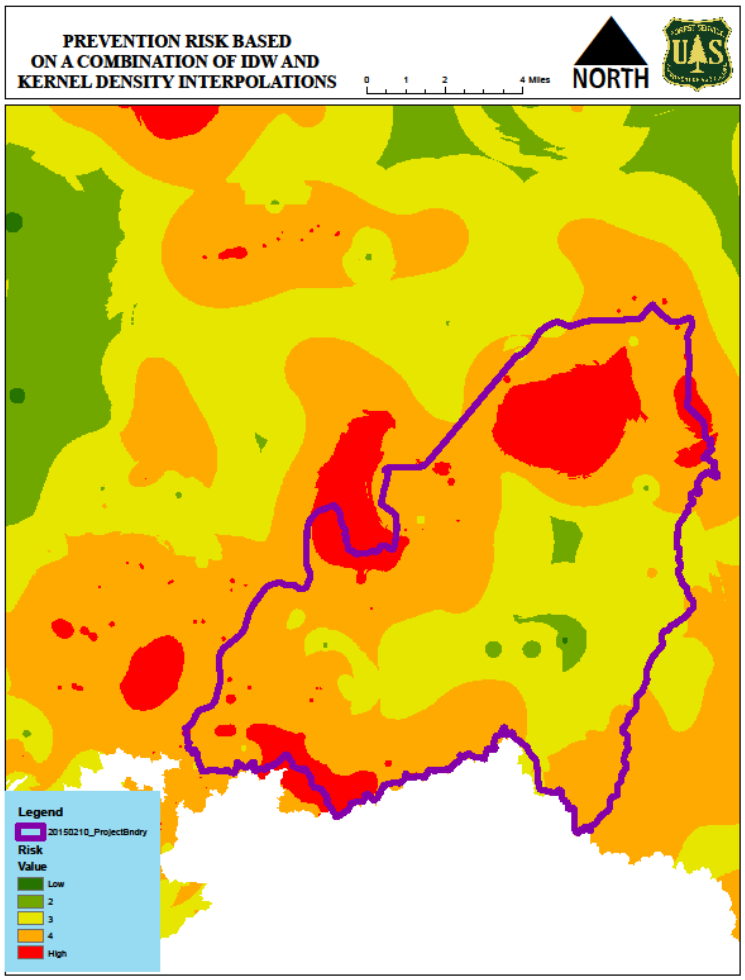


Figure 36. Fire Prevention Risk. This map is based on the occurrence of human caused fires and abandoned camp fires from 2010 -2014. High risk areas generally coincide with high recreational use and camping areas on the rim near Baker Butte, in the Clints Well Long Valley area and around C.C. Cragin Reservoir.

High risk areas (levels 3, 4 and High on Figure 36) are areas where fire prevention efforts will be focused and increased patrolling is most likely to occur.

The Wildland-urban interface (WUI) includes residential areas and human developments having special significance at imminent risk from wildfire. The CWPP project uses the Southwestern Region USFS WUI definition as follows:

> WUI includes those areas of resident populations at imminent risk from wildfire, and human developments having special significance. These areas may include critical communications sites, municipal watersheds, high voltage transmission lines, observatories, church camps, scout camps, research facilities, and other structures that if destroyed by fire, would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved. FSM 5140.5 Definitions, Fire Use

Within CWPP, there is approximately 17,000 acres of WUI sites and values at risk, which includes private property, the Cragin Project dam infrastructure and facilities, powerlines, DOPLAR radar site, campgrounds and lookout towers (Figure 37). The three municipal water supply watersheds are also considered as WUI in this project and amount to about 45,485 acres

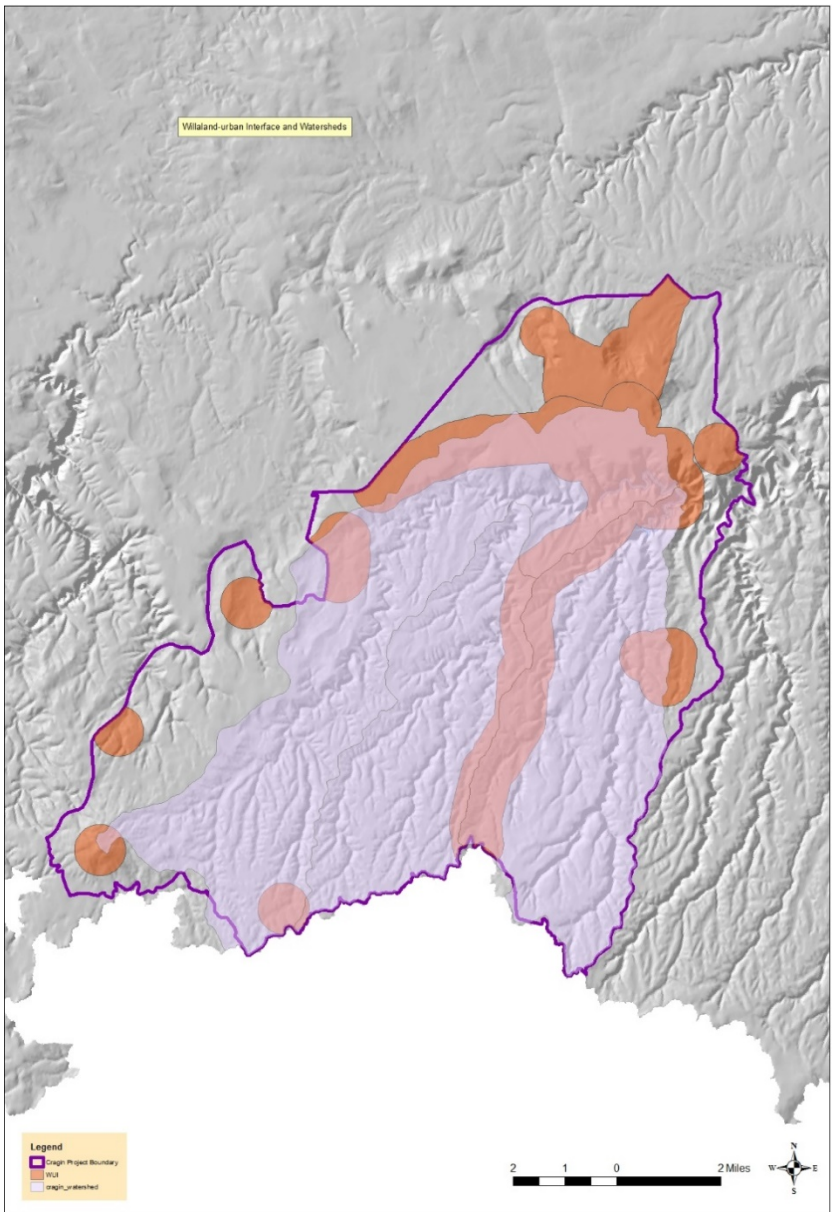


Figure 37. Wildland Urban Interface associated with WUI sites and values at risk in orange. The three Cragin sub-watersheds are shown in purple.

Crown Fire Potential

A number of factors contribute to crown fire potential. One of the factors is crown base height (CBH). This is the height from the ground to the lowest live limbs of a tree. The lower the CBH the easier it is for fire to transition from the ground into the tree canopy. Another factor is surface fire intensity (flame length). The flame lengths can change depending on weather, slope, available fuels, and fuel bed depth. The higher the flame lengths the higher the chance of a surface fire transitioning to the tree crowns. The number of trees per acre contribute to crown fire potential. This can be

measured by crown bulk density (CBD) and canopy cover. The higher the value or percentage leads to a more active crown fire situation. In other words if one tree or a small group of trees burn, it may not result in a crown fire or loss of a majority of tree crowns in area represented by the model. This would be referred to as passive crown fire. But if there are multiple trees torching in large groups that all have interlocking crowns this would be active crown fire. The broad scientific analyses available on the effects of fuels treatments in southwestern forests have shown that all of the previous elements can be changed through prescribed burning and thinning. Crown base heights can be raised by cutting smaller trees that have the lowest CBH. Also through the application of prescribed fire treatments, lower limbs can be killed to raise CBH. Flame lengths can reduced by reducing the amount of dead surface fuels through prescribed burning. Finally, crown bulk density and canopy cover can be reduced by thinning of trees (Van Wagner, 1977).

Some of the other factors that affect crown fire potential are weather and topography. The hotter, drier, and windier the weather the more potential there is for a crown fire. Also, the steeper the slope the more potential there is for a crown fire. These factors cannot be changed or controlled so that is why the proposed treatments focus on affecting current and future fuel accumulations through mechanical thinning and repeated prescribed fire treatments.

Currently, much of the analysis area is comprised of stands with one of or a combination of the following stand characteristics that contribute to moderate or high crown fire hazard:

- Low CBH
- High CBD
- High surface fuel loading

Data collection of vegetation conditions have shown that on average, stands exhibit a high stocking level for small and medium sized trees. High stocking levels of small diameter ponderosa pine result in canopy cover, CBD, and vertical fuel continuity (ladder fuels) that exceed historic values. As a by-product, this additional biomass produces a substantial increase in persistent surface fuel accumulation. This is due primarily to the very slow annual decomposition rate of ponderosa pine litter relative to the annual rate of accumulation (Brown & Kapler, 2000).

Crown fire potential was modeled for the existing condition using weather parameters for the Clover Fire, stand condition parameters from the Forest Vegetation Simulator, LANDFIRE, and the FlamMap program.

Table 34. Existing Crown Fire Potential

Crown Fire Potential	Existing Fire Type
Surface	47%
Passive	36%
Active	17%

Table 34 and Figure 9 illustrate that a majority of the project area is at risk of some level of crown fire. Active crownfire potential occurs on 17% of the project area, but appears to be concentrated in areas just upstream of the reservoir, which could result substantial in post-fire effects. Portions of the project area, such as portions of Long Valley and McCarty ridge appear to have a preponderance of

active crownfire potential. These areas in particular has also been identified as having high fire hazard (as a result of ignitions), and is within close proximity to WUI.

Vegetation Condition Class

For this analysis, Vegetation Condition Class (VCC) data was used from LANDFIREs 1.0.0 dataset. This dataset gives a coarse assessment of vegetative conditions as it relates to ecosystem process and functions. Vegetation characteristics include species composition, structural stage, stand age, canopy closure and degree of mosaic pattern.

The VCC classes are described as follows (Schmidt et al. 2002).

- Class 1: less than 33% departure from the central tendency of the historical range of variation (HRV) with vegetation attributes (composition and structure) are well intact and functioning.
- Class 2: 33 to 66% departure
- Class 3: greater than 66% departure

The Blue Ridge Community Wildfire Protection Plan of 2009 also shows the majority of the project area in condition Class 2 and 3.

Stated another way, characteristic conditions are those described in available biophysical settings models. In contrast, uncharacteristic conditions are those that did not occur within the natural regime, and hence produce a VCC 3 (high departure) assessment outcome. Uncharacteristic conditions include (but are not limited to): invasive species (weeds and insects), diseases, “high graded” forest composition and structure in which, for example, large fire-tolerant trees have been removed and small fire-intolerant trees have been left. Common causes of departure include advanced succession, effective fire suppression, timber harvesting, overgrazing by livestock and other herbivory, introduction and establishment of exotic plant species and introduced insects and disease (Brown and Smith 2000; Schmidt et al. 2002; Brown et al. 2004; Hood and Miller 2007; Tausch and Hood 2007 Stambaugh and others 2008; Keane et al. 2009).

Environmental Consequences

Units of Measure

The measurement units used to evaluate effects of the alternatives on fire and fuels are:

- Change in fire type (acres)
- Fire Regime Condition Class/Vegetation Condition Class
- Dead/Down Fuel Loading (tons/acre)
- Arrival Time (burned acres under a given weather condition, ignition start location and time)

Other Actions Analyzed

Over the last years since project initiation (2015 and 2016) at stakeholder and FS IDT meetings there has been much discussion about what to do with un-merchantable material or “slash”. The other possible action that has been brought forward by a cooperating agency is in-forest processing sites or log sort yards. Within the Proposed Action analysis in the fire and fuels specialist report, different slash treatments methods that have been practiced on the Mogollon Rim Ranger District in the past are fully analyzed along with the positive and negative effects associated with them. This information

is an important part of the decision making process, but was not identified as a concern from public comment. The full discussion of the effects of each slash disposal method is available in the Fire, Fuels, and Air Quality Specialist Report located on the project website: https://www.fs.usda.gov/project/?project=46075. Effects of the proposed processing sites are also discussed as they related to the fire and fuels resource.

Alternative 1– No Action

Direct and Indirect Effects

No treatments would occur with Alternative 1 that will modify the existing condition of the fuels. Fuels, both live and dead/down within the analysis area will not be affected. If a wildfire occurs during extreme fuel and weather conditions, the potential exists to eliminate much of the dead/down fuels within the fire's perimeter and to eliminate many of the live fuels through stand replacement crown fire. The modeled crown fire and vegetation condition class of the existing condition (Table 34, Figure 38) would persist and over time if no prescribed cutting or burning activities are conducted more acres would convert to conditions that are likely to support active and passive crown fire and VCC 3.

Areas that do experience crown fire will lose much of their live fuel loading and dead/down surface fuel loading. Fire killed trees will deteriorate due to rotting, eventually falling and becoming dead/down surface fuels. Forest litter accumulates on average 1 to 3.5 tons per acre annually (Sackett 1996) so over a 20 year span over the no action alternative would contribute an additional 20-60 tons of forest litter. In the southwest there is a very slow decomposition rate. Increased surface fuels increase flame lengths which in turn increase potential for active and passive crown fire. The number of acres that may be affected by a high intensity, high severity fire will also increase due to increasing homogeneity of surface and aerial fuels across the entire project area.

The increase in crown fire under severe wind events is the result of growth of all trees that presently exist within the analysis area and establishment of conifer regeneration and a high wind speed that increases fire behavior. Growth and regeneration will cause an increase in the average amount of woody biomass (limbs, twigs, pine needles, leaves, etc.) produced on every acre, contributing to increased surface fire intensity and severity over time. Growth will also increase average percent canopy closure, increasing the likelihood of a crown fire, once initiated, to advance through the forest canopy continuously. Potential for transition of surface fire to crown fire increases as surface fire intensity increases. Potential for widespread overstory and understory mortality due to root and cambial injury increases as potential fire severity increases. Soil sterilization, soil seed bank destruction, and soil erosion also increase as potential fire severity increases.

The CWPP project area will likely continue to have fires that are managed for resource objectives. This will continue to help reduce effects of potential uncharacteristic wildfire where these fires can be managed safely at levels that do not result in unacceptable risk to forest and community values. Since wildfire location and extent is unpredictable, there is little information for when and to what extent these fires will impact the Cragin watershed. However, as more acres within the project area convert to a condition where they support passive or active crownfire, it will become more and more difficult to safely manage naturally caused wildfires for resource benefit, which will further limit forest conditions from meeting or moving toward desired conditions. Table 35 below demonstrates the changes if no thinning or burning takes place within the project area over the next 20 years. More of the area becomes susceptible to passive crown fire and less surface fire. Active crown fire does decrease some but this is from the projected growth of trees that increase the crown base heights. In

other words not all of given area would burn but there would be more areas that have groups of trees torch.

Table 35. No Action Crown Fire Potential in 2017 and in 2037

Crown Fire Potential	Existing Condition	No Action
Surface	47%	35%
Passive	36%	54%
Active	18%	11%

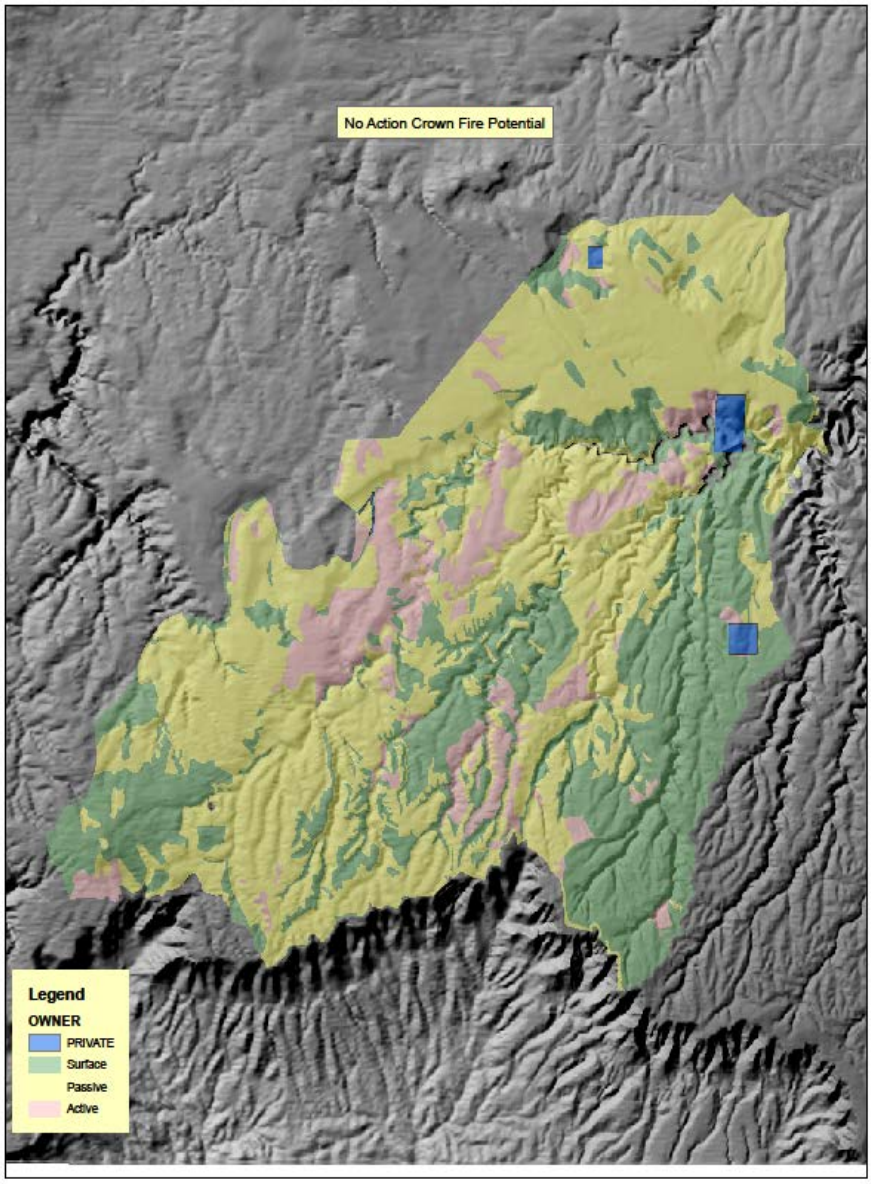


Figure 38. Crown Fire Potential under the No Action Alternative in 2037

Cumulative Effects – No Action

Activities relevant to fire and fuels cumulative effects

The geographic setting for the cumulative effects analysis is the project area boundary. The time frame for past treatments is 10 years based on the recovery time for fuels to accumulate. The time frame for future and foreseeable projects is 20 years, based on the expected timeframe of the project. Activities considered in the cumulative effects analysis include wildfires, prescribed burning, timber sales, thinning, and grazing. The cumulative effects from ongoing and future activities are continued prescribed burning and thinning within the East Clear Creek and Blue Ridge Urban Interface Projects.

Within the last 9 years there have been 16 wildfires greater than 100 acres totaling about 26,151 acres within the CWPP boundary (including fire <100 acres the total is 26,267 acres). A large amount of the project area has had past wildfires (13 fires) that have been managed for resource objectives totaling about 21,151 acres (33%) of the CWPP boundary.

Table 36. Past wildfires over 100 acres in the CWPP boundary. Names with an * are fires that were managed for resource objectives.

Fire Name	Year	Acres in the CWPP Boundary
Independence*	2009	1,371
July 4th Complex*	2009	3,084
Reservoir	2009	170
Rim*	2009	276
Bravo*	2010	3,285
Ranger*	2010	2,138
Kehl*	2011	187
Scout*	2011	803
General*	2014	2,086
Kinder*	2014	451
General*	2015	2,690
Reservoir	2016	124
Poverty*	2016	300
Crackerbox*	2016	922
Pinchot*	2016	3,864
Highline/Bear	2017	4,400
TOTAL ACRES		***26,151***

Broadcast, maintenance and pile burning has occurred over 4,736 acres of the CWPP area (Table 37).

Table 37. Prescribed burning in the CWPP project area.

Project Name	Year	Acres in the CWPP Boundary
Blue Ridge Urban Interface – Maintenance Burning	2010	603
Blue Ridge Urban Interface – Maintenance Burning	2011	957
East Clear Creek Watershed Health – Broadcast Burn	2007	748
East Clear Creek Watershed Health – Broadcast Burn	2010	1,238

Project Name	Year	Acres in the CWPP Boundary
East Clear Creek Watershed Health – Broadcast Burn	2011	1,190
TOTAL ACRES		***4,736***

One small timber sale is planned in the project area as part of the East Clear Creek Watershed Health project. The LEARN Mixed Conifer study is a treatment jointly conducted by the MRRD and Ecological Restoration Institute of Northern Arizona University. LEARN stands for **L**ong-term **E**cological **A**ssessment and **R**estoration **N**etwork. Acres planned for thinning total about 56 acres in the CWPP boundary. This project was approved under the East Clear Creek Watershed Health project to study different thinning and prescribed fire treatments on small plots, and is expected to be implemented over the next several years.

Other past or ongoing actions that involve vegetation treatments, hazard tree cutting, and fuel wood retrieval have resulted from C.C. Cragin Dam and pipeline infrastructure maintenance, APS power line vegetation maintenance, and fuelwood and Christmas tree permits issued for areas that include the project area. In addition, approximately 51% of the project area is currently grazed under active range management permits. These are discussed in more detail in the Cumulative Effects Activities Considered section at the end of Chapter 3.

Cumulative Effects

The current conditions are related to past management activities and disturbance events, including timber sales, wildfires, and a tornado. Timber sales, which occurred over the last several decades have primarily affected vegetation structure in Ponderosa pine vegetation on ridges and other flat to slightly sloped areas throughout the project area. Timber sales that occurred throughout the 1940s-1990s often included removing the majority of overstory trees to improve sun exposure and growing conditions for the forest understory. These treatments had the effect of causing a more homogenous forest structure with fewer old, large trees and an overabundance of small and intermediate sized trees. In addition, past timber management has resulted in more contiguous forest cover and fewer small openings than historically occurred, thus increasing risk of crown fires over the last several decades. Recent thinning and fire treatments within the project area have slightly counteracted this effect on those acres where treatments have recently occurred.

There has been very limited thinning activities, totaling slightly over 2% of the project area. For the past 100+ years, it has been the policy and decision to control wildfires. Prescribed burning has been limited primarily to burning of slash piles, until about 15 years ago when broadcast burning began to be used on small portions of the analysis area totaling about 4,736 acres. The cumulative effect of fire suppression and limited prescribed burning has been an increase in dead/down fuel loadings (from an estimated range and average of 1-4 tons per acre historically, to 1-50+ tons per acre currently). Wildfires managed for resource objectives have occurred over approximately 33% of the project area within the last nine years, but some of the fires have occurred in the same areas multiple times leaving other areas without having any fuels reduced by wildfire.

In addition, long term cumulative effects include livestock and wild ungulate grazing that have created microclimates that have been conducive to natural regeneration of ponderosa pine (Savage and Swetnam, 2000; Belsky and Blumenthal 1997). This has resulted in live fuel loadings of ponderosa pine that exceeds natural ranges of variability. Where thinning and prescribed burning have not occurred recently, live fuel loadings are excessive. The live fuel loadings contribute significantly on an annual basis to levels of dead/down fuel loading through needle cast, branch and cone dropping

(self-pruning). Without some attempt to reduce live and dead fuel loadings on a controlled basis, potential for uncharacteristic wildfire occurrence will increase in amount and acreage over time (Covington et al. 1994).

The effects of climate change would also have an effect on the risk of high intensity wildfire in the project area. Several studies have concluded that expected changes in climate will likely result in more burned area from wildfires than in the past (Litschert et al. 2012, Marlon et al. 2009), and that there will be more wildfires of much greater intensity, especially in the spring and early summer (Westerling et al. 2006). This is of particular importance for landscapes where there has been little or no management of current fuel loads (Williams 2013), where the increased risk of high intensity wildfire would cumulatively combine with the increased risk from dense forest stands with ladder fuels and a contiguous canopy layer. These expected effects are evidenced by the Tinder Fire, which began burning in late April 2018 on the northwest boundary of the CWPP area. This wildfire burned over 16,000 acres to the northeast of the CWPP area, with approximately 30% of the burned area exhibiting high and moderate burn severity. Areas with recent mechanical or prescribed fire treatments resulted in low severity burn or were classified as unburned during post-fire reconnaissance (MacDonald 2018).

Based on the information above, this alternative would not only increase the likelihood of large crown fire occurrence in the project area, but it would also make it more difficult to allow wildfire management for resource benefit due to increased risks of operations and forest and community values. As a result, the no action alternative would cause a cumulative increase in high intensity wildfire risk and a greater potential for post-fire effects throughout the project area over the next twenty years.

Alternative 2– Proposed Action

Direct and Indirect Effects

Prescribed Burning

Prescribed burning is the application of fire to a landscape within a specific set of weather (winds, temperatures and relative humidity's) and fuel moisture parameters that make up a "prescription" within which fire behavior and effects are more predictable. Prescribed fire can effectively alter potential fire behavior by influencing multiple fuel bed characteristics including: reducing loading of fine fuels, duff, large woody fuels, rotten material, shrubs, and other live surface fuels, which, together with compactness and continuity, change the fuel energy stored on the site and potential spread rate and intensity (Graham, et al. 2004; Agee and Skinner, 2004; Peterson et al. 2005).

Burning will take place across all vegetation types. Ponderosa Pine is the dominant vegetation type and has the widest window for application. Mixed conifer stands are generally surrounded by Ponderosa pine but fire effects are expected to be slightly different in mixed conifer stands. Mixed conifer stands have a denser needle cast and lack a herbaceous understory, so do not generally carry a surface fire unless intermixed with Ponderosa pine. Fire in mixed conifer stands will generally just creep and smolder in ground fuels or not burn at all while Ponderosa pine will carry a surface fire. What drives fire under prescribed burning conditions in mixed conifer is the amount of large dead and down fuels. So within dry and/or wet mixed conifer stands areas that have heavy dead and down component can potentially torch pockets of trees. These areas are generally isolated and there is numerous areas of unburned fuels across the landscape. When conditions are favorable for burning in mixed confer stands to have higher severity we are generally out of prescription for burning in Ponderosa pine. So most effects in mixed conifer stands for prescribed burning will be low severity to

unburned. For areas identified as dry or wet mixed conifer stands coordination with wildlife biologists prior to implementation will occur.

Agee and Skinner (2004) note that to create a fire resilient timber stand, three principles need to be applied: 1) reduce surface fuels; 2) reduce ladder fuels; and 3) reduce crown density. Carey and Schumann (2003) note that prescribed burning achieves principle 1 and a portion of principles 2 and 3. Principle 2 is achieved through raising CBH, and principle 3 can be achieved if small trees are killed through burning.

The effects described above will be applied in the proposed action by prescribed burning approximately 63,656 acres with about 37,732 acres of maintenance burning and 25,924 acres in a "first entry" burning. About 59% of the project area is treated by both thinning and burning.

Generally, within the project area we will look to broadcast burn approximately 5,000-20,000 acres annually. On average we would broadcast burn 500-1,000 acres per day, which equates to a maximum of 40 days annually. For broadcast burning we will attempt to burn half of the acres during the fall months and half of the acres during the spring months to allow for better smoke ventilation. Pile burning acreage will depend on how much activity slash is generated, but normal pile burning within a year would be about 1,000-3,000 acres. Generally 100 acres of piles are burned daily, so an additional 30 days could be spent burning piles. Piles can be burned with higher winds which allows the piles to consume more efficiently so that overnight smoke impacts are not as significant. Piles are also generally burned during the winter months when snow is present to reduce "creep" from piles.

Of the total burning, just over 17,000 acres would be burned within the urban interface area. As suggested by Nowicki (2002), spotting can occur and lift firebrands "miles ahead of the forest fire". The treatments proposed within the WUI will limit the number of firebrands produced by treating fuels to diminish crown fire, the largest producer of long-range spotting. The actions proposed do not treat directly adjacent to houses as Nowicki (2002) suggests, because the Forest Service does not have jurisdiction on private lands. As part of the proposed action, hand thinning as a pretreatment will occur adjacent to private lands and campgrounds where the ground is steep and no mechanized thinning treatments are proposed. The hand thinning slash will be piled and burned prior to the "first entry" burning. This will also occur in area proposed for pre-commercial thinning.

Thinning

Thinning alone can alter fire behavior primarily through a reduction of CBD, but can also increase surface fuel loadings through the placement of slash on the ground (Carey and Schuman, 2003). Carey and Schumann (2003) further note that the use of mechanical thinning alone has a varied effect on modifying fire behavior, primarily because of the created slash. All of the thinning treatments proposed within this analysis are paired with prescribed burning, therefore, the effects will be a combination of thinning and burning. Various researchers have concluded that the combination of thinning and burning as the most effective way to alter fire behavior (Strom 2005; Graham et al. 2004; Peterson et al. 2005; Cram et al. 2006).

Removal of small diameter trees will decrease trees per acre and decrease basal area. Understory thinning eliminates some of the lower portion of the forest canopy, increasing the overall CBH of the remaining forest canopy. Increasing CBH reduces the potential for surface fires to transition into the forest canopy by increasing the distance between surface fires and the aerial fuel layer, thereby increasing the surface fire intensity required to ignite the crowns (Agee and Skinner 2004; Graham et al. 2004; Peterson et al. 2005; Cram et al. 2006). Decreasing CBD reduces the ability of fire to spread

horizontally through the forest canopy if it does transition from the surface layer into the aerial layer (Agee and Skinner 2004; Graham et al. 2004; Peterson et al. 2005).

If thinning material is not removed, it rearranges live aerial fuels into dead /down surface fuels resulting in a potentially substantial increase in surface fuel loading, fuel bed depth, and fuel bed continuity (Carey and Schuman 2003; Graham et al. 2004). Slash fuel beds produce higher fire intensities and longer flame lengths than the existing pine litter fuel bed under constant atmospheric conditions. Therefore, the increase of CBH gained through thinning may be ineffective in reducing the ability of a surface fire to transition into the crowns until the fine fuels are removed from the aerial portion of the slash layer. The use of whole tree skidding to landings or slash piling will minimize this potential effect.

Stand attributes have been modeled within thinned stands using Forest Vegetation Simulator. Based on trees per acre, tree size class calculations can be made that determine the CBH and CBD. Generally thinning objectives are to raise CBH and to break up canopy closure or reduce CBD. The modeled measurements through FVS which include CBD and CBH are hard to quantify through field measurements, so the measurements used to describe changes from thinning are based on trees per acre or basal area per acre.

Processing sites

The proposed processing sites would have little impact from a fire and fuels perspective. The challenges would be how long material is left at sites, and what impacts can be allowed during their operation. It is possible that additional coordination or planning is required for fire treatments surrounding processing sites, and as a result delays could be caused for being able to use fire or conduct prescribed burns. If there is addition expectations for protecting processing sites from fire impacts, additional control features may be needed and equipment and personnel to meet these expectations. Operators located at processing sites would be required to have a fire plan and would comply with any fire restrictions.

Crown Fire Potential

Modeled results for crown fire potential indicates that after thinning treatment, activity fuels treatment and two broadcast or maintenance burning across the whole treatment area, active crown fire is reduced from 17% to 1% of the area, passive fire also is reduced from 36% to 15%. While surface fire goes from 47% to 84% of the project area (Table 38, Figure 39). Most of the project area is altered by the combination of treatments or by prescribed fire alone to significantly alter fire behavior.

Table 38. Crown Fire Potential after thinning and prescribed fire treatments

Crown Fire Potential	Existing Condition	Proposed Action
Surface	47%	84%
Passive	36%	15%
Active	17%	1%

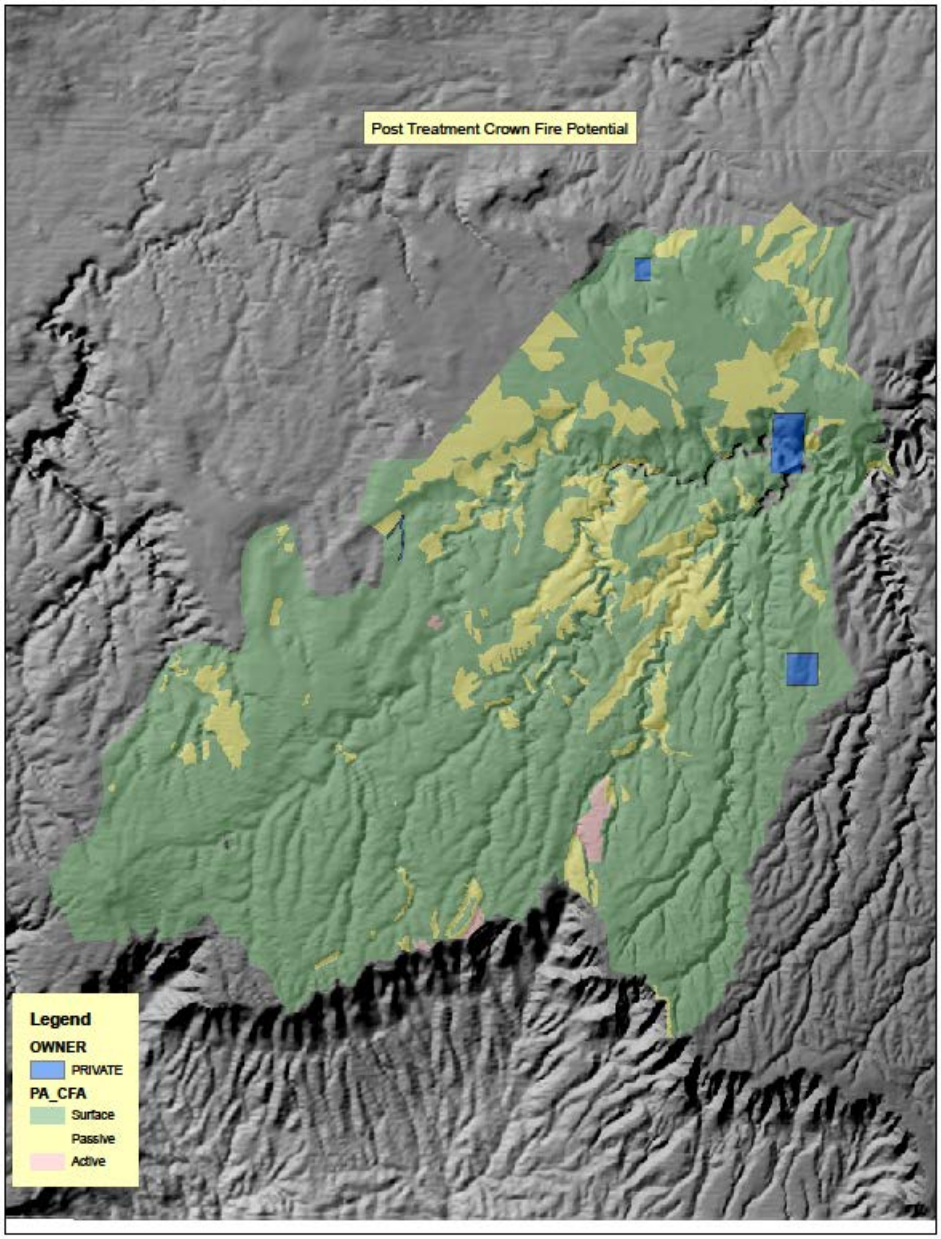


Figure 39. Post treatment crown fire type

Vegetative Condition Class

Post treatment consisting of thinning, and burning treatment alter the vegetative condition class to a majority of the project area in class 2 and 1 (Table 39).

Table 39. Vegetation condition class pre and post-treatment

Vegetative Condition Class	Existing Condition	Post Treatment
1	0%	36%
2	42%	24%
3	58%	40%

Many of the acres in VCC 3 (40%) are not changed as a result of proposed action treatments, but would still be less likely to support crown fire. Areas in drainages or on slopes that have had limited exposure to fire over the last 100 years will not be receiving thinning treatments. Prescribed fire activities will be applied to these areas, and these treatments are expected to reduce downed fuels and small trees, thus they will be more resilient to wildfire disturbance, but fire alone is not expected to change vegetation structure in these areas and as a result they will likely continue to best fit VCC 3 conditions.

Cumulative Effects - Proposed Action

Activities that contribute to past, ongoing and future cumulative effects for fire and fuels are described in the No Action alternative cumulative effects section.

Large wildfires over the past 9 years (2006-2017) have burned 26,151 acres in the project area (Table 36). A large majority of the fires were lightening caused and were managed for multiple resource objectives. Past prescribed burning the project area totals about 4,437 acres from 2004 to 2017 (Table 37). Past thinning projects from 2009-2014 have occurred over a small acreage, about 1,565 acres (Table 89). The LEARN Mixed Conifer study is planning to thin and burn 56 acres within the CWPP boundary in their Block #1. The acres of thinning and burning proposed in CWPP total about 37,732 acres and prescribed burning alone totals about 25,924 acres. Other vegetation treatment of fuels reduction projects include highway and powerline hazard tree and right of way clearing, firewood collection and Christmas tree harvest (Table 93). Other reasonably foreseeable projects within the CCWPP area include the 4FRI Rim Country EIS. This project is expected to include restoration-based treatments that could include activities such as thinning of young and intermediate aged ponderosa pine for purposes of meadow restoration.

These treatments encompass relatively small acreages and would contribute to this alternative's effect of modifying stand conditions, trees per acre and basal area enough to greatly reduce active crown fire potential in the thinned and burned areas, such as was observed in the adjacent Tinder Fire (MacDonald 2018).

The effects of climate change would also have an effect on the risk of high intensity wildfire. Several studies have concluded that expected changes in climate will likely result in more burned area from wildfires than in the past (Litschert et al. 2012, Marlon et al. 2009), and that there will be more wildfires of much greater intensity especially in the spring and early summer (Westerling et al. 2006). According to Millar et al., resilient forests are "those that not only accommodate gradual changes related to climate but tend to return toward a prior condition after disturbance either naturally or with management assistance (2007). Prescribed burning has been identified as an important management strategy for maintaining desired habitats in a changing climate with more natural disturbances (USDA FS 2010, Williams 2013). The Mogollon Rim and surrounding area includes several hundred thousand acres that have been approved for fire risk reduction activities over the next several decades.

Projects including the 4FRI First EIS, 4FRI Rim Country EIS, Clints Well Forest Restoration Project, East Clear Creek Watershed Improvement Project, Upper Beaver Creek Watershed Fuels Reduction Project, Larson Forest Restoration Project, Rim Lakes Forest Restoration Project, and others. This project will cumulatively contribute to the improved resilience of the much larger landscape by facilitating the ability of ponderosa pine and mixed conifer forests to return toward prior conditions after disturbance from drought and wildfire.

Wildfires occurring in these treated areas would be easier to control or manage for resource benefits. When conditions include unacceptable risks, wildfires could be managed with suppression to burn less severely with less acreage burned than if the areas were left untreated. As more treatments are implemented in the project area, land managers will be more effective at managing wildfires for resource benefits across more acreage. This project will cumulatively improve efforts to manage fire both within the project area and will cumulatively contribute toward returning fire as a functional process on the greater landscape.

Soils

The following section describes the affected environment and effects of the alternatives relating to soil resources.

Affected Environment

The description of existing conditions of soil resources in the analysis area is based on information published in the Coconino National Forest (CNF), Terrestrial Ecosystem Survey (TES) (Miller, et. al. 1995) and the CNF soil condition geodatabase.

Soils within the project area are mainly derived from sedimentary rock parent material (i.e., Kaibab Formation or Coconino Sandstone) in the eastern and southern portion of the project area and basalt in the western and northern portion of the project area and belong to one of three soils orders: alfisols, mollisols, and inceptisols. Mollisols often develop under grassland vegetation whereas alfisols generally develop under forested conditions (Abella, et. al. 2013). Some of the alfisols in the project area contain a mollic epipedon, a dark, organic matter-rich upper layer that suggests that these soils may have developed under more open conditions (Abella et. al., 2013).

Soils found with the project area were rated as “satisfactory” with the exception of those associated with TEUs 53 and 55, which were rated as impaired. These areas with impaired soils make up approximately 830 acres of the project area, or approximately 1.2%. As discussed previously, impaired soils are those that exhibit decreased nutrient cycling and/or hydrologic functioning. These soils, mapped by the former Soil Conservation Service (SCS now NRCS) as being part of the Clover Springs series, have been identified as susceptible to gullying and evidence for this type of impairment is present in the project area particularly in the vicinity of Clints Well. Incised stream channels and actively expanding headcuts occur in these map units including those found within the project area and associated with the following drainages: Long Valley, Kinder Draw, East Clear Creek, Cienega Draw, Poverty Draw, Houston Draw, General Springs, Miller Canyon, East Miller Canyon, Dick Hart Draw, and Bear Canyon. The degraded conditions existing within these map units have mainly been attributed to historic overutilization by grazing animals, which resulted in compaction of meadow soils, and transition from a native bunchgrass plant community to non-native sod-forming Kentucky bluegrass-dominated community (Finch, 2004).

The Forest Plan includes a number of desired conditions and management guidelines for soils. Guidelines, such as incorporation of appropriate BMPs for all activities with the potential to impair water quality, avoidance of long-term impacts to soils, and use of design features for activities on steep slopes have been addressed by avoiding mechanical treatments on steep slopes and including BMPs and other design features as part of the proposed action. Desired conditions for soil are to move toward or maintain soils for proper function, maintain vegetative ground cover, and minimize the impacts of and loss of soil from disturbances such as high-intensity wildfire.

Environmental Consequences

This section describes the direct, indirect, and cumulative effects of implementing each alternative on affected soils. Affected soils are those soils occurring within the analysis area that may be impacted by the no action and proposed action alternatives.

Alternative 1– No Action

Direct and Indirect Effects

This alternative would not authorize ground disturbance from mechanical vegetation and prescribed fire treatment activities. As a result, there would be no risk to soil productivity from disturbance associated with these activities. Soil resources, however, would continue to be at risk from a wildfire as noted below.

Fire suppression and historic grazing combined with subsequent favorable weather conditions for pine recruitment have been identified as causative factors in the high densities of trees in southwestern ponderosa pine forests under post-European settlement conditions (Covington, et.al., 1997). The high canopy cover in these forests has reduced understory shrub and herbaceous species leading, in some cases, to monoculture stands of stunted ponderosa pines. Under the No Action Alternative, the current forest structure would remain unaltered. The density of forest overstory cover would remain higher than historic evidence suggests it was, and herbaceous and shrub species would continue to be suppressed. The risk of stand-replacing fires would remain elevated. These “no action” conditions have important consequences to soil resources.

The likelihood of a stand-replacing fire under the current (no action) forest structure poses a serious risk to soil condition. Since there would be no vegetation treatments authorized under the No Action Alternative, forest soils in untreated areas would potentially be vulnerable to the effects of an uncharacteristic stand-replacing wildfire given the departure of existing forest conditions from reference conditions. Such a fire occurred on the Coconino National Forest in June, 2010. The Schultz Fire burned approximately 15,000 acres with roughly 39 percent of the area classified as high burn severity and 27 percent as moderate burn severity (Higginson, 2010). These types of fires can result in large losses of soil nutrients through volatilization, mineralization, and subsequent accelerated erosion (Neary, et.al., 1999).

In addition, adverse impacts to soil hydrologic functioning (i.e., reduced infiltration through consumption of soil organic matter, loss of soil structure, and formation of soil hydrophobicity) can occur (Neary, et.al., 1999). Given the length of time needed for soil to develop in the semi-arid Colorado Plateau region, the erosive consequences of a wildfire may render areas of the landscape unproductive for millennia. This would result in conditions that move away from desired conditions identified in the Forest Plan for soils such as maintaining soil productivity, reduced risk of long-term impairment of downstream water sources, and improved resilience to disturbance events.

Cumulative Effects - No Action

While there would be no direct effects under this alternative, the indirect effects of increasing fire risk and increasing risk of post-fire erosion would combine with increasing risks associated with climate change to result in a cumulative effect to soils within the project area over the next several decades. According to Segura et al. (2014), climate projections general agree that increasing temperatures and an expected increase in the frequency of events with high rainfall intensity over the coming decades will increase rainfall runoff erosivity, especially for landscapes with steep terrain (i.e. slope >10%). Combined with a greater risk of soils loss as a result of increased crown fire risk under this alternative, there is a long-term cumulative increase of loss of soil productivity throughout the project area, and especially on steep slopes throughout the project area.

Alternative 2– Proposed Action

Thinning treatments would be done by mechanized, ground-based harvesting and yarding methods on slopes less than 40 percent. Ground-based harvesting involves the use of either wheeled or tracked machinery in contact with the ground surface to both cut trees and remove them from the harvest area to landings in a process called "yarding." Ground-based harvesting systems include whole tree harvesting systems in which trees are felled and the entire tree is skidded from the harvest area to landings, where the trees are further processed by delimbing and bucking (i.e., cutting the trees to specific lengths) and cut-to-length systems in which trees are felled and processed at the stump with transport of processed logs to landings. In whole tree harvesting, trees are generally felled and bunched using a tracked or rubber-tired feller-buncher, and tree bunches are skidded (i.e., dragged with crowns in contact with the ground) along designated skid trails to landings. Skidding is generally accomplished using tracked or rubber-tired skidders. In cut-to-length systems, trees are generally felled using a harvester equipped with a head that allows both cutting and processing of trees. Logs are then transported to landings using a forwarder that carries the logs fully suspended from the ground in a trailer-type fashion. Occasionally, harvesting and forwarding is accomplished with a single piece of equipment referred to as a "harwarder." There are various types of harvesters including trackhoes fitted with processing heads as well as multi-wheeled machines.

The proposed action also includes the designation of up to eight biomass processing sites ranging in size from 5 to 15 acres and the construction of up to 16 miles of temporary roads and additional construction of up to 6 miles of decommissioned road without an existing roadbed. Maintenance and vegetation removal is expected on 23 miles of decommissioned and temporary roads where an existing road bed has been identified. Variables such as current road system, economics of transportation, recreation sites, slopes and landforms, visual aesthetics, and wildlife and hydrological concerns were used to identify the eight proposed processing sites. These processing sites would be used to facilitate the processing of harvested biomass, including logs and the slash generated from delimbing, to improve the economics of thinning activities in the CWPP area.

Direct and Indirect Effects

Hand Thinning

Hand thinning using chainsaws and hand piling of downed material with no yarding of felled timber may occur in areas where use of mechanized equipment would not be feasible. Hand thinning is primarily expected to occur in the precommercial treatment areas where trees <9 inches dbh would be cut and piled along existing roads. Hand thinning would result in minimal impacts to soils since no construction of temporary roads would be needed, and heavy machines would not be used for felling and transporting of harvested timber. Soil disturbance from hand thinning operations is generally considered negligible (Robichaud, et. al., 2010; Berg and Azuma, 2010). Hand piles would typically

be burned in the winter when snow covers the soil. No negative impacts to soil productivity would be expected to occur from hand thinning and hand piling operations. Hand thinning and pile burning of the approximately 386 acres within the project area would result in long-term benefits by reducing crown fire risk on these acres, and thus reducing the potential for loss of vegetation that would result in susceptibility of accelerated erosion. These activities would help move the approximately 386 acres towards desired conditions for soils including maintaining vegetation cover and supporting proper function of soil in these areas.

Mechanical Thinning

Ground-based mechanized thinning causes disturbance to soils including compaction, displacement of surface soil, and exposure of bare mineral soil attributable mainly to the network of temporary roads, skid trails, and landings needed to accomplish thinning. These effects have the potential to alter soil productivity, as well as surface runoff and erosion rates, which are normally very low under undisturbed forest conditions (MacDonald and Stednick, 2003). In turn, changes in surface runoff and erosion may have an effect on water quality primarily through increased sediment delivery to stream courses.

Compaction is the process by which soil particles are rearranged resulting in a decrease in void space and a corresponding increase in bulk density (Miller, 2004). Soils are compacted by repeated passes of mechanical equipment over the forest floor along the designated road and skid trail system and landings established to facilitate harvesting, processing, and transport of logs. The degree of compaction is a function of soil characteristics, soil moisture content, number of machine passes over the soil, and pressure exerted by the machinery. Soils with water content just under field capacity (i.e., the water remaining in soil after gravity drainage) are most susceptible to compaction whereas soils with higher water content are susceptible to displacement generally observed as rutting of the soil (Miller, 2004). Soil compaction may impact soil productivity by decreasing soil macroporosity, leading to reduced water infiltration and gas exchange important for soil biological activity and oxygen uptake by roots (Han, et.al. 2009). Soil compaction may also impact soil productivity by increasing the resistance of soil to root penetration thereby limiting root growth (Lacey and Ryan, 2000). Reduced infiltration rates attributable to soil compaction may lead to increased runoff and accelerated soil erosion with potential impacts to water quality and soil productivity.

Displacement of soil typically occurs when soil moisture is above field capacity and the presence of water-filled voids in the soil prevents further compaction by heavy equipment but causes soil to be displaced forming ruts. The displacement of soil can expose less productive soil horizons and/or those with a different chemistry potentially altering site productivity. In addition, the formation of ruts can concentrate runoff, increasing its velocity and capacity to detach and transport soil particles. Ruts may also disrupt natural runoff patterns from hillslopes.

Up to 37,360 acres would be mechanically thinned with logging equipment under this alternative. Mechanical thinning in the region is almost entirely by whole tree yarding in which trees are cut and the entire tree skidded to a landing for subsequent delimbing and cutting to length. This method of logging requires a network or roads, skid trails, and landings, the sum total of which would likely cause compaction and exposure of bare mineral soil on 10 to 15% of the harvested area according to best management practice monitoring on the Mogollon Rim Ranger District (Jagow 1994; Fleishman 1996 and Fleishman 2005).

Machine piling of created slash is one option for removing logging slash, and is expected to have the greatest impact on soils. Machine piling of slash from thinning activities disturbs the greatest amount of ground through re-arrangement of the soil surface. For this analysis, it is assumed that 90 percent

of the slash would be felled and left on-site or removed from site, and up to 10 percent of the area would have a sufficient concentration to warrant machine piling. Approximately 80-90% of the area being machine piled would have ground disturbance. Other methods of slash disposal such as hand piling and burning, chipping and scattering, or biomass removal would have much less effect on soils. Design features included in this alternative would prevent the effects of machine piling from occurring in sensitive areas such as AMZs or on steep slopes. Actual felling of trees by a rubber-tired machine such as a feller-buncher is estimated to cause 1% or less exposure of bare mineral soil but may cause some compaction although this would be minimized through prohibiting operations when soils are wet.

The exposure of bare mineral soil increases the susceptibility of soil to detachment from raindrop impact and sheetflow potentially contributing to accelerated erosion on hillslopes. The exposure of bare mineral soil is most pronounced on temporary roads and the road system needed to conduct logging operations has been identified as far overshadowing that from other aspects of treatment operations (Rice, et.al. 1972; Megahan and Kidd, 1972). Temporary roads are those that are constructed during timber harvesting to facilitate access to timber stands and that are rehabilitated after harvesting by restoring the roadbed to its pre-disturbance condition to the extent practicable. The Cragin project would include the construction of up to 16 miles of temporary roads and additional construction of up to 6 miles of decommissioned road without an existing roadbed. Maintenance and vegetation removal is expected on 23 miles of decommissioned and temporary roads where an existing road bed has been identified. To minimize impacts to soil and water resources, standard BMPs would be implemented. Up to 65 acres of ground disturbance would be caused from the construction of new temporary roads, re-development of decommissioned roads, and re-grading and vegetation removal on existing temporary and decommissioned roads. These effects would be distributed across the project area and thus the effects on soils would be dispersed and limited at the project scale. The time of disturbance is expected to be short-term (< 5years), with revegetation occurring on the sites within 5 years after use.

The positive effects of mechanical thinning typically include an increase in understory vegetation within one to five years following treatment (Pearson et al. 1972), as well as an initial increase in soil organic matter in the form of residual woody debris from tree harvesting activities. As grasses and forbs increase in numbers, fine root material contributes to soil organic matter accumulation, and improves soil aggregate stability and soil porosity. Reduction of tree canopy and fuel loads would reduce the threat of uncharacteristic wildfire that could remove plant and litter cover, consume soil seed banks, sterilize soils, and create erosion and flooding hazards.

In the short term (1-3 years) after treatments, the use of heavy machinery involved in thinning activities may result in soil effects such as compaction. However, the effect of thinning activities over the next two decades is expected to reduce the risks of soil loss and soil impairment. Decreasing canopy cover is expected to result in increased growth of understory vegetation, which would increase soil nutrient cycling and provide better upland forage for grazing animals. This would in turn, decrease grazing pressure in headwater meadows resulting in improved storage of water in meadow soils. . Thus, this alternative would help move toward desired conditions over the next two decades by increasing vegetative ground cover and water storage, improving resiliency to disturbance, and reducing erosion and risks to soil productivity from uncharacteristic fire.

Prescribed Burning

The conditions under which prescribed burning would be conducted are generally characterized by high relative humidity, low air temperatures, low fuel loadings, and high fuel moisture. These conditions typically produce low soil burn severity in which surface litter is only partially consumed.

In addition, the timing of controlled burns is such that burns are conducted during fall or spring, when lower ambient temperatures minimize surface litter consumption. Prescribed fires, however, do produce spatial variations in burn severity depending on surface fuel loads. This spatial variability leads to varying runoff and erosion rates (Robichaud, et. al, 2010).

In areas of low to moderate soil burn severity, which is expected over the large majority of the CWPP area, only a portion of the surface organic matter is consumed, leaving adequate soil cover over much of the burned area. In general, prescribed fire does not cause excessive erosion or sediment transport since soil cover is retained in a discontinuous pattern across the landscape. Because of this, long-term adverse impact to soils are not expected from prescribed fire activities. This conclusion is supported by controlled burning experiments conducted on the Fort Apache Reservation located in the White Mountains of northeastern Arizona, which indicated minimal soil erosion following controlled burning (Weaver, 1952; Cooper, 1961). Cooper (1961) evaluated post-burn erosion on a 35 percent hillslope in the White Mountains and concluded that accelerated erosion attributable to controlled burning could not be considered severe and that the soil appeared to be stabilized within a year of treatment. It was also noted that eroded material was only moved a short distance down slope and did not measurably affect water quality. Conversely, prescribed burning would be expected to have a long-term benefit to soil resources by reducing the build-up of fuels, and restoring soil nutrient cycling through reduction of overstory and encouragement of herbaceous cover. Thus, broadcast burning treatments are expected to move toward desired conditions for soil over the next two decades.

Pile Burning

Burning of slash piles has been shown to negatively affect soil biotic and chemical properties due to intense soil heating (Korb, et. al., 2004 and Seymour and Tecle, 2004). It can result in soil sterilization, increased erosion risk and an increased risk of invasive and noxious weeds that displace native vegetation. Pile burning of hand piles or machine piles may be used throughout portions of the 37,360 acres proposed for mechanical thinning. However, even given this acreage, pile burning sites would constitute a very small portion of the thinning treatment area (i.e., less than 5 percent), and would occur within a matrix of undisturbed soils with vegetative cover that would function to catch soil eroded from burn piles. Monitoring of these sites for the presence of invasive or noxious weeds following pile burning, and treatment of any infestations found, would mitigate most adverse effects to soils caused by pile burning of slash (see the Botany and Weeds specialist report for more information). Thus, while pile burning may result in small localized effects on soil where it occurs throughout the project area, the effects would be very limited in space and time and would not prevent soils in the project area from moving toward desired conditions for soils.

Transportation System

The transportation system proposed for use under alternative 2 utilizes a combination of existing Forest Service system roads, decommissioned roads used as temporary roads, new temporary roads and temporary roads placed on existing road beds. No new permanent roads are proposed. Of the roughly 45 miles of proposed temporary roads, 23 miles would be new roads where none have previously existed and the remainder would be on existing roads that are no longer part of the designated road system. An issue was raised during public scoping concerning the construction of temporary roads on sensitive soils or soils with a high erosion hazard rating. There is no scientific definition of sensitive soils but experience suggests that temporary roads constructed in deep (1 meter or greater), fine-grained alluvial soils in valley bottoms can become incised potentially leading to drainage problems and pirating of stream flow (i.e., the road becomes the stream channel). Alluvial soils in valley bottoms associated with terrestrial ecological units (TEUs) 53 and 55 are those soils that are likely to develop drainage problems when roads are constructed in them. The proposed

temporary roads do not cross these TEUs. TEUs identified with a high erosion hazard rating are often rated as such because of their hillslope gradient. Construction of roads in TEUs with a high erosion hazard rating is generally not a problem as roads are not constructed perpendicular to the fall line and BMPs would be used to prevent concentered flow from developing on the roadbed and leading to accelerated erosion and sediment delivery to streams.

Processing Sites

The processing of biomass at up to eight different sites within or immediately adjacent to the project area may involve such tasks as drying and debarking of logs; chipping stems, bark, and limbs; cutting logs; sorting logs; producing wood cants (logs sawn flat on one to four sides); scaling and weighing logs; and creating poles from suitable sized logs. Equipment that may be used at processing sites includes circular or band saws, various sizes and types of front-end loaders, log loaders, chippers of several types, mechanized cut to length systems, associated conveyers and log sorting bunks for accumulation and storage of logs, as well as electric motors and gas or diesel generators to provide power. Aboveground fuel storage tanks may be necessary to provide on-site fuel to equipment.

Biomass processing sites would range in size from 5 to 15 acres. These sites were screened so as to be located outside of meadows where some of the most productive forest soils are found, and in relatively flat areas. The siting of processing sites in relatively flat areas would minimize the need for extensive site grading.

In order to facilitate the types of tasks and equipment that may be used at these sites, they would typically have to be cleared and grubbed (i.e., vegetative cover and trees removed) resulting in displacement of top soil and exposure of subsoil over the majority of the processing area. The operation of equipment on these sites would result in compaction of the soil and reduced ability of soils to infiltrate water. Areas of exposed soil would be covered with aggregate material to minimize erosion and facilitate use of the site. Aboveground fuel storage tanks would be manufactured, installed, and operated in accordance with Federal, state, and local requirements. For example, a permit for installation of an aboveground storage tank would have to be obtained through the Arizona State Fire Marshall's Office (https://www.dfbls.az.gov/ofm/AGST.aspx). Additionally, the processing sites would likely be regulated as industrial sites subject to permitting under Arizona Department of Environmental Quality's (ADEQ) Multi-Sector General Permit (MSGP) program. This permit program requires that certain industrial facilities, including those involved in the types of activities that would likely occur at the processing sites, implement control measures and develop site-specific stormwater pollution prevention plans (SWPPP) to comply with Arizona Pollutant Discharge Elimination System (AZPDES) requirements. Among other things, the SWPPP would identify best management practices that minimize non-point source water pollution including measures to minimize or prevent soil erosion and contamination.

Following completion of use of processing sites and removal of all equipment and materials, site rehabilitation would be accomplished including but not necessarily limited to removal of aggregate, restoration of pre-disturbance site grades, decompaction of soil for seedbed preparation, and seeding and mulching of the site with native grasses and forbs.

The proposed processing sites would result in a very small and dispersed effect on soils, affecting less than 0.01% of the project area. Soil productivity would be affected during operation of the processing sites, but as a result of the rehabilitation requirements, it is expected that they would return to productivity within 5 years after operations and reclamation is completed. Thus, while processing sites may result in small localized effects on soil where they occur throughout the project area, the

effects would be very limited in space and time and would not prevent soils in the project area from moving toward desired conditions for soils.

Cumulative Effects - Proposed Action

The following past, ongoing and future projects/activities were considered in the analysis of cumulative effects to soils:

- Vegetation and Fuels Management activities including:
  - East Clear Creek (ECC) Watershed Health Improvement Project
  - Four Forest Restoration Initiative (4FRI) Rim Country EIS
  - Managed Wildfires and Prescribed fires
- Watershed restoration activities including:
  - East Clear Creek (ECC) Watershed Health Improvement Project
  - Four Forest Restoration Initiative, Rim Country EIS
  - Long Valley Meadow Restoration
- Grazing: livestock and wild ungulates (elk and deer)
- Motorized Travel/Recreation
- Wildfires

The boundary for the cumulative effects analysis for soils is the CWPP area. The timeframe for the consideration of the cumulative effects of past actions to soil resources is five years based on the expected recovery of vegetative ground cover conditions such that accelerated erosion and increased runoff would not be elevated compared to the undisturbed condition.

A brief description of the ECC Watershed Health Improvement Project, 4FRI, and Long Valley Channel Stabilization projects is provided below, followed by a discussion of the cumulative effects of the above activities on soils within the proposed project area.

The CWPP partially overlaps the ECC Watershed Health Improvement Project NEPA Decisions (2006); the overlap comprises about 30,446 acres (47% of the CWPP project area). Past pre-commercial hand thinning (i.e., thinning of trees less than about 9" diameter at breast height using chainsaws) of over 1,020 acres and prescribed burning over about 3,176 acres as part of the ECC project have been completed since 2004 within the CWPP project area. Watershed restoration activities that would improve conditions in the CWPP project area have been identified in the East Clear Creek Watershed Health Improvement Project decision and include but are not limited to hand thinning of conifers in meadows, stabilization of incised stream channels, and protection of riparian areas by fencing out access by elk and deer. One treatment block (56 acres) of the Long-Term Ecological Assessment and Restoration Network (LEARN) research project to study dry mixed conifer treatments on the Mogollon Rim is within the CWPP area. Research treatments in dry mixed conifer stands were analyzed in the East Clear Creek Watershed Health Improvement Project EA and approved in the Decision Notice (2006).

The entire project area of the CWPP is included in the Rim Country Environmental Impact Statement (EIS) analysis area. The 4FRI Rim Country project has a much broader purpose of forest restoration than the more focused purpose of CWPP which is to reduce fuels in such a way as to decrease the chance of an uncharacteristic wildfire affecting critical infrastructure and values at risk within the project area. Possible project activities that the Rim Country EIS may consider in the CWPP area include wildlife habitat improvement, stream channel restoration, aspen regeneration and restoration of meadows and springs. Thinning and prescribed burning activities completed through CWPP would not be intensified or further analyzed for treatment under 4FRI; rather 4FRI activities would complement CWPP by focusing on other restoration objectives.

The Long Valley Channel Stabilization project and Long Valley Work Station Meadow Restoration project would stabilize actively eroding stream channels in Long Valley and one of its tributaries, fill in a stock tank, improve infiltration of water in meadow soils, and remove conifers that have encroached into the meadow. Stabilization could include laying back the channel banks to promote establishment of vegetation, constructing loose rock structures to stabilize headcuts, adding roughness to stream channels, and promoting the spread of water across the meadow surface.

Vegetation and Restoration Treatments

Hand thinning using chainsaws and hand piling of downed material with no yarding of felled timber has occurred under the ECC project (1,020 acres in CWPP), Blazed Ridge/Little Spring Tornado Recovery Stewardship contract (530 acres), and would likely occur under 4FRI to mostly remove small diameter trees (typically 9" diameter at breast height or less) from upland areas and meadows. Hand thinning would result in minimal impacts to soils since no construction of temporary roads would be needed, and heavy machines would not be used for felling and transporting of harvested timber. Soil disturbance from hand thinning operations is generally considered negligible (Robichaud, et.al, 2010; Berg and Azuma, 2010). No loss of soil productivity nor accelerated erosion would be expected to occur from hand thinning and hand piling operations.

In addition to proposed thinning treatments under this project, commercial mechanized thinning would occur on an additional approximately 1,400 acres in the project area as approved under the ECC project and would cause the same types of disturbance to soils as discussed in the Cumulative Effects section of this report.

Within the CWPP project boundary, the Rim Country EIS may include various proposed actions that could lead to short-term soil disturbance but long-term soil improvement such as stream channel restoration, and obliteration and re-alignment of roads. Stream channel restoration efforts may include reshaping and/or reconstructing incised stream channels to reduce streambank erosion and/or reconnect streams to their floodplains, grade stabilization using rock and/or log structures to prevent incision and/or arrest headcut expansion, construction of exclosures to prevent over-utilization of headwater meadow and/or near channel vegetation, removal and rehabilitation of stock tanks located within or impacting drainages, restoration of native vegetation consistent with site potential, and thinning of upland species encroaching on meadows. Obliteration of roads may include scarifying, seeding, and draining of roadbeds, and/or regrading of the road to reestablish native hillslope gradient. Road re-alignment would likely involve obliteration of an existing segment of roadbed that is leading to resource damage, particularly those road segments traversing flood plains or meadows and re-building the road in a landscape position that would allow positive drainage and long-term sustainability.

Travel Management and Recreation

Recreational activities with potential impacts to soils occurring within the project boundary include motorized and non-motorized travel, and motorized camping. In terms of these recreational activities, forest roads are the common thread through which most recreational uses of public lands occur, therefore, the impacts of travel management and recreation on soils within the project area are considered together.

Forest roads have an impact on soils because soils are left unprotected (i.e., vegetation and/or litter is removed) and soils are compacted by use of these features. The combined effects of compaction and exposure of bare mineral soil on forest roads tend to increase soil erosion by reducing infiltration and exposing the soil to raindrop impact, which detaches and displaces soil particles. The Coconino National Forest signed a record of decision (ROD) in September, 2011, implementing new travel

management rules as required under the 2005 Federal travel management regulations (Travel Management Rule or TMR) (USDA Forest Service 2011a). Under these new rules, off-road vehicle access is restricted to designated routes and areas, and undesignated areas are prohibited for public motor vehicle use. A summary of road status within the project area is included below:

Table 40. Road Status Summary in the CWPP Project Area

Road Status	Mileage
Decommissioned or converted	20.7
Closed roads for administrative/permitted use only	219.1
MVUM-open, all vehicles, yearlong	87.0
MVUM-open, highway-legal vehicles, yearlong	105.5
MVUM-open, public roads or highways	56.2
Total	**488.5**

Roads not open for any use, including administrative and public use, are identified in rows 1 of Table 40. These roads have generally been blocked at the road entrance and sections of the roadbeds may have also been scarified to promote infiltration and seed germination. Roads identified as "closed roads for administrative/permitted use only" are only open to administrative use of the forest and are not open to the public, unless authorized under a written permit. These roads would typically be used by FS personnel only for accessing areas in which management activities, such as prescribed fire, are taking place. They would also be used when authorized under a written permit such as for livestock grazing, special use events, or firewood collection. Roughly 249 miles within the project area are open to the public typically during the spring, summer, and fall.

The roughly 50% reduction in publicly accessible roads in the project area and prohibition of off-road vehicle access is expected to improve soil conditions throughout the CWPP project area by reducing erosion of roadbeds, a process which is enhanced by traffic (Grace and Clinton, 2007). Although changes to road designations may occur within the project area over the next five years, the improvements to soils from implementation of TMR are likely to have a long-term benefit to soils lasting well beyond five years.

Managed Wildfire/ Prescribed Fire

Wildfires over the past several years (2006-2018) have burned 26,389 acres in the project area (Table 86). Almost all of the fires were lightening caused and were managed for multiple resource objectives. Impacts to soil productivity and hydrologic function have been minimal because the large majority of the fires burned at low intensity and severity. Past prescribed burning in the project area totals about 4,736 acres from 2007 to 2011. These fires also met objectives and caused minimal impacts to soils. Managed fires (most of the wildfires over the last 10 years) are those wildfires with a natural cause in which active suppression measures are not employed. These managed wildfires are managed for multiple resource objectives when conditions are such that the wildfire can be controlled and will not cause uncharacteristic fire or negative impacts to natural resources such as soils. From a

soils perspective, this means that managed fires typically only consume a portion of surface litter leaving the soil protected against accelerated erosion. A post-fire assessment of the General Fire of 2015 indicated that there was little to no displacement of soil in a hillslope immediately adjacent to East Clear Creek. These fires are all likely to have improved soil conditions by reducing the build-up of fuels under carefully managed conditions releasing nutrients back to the soil without consuming organic matter within the soil.

Wildfires

During the past 5 years, there have been two actively suppressed wildfires, the 2013 Hart (38 acres) and the 2016 Reservoir (124 acres) fires within the project boundary. Both fires were relatively small totaling about 162 acres and occurred within and downstream of C.C. Cragin Reservoir adjacent to East Clear Creek. These fires likely resulted in limited accelerated erosion where bare mineral soil was exposed. Given the small size of the fires, it is not likely to have long-term impacts to soil productivity in the project area even when combined with other sources of disturbance to soils within the project area.

Livestock Grazing

Livestock grazing within approximately 51% of the project area in Baker Lake, Bar T Bar and Pivot Rock allotments occurs from May through October (Table 95). All grazing allotments utilize a deferred and/or rest rotation system of grazing management, which is a grazing management system that provides for a systematic rotation of the deferment among pastures that provides a delay of grazing to achieve a specific management objective. Impacts to soils have historically occurred from unmanaged livestock grazing. Today's managed livestock grazing practices take into consideration available forage and wildlife use of this forage in determining appropriate stocking rates, and take into consideration the physiological needs of grazed plants by prescribing levels of plant utilization and allowing for plant rest and recovery through pasture rotation and deferment of use. Where conflicts occur between livestock and wildlife use of forage, or where historic negative impacts have occurred, livestock access is controlled through use of fences.

Negative impacts to vegetative ground cover from grazing by both livestock and wildlife, however, are likely to occur in the immediate vicinity of stock tanks where animals congregate and the concentrated hoof action reduces or eliminates ground cover.

Summary of the Proposed Action Cumulative Effects to Soils

Because the various soil disturbing activities would be distributed through time and space within the analysis area, they are not likely to have an overall long term negative effect on soils. Rather, the combined effects of the past, present, and reasonably foreseeable vegetation treatments along with the treatments proposed would have long-term benefits to soils by reducing the risk to soils from an uncharacteristic wildfire, and by improving nutrient cycling through the creation of conditions favorable for return of herbaceous cover in areas where increased pine density has reduced this cover to near zero.

Various efforts have been implemented or are underway to reduce ground disturbance associated with recreation such as reducing the number of publicly accessible roads and placing certain roads in long-term storage when administrative use of the road is not anticipated for at least a year. Other ground disturbing activities such as grazing by livestock are being managed to sustain soil resources and avoid conflicts with wildlife use of forage. In instances where wildlife grazing has been noted to be negatively impacting the soil by reducing cover and causing accelerated erosion such as in headwater meadows, projects have been implemented, are underway, or being planned to rehabilitate these areas

through exclosures and stream stabilization efforts that prevent headcutting and reconnect streams to floodplains in various parts of the project area. Although stream restoration activities proposed under 4FRI, Long Valley Channel Stabilization, and Long Valley Workstation Meadow Restoration are likely to cause short-term disturbance to soils, these activities are predicted to have a long-term benefit to soils by reducing channel and floodplain erosion.

Combined with the proposed action, these activities would result in a cumulative long-term improvement to soils productivity throughout the project area. These activities would cumulatively contribute to moving toward soil desired conditions over the next several decades for increased vegetation cover by grasses and forbs, increased resilience to wildfire, and improved nutrient cycling.

Watersheds and Water Quality

The following section describes the affected environment and effects of the alternatives relating to water.

Affected Environment

Watershed Condition and Water Quality

By design, the project area encompasses essentially all of Miller Canyon, Bear Canyon, and East Clear Creek-Blue Ridge Reservoir sub-watersheds since these are the sub-watersheds that drain to C.C. Cragin Reservoir. The project area extends slightly beyond these sub-watershed boundaries so that the project is bounded by major landscape features and landmarks, such as State Highway 87, which includes portions of an additional nine sub-watersheds as listed in Table 41.

Table 41. Watersheds of Cragin Watershed Protection Project

Watershed Name	Watershed Condition	Total Watershed Area (acres)	Watershed Area, FS (acres)	Watershed Area, Non-FS (acres)	% Watershed Area, FS	Watershed Area within Project Boundary (acres)	% Watershed Overlapping CWPP Project Area
Miller Canyon	Functioning at Risk	10,680	10,680	0	100	10,666	99.9
Bear Canyon	Functioning at Risk	14,595	14,529	66	100	14,492	99.3
East Clear Creek-Blue Ridge Reservoir	Functioning at Risk	20,246	19,949	298	99	19,673	97.2
Barbershop Canyon	Functioning at Risk	13,424	13,373	50	100	54.5	0.4
East Clear Creek-Clear Creek	Functioning at Risk	39,178	36,717	2,461	94	6,386	16.3
Windmill Draw-Jacks Canyon	Functioning at Risk	27,323	26,946	376	99	4,406	16.1
Long Valley Draw	Functioning at Risk	18,290	17,455	836	95	2,854	15.6

Watershed Name	Watershed Condition	Total Watershed Area (acres)	Watershed Area, FS (acres)	Watershed Area, Non-FS (acres)	% Watershed Area, FS	Watershed Area within Project Boundary (acres)	% Watershed Overlapping CWPP Project Area
Toms Creek	Functioning at Risk	8,530	8,530	0	100	402	4.7
Clover Creek	Functioning at Risk	9,936	9,936	0	100	4,269	43.0
East Verde River	Functioning at Risk	18,831	18,265	566	97	77	0.4
Webber Creek	Functioning at Risk	22,506	21,966	540	98	843	3.7
Pine Creek	Functioning at Risk	30,727	27,864	2,863	91	313	1.0

All sub-watersheds that intersect the project area are rated as "functioning at risk" with individual watershed condition qualitative indicator ratings identified in Table 42. Several key factors strongly influence the overall watershed condition ratings for those watersheds intersecting the project area.

The watershed condition assessment was performed prior to the Coconino National Forest's record of decision (ROD), signed in September 2011, implementing new travel management rules as required under the 2005 Federal travel management regulations (Travel Management Rule or TMR). Under these new rules, off-road vehicle access is restricted to roads that are designated as open to all motorized vehicles, open but restricted to highway legal vehicles, or are not designated, which means that they are closed to public use. In addition to designated roads, the Forest Service road system includes closed roads that are open to administrative use only or permitted uses

Roughly 468 miles of Forest Service systems roads within the sub-watersheds intersect the project area. Prior to implementation of TMR, all these roads were accessible to the public either year round or seasonally. TMR resulted in roughly 172 miles of system roads not designated as open to the public. This roughly 1/3rd reduction in the open road network within these sub-watersheds will likely have improved the "roads and trails" indicator ratings scores for at least a portion of these sub-watersheds. The other key factor that is strongly influencing overall watershed condition ratings is the presence of non-native aquatic species within the sub-watersheds. Non-native aquatic species such as crawfish compete with and otherwise negatively impact native fish populations so the presence of non-native aquatic species lowers the indicator watershed condition score for aquatic biota condition.

Table 42. Qualitative Sub-Watershed Indicator Scores for Sub-Watersheds Intersecting the Project Area

Sub-watershed name	Water quality	Water quantity	Aquatic habitat	Aquatic biota	Riparian /wetland vegetation	Roads and trails	soils	Fire regime	Forest cover	Range vegetation	Invasion species	Forest health
Miller Canyon	Fair	Good	Good	Fair	Good	Fair	Good	Good	Good	Good	Good	Good
Bear Canyon	Good	Good	Fair	Poor	Good	Fair	Good	Good	Good	Good	Good	Good

East Clear Creek-Blue Ridge Reservoir	Good	Good	Fair	Poor	Good	Fair	Good	Good	Good	Good	Good	Poor
Barbershop Canyon	Good	Good	Fair	Poor	Good	Poor	Good	Good	Good	Good	Fair	Fair
East Clear Creek – Clear Creek	Good	Good	Fair	Poor	Fair	Poor	Good	Good	Good	Good	Fair	Fair
Windmill Draw – Jacks Canyon	Fair	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Good	Good	Fair
Long Valley Draw	Fair	Fair	Fair	Fair	Good	Fair	Good	Good	Good	Fair	Good	Fair
Toms Creek	Fair	Fair	Poor	Fair	Good	Fair	Good	Good	Good	Fair	Fair	Fair
Clover Creek	Good	Good	Fair	Fair	good	Poor	Good	Fair	good	-	Fair	Poor
East Verde River Headwaters	Good	Poor	Poor	Fair	Poor	Poor	Fair	Fair	Good	Good	Fair	Good
Webber Creek	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Good	Good
Pine Creek	Good	Poor	Poor	Fair	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good

Surface drainage in the project area is generally to the north with most surface runoff exiting the project area through East Clear Creek. East Clear Creek merges with the Little Colorado River some 35 miles north of the project area. The exceptions to this drainage pattern are found on the west side of the project area where stream channels drain to Clover Creek or Long Valley, both of which are tributary to West Clear Creek.

Flow permanency of stream courses is characterized as perennial, intermittent, or ephemeral. Perennial streams generally flow continuously but portions may go dry during periods of drought. Ephemeral streams flow only in direct response to precipitation, whereas intermittent streams fall somewhere in between. No clear boundary delineates these various classes of stream courses, leading to the use of such terms as “wet-intermittent” and “dry-intermittent” to refer to those intermittent systems that are more like perennial streams or ephemeral streams, respectively. Additionally, perennial streams may not have continuous flowing water throughout the year but may have perennial pools of water or segments of perennially flowing water interrupted by dry reaches. These streams are referred to as “perennial-interrupted”.

Streams in the project area with perennial water as determined by the presence of fish species and/or periodic observations include East Clear Creek, Miller Canyon, East Miller Canyon, Kehl Canyon, General Springs Canyon, Houston Draw, and Bear Canyon.

The Arizona Department of Environmental Quality (ADEQ) is responsible for establishing state water quality standards and monitoring the quality of the state's surface water. Every two years, ADEQ is required under the Clean Water Act to conduct a comprehensive analysis of water quality data associated with Arizona's surface waters to determine whether state water quality standards are being met and designated uses of these waters are being supported. Designated uses of a surface water include full-body contact, partial-body contact, domestic water source, fish consumption, aquatic and wildlife (cold water), aquatic and wildlife (warm water), aquatic and wildlife (ephemeral), aquatic and wildlife (effluent-dependent water), agricultural irrigation, and agricultural livestock watering. Based on the results of this assessment, surface waters are classified into one of five categories as shown in Table 43.

Table 43. Classification of Surface Waters in the CWPP

Category number	Category	Description
1	Attaining All Uses	All uses were assessed as attaining uses all core parameters monitored
2	Attaining Some Uses	At least one designated use was assessed as attaining and no designated uses were not attaining or impaired
3	Inconclusive or Not Assessed	Insufficient samples or core parameters to assess any designated uses
4	Not Attaining	One or more designated use is not attaining, but a TMDL is not needed
5	Impaired	One or more designated use is not attaining, and a TMDL is needed

The most recent ADEQ report summarizing monitoring results reflects 2012 through 2014 monitoring activities and is the basis for this analysis (ADEQ, 2015).

Within the project area, water quality was assessed for C.C. Cragin (a.k.a., Blue Ridge Reservoir) and a reach of East Clear Creek extending 38 miles from the headwaters to the junction with Yeager Canyon roughly 2 miles downstream of the project area. C.C. Cragin Reservoir water quality was assigned category 2, attaining some uses, with one exceedance for pH out of seven samples tested. Water quality in the upper reach of East Clear Creek, occurring mostly in the project area, was assigned category 2, attaining some uses, with two exceedances of the biocriteria parameter. This parameter and its associated Index of Biological Integrity (IBI) scores apply to wadeable, perennial streams of Arizona and the narrative biocriteria language is as follows (ADEQ, 2015):

> **A wadeable, perennial stream shall support and maintain a community of organisms having a taxa richness, species composition, tolerance, and functional organization comparable to that of a stream with reference conditions in Arizona. [A.A.C. R18-11-108(E)]**

Wetlands, Springs and Riparian Areas

Springs

Springs are surface water features formed where ground water intercepts the earth's surface. Spring discharge is dependent on numerous factors including but not limited to climate, source area, geology, and topography. Where springs are fed by regional ground water systems, discharge tends to be more uniform and perennial surface flow is maintained for longer distances downstream. Where spring flow is derived from aerially limited perched water bearing zones, spring discharge may fluctuate widely and cease during extended periods of drought (Bills, et. al., 2007).

Spring discharge in the project area is mostly derived from perched water bearing zones often found at the contact between the Kaibab Formation and the underlying Coconino Sandstone since the regional aquifer is found at too great a depth to intercept the earth's surface in this area (Bills, et. al., 2007). This contact is frequently exposed in the narrow canyons and drainages dissecting the project area. The source of spring water is most likely snowmelt since much of the rainfall occurring from summer thunderstorms is lost through evapotranspiration (Bills, et. al., 2007).

Information on the development status and flow conditions (i.e., perennial or non-perennial) for each spring, where known, has been identified for 47 springs in the project area based on information from the Springs Stewardship Institute (SSI) on-line database (Ledbetter, et.al, 2015) and visits to the springs by Forest Service specialists in 2011 and 2015. More detailed information for each spring is included in the Soil and Water Specialist Report.

Riparian Areas

Riparian areas within the project area as identified by RMAP generally occur as thin strips along portions of major perennial or intermittent drainages within the project area including East Clear Creek, Potato Lake Draw, Cienega Draw, Poverty Draw, Kehl Canyon, Miller Canyon, East Miller Canyon, Crackerbox Canyon, General Springs Canyon, Houston Draw, Bear Canyon, and Dick Hart Draw. A total of 986 acres of riparian area were identified by RMAP.

A detailed description of riparian plant communities in the project area was included in a report titled "East Clear Creek Riparian Analysis" (Keller, 1998). The following summary of riparian plant communities and their condition as assessed in 1998 is reproduced here in its entirety, since it is still an accurate description:

> **Vegetation in these communities is dominated by thin-leaf alder (*Alnus tenuifolia*) in the lower and middle reaches. Several species of willow (*Salix sp.*) are found primarily in the lower reaches, one species (*Salix bebbiana*) is found in the headwater meadows. Bebb's willows now number very few, but once were more common from observing the dead remains. Box elder (*Acer negundo*) was found scattered throughout many reaches and a few stands of narrow-leaf cottonwood (*Populus angustifolia*) were also present. Other common shrubs include current (*Ribes pinetorum*) and red-osier dogwood (*Cornus stolonifera*). The herbaceous component is dominated by coneflower (*Rudbeckia laciniata*), sneezeweed (*Helenium hoopesii*), corn lily (*Veratrum californicum*), water hemlock (*Cicuta douglasii*), monkshood (*Aconitum**

> ***columbianum*) and numerous grasses and grass-like plants. (Keller, 1998).**

Riparian area assessments conducted in 1998 and documented in the aforementioned report were performed using the proper functioning condition (PFC) methodology (Prichard, et.al., 1998). Riparian stream reaches classified as "functional at risk" or "non-functional" are typically deeply incised reaches where the stream no longer has access to its floodplain and riparian obligate or facultative species are no longer able to access the water table. These conditions have been noted throughout the area and have been attributed to historic unmanaged grazing as described by Hanes (1993):

> **Persistent overgrazing within the drainage bottoms undoubtedly initiated the ubiquitous gullying which has affected nearly every drainage in these watersheds. The historical aerial photograph study indicates that diffuse meandering channels with streamside meadows and abundant willow and alder were the historical norm. Beaver were also active in many of the drainages which further enhanced the riparian-wetland characteristics of these drainages. Two episodes of gullying have been observed. The first, apparent on the 1946 photographs, is believed to have been initiated around the turn of the century. A second episode probably began in the early 1900s, and headcuts continued to migrate up the channel system through the l950s. The study results indicate that this second episode was apparently more severe than the first, with 6 foot deep headcuts observable in Kehl Canyon, Buck Springs and Upper Leonard Canyon. The study also found that since the 1959 photographs were taken, that the channel widths in many areas have increased by 2-3 times. East Clear Creek near Jones Crossing is specifically mentioned as a case where a stable, riparian/channel system has been virtually eliminated by incision and widening and replaced by a gravel wash.**

The historical aerial survey study referred to by Hanes was conducted by Keith Pajkos under Forest Service contract using stereoscopic analysis of repeat aerial imagery collected in 1946, 1948, 1959, 1960, and 1990 (Pajkos, 1992). Pajkos made the following conclusion about riparian areas based on his study:

> **Riparian communities were widespread in the 1946 flight, including major Bebb's willow communities in Merritt Draw, East Bear Canyon, Barbershop Canyon, Dane, Kehl, Houston, Buck Springs, and Leonard Canyons, etc. Most of these communities had been completely lost by the time of the 1990 flight. Additionally, areas such as Upper East Clear Creek around Jones Crossing, which had fairly continuous riparian vegetation in 1946, now have been completely destroyed. This situation is not uncommon throughout the watershed. Almost every riparian area examined has been severely impacted over time in all the canyons. The headwater meadows have suffered the most. These meadow**

reaches supported thriving communities of willow, alder, and cottonwood at one time and now are reduced to gravel washes.

Unfortunately, recovery of degraded riparian areas has generally not occurred without active intervention since the initial PFC assessments were completed. Figure 40 shows a stream reach within Houston Draw that is incised to bedrock converting the former adjacent floodplain into a terrace. As part of channel restoration efforts, an earthen plug was installed at the upstream end of this reach of incised channel, a meandering bypass channel was routed across the former floodplain surface partially reconnecting the stream channel to its former floodplain, and an 8' tall ungulate exclosure was constructed around the restored channel section and floodplain. As noted during a visit to the site on September 1, 2015, the constructed bypass stream channel remains stable and vegetation within the exclosure is robust.

Figure 40. Incised Stream Channel in Houston Draw. Flow through this reach is blocked by an earthen plug installed at the upper end of the reach and diverted through a constructed earthen channel in an ungulate exclosure.

Wetlands

Within the project area, there are four wetlands that are identified as such by both NWI and the Coconino National Forest including Potato Lake, Poe Lake, Dry Lake, and Dude Lake. These wetlands cover an area of approximately 12 acres and are classified by NWI as palustrine, seasonally or temporarily flooded wetlands. Other features within the project area that are mapped as wetlands by NWI but not managed as such by the Coconino National Forest include stockponds (a.k.a., tanks), perennial or intermittent pools within drainages, and C.C. Cragin reservoir. Drainages with NWI-mapped wetlands are typically managed as riparian areas.

Environmental Consequences

This section describes the direct, indirect, and cumulative effects of implementing each alternative on affected soils and water resources. Affected water resources include some of the sub-watersheds that overlap the project boundary; wetlands, springs, and riparian areas within the project boundary; and

water quality in stream courses that convey surface flow in some of the sub- watersheds overlapping the project boundary.

Alternative 1– No Action

Direct and Indirect Effects

Under the No Action Alternative, water quality, springs, riparian habitat, and wetlands would not be affected by the treatments included in the proposed action as no actions would be authorized. However, all of these resources would potentially be affected by the failure to reduce current fuel load conditions that are conducive to an uncharacteristic stand-replacing wildfire. The potential threat of wildfire to the use of C.C. Cragin as a domestic and municipal water supply is exemplified by the 2003 Hayman Fire in Colorado. This wildfire burned over 137,000 acres, impacting watersheds that provide domestic and municipal water to several cities, including Denver, along Colorado's Front Range. Over a two year period following the fire, water providers spent $25 million removing sediment from a water storage reservoir (https://www.planning.org/research/postdisaster/casestudies/haymanfire.htm). This post-fire erosion response is typical of wildfire-impacted watersheds with reports of increases in sediment yield of over 1,400 times pre-fire conditions (Smith et. al. 2011). In addition to increased erosion and its impact on suspended sediment concentrations in surface waters, wildfires can result in an increase in nutrient (i.e., nitrogen and phosphorus) loading to water bodies resulting in an increase in algal growth and reduction in dissolved oxygen leading to fish kill (Ranalli, 2004). A study on the Dude Fire, which occurred partially within the project area in 1990, found that water quality indicators such as macroinvertebrate richness, diversity, and abundance were altered from pre-fire conditions up to a decade after the fire (Leonard et al. 2017).

A wildfire under the No Action alternative would also result in effects to springs, riparian habitats, and wetlands. Studies after the Dude Fire found that riparian areas across burned streams remained with 28% canopy cover decades after the fire (Leonard et al. 2017). Nutrient rich and ash-saturated post-fire flows could also affect the biological function of springs, riparian, and wetlands in the project area. This effect is dependent on a number of factors including the intensity of post-fore storms, steepness of slopes, and catchment area for the spring, riparian area, or wetland. In a study of post-fire conditions in the Rodeo-Chedeski Fire area, researchers found that downstream watersheds showed that the stormflows generated by the initial summer rainstorms following the burn contained large concentrations of organic debris, dissolved nutrients (including nitrogen, phosphorus, and carbon), and other chemical constituents that were released by the burning event. However, these conditions were relatively short-lived, and returned to pre-fire levels after initial stormflow events (Ffolliott et al. 2011). While the effects of this alternative are highly dependent on the occurrence of a crown fire in the project area, and post-fire conditions, this alternative would move conditions away from desired conditions identified for water because it would result in a continued high risk for the further degradation of watershed function, and the potential for large impacts to water quality due to an elevated risk of crown fire and post fire sedimentation over the next several decades.

Cumulative Effects - No Action

While there would be no direct effects under this alternative, the indirect effects of increasing fire risk and increasing risk of post-fire erosion would combine with increasing risks associated with climate change to result in a cumulative effect to watershed condition within the project area over the next several decades. According to Segura et al. (2014), climate projections general agree that increasing temperatures and an expected increase in the frequency of events with high rainfall intensity over the coming decades will increase rainfall runoff erosivity, especially for landscapes with steep terrain (i.e.

slope >10%). Combined with a greater risk of soils loss as a result of increased crown fire risk under this alternative, there is a long-term cumulative risk to watershed function throughout the project area, and especially on steep slopes throughout the project area.

The recent Tinder Fire adjacent to the project area affected 15,628 acres of the East Clear Creek – Clear Creek watershed. This is almost 40% of this watershed. Since the No Action Alternative increases the risk of crown fire over the next several decades, it would result in a cumulative effect by causing loss of watershed function on an additional 16% of the watershed included in the CWPP area. Thus, cumulatively, this alternative could result in the long-term decrease in watershed function as a result of high and mixed severity wildfire in over half of the East Clear Creek – Clear Creek watershed.

This alternative would also result in cumulative effects to wetlands, springs and riparian areas. The no action alternative would increase the risk of crown fire across the project area in the next several decades, which would result in indirect effects to wetlands, springs, and riparian areas. The effects of climate change would also result in an increased risk of high intensity wildfire in the project area, resulting in a cumulative increase in crown fire risk across the project area and a cumulative indirect effect to these resources. Several studies have concluded that expected changes in climate will likely result in more burned area from wildfires than in the past (Litschert et al. 2012, Marlon et al. 2009). In addition to cumulatively increasing the crown fire risk, which results in the degradation of wetlands, springs, and riparian areas, climate change would result in cumulative stressors to these forest resources due to increasing frequency and intensity of drought, which would reduce woody riparian vegetation and decrease the abundance of water that would degrade water quality, riparian vegetation, and the resilience of native vegetation (Poff et al. 2011). The cumulative increase in crown fire risk across the project area and cumulative increase in stressors to wetlands, springs, and riparian areas would result in conditions moving away from those identified in the desired conditions for these resources.

Alternative 2– Proposed Action

Direct and Indirect Effects

Watershed Condition and Water Quality

The potential effects of the proposed action on water quality are related to the extent to which disturbance from the various treatment methods directly impact stream channels at stream crossings and whether various treatment methods increase sediment yield defined as the input of sediment to a stream from hillslope erosion. Hillslope erosion depends on such factors as amount of soil exposed, changes to infiltration rates, slope steepness, type and depth of soil, and the nature of precipitation (i.e., type and intensity) (MacDonald and Stednick, 2003). The movement of sediment from actively eroding hillslope areas to streamcourses is dependent on these same factors plus the spatial aspects of disturbance (i.e., whether disturbed areas are surrounded by relatively undisturbed areas, and the proximity of disturbance to streamcourses), and the types of post-treatment mitigation methods or BMPs that are applied. Erosion and potential contamination of surface water from vegetation treatment activities including use of processing sites would be minimized through use of best management practices as either required under state law and associated applicable permits or as specified in timber sale contracts and identified above.

Processing sites would range in size from 5 to 15 acres. These sites were screened so as to be located outside of meadows where some of the most productive forest soils are found, and in relatively flat areas. The siting of processing sites in relatively flat areas would minimize the need for extensive site

grading and would minimize the likelihood of erosion at such sites since erosion is strongly influence by gradient (Wischmeier and Smith, 1978).

In order to facilitate the types of tasks and equipment that may be used at these sites, they would typically have to be cleared and grubbed (i.e., vegetative cover and trees removed) resulting in displacement of top soil and exposure of subsoil. The operation of equipment on these sites would result in compaction of the soil and reduced ability of soils to infiltrate water. Areas of exposed soil would have to be covered with aggregate to minimize erosion and facilitate use of the site. Aboveground fuel storage tanks would have to be manufactured, installed, and operated in accordance with Federal, state, and local requirements. For example, a permit for installation of an aboveground storage tank would have to be obtained through the Arizona State Fire Marshall's Office (https://www.dfbls.az.gov/ofm/AGST.aspx). Additionally, the processing sites would likely be regulated as industrial sites subject to permitting under Arizona Department of Environmental Quality's (ADEQ) Multi-Sector General Permit (MSGP) program. This permit program requires that certain industrial facilities, including those involved in the types of activities that would likely occur at the processing sites, implement control measures and develop site-specific stormwater pollution prevention plans (SWPPP) to comply with Arizona Pollutant Discharge Elimination System (AZPDES) requirements. Among other things, the SWPPP would have to identify best management practices that minimize non-point source water pollution including measures to minimize or prevent soil erosion and contamination. Because of these requirements as well as the siting of processing areas in relatively flat areas, negative impacts to water quality and overall watershed condition are not expected to occur.

Roads are generally considered to be the largest source of sediment to streams from human activities with sediment being the main source of water quality degradation in forest streams (Elliot, et. al., 2009). The introduction of sediment to streams from roads occurs where roads directly cross flowing streams (as opposed to roads crossing streams at bridges or culverted road crossings) and where road segments drain to streams, the latter often referred to as hydrologically connected roads. The main haul routes for logging would generally be on maintenance level (ML) 3 or 4 roads, which are roads maintained for passenger vehicles. These roads cross perennial streams in the project area over bridges or culverts eliminating direct traffic disturbance to streams. These roads also have drainage features such as cross drains, lead out ditches, and rolling dips that prevent water from becoming concentrated on the roadbed and directed to a stream channel. Many of these roads are located on ridgetops between steep canyons with little to no cut and fill sections. Their locations on ridgetops often places them the maximum possible distance from stream channels and as a result minimizes the amount of sedimentation from roads to downstream water sources.

Shorter ML 1 and 2 roads that are typically less than a mile long connect to the main haul routes and would be part of the system of roads needed for mechanized harvesting. These roads are typically not maintained and usually require a high clearance vehicle to access but would be improved and maintained for mechanized thinning. None of the existing ML-1 or ML-2 roads that cross perennial streams would be used for mechanized thinning so direct perennial stream crossings would not occur. ML 1 and 2 roads that would be used for mechanized thinning do cross ephemeral drainages that flow for short periods only in response to storm events or snowmelt. It is not anticipated that direct crossings of ephemeral streams would negatively impact water quality. Temporary roads that would be constructed to facilitate timber harvesting would not directly cross perennial streams in the project area.

Using Disturbed WEPP, Elliot and Robichaud (2001) compared rates of sediment yield (i.e., the amount of sediment reaching a channel from hillslope erosion) under average weather conditions for

the first year following simulated ground-based mechanical thinning/yarding, prescribed fire, and wildfire conditions in a relatively dry forested ecosystem in the inter-mountain west with precipitation mostly in the form of snow (Elliot and Robichaud, 2001). *Disturbed WEPP* is an Internet-based computer program designed to predict runoff and rill/interrill erosion from undisturbed forests, forest fires (prescribed and wild), forests disturbed by timber harvesting, and rangelands under various cover conditions, and is based on Water Erosion Prediction Project (WEPP) model.

The greatest amount of erosion typically occurs in the first year following disturbance, and after several years, erosion declines to near zero. Thinning was assumed to reduce ground cover by 15 percent over a harvest unit, although this analysis did not include the road system used to accomplish thinning. This level of disturbance is, perhaps, conservatively high as evidence for total ground disturbance (i.e., disturbance as evidenced by compacted soil, rutted soil, and exposed soil) from landings, temporary roads, skid trails, and slash management was measured to be approximately 16 percent in a harvest unit thinned by ground-based mechanical harvesting on the Kaibab National Forest (MacDonald and Stednick, 2013), and 10-15% from past timber sales on the Mogollon Rim Ranger District (Jagow 1994; Fleishman 1996 and Fleishman 2005). The rate of sediment yield in the first year following simulated thinning and wildfire was predicted to be 0.03 Mg/hectare and 8.1 Mg/hectare, respectively. Predicted rates of sediment yield for simulated thinning followed by prescribed fire were approximately 0.1 Mg/hectare during the first year after disturbance.

In the past two years, best management practice monitoring of several timber sales has been conducted by the author and there have been no documented instances of sediment from skids trails, temporary roads, or landings reaching stream channels (Runyon, 2016). The reasons for this include the protection of stream courses by designation as aquatic management zones (AMZs) in which ground disturbing activities such as landings, temporary roads, and skid trails are prohibited from within a designated area surrounding the stream course as well as the limited amount and spatial separation of disturbance that occurs during typical timber harvesting activities conducted on the Coconino National Forest. Areas disturbed by timber harvesting are frequently isolated from other areas of disturbance with intervening areas of no or limited disturbance. Runoff generated from heavily disturbed areas such as landings typically infiltrates in the intervening areas of limited to no disturbance. As a result, it is expected that ground disturbance from mechanical thinning and associated disturbance from landings and skid trails on approximately 36,000 acres in the CWPP area would result in a minimal delivery of sediment to downstream water sources.

These simulation results highlight the increase in erosion following wildfire versus that from vegetation treatment. When compared to natural rates of erosion in forest environments, which have been reported to be less than 0.1 Mg/hectare (Elliot, et.al., 1999), it can be seen that thinning or thinning combined with prescribed fire is not likely to substantially increase the amount of sediment reaching streamcourses, but that high-intensity wildfire may do so by several orders of magnitude.

To aid in determining the effectiveness of proposed fuels reduction treatments in reducing the threat of uncharacteristic wildfire and subsequent hillslope erosion, fire behavior and erosion modeling was performed. The simulated fire behavior modeling conducted for this project is described in the Fire/Fuels Specialist Report. Soil burn severity has been identified as a key indicator of the susceptibility of a burned area to accelerated erosion and, consequently, soil burn severity categories are used to determine appropriate soil and hydrologic parameters needed for post-fire erosion modeling (Elliot, et. al., 2015). Following the method of Elliot, et.al. (2015), the fire model output of flame length was selected as a proxy for soil burn severity. The fire model produced a grid-based file with flame length assigned to each cell. To select the range of flame length values for each soil burn severity class, it was assumed that a wildfire that might be expected for the climate and fuel

conditions used for the no action fire simulation would produce a soil burn severity distribution of approximately 41% low, 39% moderate, and 20% high. Flame length values were then selected to achieve this distribution of soil burn severity through a ranking procedure that assigned the highest 20% of flame length grid values to the high soil burn severity class and so on. Table 44 includes soil burn severity categories and associated flame length values.

Table 44. Soil Burn Severity (SBS) Categories and Distribution of Soil Burn Severity by Alternative

SBS Class	No Action	Proposed Action
Unburned	0.04%	2.31%
Low	40.58%	88.98%
Moderate	38.92%	8.19%
High	20.46%	0.52%

Predictions of the relative change in hillslope sediment yield between the no action and proposed action alternatives were made using KINEROS2 as executed through the Automated Geospatial Watershed Assessment (AGWA) tool. KINEROS2 is a semi-distributed, physically-based, single rain event driven surface runoff and erosion model for watersheds dominated by infiltration-excess overland flow (Semmens, et al, 2008). Although infiltration-excess overland flow is not thought to be the dominant mode of runoff generation in undisturbed forested watersheds, it has been hypothesized that this mode of runoff generation may become dominant in a post-fire environment. The model is considered semi-distributed in that unique soil and hydrologic parameters can be applied at the hillslope scale versus lumped models which apply such parameters at the watershed scale or fully distributed models which apply such parameters at the grid scale. The AGWA tool is a GIS-based hydrologic modeling tool that uses geospatial data related to topography, land cover, and soils to fully parameterize, execute, and spatially visualize results for several hydrologic and erosion models including KINEROS2. It was designed specifically to evaluate the hydrologic impact of land cover and land use changes on watershed response to rainfall and has been modified since its development to improve simulations of runoff and erosion in a post-fire environment (Canfield and Goodrich, 2005). Modeling results are subject to the assumptions and limitations of the data and equations developed to parameterize the model using readily available geospatial data. National Oceanic and Atmospheric Administration (NOAA) point frequency data was used to determine the total rainfall for a 60-minute long rainfall event with an average recurrence interval of 10 years. This rainfall amount was uniformly applied over the three sub-watersheds that drain to C.C. Cragin Reservoir.

Figure 41 shows the modeled reduction in post-simulated fire hillslope sediment yield between the proposed action (post treatment) and no action alternatives. The majority of the 83 modeled hillslopes show post-treatment reductions in sediment yield ranging from greater than 90% to approximately 15%, however, four hillslopes showed no difference in sediment yield and two hillslopes showed increases in sediment yield (see Figure 41). Such factors as hillslope gradient, hillslope roughness, aspect, and fuel conditions are the most likely factors affecting modeling results.

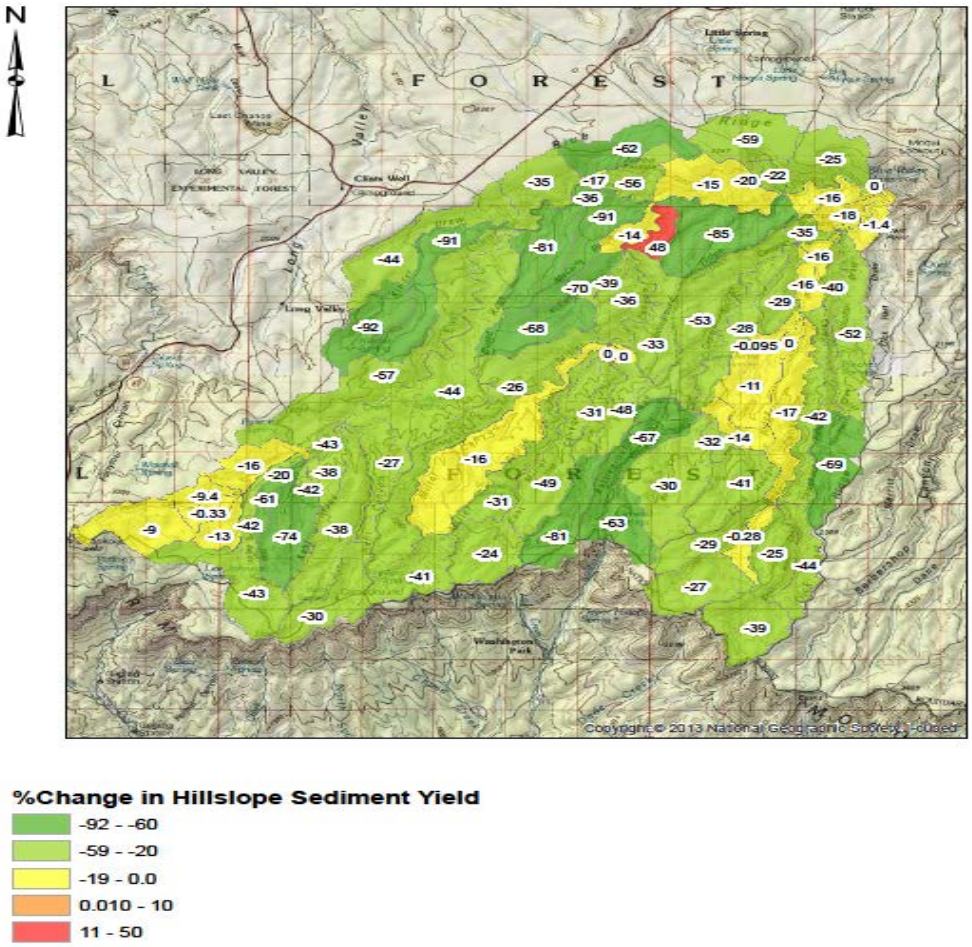


Figure 41. Change in hillslope sediment yield between the proposed action alternative and no action alternative following simulated fire and a single rain event evenly distributed over the watersheds that drain to C.C. Cragin Reservoir. Negative values indicate a decrease in hillslope sediment yield for the proposed action versus no action.

In summary, the proposed treatments would have the overall effect of moving towards Forest Plan desired conditions for natural disturbance regimes that are protective of water quality and watersheds by reducing the threat of uncharacteristic fire.

Springs, Riparian Areas, and Wetlands

Direct and indirect effects of the proposed action on wetlands, springs, and riparian areas would most likely occur through either direct disturbance of these resources from thinning activities or through upstream of adjacent disturbance that impacts the functioning of these water-dependent resources. There are several reasons why proposed treatment activities would not directly or indirectly negatively impact these resources, but would likely have a positive impact. Wetlands, springs, and riparian areas would be protected through designation as aquatic management zones, which is identified as a design feature included as part of the proposed action alternative. This means that a minimal impact buffer would be established around each of these features prohibiting temporary roads, landings, skid trails, slash piles, prescribed fire ignitions, and equipment/material staging areas

to be established within them. Buffer widths would take into consideration the adjacent slope and soils to allow for adequate buffering of these features. In particular, because of the minimal disturbance allowable within these buffer zones, they would maximize the retention of sediment that may be mobilized from adjacent disturbed areas preventing this sediment from directly impacting these water-dependent resources. Secondly, many of the water-dependent resources are located in areas that would not be mechanically harvested because they occur in inaccessible areas such as in the bottom of the steep canyons that dissect the project area or on the side of hillslopes where mechanical thinning would not occur (i.e., slopes greater than 40%). Conversely, mechanical thinning and prescribed fire activities may increase the availability of water to these features by reducing evaporative demand by surrounding trees. Additionally, treatment activities would reduce the potential for uncharacteristic fire that could negatively impact these resources through increased headwater erosion.

Construction of temporary roads or decommissioned roads where there is no existing road bed, and development and use of processing sites are not expected to result in direct or indirect effects to wetlands, springs or riparian areas. Wetlands, springs, and riparian areas would be avoided through designation as aquatic management zones, which is identified as a design feature included as part of the proposed action alternative. In addition, locations for processing areas were identified by using a process that located these sites only in areas that were at least 300-feet from wetlands, springs, and riparian areas. Based on design features and BMPs that would limit sediment from leaving the site, and the distance from these features, effects to these resources are not expected through the implementation of the proposed action.

Cumulative Effects – Proposed Action

The timeframe for the consideration of the cumulative effects of past actions to water and soil resources is five years based on the expected recovery of vegetative ground cover conditions such that accelerated erosion and increased runoff would not be elevated compared to the undisturbed condition. This time period is based on information from the Beaver Creek experimental watershed in northern Arizona indicating that suspended sediment concentrations in a catchment that was clear cut stabilized approximately five years following treatment. It is also based on the expected recovery to pre-disturbance erosion and runoff conditions following a major disturbance such as wildfire (Pietraszek, 2006). It is recognized that the effects of disturbance from past actions, both positive and negative, may extend beyond this timeframe but would likely be negligible in terms of cumulatively affecting the resources considered in this analysis. Those activities being considered for cumulative effects to watersheds, water quality, springs, riparian areas and wetlands are the same as those considered for soils.

Alternative 2– Proposed Action

Watershed Condition and Water Quality

Vegetation Management Activities

Vegetation management activities that have occurred in the cumulative effects sub-watersheds in the past 5 years or may occur within the next 5 years and that could affect watershed condition and/or water quality include mechanical thinning, prescribed fire, and managed fires. A summary of vegetation management activities within the affected sub-watersheds is included in the cumulative effects section in Tables 87, 89 and 90. The estimated areas are based on the best available information at the time of report preparation and are likely to differ when vegetation management

projects are implemented. The actual area of thinning will most likely be less than that reported as equipment operability or other issues may prevent treatment in all areas identified.

Past, present, and reasonably foreseeable future vegetation treatment activities are likely to have caused or would likely cause disturbance to soils and vegetative cover that would potentially alter the rainfall-runoff response (i.e., increase the amount of runoff for a given amount of rainfall) at a scale of typically less than an acre. However, these treatment activities are not likely to impact water quality or watershed condition at the sub-watershed scale. Mechanized thinning has been occurring on the Coconino and adjacent national forests for the past several decades.

Timber harvesting and associated activities (skid trails, temporary roads, landings, and processing areas) are expected to result in minimal downstream sedimentation, and because of the separation of timber harvesting activities in time, these effects are unlikely to result in measurable cumulative effects with past or future timber sales. Previously disturbed areas have often recovered or are in recovery (i.e., the post disturbance rainfall-runoff response has returned to pre-disturbance levels) when thinning in adjacent areas begins. The most likely source of sediment from timber harvesting activities is the road system that is necessary to support this activity. This road system includes those existing Forest Service system roads that are used for multiple purposes and temporary roads which are needed only for the purpose of timber harvesting in areas where roads do not currently exist. Temporary roads are required to be scarified, re-seeded, and adequately drained (i.e., runoff is directed off the roadbed before it has time to concentrate and increase erosion) after harvesting is complete which reduces the likelihood of water quality impacts from these features, and reduces the likelihood that there would be cumulative effects with other activities in the same subwatersheds.

Managed fires are those wildfires with a natural cause in which active suppression measures are not employed. These managed wildfires are managed for multiple resource benefits when conditions are such that the wildfire can be controlled and will not cause uncharacteristic fire or negative impacts to natural resources such as water quality and watershed condition.

Fire and Fuels Management

Best Management Practice (BMP) monitoring was conducted for one of the fires, the General Fire of 2015, to monitor the implementation and effectiveness of BMPs used to protect water, aquatic, and riparian resources applied during the planning and implementation of wildfire management actions. BMP monitoring indicated that soils remained protected from raindrop impact by litter with no evidence of sediment movement into an immediately adjacent aquatic management zone. Overall, these managed wildfires benefit watershed condition and water quality by reducing the likelihood of uncharacteristic wildfires which can lead to greatly increased erosion and water quality impacts (Smith, et. al., 2011).

Fuels reduction projects often include prescribed fire either following mechanized thinning or as stand-alone efforts to restore forest conditions such that uncharacteristic wildfires are less likely to occur. The conditions under which prescribed burning would be conducted are generally characterized by high relative humidity, low air temperatures, low fuel loadings, and high fuel moisture. These conditions typically produce low to moderate soil burn severity in which surface litter is only partially consumed. In addition, the timing of controlled burns is such that burns are conducted during fall or spring, when lower ambient temperatures minimize surface litter consumption. Prescribed fires, however, do produce spatial variations in burn severity ranging from high to unburned depending on surface fuel loads. This spatial variability leads to varying runoff and erosion rates (Robichaud, et. al., 2010). A typical prescribed fire travels along the ground surface consuming a portion of the forest floor (i.e., litter, herbaceous cover) and understory (i.e., shrubs and

seedlings). These fires can cause some scorching of the overstory canopy but do not spread through the canopy like uncharacteristic crown fires. In areas of low to moderate soil burn severity, only a portion of the surface organic matter is consumed, leaving adequate soil cover over much of the burned area. In general, prescribed fire does not cause excessive erosion or sediment transport since soil cover is retained in a discontinuous pattern across the landscape. Because of this, long-term adverse impact to soils are not expected from prescribed fire activities.

This conclusion is supported by controlled burning experiments conducted on the Fort Apache Reservation located in the White Mountains of northeastern Arizona, which indicated minimal soil erosion following controlled burning (Weaver, 1952; Cooper, 1961). Cooper (1961) evaluated post-burn erosion on a 35 percent hillslope in the White Mountains and concluded that accelerated erosion attributable to controlled burning could not be considered severe and that the soil appeared to be stabilized within a year of treatment. It was also noted that eroded material was only moved a short distance down slope. Conversely, prescribed burning would be expected to have a long-term benefit to soil resources by reducing the build-up of fuels, and restoring soil nutrient cycling through reduction of overstory and encouragement of herbaceous cover.

The cumulative impact of vegetation management activities on the condition of sub-watersheds included in the cumulative effects analysis for the no action alternative is dependent on the extent of these activities in the applicable sub-watershed. Under the no action alternative, except for thinning conducted as part of the ECC Watershed Health EA, East Clear Creek-Blue Ridge Reservoir, Miller Canyon, and Bear Canyon would largely remain untreated by mechanical thinning. Although the watershed condition indicator "fire regime and wildfire" was rated as "good" in these sub-watersheds, fire behavior modeling conducted as part of this proposed project suggests otherwise. Despite managed fires reducing fuel loads in these sub-watersheds, fuel conditions would still potentially lead to uncharacteristic fire in these sub-watersheds, and it cannot be predicted whether future managed fires would occur or be able to reduce fuel loads enough to prevent uncharacteristic fire from occurring in these sub-watersheds. As discussed above, an uncharacteristic fire could greatly alter the runoff response to rainfall leading to increased erosion, and sediment deposition in sub-watershed drainages and in Blue Ridge Reservoir. An uncharacteristic fire in these sub-watersheds could negatively affect the following indicators of watershed condition: water quality, water quantity, aquatic habitat, aquatic biota, riparian/wetland vegetation, soils, and forest cover.

Wildfires are expected to result in the largest effect to watershed function for watersheds in the project area in the coming years. Wildfires within watersheds included in the CWPP area over the past 10 years have effected 93,131 acres. The large majority of these wildfires have exhibited low and small areas of mixed fire severity, with occasional patchy occurrences of high severity that have been less than 80 acres in size. The recent Tinder Fire from April 2018, started on the northeast boundary of the CWPP and affected almost 40% the East Clear Creek – Clear Creek watershed. This fire included approximately 30% of the area burned in the high and moderate severity burned area classification, which is much higher than observed from previous wildfires in this watershed over the last several decades. Treatments included in the proposed action over the next several years may slightly contribute to a cumulative increase in sedimentation from the wildfire in this watershed, but the amount contributed from treatments would be insignificant and immeasurable compared to the pulses of sedimentation from high and moderate severity burned areas in the first 1-2 years. Over the next several decades, the treatments in the proposed action would act to limit the potential loss of watershed function from the Tinder Fire, by making the 16% of the watershed in the CWPP area more resilient to wildfire and other disturbance.

Livestock Management

Active livestock grazing occurs from May through October in 51% of the CWPP project boundary. All grazing allotments utilize a deferred and/or rest rotation system of grazing management, which is a grazing management system that provides for a systematic rotation of the deferment among pastures that provides a delay of grazing to achieve a specific management objective. It is a strategy aimed at providing time for plant reproduction, establishment of new plants, restoration of plant vigor, a return to environmental conditions appropriate for grazing, or the accumulation of forage for later use. Under this system of grazing, livestock are rotated between pastures when certain levels of seasonal utilization, defined as the percentage of the forage produced in the current season to date of measurement that has been consumed or trampled by animals, have occurred. Each season, at least one pasture is deferred/rested from grazing during all or a portion of the grazing season and the inter-annual sequence of rotation is adjusted such that pastures are not grazed during the same period each year. For example, a pasture may be grazed in May of one year and August of the next year or may be entirely rested from grazing during one of the years. Grazing use is measured by "grazing intensity and/or utilization" and are managed at 40% for the allotments occurring within the project area.

Managed grazing using a deferred-rotation grazing system has been determined to provide for sustained, multiple use (i.e., use by both livestock and wildlife) of semi-arid forested rangelands with bunchgrass understory provided that stocking rates are maintained at levels resulting in seasonal utilization of between 30 to 40% (Skovlin, et.al., 1976). In fact, climate and overstory tree density rather than managed livestock grazing have been identified as the primary drivers of vegetative ground cover conditions in forested rangelands of northern Arizona (Bakker and Moore, 2007). Bunchgrass density and variety have been shown to decline with an increase in ponderosa pine overstory and during periods of drought (Bakker and Moore, 2007). Negative impacts to vegetative ground cover from grazing by both livestock and wildlife, however, are likely to occur in the immediate vicinity of stock tanks where animals congregate and the concentrated hoof action reduces or eliminates ground cover. Perennial bunchgrass ground cover is diminished or absent where closed overstory tree canopies create conditions counter to bunchgrass growth. This does not necessarily result in a change in watershed response or impact to water quality as ground cover generally is in excess of that needed to prevent accelerated erosion.

Travel Management and Recreation

Recreational activities with potential impacts to water quality and watershed condition include motorized and non-motorized travel on existing FS system roads. Off-road motorized vehicle use is limited to game retrieval and fuelwood harvesting and does not likely lead to negative impacts to water quality and watershed condition due to the limited area of occurrence and dispersed nature of off-road travel (i.e., off-road travel is not likely to occur in the same footprint). For these reasons, off-road vehicle travel will not be further addressed in this report.

In terms of these recreational activities, forest roads are the common thread through which most recreational uses of public lands occur. Therefore, the impacts of travel management and recreation on water quality and watershed condition are considered together.

On National Forest lands, roads are frequently identified as the largest source of sediment delivery to stream courses, with the amount of erosion a function of rainfall, road condition (e.g., rutted vs. non-rutted), maintenance, road gradient and traffic type and volume. To address this issue and other issues, the Coconino National Forest signed a record of decision (ROD) in September 2011 implementing new travel management rules as required under the 2005 Federal travel management regulations (Travel Management Rule or TMR). Under these new rules, off-road vehicle access is restricted and Forest Service roads are designated as open to all motorized vehicles, open but

restricted to highway legal vehicles, or are not designated, which means that they are closed to public use. The reduction in publicly accessible roads and prohibition of off-road vehicle access is expected to improve water quality and watershed conditions throughout the sub-watersheds by reducing erosion of roadbeds, a process which is enhanced by traffic (Grace and Clinton, 2007). Although changes to road designations may occur over the next five years, the improvements to water quality and watershed condition from implementation of TMR are likely to have long-term benefits lasting well beyond five years.

Summary of Cumulative Effects for Watershed Condition and Water Quality

Combined with the effects of the proposed action, the primary cumulative effect would be to decrease the amount of sedimentation to water sources downstream of the project area over the next several decades. This would occur as a result of net understory vegetation cover improvements throughout the project area as a result of travel management, watershed improvement projects, past logging and prescribed fire treatments, past low- to moderate intensity wildfires, and activities conducted by the proposed action, all of which would combine at the scale of the project area to reduce water quality effects. In addition, the proposed action would combine cumulatively with these activities to reduce the risk of water quality impairment from major disturbance events by making the project area less likely to experience a crown fire and improve the resistance of the landscape to soil loss to downstream waterways during post-fire precipitation events. Cumulatively, the past, present, reasonably foreseeable activities in the project area would combine with the effects of this alternative over the next several years to move toward Forest Plan desired conditions for water, improve watershed condition framework ratings, and decrease the potential for water quality impairment caused by increased sediments in East Clear Creek and the C.C. Cragin Reservoir.

Springs, Riparian Areas, and Wetlands

The same types of activities that cause disturbance to soils could potentially cause disturbance to wetlands, springs, and riparian areas within the project area. Mechanized and hand thinning activities approved under the ECC Watershed Health Improvement Project decision are not expected to negatively impact these water-dependent resources, because they either cause minimal disturbance as is the case with hand thinning, or these water-dependent resources would be protected by designation as aquatic management zones (AMZs).

Wetlands, springs, and riparian areas have been negatively impacted by past land uses. In particular, unmanaged livestock grazing is thought to have initiated a process of gullying that has impacted many of the riparian areas within the project boundary (Hanes, 1993). Current managed livestock grazing, however; is not likely to negatively impact these resources, because they are generally inaccessible to livestock through fencing or topography. Grazing by wild ungulates is likely having a negative impact primarily on riparian areas and wetlands owing to their high quality forage and presence of water.

Many of the roads that previously traversed wetlands, springs, and riparian areas have either been decommissioned or have been closed to public access and physically blocked. In 2015, AmeriCorps volunteers working alongside Forest Service employees blocked numerous roads in the Potato Lake area that are not designated as open to the public but were, nevertheless, experiencing motor vehicle traffic. In 2015, the main road to Potato Lake was gated, and this wetland is now only accessible by foot or horse travel. Since 2014, unauthorized motor vehicle access to East Clear Creek in its headwaters has largely been prevented through construction of a series of log worm fences by various volunteer groups working with Forest Service employees.

Stream restoration activities approved under the ECC Watershed Health decision and proposed in the 4FRI Rim Country EIS would have a short-term impact on riparian areas but would improve the long-term function of these water dependent resources through reconnecting streams to their flood plains, planting riparian species where they have been extirpated, and removing human-made spring capture and diversion features where feasible.

Combined with the effects of the proposed action, the primary cumulative effect would be to decrease the risk of direct effects from wildfire or indirect effects such as sedimentation and erosion from post-fire peak flows. This would occur as a result of net understory vegetation cover improvements throughout the project area as a result of travel management, watershed improvement projects, past logging and prescribed fire treatments, past low- to moderate intensity wildfires, and activities conducted by the proposed action, all of which would combine at the scale of the project area to reduce risks from disturbance events to riparian areas, wetlands, and springs in the project area over the next several years. Cumulatively, the past, present, reasonably foreseeable activities in the project area would combine with the effects of this alternative over the next several years to move toward Forest Plan desired conditions for wetlands, springs, and riparian areas.

Geology

The following section describes the affected environment and effects of the alternatives relating to geology, specifically cave and karst resources.

Affected Environment

Caves and Karst Terrain of the CWPP Area

Geology and Physical Expression

All of the CWPP is in karst terrain. The CWPP project area contains carbonate karst associated with the Kaibab Formation limestone, evaporate karst associated with the Moenkopi Sandstone formation and evaporate rocks at depth including Kaibab Limestone underlying basalt bedrock (Figure 42). The

extent of the basalt flows in the CWPP area is shown on Figure 42 in the light tan color. The bedrock unit shown in the bright pink color consists of Tertiary age sedimentary rocks.

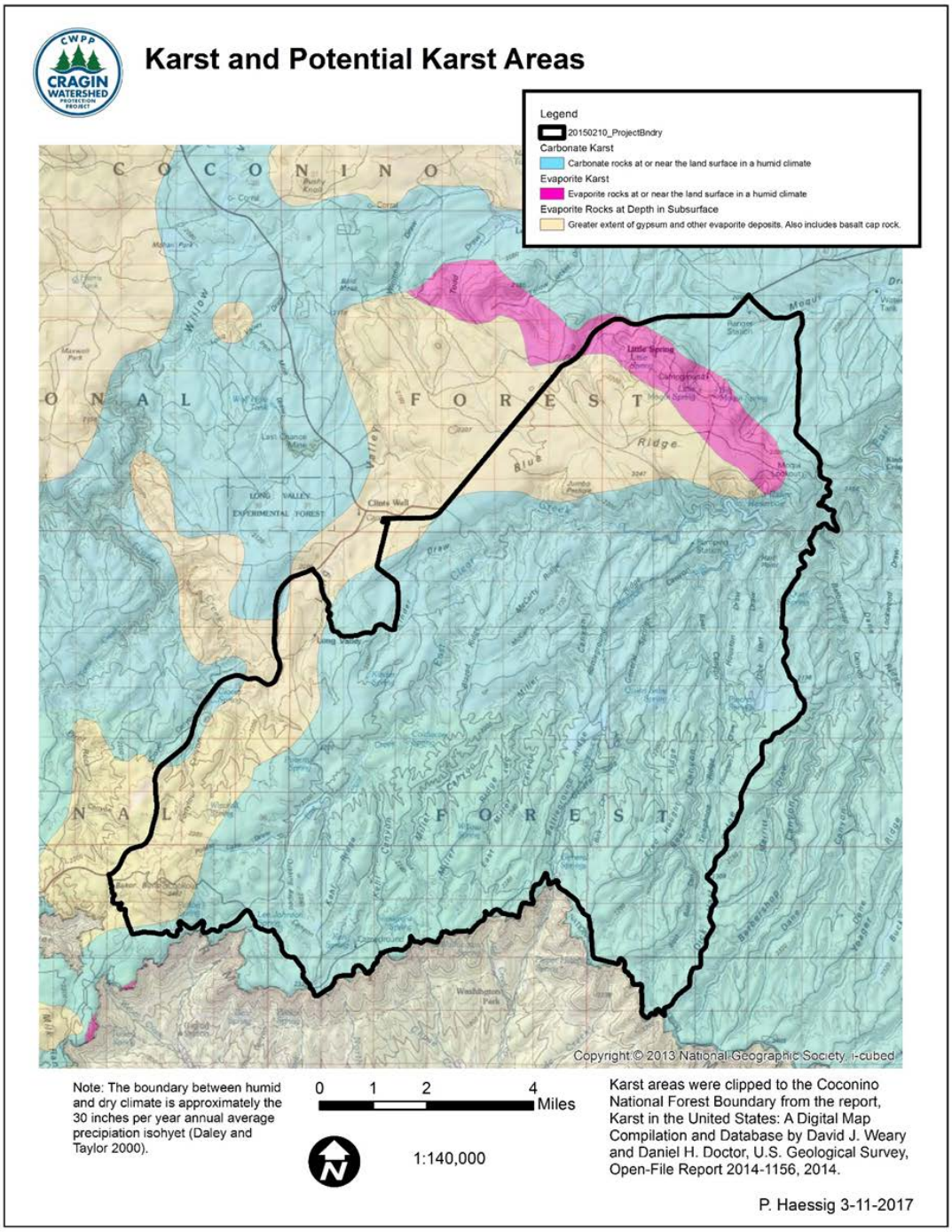


Figure 42. Karst and potential karst areas in the CWPP area consisting of carbonate karst and evaporate karst at or near the surface and at depth in the subsurface.

Karst Types

In the CWPP area, 293 features were surveyed and inventoried. Features that upon field assessment turned out to be "not karst" are in the following categories: erosional features and headcuts, steam channel incisions, shallow depressions in basalt bedrock; tree stump holes; and historic manganese mine trenches and pits. Features that are classified as "other karst" include shallow depressions and sinkholes in alluvial deposits and soils overlying bedrock.

Features classified as "pseudokarst" are various descriptions of depressions and sinkholes in basalt overlying soluble limestone bedrock, filled in sinkholes in basalt bedrock with or without openings and air flow and possible collapsed lava tube openings and entrances.

Resource Protection Buffers

Resource protection buffers were developed by the geology crew together with the project geologist based on karst feature observations during the survey. The protection buffers were designed individually for each cave and karst feature based on the field inventory and assessment data. The criteria for the buffers included the feature type and whether the karst feature or cave was open, had an opening or blowing air, had an opening that water drained into or was a karst feature associated with a sinking or emerging stream. Sinkholes or pits that were filled in with sediment or did not have identifiable openings were buffered but the buffer radius was less than 300 feet. All buffers extend from the edge of the karst feature. Each karst feature was digitized on the LiDAR image to provide a better representation of the karst feature. This resulted in a "Feature Footprint" layer for the project.

For the CWPP, 179 features were assigned protection buffers. The buffers total 822 acres.

Table 45. Karst Protection Buffers

Buffer Width	Number of Features
No buffer	114
50 feet	56
100 feet	35
300 feet	88
Total	293

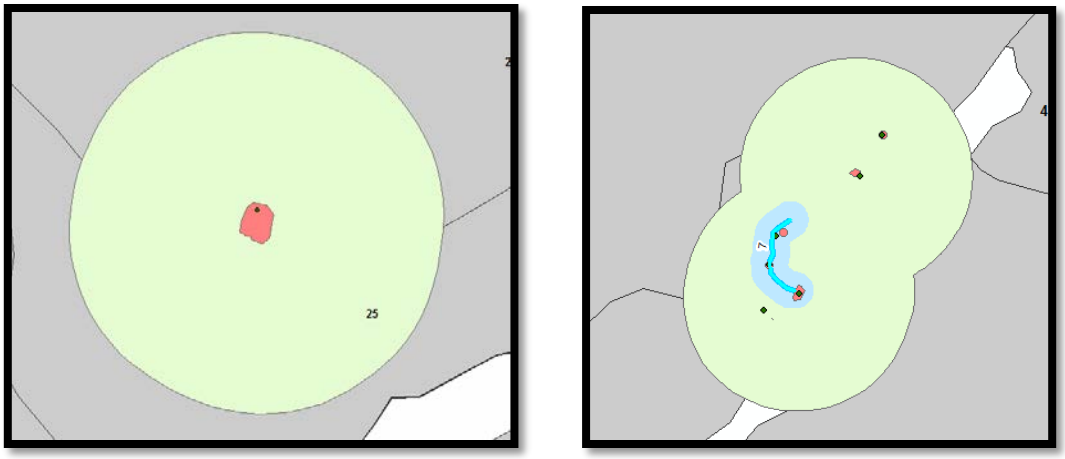


Figure 43. Two examples of karst features and their buffers.

In the picture on the left, a karst sinkhole with an opening has a 300 foot buffer shown with the buffer radius drawn from the edge of the feature footprint colored in red. In the picture on the right six karst features were assessed in the field and two of the features were sinkholes with openings or sinking streams. The two features were each buffered 300 feet from their feature footprint and the buffers overlap and include the other karst features. Polygons colored in gray are cutting units; polygons colored white are areas excluded from thinning for other reasons (slope, rocky benches, etc.).

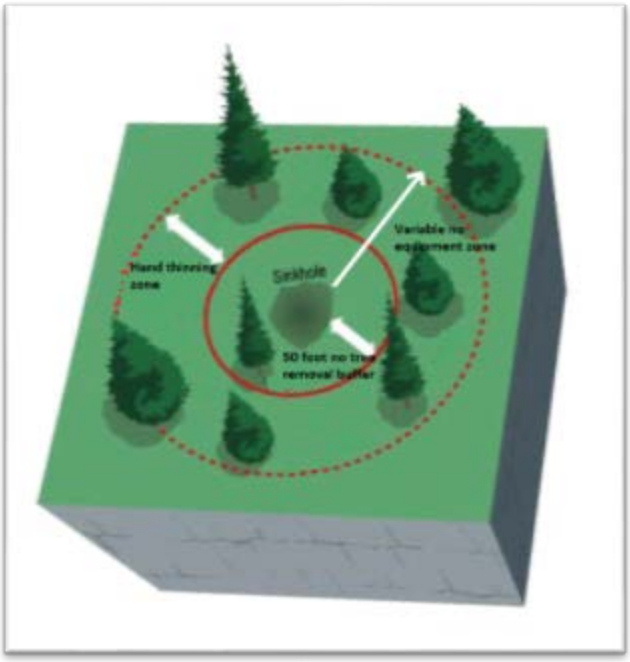


Figure 44. This is a graphical representation of karst protection buffers around a sinkhole.

Around the sinkhole is a 50 foot buffer (red solid line) from the edge of the karst footprint where no trees can be removed so that the desired conditions of the karst feature can be maintained. From the edge of the karst footprint out to the red dashed line is a variable buffer width (50, 100 or 300 foot) where logging equipment and skidding is excluded. Outside of the 50 foot buffer, hand thinning of trees may occur under a timber stand improvement or similar type of prescription.

The protection buffers are equipment exclusion zones as well as no timber harvest areas. This is to protect the cave and karst features from impacts such as erosion and sedimentation, and will maintain the current vegetation and ecology of the sinkhole, cave or other karst feature. The large buffer widths for caves and sinkhole/pits with openings are to protect the underground passages from collapse from heavy equipment operating over them. The buffer width is meant to be conservative because little underground survey or mapping has been done on the caves and karst features with openings, so we don't really know how extensive in area the underground passages are. However, most of the caves, fissures, lava tubes and pit/sinkholes with caves in the project area known (from underground survey) are anticipated to extend more than 300 beyond the feature footprint.

The no treatment buffer width does not apply for prescribed burning activities. Prescribed burning can have positive benefits of reducing ground and ladder fuels and raising crown base heights of live trees in karst terrain. As long as the burning is of low-to-moderate burn intensity so that the soil is not damaged, and the overall burn severity is low-to-moderate so that the trees and brush within the karst feature are not killed then the prescribed burning will have no impacts on the karst feature and the cave microclimate, karst ecology hydrology, and entrance vegetation should be maintained. Management ignitions and fire control lines should not occur within karst features, the feature footprint or near cave openings. The preferred best management practice is to have fire creep up to the feature and back down into it thereby reducing the dead and down fuels and litter within the karst feature.

The buffer width for hand thinning activities such as implementing a timber stand improvement prescription will consist of a 50 foot no thinning buffer width from the edge of the karst feature footprint. Thinning and piling of slash can occur outside of the 300 foot protection zone. No slash should be put into the cave or sinkhole feature. Directional felling should be used to fell trees away from the karst feature.

Stream Channel Protection Buffers

Twelve (12) infeeder and emerging stream channels were identified in the surveys. Some of the stream channel buffers are entirely within the no ground disturbance buffer and so will have enhanced protection. Stream channel buffers that extend outside of the feature buffer will be managed as Aquatic Management Zones so though logging may occur it will be managed carefully applying appropriate BMPs so that management related sediment and debris mobilization is minimized and that the overall water quality is protected.

Environmental Consequences

Alternative 1– No Action

Direct and Indirect Effects

Under this alternative there will be no activities that will affect known cave and karst features or inflowing or outflowing streams associated with caves and karst features. There will be no thinning, burning, road use connected with logging and burning activities and no use of proposed processing sites.

The only other disturbances to cave and karst resource in the project area will be by recreation activities and from wildfire. The primary recreation activities that are known include cave entry and exploration by local caving groups. They are known to the district geologist and practice ethical and responsible cave exploration techniques. The fire intensity and severity predicted by the No Action

alternative will have the potential to increase sedimentation, debris and ash delivery into karst features, cave entrances and infeeder drainages. The vegetation, shading and microclimate around cave entrances and openings could be altered and changed which will affect cave habitat and climate. These effects could result in changes to the wildlife living in caves and growth of cave formations. Trees that are burnt and killed in or surrounding karst formations could fall into sinkholes and the needles and debris form the dead trees could enter the opening and cave entrances.

Karst springs, infeeder drainages or resurgent streams could be impaired by high sediment loads, ash and debris from areas burned at moderate to high severity. Ash and nutrients released from the burned soil could enter the karst groundwater system and could degrade the groundwater quality over natural levels. Sediment, ash and debris could plug up cave entrances or swallets (opening through which a stream disappears underground in a karst system) and completely change sinkhole or cave system and habitat. Fire reduces soil CO_2 concentration by killing vegetation and soil dwelling microbial communities that contribute to soil respiration. While reductions in microbial respiration are short-lived, root respiration from trees takes longer to recover and could take 5-10 years to return to pre-fire levels. The depression in soil respiration and long term reduction in soil CO_2 caused by wildfire in karst environments is likely to cause decreased rates of cave formation growth (Coleborn, et al., 2014).

Cumulative Effects - No Action

Past thinning and timber harvest in the CWPP is minor in extent, totaling about 1,565 acres from the East Clear Creek Watershed Health Vegetation Treatments decision (2009) and Tornado sale (2014) and 15 acres of thinning in meadows as part of the Long Valley Meadow Restoration Project (2017). A future small timber sale will be the LEARN Mixed Conifer study which has Block #1 in the CWPP area totaling 56 acres. None of the past thinning, timber harvest, wildfires or prescribed burns in the project area protected karst and cave features because their locations were unknown until the survey occurred.

Restoration actions proposed by the Rim County EIS, the Long Valley Meadow and Work Center Restoration Project and Changes to Motor Vehicle Designations NEPA analysis on the Mogollon Rim District are all considering impacts to cave and karst resources in the CWPP area using the results of the karst inventory.

The no action alternative would include no thinning, prescribed burning and fuel reduction activities, and will not result in a reduction in the risk of crown fire across the project area. Combined with the expected increase in area and intensity of high-intensity crown wildfire in the project area as a result of climate change, there is be a greater risk to karst and cave features integrity and groundwater quantity from uncharacteristic wildfire. Despite managed fires reducing fuel loads in locations throughout the project area over the past few years, existing fuel loads and stand conditions (high density of trees and low crown base heights) will still potentially lead to uncharacteristic fire and risk of active crown fire. This combined with the increasing risk of high-intensity wildfire as a result of climate change will lead to a cumulative increased risk of an uncharacteristic wildfire in the project area that could lead to increased sedimentation into sinkholes and caves, changes to hydrologic conditions, shading and infeeder stream water quality affecting karst and cave features and the subsurface groundwater system.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Identification and protection of cave and karst resources from project activities and ground disturbance.

Cutting trees, skid trails, mechanized equipment harvesting, piling and burning etc. at or near cave entrances or in or near sinkholes with openings can change the microclimate, water flow, air flow, air temperature, relative humidity and level of shading. Disruption of these conditions can alter air and water exchange, subsurface habitats (e.g. bats, invertebrates) and cave formation processes beyond the range of natural variability. Cave entrances and sinkholes provide habitat conditions for flora inhabiting the cave entrance and /or cave dwelling organisms (e.g. spiders, crickets, salamanders) that forage in the cave entrance or rely on organic matter falling into the cave or opening as a food source. Logging, skidding, mechanized harvesting and temporary road construction can mobilize sediment, expose bare soil and discharge logging debris into cave entrances and openings in sinkholes. The weight and vibration from logging equipment and haul trucks in the cutting unit and on skid trails and temporary roads, can damage cave formations underground and could cause ground collapse into the cave or underground passages. Prescribed burning can have damaging effects to cave and karst resources if the burn intensity and severity is high where trees and understory vegetation are scorched and killed and the duff layer above the soil is totally consumed damaging the soil. The effects from this can damage the microclimate around caves and openings and can increase sedimentation and debris mobilization into caves and sinkholes (Karst Management Handbook for British Columbia, 2003).

By conducting extensive survey and inventory of cave and karst resources in the project area, the location of these features is accurately known in the project area and appropriate protection buffers have been delineated. By implementation of the 50, 100 or 300 foot no mechanized thinning buffers around karst feature footprints and applying the project design features there will be no direct impacts to these features from logging, skidding, mechanized harvesting and temporary road construction. They will be protected from physical damage and the important microclimate, water flow, air flow, air temperature, relative humidity and level of shading will be maintained at the current condition. Hand thinning may be conducted to implement timber stand improvement but a 50 foot no treatment or slash piling buffer away from the cave entrance or karst feature foot print will be protective and minimize impacts to the feature. Implementation of the buffers will also minimize indirect effects of sedimentation and erosion into cave entrances or other karst features.

During implementation of prescribed burning, broadcast and maintenance burning, the locations of karst features will be identified as part of the burn plan and there will be no direct ignition near cave entrances or within sinkholes. The desired management objectives for vegetation, soils, snags, down logs, etc. will be met in the areas of karst features (CK4). Management ignitions and fire control lines will not occur within karst features, the feature footprint or near cave openings (CK4). Allowing prescribed fire to creep up to the karst feature and back down into it will minimize effects of the burning and thereby reduce the dead and down fuels and litter. Positive benefits will be to reduce fuels near karst features and to stimulate growth of understory vegetation.

Existing roads may be used for mechanical harvest and hauling within buffers in preference to building new roads as long as the road is stable and is not currently impacting karst features. Erosion control measures (straw wattles, silt fences, etc.) will be used to minimize road-related sedimentation into nearby caves or sinkholes (CK3).

No skid trail use will occur within buffers. New temporary roads and landings will be constructed outside cave or karst feature buffers. Because cave and karst resources have been identified on the ground and protection buffers have been delineated, new temporary roads and landings can be routed outside of the cave and karst buffer zones so as to not impact the features (CK1, CK2).

Processing site locations are all outside of any cave or sinkhole buffer zone so there will be no effects to cave or karst features from use of these sites.

Identification and protection of inflowing streams to caves and sinkholes and outflowing or resurgent streams from caves and sinkholes.

Karst springs and streams that emerge from karst formations (resurgences) are important for the maintenance of water quality and water quantity within the range of natural variability and provide wildlife and aquatic habitat. Similarly, maintenance of water quality and quantity for sinking streams that enter sinkholes and cave openings is important for the health of the underground system because eventually this water will emerge as a spring or a stream.

The desired condition is to maintain water quality and quantity and to limit the introduction of sediment, fine organic material, ash and woody debris into subsurface environments within the range of natural conditions. In addition, the desired conditions are to limit degradation of the channel banks, loss of riparian and understory vegetation and maintain the stability and root support function of the trees.

By conducting extensive survey and inventory of cave and karst resources and springs in the project area, the location of 12 infeeder and emerging streams have been identified and stream channel buffers have been applied. Where the streams occur within the overall karst or cave protection buffer they will be fully protected from logging disturbance. Where the infeeder or emerging stream is located outside of the protection buffer, the stream will be managed as an Aquatic Management Zone (AMZ) where logging activities and skid trail crossings will be carefully managed so as not to impact the streamside zone or water quality.

AMZ buffer strips associated with karst features will be used to minimize erosion and sedimentation within stream courses that lead into or emerge from caves, sinkholes and karst springs. The AMZ buffer should extend 1,000 feet upstream or downstream of the karst feature or to where the channel ends if less than 1,000 feet. The buffer should be 100 foot wide or 50 feet from the center of the channel. The AMZ buffer for karst infeeder or emerging drainages is similar to the standard stream course buffer of 25 feet from the stream bank edge (see SW4 in Appendix B). On hillslopes >35%, the stream course buffer is 50 feet from the stream bank edge (SW4).

Of the 12 identified karst infeeder stream AMZs, four are not within thinning treatment units. The other eight are all or partly within thinning units and the AMZ extends beyond the karst feature buffer. These karst infeed stream AMZs will be displayed on the sale area map for the project along with all of the other AMZs.

The soil and watershed protection design features for the project during prescribed burning activities restrict the location of equipment staging and fueling areas outside of AMZ and ignition of fuels will not be initiated in AMZs (SW5). Similar to the karst design feature CK4, prescribed fire can occur within AMZs while meeting desired objectives for vegetation, soils, snags, down logs etc. Hand piling and burning of slash will be avoided n AMZs to the extent possible.

None of the 12 infeeder stream channel buffers are near or cross proposed new temporary roads. An existing closed road, the 612C crosses an infeeder channel in a proposed thinning treatment unit. Of

the 12 infeeder stream channel buffers five have existing system roads within the karst feature buffer and two roads cross the AMZ. All of the karst stream channel buffers as well as the karst feature buffers will be identified on maps during project layout. The logging units will be designed to avoid impacts to the karst features and infeeder streams.

Processing site locations are all outside of karst infeeder stream buffers.

Cumulative - Proposed Action

The boundary for the analysis of cumulative effects is the CWPP project area. The time frame for the analysis of effects is throughout the project duration which could be up to 20 years to complete thinning and prescribed burning activities. The ongoing and foreseeable activities and projects considered for cumulative effects include planned timber sales, prescribed burning, and restoration actions proposed by the Rim County EIS, the Long Valley Meadow Restoration Project and Changes to Motor Vehicle Designations NEPA analysis on the Mogollon Rim District.

All of the past thinning and prescribed burning projects did not have previous cave and karst inventory or LiDAR imagery so protection of these features has not occurred during past project implementation. However the current condition of these features is remarkably good and few impacts for forest management or recreational use were identified during recent surveys.

The inventory and karst database that was developed in 2015 specifically for the CWPP project has identified 179 features for protection and 12 stream courses for AMZs and protection from the thinning, prescribed burning, temporary road construction and road use actions proposed under the Proposed Action Alternative 2. Processing sites will not affect any karst features as they were identified early and prospective areas that were considered avoided these sensitive karst terrain. When new temporary roads are laid out as part of implementation in CWPP, they will avoid karst feature buffers and avoid AMZs where possible.

The inventory and karst database that was developed in 2015, and LiDAR imagery for MRRD is used for informing other projects that are ongoing or in the planning stages in the project area. Karst features and protection buffers have been identified for the East Clear Creek Task Order timber sale, prescribed burning as part of the East Clear Creek Watershed Health project and maintenance burning as part of the Blue Ridge Urban Interface Project. Karst feature buffers are identified in planning and layout of timber sale projects. Karst feature locations are made available to the fire crews implementing burns so they can be informed of sinkholes for safety reasons and so that no fire ignitions occur within karst features. As part of environmental review for the Rim County EIS, the Long Valley Work Center Restoration Project, the LEARN Mixed Conifer study, and Changes to Motor Vehicle Designations NEPA analysis on the Mogollon Rim District, sensitive karst features and cave locations have been identified for protection in the planning for these projects as part of the IDT environmental review process. Thus there is no expecte cumulative impact to caves and karst features from the future implementation of current or reasonably foreseeable projects.

The karst inventory database, protection buffers and design features in this EA for the CWPP project will mitigate any of the project's adverse effects to cave and karst resources, resulting in no detrimental cumulative effects. CWPP in combination with other ongoing and future foreseeable projects will be protective of cave and karst resources by using the existing inventory and available imagery, conducting any new surveys as needed, and implementing protection buffers.

The proposed action is also expected to reduce the risk of high-intensity crown fire throughout the project area. This will function to counteract the increasing risk of high-intensity wildfire as a result

of climate change, thus reducing the potential effect to cave and karst features within the project area over the next two decades.

Wildlife

The following section describes the affected environment and effects of the alternatives relating threatened, endangered, and Forest Service sensitive species (TES), management indicator species, migratory bird priority species that may occur or may have habitat in the project area. This section also discusses effects to wildlife cover and key habitat components such as snags and downed logs.

Affected Environment

Threatened, Endangered, Proposed, and Candidate Species

Two terrestrial wildlife species listed as threatened or endangered under the Endangered Species Act are known or have the potential to occur in the project area are listed in Table 46. Mexican spotted owls (MSO) are known to occur and critical habitat for the species is designated in the project area. Chiricahua leopard frogs have not been detected in the project area since the early 1970s but the project area is located in the East Clear Creek Management Area in Recovery Unit 5 and contains potential habitat.

Table 46. Threatened, endangered, proposed, and candidate wildlife species considered in the Cragin Watershed Protection Project Area.

Species, (*Scientific Name)*	Status
Mexican Spotted Owl (*Strix occidentalis lucida*) Species, Habitat & Critical Habitat	Federally Threatened
Chiricahua Leopard Frog (*Lithobates chiricahuensis*) Habitat	Federally Threatened

Mexican Spotted Owl

For the Mexican spotted owl, the analysis area is defined as the project footprint plus a 0.25 mile buffer. The area within in the buffer is included to account for potential disturbance of nesting owls in areas adjacent to the project footprint from proposed project activities.

The analysis area contains both PAC and recovery habitats as defined in the 2012 Mexican spotted owl recovery plan. Recovery habitats are potential owl forest and riparian habitats outside of PACs and are divided into two types: those areas that are identified as future nesting and roosting habitats, referred to as nest/roost replacement recovery habitat in this document, and those habitats that are identified for all other uses, referred to as foraging/non-breeding recovery habitat in this document. Existing acres of owl habitat in the project footprint are summarized in Table 47 and Figure 45.

Recovery Habitat

To identify potential recovery habitat in the project footprint, information from Prather et al. (2008) was overlaid with the stand layer for the CWPP in GIS. The data used from this publication was the owl nesting and roosting habitat predictive layer developed from data from the Forest Ecological Restoration Analysis project. Since the authors stated that this model overestimates owl habitat, only those stands that contained at least one pixel of habitat identified as “high suitability” were identified as potential recovery habitat. Additionally, all slopes greater than or equal to 40 percent were included as potential recovery habitat. Forest type (mixed conifer or pine-oak) was determined using the

Ecological Response Unit layer created by the Four Forest Restoration Initiative planning team for the Rim Country analysis area. This layer delineates the differences between forest types such as pine – oak from pure ponderosa pine. This methodology was developed with USFWS Supervisory Fish and Wildlife Biologist Shaula Hedwall.

Table 47. Summary of acreages of Mexican spotted owl recovery habitat in the Cragin Watershed Protection project footprint.

Forest Type	Description		Acres of Habitat
Mixed Conifer	Nest/Roost Replacement		1,374*
	Foraging/Non-Breeding		8,738
	Total		**10,112**
Pine-Oak	Nest/Roost Replacement	176*	
	Foraging/Non-Breeding	7,541	
	Total	**7,717**	
Total Acres of Recovery Habitat		**17,829**	

*A District-wide assessment was conducted to identify nest/roost replacement habitat that included those acres identified in previous decisions (Clints Well Forest Restoration Project, 2013 and Upper Beaver Creek Fuels Reduction Project, 2010) as well as those acres in the CWPP and Four Forest Restoration Initiative Rim Country analysis areas, which includes CWPP.

During the spring/summer of 2017, a large portion of these stands were field-verified to better refine potential recovery habitat in the project footprint. Adjustments to the potential owl habitat layer were made to reflect forest types observed. As depicted in Figure 45 and shown in Table 47, recovery habitat is comprised of approximately 10,112 acres of mixed conifer and approximately 7,717 acres of pine – oak for a total of approximately 17,829 acres. The project footprint does not contain any riparian habitats, as defined in the recovery plan.

Table 48 lists fire type rating for recovery habitats. Approximately 37 percent of recovery habitat in the project footprint was rated as having active or passive crown fire potential through fire modeling efforts, indicating that wildfire activity under extreme weather conditions would result in more severe impacts to ecosystem components than should occur for the natural fire regime. This includes approximately 31% of mixed conifer recovery habitat and 43% of pine – oak.

Table 49 contains information about the snags, logs, and coarse woody debris in the spotted owl recovery habitats. This data was collected in 2015 by the District fuels crew at randomly selected points across the project footprint. None of nearly 200 plots were located in the small number of acres of pine-oak nest roost replacement habitat, so these numbers could not be estimated.

Table 48. Existing conditions for fire potential in MSO recovery habitats in the CWPP footprint

Forest Type	Description	Surface Fire	Passive Crown Fire	Active Crown Fire
Mixed Conifer	Nest/Roost Replacement	**85%**	**13%**	**2%**
	Foraging/Non-Breeding	**66%**	**25%**	**9%**
	Total	**69%**	**23%**	**8%**

Pine - Oak	Nest/Roost Replacement	**49%**	**51%**	**0%**
	Foraging/Non-Breeding	**58%**	**29%**	**13%**
	Total	**57%**	**30%**	**13%**
Total For All Recovery Habitats		**64%**	**26%**	**11%**

Table 49. Existing snags, logs, and tons per acre of woody debris in Mexican spotted owl recovery habitats in the Cragin Watershed Protection Project footprint.

Forest Type	Description	Average # of Snags per acre*	Average # of Logs per acre*	Average Tons per Acre of Coarse Woody Debris
Mixed Conifer	Foraging/Non-breeding	1.5	8	14
	Nest Roost Replacement	3.5	26	25
	Recovery Habitat Total	**2.5**	**17**	**20**
Pine Oak	Foraging/Non-breeding	1	8	13
	Nest Roost Replacement	Not available	Not available	Not available
	Recovery Habitat Total	**1**	**8**	**13**

*Snags are defined as those observed that are equal to or greater than 18 inches dbh. Logs are defined as those observed that are equal to or greater than 12 inches dbh and greater than 8 feet long.

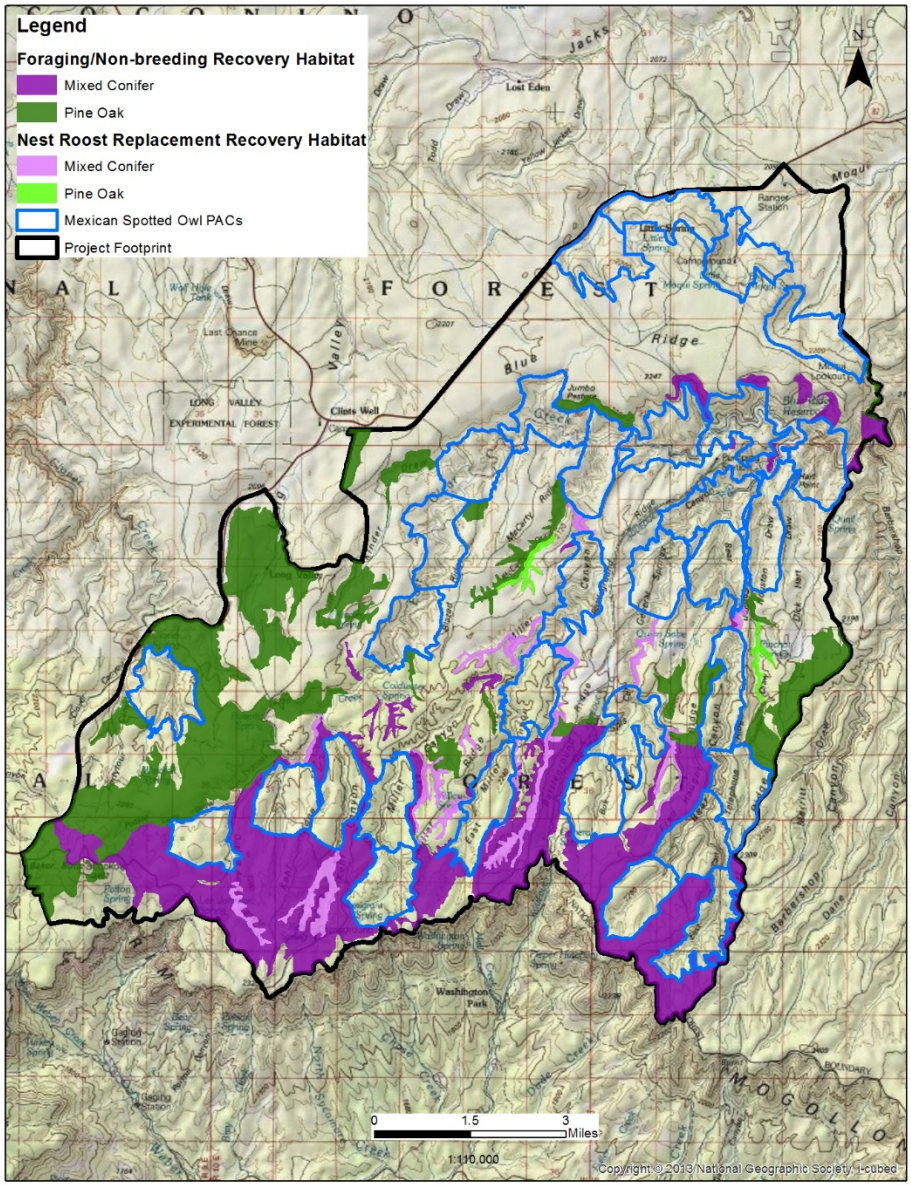


Figure 45. Mexican spotted owl recovery habitat identified in the Cragin Watershed Protection Project footprint.

Foraging/Non-Breeding Recovery Habitat

As shown in Table 47 and depicted in Figure 45, approximately 16,335 acres of foraging/non-breeding habitat occur in the project footprint, including approximately 8,677 acres of mixed conifer and 7,658 acres of pine – oak. Approximately 38 percent of foraging/non-breeding habitat in the project footprint was rated as having active or passive crown fire potential (Table 48). This includes approximately 34% of mixed conifer and 43% of pine – oak.

Foraging/non-breeding recovery habitat is characterized by hardwood tree species and large trees, snags, and logs. Stands of foraging/non-breeding recovery habitat in the project footprint have more than half of their stand densities in young trees greater than 12 inches dbh and a little over one-tenth of their stand densities in trees greater than 18 inches dbh in both mixed conifer and pine-oak forest types. While there are no set values for stand densities in this recovery habitat type, the lower number

of trees greater than 18 inches dbh in the project footprint suggests that desired conditions are not being met. There are high volumes of coarse woody debris and logs greater than 12 inches dbh, and while there are no set values in the 2012 Recovery plan, these numbers do meet or exceed desired conditions in both forest types in the Forest Plan. Snags equal to or greater than 18 inches dbh are on the low end of desired conditions in pine-oak and below desired levels in mixed conifer, according to the Forest Plan. High densities of smaller trees and limited openings in the foraging/non-breeding recovery habitats are preventing development of a structurally and biologically diverse assemblage of tree and understory species. This reduces the number of perches available to owls and shrub and herbaceous vegetation cover hat support prey. Also, these high density of smaller trees can act as ladder fuels and is one of the main factors that contributes to the high potential for active crown fire in foraging/non-breeding habitats in the project footprint.

Nest/Roost Replacement Recovery Habitat

A District-wide assessment to identify nest/roost replacement recovery habitat was conducted in 2017. In addition to those acres of nest/roost replacement habitat identified in previous decisions (Clint's Well Forest Restoration Project, 2013 and Upper Beaver Creek Fuels Reduction Project, 2010), acres in the 4FRI Rim Country analysis area and CWPP were identified. For pine-oak acres identified as nest/roost replacement habitat exceeded recovery plan guidelines of 10% of the acres of this habitat on the District. For mixed conifer, the number of acres of nest roost replacement habitat identified on the District is slightly less than the recommended 25% of mixed conifer. As shown in Table 47 and depicted in Figure 45 approximately 1,550 acres of nest/roost replacement recovery habitat identified on the District exists in the project footprint, including approximately 1,374 acres of mixed conifer and 176 acres of pine – oak. Based on modeling efforts, approximately 19 percent of the acres of nest/roost replacement habitat in the project was rated as having passive or active crown fire potential (Table 48).

Nest/roost replacement habitat is characterized by threshold minimum basal areas, trees per acre greater than 18 inches dbh, and a threshold percent of basal area of trees 12-18 inches dbh and greater than 18 inches dbh. To be identified as nest-roost replacement habitat, the minimum basal area in mixed conifer is 120 square feet per acre and 110 square feet per acre in pine-oak. Recovery plan direction is for both cover types to have a minimum of 12 trees per acres greater than 18 inches dbh and greater than 30 percent of their basal area in trees 12-18 inches dbh and 30 percent of basal area in trees greater than 18 inches dbh. Stands of nest/roost replacement habitat in both mixed conifer and pine-oak have approximately one-third of their stand densities in young trees less than 12 inches dbh and approximately one-quarter of their stand densities in trees greater than 18 inches dbh. Trees per acres in both cover types exceed desired conditions. Coarse woody debris, logs greater than 18 inches dbh and snags greater than 18 inches dbh meet or exceed desired conditions in mixed conifer, but the conditions in pine oak habitats are unknown due to a lack of sampling in the limited number of acres in the project footprint.

Protected Activity Center Habitat

There are 32 PACs totaling approximately 19,471 acres in the project footprint. Approximately 17 percent of these acres are in designated nest cores. Information about PAC acres are summarized in Table 50 and displayed in Figure 45.

Table 50. Summary of acreages of MSO PACs, nest cores, and habitat types in the CWPP footprint.

Name	Protected Activity Centers in Project footprint			
	Acres	Habitat Type	Acres* (% of total)	Nest Core (acres)
Bear Canyon	603	Mixed Conifer	597 (99)%***	101
		Pine – Oak	0	
Blue	615	Mixed Conifer	162 (26%)	101
		Pine – Oak	453 (74%)	
Blue Ridge	614	Mixed Conifer	208 (34%)	104
		Pine – Oak	406 (68%)	
Box Canyon	644	Mixed Conifer	629 (98%)	100
		Pine – Oak	15 (2%)	
Budapest	602	Mixed Conifer	602 (100%)	102
		Pine – Oak	0	
Clearcut	600	Mixed Conifer	308 (51%)	101
		Pine – Oak	292 (49%)	
Dirty Neck	617	Mixed Conifer	0	100
		Pine – Oak	617 (100%)	
East Miller Canyon	622	Mixed Conifer	464 (75%)	102
		Pine – Oak	157 (25%)	
Fred Haught	601	Mixed Conifer	320 (53%)	**
		Pine – Oak	281 (47%)	
General Springs	612	Mixed Conifer	366 (60%)***	101
		Pine – Oak	233 (38%)***	
Hart Point	601	Mixed Conifer	476 (79%)	100
		Pine – Oak	125 (21%)	
Hoot	633	Mixed Conifer	369 (58%)***	101
		Pine – Oak	258 (41%)	
Houston	601	Mixed Conifer	199 (33%)	100
		Pine – Oak	402 (67%)	
Hunter	643	Mixed Conifer	0	**
		Pine – Oak	643 (100%)	
Immigrant	604	Mixed Conifer	604 (100%)	100
		Pine – Oak	0	
Jones Crossing	605	Mixed Conifer	381 (63%)	102
		Pine – Oak	224 (37%)	
Kehl Ridge	603	Mixed Conifer	603 (100%)	101
		Pine – Oak	0	
Little Springs	608	Mixed Conifer	288 (47%)	101
		Pine – Oak	320 (53%)	
McCarty	617	Mixed Conifer	288 (47%)	101
		Pine – Oak	329 (53%)	
Mid Miller Canyon	605	Mixed Conifer	431 (71%)	110
		Pine – Oak	174 (29%)	
Miller Canyon	600	Mixed Conifer	582 (97%)	101
		Pine – Oak	18 (3%)	

Name	Protected Activity Centers in Project footprint			
	Acres	Habitat Type	Acres* (% of total)	Nest Core (acres)
Mud Springs	601	Mixed Conifer	601 (100%)	101
		Pine – Oak	0	
North Miller	605	Mixed Conifer	261 (43%)***	101
		Pine – Oak	332 (55%)***	
Panda	655	Mixed Conifer	655 (100%)	101
		Pine – Oak	0	
Pinchot	601	Mixed Conifer	357 (59%)	101
		Pine – Oak	244 (41%)	
Potato Lake	476	Mixed Conifer	76 (16%)***	100
		Pine – Oak	377 (79%)***	
Quien Sabe	604	Mixed Conifer	242 (40%)	101
		Pine – Oak	362 (60%)	
Rock Crossing	600	Mixed Conifer	276 (46%)***	100
		Pine – Oak	195 (33%)***	
Rock Crossing West	617	Mixed Conifer	290 (47%)***	101
		Pine – Oak	292 (47%)***	
Telephone Ridge	629	Mixed Conifer	420 (67%)***	104
		Pine – Oak	197 (31%)	
Turkey	610	Mixed Conifer	251 (44%)	100
		Pine – Oak	359 (59%)	
Upper East Miller	625	Mixed Conifer	625 (100%)	100
		Pine – Oak	0	
Total Protected Activity Center Habitat	**19,471 acres**	**Mixed Conifer**	**11,938 acres******	**3,040 acres**
		Pine – Oak	**7,299 acres******	

*Acres of habitats in PACs were estimated using GIS information. Field verification of habitats will occur prior to implementation.
**Insufficient detection information exists to confidently designate nest cores for Fred Haught and Hunter PACs. Surveys will continue and nest cores will be delineated in conjunction with USFWS prior to implementation of treatments in these two PACs.
***Five PACs include approximately 149 acres of the C.C. Cragin Reservoir and four PACs contain approximately 38 acres of meadow habitats, so the acres and percentages of habitat do not add up to the total PAC acres or 100 percent.
****The Rock Crossing PAC contains approximately 48 acres of pine-oak habitat and 3 acres of mixed conifer habitat that are on private land; these acres are not reflected in total habitat acres.

There are eight additional PACs within the analysis area outside of the project footprint: Barber Lake (601 acres), Dane Barber (603 acres), Horse Crossing (638 acres), Lockwood Draw (647 acres), Maverick Canyon (606 acres), Middle Tank (601 acres), Quail Springs (602 acres), and Valley (605 acres).

One of the primary concerns for the Mexican spotted owl is the potential loss of habitat from uncharacteristic stand-replacing wildfire (USFWS 2012b). Crown fire potential was analyzed for the project footprint using data generated from modeling performed using FlamMap. Three types of fires result from the modeling: surface fire, passive crown fire, and active crown fire. Surface fire describes fire that burns through the surface fuels of the forest floor. This type of fire is the least active of fire behaviors and is the most role of low intensity, high frequency fire in the southwestern ponderosa pine ecosystem. Passive crown fire, or torching, occurs when flame lengths are long

enough to reach the lower edge of the canopy and can result in individual or small group tree torching but does not proliferate through the forest canopy through continuous crown fire spread. Active crown fire occurs when flames reach the forest canopy and spreads through it with intensity and continuity. Table 51 summarizes the fire potential for PAC habitats in the project footprint.

Table 51. Existing conditions for crown fire potential in Mexican spotted owl protected activity center habitats in the Cragin Watershed Protection project footprint.

Protected Habitat Type	Surface Fire	Passive Crown Fire	Active Crown Fire
Mixed Conifer	68%	17%	15%
Pine - Oak	43%	45%	12%
Totals*	**59%**	**28%**	**13%**

Approximately 41 percent of the PAC habitat in the project footprint was rated as having active or passive crown fire potential, indicating that wildfire activity would result in more severe impacts to ecosystem components than should occur under the natural fire regime. This includes 32% of mixed conifer PAC habitat and 57% of pine – oak.

Occupied or PAC habitat tends to be characterized by percent of basal area by size class and trees per acre greater than 18 inches diameter as well as the amount of course woody debris and snags greater than 18 inches. PAC habitat in both mixed conifer and pine-oak are below the minimum basal area of 30 percent in trees larger than 18 inches dbh. In both cover types in PACs, stands have less than half (42%) of their stand densities in trees less than 12 inches dbh and approximately one-quarter of their stand densities in trees greater than 18 inches dbh. Coarse woody debris and logs greater than 12 inches dbh meet or exceed desired conditions in both habitats, while snags equal to or greater than 18 inches dbh in pine-oak meet desired conditions but are below desired conditions in mixed conifer (Table 52).

Table 52. Snags, logs, and tons per acre of woody debris in Mexican spotted owl protected activity center habitats in the Cragin Watershed Protection Project footprint.

Forest Type	Average # of Snags per acre*	Average # of Logs per acre*	Average Tons per Acre of Coarse Woody Debris
Mixed Conifer	1	7	9
Pine Oak	1	7	10

*Snags are ≥ 18 inches dbh and logs are ≥ 12 inches dbh and ≥8 feet long.

Mexican Spotted Owl Critical Habitat

Critical habitat for the Mexican spotted owl was established in 1995 and revised in 2012 (USFWS 2012b). For this species, critical habitat includes areas within mapped boundaries of protected and recovery habitat which has one or more primary constituent elements (PCEs). PCEs of critical habitat in non-riparian habitats for the Mexican spotted owl include the following:

(A) Primary constituent elements related to forest structure:

(1) A range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30 percent to 45 percent of which are large trees with a trunk diameter of 12 inches (0.3 meters) or more when measured at 4.5 feet (1.4 meters) from the ground;

(2) A shade canopy created by the tree branches covering 40 percent or more of the ground; and

(3) Large dead trees (snags) with a trunk diameter of at least 12 inches (0.3 meters) when measured at 4.5 feet (1.4 meters) from the ground.

(B) Primary constituent elements related to maintenance of adequate prey species:

(1) High volumes of fallen trees and other woody debris;

(2) A wide range of tree and plant species, including hardwoods; and

(3) Adequate levels of residual plant cover to maintain fruits, seeds, and allow plant regeneration.

There are approximately 35,845 acres of designated critical habitat in the project footprint, all of which are located in the Upper Gila Mountain Ecological Management Unit. Of these acres, approximately 15,312 have been identified as pine – oak PAC (approximately 7,478 acres) and recovery habitat (approximately 7,834 acres) and approximately 20,533 acres have been identified as mixed conifer PAC (approximately 11,469 acres) and recovery habitat (approximately 9,064 acres). These numbers are slightly lower than those for PAC and recovery habitat analyzed in the Mexican spotted owl section above as there is a small portion of the project footprint that is not included in the boundary of designated critical habitat for the species. Refer to the Mexican spotted owl section for a description of the existing conditions in PAC and recovery habitats.

Chiricahua Leopard Frog

The Chiricahua leopard frog was listed as a threatened species on June 13, 2002 (USFWS 2002). Critical habitat for the species was designated on March 20, 2012. This leopard frog uses permanent or nearly permanent pools and ponds for breeding with water permanency more important at higher elevations and in the northern portion of the species' range. Chiricahua leopard frogs are rarely found in aquatic sites inhabited by non-native fish, bullfrogs, or crayfish.

The project footprint is located within the East Clear Creek Management Area in Recovery Unit 5 (USFWS 2007b). Historically, Chiricahua leopard frogs were found in East Clear Creek and associated drainages in the project footprint. While the species has not been documented in this area for more than 40 years, suitable habitat does exist in perennial and intermittent drainages, springs, stock tanks, and lakes in and immediately adjacent to the project footprint. Potential habitat for Chiricahua leopard frogs exists in the perennial drainages in the project footprint including East Clear Creek, Miller Canyon, East Miller Canyon, Kehl Canyon, General Springs Canyon, Houston Draw, Bear Canyon, and West Bear Canyon. Some of these drainages support nonnative fish and crayfish, reducing the quality of habitat they provide for this species. There are approximately 66 earthen stock tanks (each less than ¼ acre in size) and five small lakes (Baker, Dry, Dude, Huffer Spring, and Potato) within the project footprint may or may not provide potential habitat as most, if not all, lack the vegetation along their banks and aquatic vegetation preferred by leopard frogs. There are approximately 45 springs in the project footprint that could provide both potential breeding and dispersal habitat.

Forest Sensitive Species

Nine terrestrial wildlife species from the most recent U.S. Forest Service Region 3 sensitive species list (USDA Forest Service, 2013a) are known or have the potential to occur in the project area (Table 53).

Table 53. Regional Forester's R3 Sensitive Wildlife Species that are present or have potential habitat in the Cragin Watershed Protection Project area.

Common Name *Scientific Name*	Listing Status	Surveys Results and Description of Habitat in the Project Area
Birds (3)		
Bald Eagle *Haliaeutus leucocephalus*	SEN	No surveys conducted. Potential winter roosting and nesting in forested habitats and summer foraging habitat on reservoir and East Clear Creek.
Northern goshawk *Accipiter gentilis*	SEN / MIS	Detected during surveys. Foraging and nesting habitat in forested areas.
American peregrine falcon *Falco pereginis anatum*	SEN	No surveys conducted. Potential nesting habitat along steep rocky slopes and foraging habitat on reservoir and East Clear Creek.
Mammals (5)		
Navajo Mogollon Vole *Microtus mogollonensis navaho*	SEN	No surveys conducted. Potential habitat in meadows and grassy forest openings.
Allen's lappet browed bat *Idionyctris phyllotis*	SEN	No surveys conducted. Potential foraging habitat in meadows, forest openings, creeks, drainages, springs, and stock tanks. Roosting habitat in forested areas.
Spotted bat *Euderma maculatum*	SEN	No surveys conducted. Potential foraging habitat throughout the project area. Roosting habitat in rocky cliffs.
Pale Townsend's Big eared bat *Corynorhinus townsendii pallescens*	SEN	No surveys conducted. Potential foraging habitat in forest openings, creeks, drainages, springs, and stock tanks. Roosting habitat in karst caves.
Western red bat *Lasiurus blossevillii*	SEN	No surveys conducted. Potential foraging habitat in meadows creeks, drainages, springs, and stock tanks. Roosting habitat in areas that support deciduous trees.
Amphibians and Reptiles (1)		
Northern leopard frog *Lithobates pipiens*	SEN	No surveys conducted. Potential habitat in creeks, drainages, springs, and stock tanks.

SEN = Regional Forester's Sensitive Species; MIS = Management Indicator Species

Bald Eagle

The bald eagle was removed from the list of threatened and endangered species August 8, 2007 (USFWS 2007c). Bald eagles in central Arizona prefer to nest on cliff ledges or pinnacles or in tall trees (USFWS 1982). Eagles typically roost in ponderosa pine stands that are variable in size (less than an acre to 43 acres), are often on north or northeast-facing slopes, and are close to daytime foraging areas (Dargan 1991).

Bald eagles are infrequently encountered in the project footprint and, to date, only during the winter months and on migration. Mid-winter bald eagle surveys have been conducted in the project footprint each year since 1992, weather permitting, along Highway 87 and Forest Road 751. C.C. Cragin Reservoir can be an important feeding area for eagles until it freezes as it is stocked with trout by AZGFD and supports waterfowl. While no winter roosts have been documented in the project

footprint, potential locations exist in stands of old growth ponderosa pine dominated by large, tall trees with open canopies along the slopes of East Clear Creek and its tributaries. Additionally, no nest have been documented in the project footprint, but potential nesting habitat exists in the form of cliff ledges and large trees and snags around the reservoir.

Northern Goshawk

The northern goshawk occupies ponderosa pine, mixed conifer, and spruce-fir forest types in the Southwest. This species is a generalist that uses a wide variety of forest stages. Nest sites are typically in stands of older larger trees with intermediate canopy cover, while foraging occurs in more open areas. Occupied and potential northern goshawk habitat exists within and adjacent to the project footprint. In 2016 and 2017, potential habitat in the project footprint plus a 0.5 mile buffer not overlapping or within 0.25 mile of any Mexican spotted owl PAC was surveyed.

There are four northern goshawk post-fledging family areas (PFAs) designated in the project footprint for a total of approximately 2,462 acres (Table 54). This includes approximately 802 acres of mixed conifer habitat, approximately 900 acres of pine-oak and approximately 760 acres of pine. Of these acres, approximately 1,592 acres are within designated Mexican spotted owls PACs. Surveys of these PFAs were conducted in 2016. While no birds or nests were found in the three previously established PFAs (Bluebench, D.L. Miller, and Houston Draw), a new nest was located and the Miller Canyon PFA was created as a result. Table 54 summarizes and Figure 46 depicts the acres of PFAs and nest stands and the amount of overlap of both with Mexican spotted owl PACs.

There is one PFA within 0.5 mile of the project boundary: Jim Bob Ubar (648 acres). Past land management activities and wildfire suppression has led to accumulations of dense, small-diameter, young ponderosa pine trees within and adjacent to the PFAs in the project footprint. This density of small trees poses an increased risk of uncharacteristic, stand-replacing fire in these habitats. They also increase the risk of disease, inhibit recruitment of important habitat features such as old-growth trees and snags, and restrict the conditions necessary to support a variety of prey species for northern goshawks.

Table 54. Summary of northern goshawk post-fledging family areas in the Cragin Watershed Protection Project footprint.

Post-fledging Family Area Name	Acres		Percent Overlap with PACs	
	PFA	Nest Stands	PFA	Nest Stands
Bluebench	607	197	49%	80%
D. L. Miller	666	258	7%	0%
Houston Draw	600	156	97%	100%
Miller Canyon	611	153	86%	100%

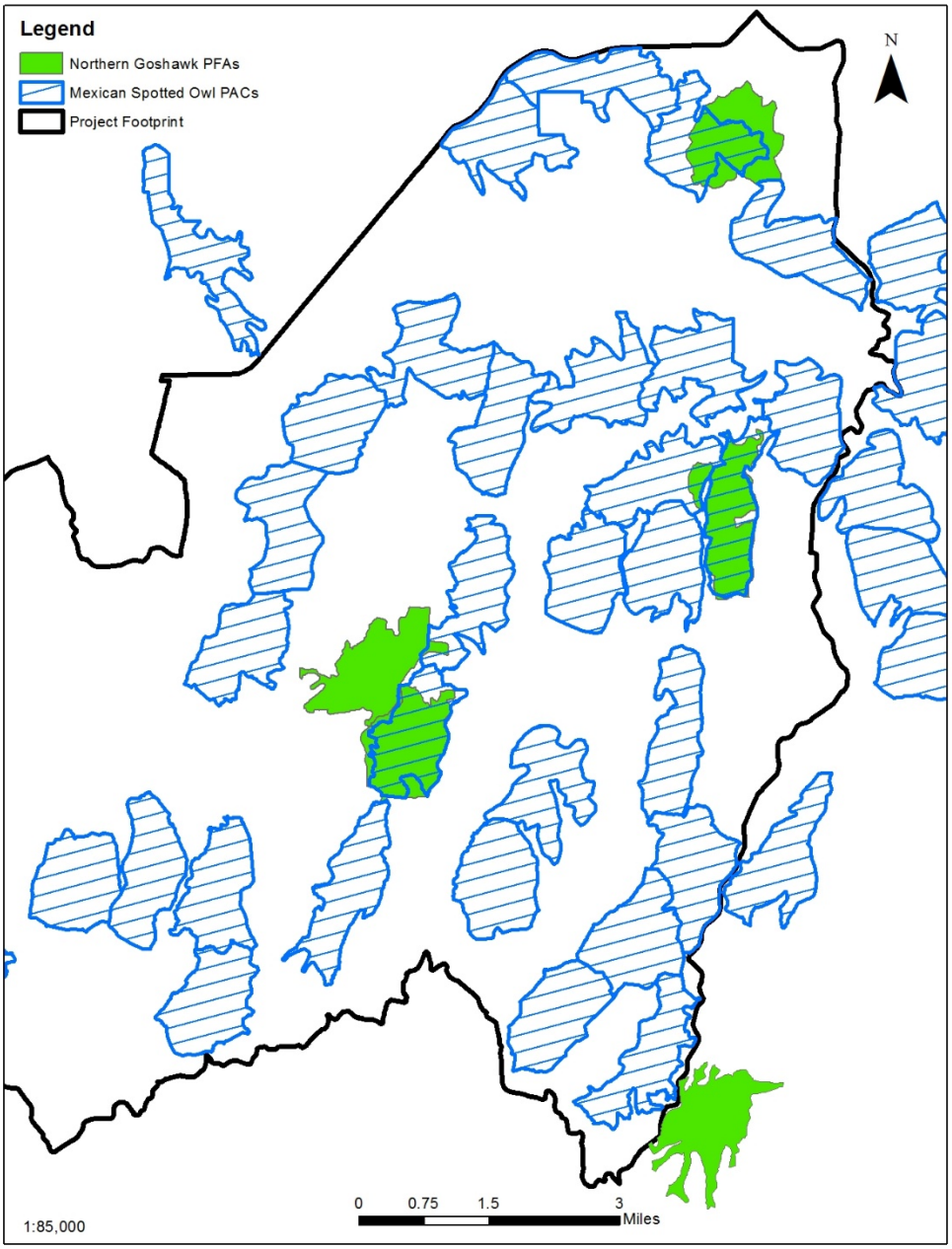


Figure 46. Northern goshawk post-fledging family areas and overlap with Mexican spotted owl protected activity centers in the Cragin Watershed Protection Project footprint.

Existing conditions outside of nest stands are variable, while conditions in nest stands are similar in the four PFAs. For example, in those acres of the Blue Bench and D.L. Miller PFAs outside of nest stands, ponderosa pine habitats are largely single storied, dominated by younger trees (less than 6 inches dbh), have a low density of older, larger trees and therefore, limited canopy cover. While the acres outside of nest stands in the Miller Canyon and Houston PFAs are also largely singled storied, they have a higher density of large trees than the other two PFAs and more canopy cover. These differences can be attributed to drier conditions and more recent mechanical treatments associated with the East Clear Creek Watershed Improvement Project in the Blue Bench and D.L Miller PFAs. In nest stands, acres are largely made up of mixed conifer and pine-oak habitats that have higher basal

areas of mid-aged to old trees (121 – 187 square feet) and consist of multi-aged stands dominated by large trees with denser canopies than both other portions of both these PFAs.

Potential nesting and foraging habitat for northern goshawks exists throughout the ponderosa pine, pine-oak and mixed conifer habitats outside of PFAs in the project footprint. See the Mexican spotted owl section of this document for detailed analysis of pine-oak and mixed conifer habitats. Outside of PFAs there are approximately 26,396 acres of ponderosa pine habitats.

American Peregrine Falcon

The peregrine falcon was delisted as a federal threatened species in August 1999. Key habitat components for this species includes rock cliffs with a mean height of 200 to 300 feet for nesting and a large foraging area including lakes, rivers, and wetlands. There are no documented nests in the project footprint, but individuals have been observed in the project footprint. Potential nesting habitat exists on the cliffs surrounding C.C. Cragin Reservoir and along East Clear Creek and these waterbodies provide potential foraging habitat. The closest known nest on the Forest is the Horse Crossing eyrie, which is located over 2.5 miles east of the project boundary along East Clear Creek. The closest known nest to the project footprint is located along the face of the Mogollon Rim approximately 0.2 of a mile from the southeastern corner of the boundary, west of the headwaters of Dude Creek on the Tonto National Forest.

Navajo Mogollon Vole

In Arizona, Mogollon voles occupy meadows and other wet areas above the Mogollon Rim associated with ponderosa pine or other coniferous forests. They also occur within forested areas where tree densities are low and herbaceous cover is high. They rely on grasses and other herbaceous vegetation for food and hiding cover, and are usually more abundant where grass biomass is high, such as in dense bunch grasses. This species has not been documented in the project footprint, but survey efforts have been very limited. There is potential habitat for Navajo Mogollon vole in montane meadows such as Long Valley and at the headwaters of East Clear Creek as well as in grassy openings in ponderosa pine and mixed conifer habitats in the project footprint.

Allen's Lappet-browed Bat

Allen's lappet-browed bats have been found in a variety of habitats in Arizona, including ponderosa pine, pinyon-juniper, Mexican woodland, white fir forests and Mohave desert scrub. Roosts have been located in mine shafts, rocky areas, cliffs, and in cavities on and under loose bark of snags. This species forages for insect prey in montane meadows and forest openings with or without wet ground and along waterways including streams, springs, and stock tanks.

This species has not been documented in the project footprint, but limited survey efforts have occurred. Suitable roosting habitat for lapped-browed bats exists along the cliffs surrounding C.C. Cragin Reservoir and the slopes of East Clear Creek and other steep drainages and large snags found throughout the project footprint. Foraging habitat exists in the waterways including the reservoir, pools and perennial waters in drainages, springs, lakes, and stock tanks as well as in wet meadows such as Long Valley and forest openings.

Spotted Bat

The historic range of the spotted bat includes Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Wyoming, Texas, Canada and Mexico. It has been found from low desert areas in southwestern Arizona to high desert and riparian habitat in the northwestern part of the state to conifer forests in northern Arizona. This species roosts in cracks and crevices along high cliff

ledges and forages across a wide range of habitats from forests to grasslands to riparian areas. Roost site characteristics are poorly known for this species, but limited observations suggest that spotted bats roost singly in cracks and crevices along cliff ledges near water.

Pale Townsend's Big-eared Bat

Pale Townsend's big-eared bat roosts in small numbers in caves, mines, and other man-made structures including cliff dwellings and abandoned shacks in desert scrub, coniferous forest, pinyon-juniper, pine-oak, and oak woodland. This species forage under the canopy and adjacent to mature forests and riparian areas including creeks, springs, and wetlands and often travel long distances to forage. The population is apparently secure, although is thought to be declining due to loss of habitat in caves and mines (AZGFD 2003).

This species has not been documented in the project footprint, but limited survey efforts have occurred. Potential roosting habitat for pale Townsend's big-eared bats exists in the karst caves scattered across the project footprint. Foraging habitat exists throughout the project footprint including springs, creeks, stock tanks, and forest openings.

Western Red Bat

Western red bats roost in the foliage of deciduous trees and forage for insects at intermittent and perennial water sources. Roosts can be found in riparian species as well as non-riparian deciduous trees such as Gambel oak, aspen, and maple. This species forages for a variety of flying insects.

This species has not been documented in the project footprint, but limited survey efforts have occurred. Suitable roosting habitat for red bats exists in the numerous drainages that support maple and aspen as well as ponderosa pine – Gambel oak forests. Foraging habitat exists at waterways throughout the project footprint including the reservoir, pools and perennial waters in drainages, springs, lakes, and stock tanks as well as wet meadows such as Long Valley.

Northern Leopard Frog

This species typically inhabits permanent waters, including streams, ponds, and stock tanks, but will also utilize more transient sites. It is well adapted to high elevations and in Arizona can be found between 2600 and 9000 feet. Similar to the Chiricahua leopard frog and other ranid species, key habitat components include undercut banks, overhanging terrestrial vegetation, and abundant aquatic vegetation. Deeper waters are needed for hibernation.

This species has not been detected in the project footprint in more than 40 years. The closest recent observation is approximately 7 miles to the north in Harris Tank, while the closest recent documentation of breeding sites is approximately 18 miles north at several locations in the Stoneman Lake area. Potential habitat for this species does exist in many of the springs, perennial and intermittent drainages, stock tanks, and lakes as described for Chiricahua leopard frog.

Bald and Golden Eagle Protection Act

All golden and bald eagles, regardless of status, are protected under the Bald and Golden Eagle Protection Act (Eagle Act). This analysis determines if take is likely to occur with implementation of the action alternatives. Take is defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." Disturb is further defined "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding,

feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (72 Fed. Reg.31132).

While there are no documented occurrences of bald eagles breeding in or immediately adjacent to the project footprint, C.C. Cragin Reservoir and the numerous large trees and snags in the area around it provide suitable nesting habitat for bald eagles with potential foraging habitat in close proximity.

Golden eagles will not be evaluated in this document. While the project footprint does have potential nesting habitat on cliffs around the reservoir and along portions of East Clear Creek, annual eagle surveys conducted by Arizona Game and Fish Department have not found any active or historic nests.

Management Indicator Species

The working draft Forest-wide assessment *Management Indicator Species Status Report for the Coconino National Forest* (MIS Report, USDA Forest Service 2013b) summarizes current knowledge of population and habitat trends for species identified as indicator species for the Forest. Below are descriptions of each of the management indicator species (MIS) identified for the habitat types in the project footprint and a discussion of the relationship of the impacts of each project alternative on forest-level population and habitat trends.

MIS for this project were identified using the Forest's Ecological Response Unit GIS layer. Three main vegetation types were identified: mixed conifer, ponderosa pine, and montane meadow. Of the three Forest MIS species, pronghorn was excluded from analysis due to a lack of indicator habitat (montane subalpine, Great Basin, and semi-desert grasslands) in the project footprint.

Table 55 contains details about the MIS in the project footprint, Mexican spotted owl and pygmy nuthatch, and their indicator habitats.

Table 55. Management indicator species analyzed, habitats and their Forest-wide population and habitat trends in the CWPP footprint.

Species	Habitat Indicator and Acres/Number in Project Footprint	Forest-wide Population Trend*	Forest-wide Habitat Trend*	Evaluation for Analysis/Affected Environment
Mexican Spotted Owl	Mixed conifer (both frequent fire and aspen types) 22,050 acres of mixed conifer**	Stable to declining	Declining	Occurs within analysis area, suitable habitat available within mixed conifer. Federally threatened species.
	Ponderosa pine – Gambel oak 15,016 acres of pine – oak**		Declining	Occurs within analysis area, suitable habitat available within ponderosa pine – Gambel oak. Federally threatened species.
Pygmy Nuthatch	Mature/old growth ponderosa pine 4,058 acres of ponderosa pine*	Stable to slightly declining	Increasing slightly	Occurs within analysis area, suitable habitat available within ponderosa pine.
	Large snags Average of 1.6 snags per acre greater than 12 inches dbh		Stable	Occurs within analysis area, suitable habitat available in snags.

*Forest-wide habitat acres and trends were derived from the acres of ERUs in the MIS Report for Forest Plan Final Environmental Impact Statement (USDA Forest Service 2018). The same percentages used to determine acres of mature/old growth indicator habitats for pygmy nuthatch at the Forest level were used to determine to acres of indicator habitat at the project level (9.8 percent).

**Acres of mixed conifer and pine-oak in this section differ slightly from those in the silviculturist report. This section uses the acres of Mexican spotted owl habitat types previously described in this document, which were used to derive mechanical treatment types. The silviculturist report uses acres of cover types derived from the Forest Vegetation Simulation to calculate mixed conifer and pine-oak.

Mexican Spotted Owl

See the Mexican spotted owl section of the federally listed species analysis for more information.

Pygmy Nuthatch

Pygmy nuthatches are generally associated with mature ponderosa pine forests, with a preference for open, park-like stands of old, yellow pines. It is also found in dense pine forests, as long as large trees and snags are present. This species requires dead trees or dead-top trees where it builds nests in cavities.

Pygmy nuthatches can be found throughout the mature/old growth ponderosa pine stands in the C.C. Cragin area. There are approximately 4,058 acres of indicator habitat and approximately 1.6 large snags per acre in the project footprint.

Population Trend

The forest-wide trend for pygmy nuthatch is stable to slightly declining.

Habitat Trend

The forest-wide trend for mature/old growth ponderosa pine is increasing slightly and for large snags is stable.

Migratory Birds

Migratory birds for this project were identified using the Forest's Ecological Response Unit GIS layer. Three main vegetation types were identified: mixed conifer, ponderosa pine, and montane meadow. A portion of Mogollon Rim Snowmelt Maple Draws Important Bird Area (IBA) is located in the project footprint, but there are no important overwintering areas.

Using Arizona Partners in Flight Plan and the Birds of Conservation Concern lists priority species of concern, the Forest developed a list of species of concern to include in project level migratory bird analysis (last revised on 8/03/17). There are 14 species from this list that have potential habitat in the project footprint. Table 56 contains the list of for neotropical migratory bird species addressed in this analysis along with the types and acres of habitats these species are associated with. More information on suitable habitat for each species within the project area is located in the Wildlife Specialist Report.

Table 56. Migratory birds with habitat in the Cragin Watershed Protection Project footprint.

Species	Suitable Habitat in Project Footprint	Acres of Habitat*
Band-tailed Pigeon	Ponderosa pine, mixed conifer forests	63,462
Cassin's Finch	Ponderosa pine forest	41,412
Common Nighthawk	Ponderosa pine forest	41,412
Cordilleran Flycatcher	Ponderosa pine, mixed conifer forests	63,462
Evening Grosbeak	Mixed conifer forest	22,050
Flammulated Owl	Ponderosa pine, mixed conifer forests	63,462

Species	Suitable Habitat in Project Footprint	Acres of Habitat*
Grace's Warbler	Ponderosa pine, mixed conifer forests	63,462
Lewis' Woodpecker	Ponderosa pine forest	41,412
MacGillivray's Warbler	Mixed conifer forest	22,050
Mexican Whip-poor-will	Ponderosa pine, mixed conifer forests	63,462
Olive-sided Flycatcher	Ponderosa pine, mixed conifer forests	63,462
Olive Warbler	Ponderosa pine, mixed conifer forests	63,462
Red-faced Warbler	Mixed conifer forest	22,050
Virginia's Warbler	Ponderosa pine forest	41,412

Environmental Consequences

Cumulative effects are disclosed for each wildlife habitat element or species or group of species. The cumulative effects boundary used for this analysis is the project area boundary, unless otherwise noted. The time scale for all species is the life of project-related activities or 20 years.

Threatened, Endangered, Proposed, and Candidate Species

Mexican Spotted Owl

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, there would be no treatments in the project footprint. Habitat conditions for Mexican spotted owls would generally remain the same in the short term with tree density and crown cover increasing throughout the project footprint over the next two decades, notwithstanding natural processes. This alternative would have no direct effect on this species; however, dense forest conditions would continue to place spotted owls and protected and recovery habitats at risk from uncharacteristic stand-replacing wildfire, resulting in indirect negative effects. Tree densities would continue to be high in owl habitats in the project footprint, affecting prey availability and slowing the growth of trees into larger diameter classes, which would affect the amount of nesting and roosting habitat available to owls. Additionally, recent studies have shown a pervasive increase in tree mortality rates in old forests, which is interpreted as symptomatic of forests that are stressed and vulnerable to abrupt dieback (Ganey and Vojta 2011, Van Mantgem et al. 2009). Most recently this has been a result of bark beetle outbreaks and the combined effects of pests, disease, and drought that have resulted in nearly complete mortality of large trees in some cases. Without some type of management, it is expected that forests would experience increasing stress, which would likely result in substantial changes in forest structure, composition, and function and greatly impact key owl habitat components (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011).

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for Mexican spotted owls is the C.C. Cragin project footprint plus a 0.5 mile buffer over the next 20 years. This spatial boundary was chosen because it is likely to include those activities that would have direct or indirect effects to owl habitat within and near the project footprint.

Under Alternative 1 there would be no direct impacts to spotted owls and their habitats; however Alternative 1 would not prevent, delay, or ameliorate predicted effects of climate change, but would likely result in a continued trajectory toward increased stressors on the owl. The dense forest conditions resulting from this alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather conditions and more frequent and severe droughts predicted for the Coconino NF (TACCIMO 2014), the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Species, including the spotted owl, requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively impacted in the long-term. This would combine with the loss of habitat from adjacent high-intensity wildfires, such as the 2018 Tinder Fire which burned through seven MSO PACs resulting in high and moderate severity effects.

Other activities including unauthorized motor vehicle use and illegal fuelwood harvest, and the vegetation removal associated with infrastructure maintenance such as near developed areas, power lines, and water pipelines would cumulatively further reduce owl habitat quality.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put Mexican spotted owls and their habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

All treatments in Mexican spotted owl habitats would be designed to move toward desired conditions identified in the 2012 Recovery Plan. Modeling shows that proposed treatments would move owl habitat towards desired conditions for some elements immediately after treatment and all habitat elements would move toward desired conditions over the next 20 years. Treatments would be designed to maintain large snags, large logs and develop trees into the larger size classes per the large tree and old tree implementation plan. Large snags would be retained to the extent practicable. Due to the large and old tree implementation plan, treatments would focus on retaining all trees greater than 16 inches that do not meet exception categories described in the plan. Even given the exception categories, trees 18 inches dbh or greater would be retained in PAC or nest/roost replacement habitats and trees 24 inches dbh or greater would be retained in recovery habitat. Treatments follow the Recovery Plan with one exception: prescribed burning may need to be completed in PACs during the breeding season, however, the potential effects of burning during the breeding season would be minimized through the application of design feature W8, which requires surveys and coordination with USFWS to inform implementation. Table 57 lists the acres of Mexican spotted owl habitat proposed for treatment under the preferred alternative.

Removal of large trees associated with the Baker Butte lookout tower are not located in owl habitat and thus, would not result in a loss of large trees in PAC or recovery habitat where large trees are important components of owl survival and reproduction.

Table 57. Acres of proposed treatments in Mexican spotted owl habitats in the Cragin Watershed Protection Project footprint.

Mexican Spotted Owl Habitat Type	Treatment Type	Acres
PAC Habitat – Mixed Conifer*	Thin and Burn	270
	Precommercial Thin and Burn	213
	Burn Only	11,455
	Total	**11,938**
PAC Habitat – Pine – Oak*	Thin and Burn	1,089
	Precommercial Thin & Burn	63
	Burn Only	6,151
	Total	**7,299**
PAC Habitat – Meadow	Burn Only	38
	Total	**38**
Recovery Habitat – Mixed Conifer	Thin and Burn	7,066
	Burn Only	1,611
	Total	**8,677**
Recovery Habitat– Pine – Oak	Thin and Burn	6,172
	Burn Only	1,486
	Total	**7,658**
Nest/Roost Replacement Recovery Habitat – Mixed Conifer	Thin and Burn	0
	Burn Only	1,374
	Total	**1,374**
Nest/Roost Replacement Recovery Habitat – Pine – Oak	Thin and Burn	0
	Burn Only	176
	Total	**176**
	Total:	**37,160***

*Approximately 200 of acres in PACs would not be treated under the preferred alternative as these acres are either located on private land or are the water in the C.C. Cragin Reservoir. These acres are not reflected in this table.

Mechanical Treatments and Related Activities

Effects to individual owls could be caused by mechanical treatments, hand thinning, and related activities including road construction and maintenance, hauling of logs, and road rehabilitation. In general, human activities have been documented to cause disturbance to raptors and in many instances can cause nest abandonment or changes in home range (Anderson et. al. 1990). No mechanical treatments or hand thinning would occur within nest cores nor would they occur in PACs during the breeding season unless surveys in that year confirm non-nesting. Mechanical treatments and hand thinning adjacent to PACs would occur in upland areas above the drainages used by nesting owls in the analysis area, so topography and vegetation would be expected to dissipate noise and minimize effects to breeding owls. Additionally, if trees are skidded and decked and personal use or commercial wood products contracts would be issued to remove the logs, locations of decks would be coordinated with the District biologist to further minimize effects to individuals.

Treatments in areas within 0.25 mile of PACs would not occur during the breeding season, unless protocol level surveys confirm owls were not nesting the year of the proposed activity or surveys locate a nest or, in coordination with USFWS, a buffer is implemented that protects breeding owls from noise throughout the breeding season. The only exception to this is in approximately 3,134 acres

that are located within 0.25 mile of PACs in the General Springs, Kinder Spring, and McCarty Ridge priority treatment areas (see Appendix A of the Wildlife Specialist Report for more details). Mechanical treatments and hand thinning on these acres would occur during breeding season, but would be limited to no more than two breeding seasons (e.g. one entry), reducing the duration of potential disturbance to nesting owls. Additionally, to minimize the number of PACs affected in a given year by this exception, treatments would occur within the 0.25 mile buffer in only one of the three priority areas in any given year.

No new temporary roads would be created to implement mechanical treatments in PACs as all acres proposed for treated would be within skidding distance of an existing system road or decommissioned road (Table 58).

Approximately 0.49 mile of decommissioned roads with existing road beds would be used to implement mechanical treatments in the Hoot and Potato Lake PACs. There would be approximately 9.71 miles of temporary roads proposed within 0.25 mile of ten different PACs (Blue, Blue Ridge, Clearcut, Dirty Neck, Hunter, Little Springs, McCarty, North Miller, Rock Crossing West, and Turkey) (Table 58). This includes approximately 4.80 miles of decommissioned roads and approximately 4.91 of new temporary roads.

Table 58. Miles of roads identified for use during mechanical treatments of Mexican spotted owl protected activity centers in the Cragin Watershed Protection Project.

Name	Miles				
	Open Roads on the MVUM*	Administrative Only Use Roads	Temporary Roads		Total
			Decommissioned	New	
Blue Ridge	0.80	0	0	0	**0.80**
Budapest	0.91	1.36	0	0	**2.27**
Clearcut	0	0.53	0	0	**0.53**
Dirty Neck	0	1.42	0	0	**1.42**
Fred Haught	0	0.15	0	0	**0.15**
Hoot	0.72**	1.01	0.15	0	**1.88**
Immigrant	0	0.14	0	0	**0.14**
Mid Miller Canyon	0	0.84	0	0	**0.84**
Miller Canyon	0	0.29	0	0	**0.29**
Mud Springs	2.27**	0	0	0	**2.27**
Panda	0	0	0	0	**0**
Pinchot	0	0.22	0	0	**0.22**
Potato Lake	0.54**	0.97	0.34	0	**1.85**
Quien Sabe	0	0.17	0	0	**0.17**
Telephone Ridge	1.68**	0.19	0	0	**1.87**
Turkey	0	1.76	0	0	**1.76**
Totals:	**6.92**	**9.05**	**0.49**	**0**	**16.46**

Table 59. Miles of roads identified for use during mechanical treatments within 0.25 mile of a Mexican spotted owl protected activity center in the Cragin Watershed Protection Project footprint.

Road Type	Description	Identified as Haul Route	Miles	Total Miles
Open Roads on the MVUM*		Yes	44.50	**70.25**
		No	25.75	
Administrative Use Only Roads		Yes	5.41	**66.50**
		No	61.09	
Temporary Roads	Decommissioned	No	4.80	**9.02**
	New	No	4.22	
			Total:	**145.77**

*MVUM is the Motor Vehicle Use Map that shows all designated roads available to public motorized use.

Temporary road construction and maintenance of existing roads inside PACs and within 0.25 mile of a PAC in the analysis area would occur outside of the breeding season with two exceptions. First, if protocol surveys that year confirm owls were not nesting, thinning and related activities could occur during the breeding season after coordination with USFWS. Second, if an assessment to identify topographic features and other relief that could dampen and dissipate noise were to be completed in conjunction with USFWS, some activities related to mechanical treatments could potentially occur during the breeding season. Under this condition, project activities would occur during daylight hours, so effects to foraging birds from mechanical treatments and road maintenance and construction would not be expected. Also, mechanical treatments adjacent to PACs would only occur in one of the three priority areas in a given breeding season, further minimizing potential effects to owls. Any exceptions to this would be made in conjunction with USFWS on a case-by-case basis. As a result of these factors, disturbance of owls from these activities would be expected to be limited.

A major concern regarding effects to individual owls from the preferred alternative would be from hauling. Hauling may cause noise disturbance to nesting owls, but more importantly, vehicles could potentially hit owls, causing injury or death. The average number of loads per day per timber sale area in the project footprint depends on many factors including the size of the individual timber sale area, the number of operators working in an individual timber sale area and the type of products being transported (logs and/or biomass). Based on the best available information, the average number of loads per day per timber sale area would be expected to be eight to ten for logs and an additional eight to ten loads for biomass in the project footprint. The number of loads per day would be tracked by the District timber sale administrator and coordination with USFWS would be required if changes in these numbers were to occur.

Main haul routes have been identified for CWPP with many of them located within 0.25 mile of one of the 32 PACs in the project footprint or the six PACs along the east boundary of the project (Barber Lake, Dane Barber, Horse Crossing, Lockwood Draw, Maverick Canyon, and Quail Springs). Forest Road (FR) 95 is a major haul route in the eastern portion of the project footprint and is immediately adjacent to Panda, Quien Sabe, Quail Springs, Horse Crossing, Lockwood Draw, and Hunter PACs and is within a 0.25 mile of Budapest, Pinchot, and Panda PACs. All of the nest cores in these PACs are 0.25 mile or greater from FR 95. Noise related to hauling would not be expected to considerably increase above current levels on FR 95 as it is maintained for passenger vehicles and is already heavily traveled by motor vehicles during the breeding season. As mentioned previously, nests and roosts within in the action area are located along the slopes of drainages while haul routes identified

for use in the action area are largely in the uplands above. Topography and vegetation would help dissipate hauling noise along most hauls routes in the action area and would be expected to minimize disturbance to nesting and roosting owls in these areas.

There are several roads in the project footprint where current levels of motor vehicle use and topography and vegetation would not be enough to minimize the potential effects of noise on hauling on owls, so timing restrictions would be implemented. No hauling would occur during the breeding season along FR 308, which bisects the Mud Springs PAC and is immediately adjacent to the nest core, or FR 139A, which runs through the middle of the Telephone Ridge PAC and is also adjacent to the nest core. Similarly, FRs 141 and 147 pass through the Hoot and Potato Lake PACs, respectively, but are also important haul routes in the project footprint. To minimize effects to nesting owls in these two PACs, hauling during the breeding season through the Hoot and Potato Lake PACs would only occur if the District determines through protocol surveys that owls are not nesting each year these road segments are proposed for use or the District locates a nest and is able to buffer the breeding owls from noise throughout the breeding season (see Design Features). Either determination would be made in coordination with USFWS annually.

Most logging traffic would occur during day time hours when owls are typically inactive; however there could be occasions when trucks are operating early in the morning or at dusk when owls would be foraging in the project footprint. An increase in the potential for collisions from project activities would be expected during these times. To minimize these effects, if hauling will occur in the 2 hours prior to sunrise or after sunset, the speed limit for trucks would be 15 mph. While the effects of noise from hauling would be expected to have insignificant effects on individual owls, the proposed project could result in adverse effects to owls through the expected increase in the potential for vehicle collisions along hauling routes.

Mechanical treatments and hand thinning may affect Mexican spotted owls through changes in habitat structure including snags, downed logs, woody debris, multi-storied canopies, and dense canopy cover. Pre-commercial and commercial thinning treatments would decrease the densities of trees including ladder fuels and create openings in areas with contiguous canopies in owl habitats in the project footprint. This would reduce the risk of uncharacteristic wildfire in the project footprint.

Treatments would be designed to retain key habitat components including hardwoods, large trees, snags, and logs, and high canopy cover. Short-term decreases in large snags and logs would be expected to allow for the safe operation of logging equipment in those acres of owl habitat that would be mechanically treated, but the habitat components would be expected to increase over the long-term after the implementation of prescribed fire and the associated creation of snag and logs. Structural diversity would be maintained in those portions of owl habitat where it currently exists and increased in those areas where it is lacking. To increase structural diversity in more even-aged stands, tree densities would be reduced and groups of trees of varying size classes and openings would be created to reduce competition between trees for space, water, and sunlight and promote growth of trees of all size classes. Development of silvicultural prescriptions in PAC and recovery habitats would require the involvement of USFWS and District biologists to ensure that key habitat components were retained and enhanced in accordance with the current spotted owl recovery plan.

Proposed mechanical treatments and hand thinning could also change the structure of prey habitat, affecting the composition and abundance of prey in the short-term (one to two years depending on climate and moisture) through loss of vegetation and soil rutting and compaction through the use of logging equipment. Conversely, openings created in owl PAC and recovery habitat and retention of desired levels of coarse woody debris and logs would improve cover and food resources for prey over the long-term. Openings would allow for an increase in sunlight reaching the forest floor and result in

an increase in the density and diversity of grasses, forbs and shrubs. Although mechanical treatments would be expected to have effects to owls and their habitats and prey in the short-term, proposed treatments would increase the structural and species diversity of overstory and understory vegetation while reducing the risk of stand-replacing uncharacteristic wildfire. This would benefit the species and its habitats in the long-term.

Creation of temporary roads, landings and skid trails and maintenance of existing roads would be needed in owl habitats in order to accomplish mechanical treatments. Similar to the effects of mechanical treatments, construction of temporary roads and use of skid trails and landings could result in changes in habitat structure. These activities could result in effects to understory vegetation that could have short-term effects (generally one to two years, depending on climate and moisture) on prey availability in a given area. To minimize these potential effects, rehabilitation of areas of ground disturbance would be required and machine piling of logging slash would be done in such a manner as to minimize the construction of new clearings for slash piles through use of natural openings, temporary roads, and landings. The construction of temporary roads, landings, and skid trails could result in the loss of key habitat components such as large trees, snags, and downed wood, but this represents a very small amount of owl habitat in the project footprint. Standard Forest Service timber contract clauses require that, prior to conducting harvesting activities, all skid trails, temporary roads, and landings be designated on a map and visibly marked by means of flagging or other suitable measures for approval by the District timber sale administrator. This would allow the sale administrator to work with the District biologist to minimize effects in owl habitats from the placement of these features. Also, all three features would be spatially distributed across the project footprint, only be in use for a short amount of time (one to three years), and be required to be rehabilitated after use.

Recovery Habitats

No mechanical treatments or hand thinning would occur in nest/roost replacement recovery habitats or any wet mixed conifer foraging/non-breeding habitats. Mechanical treatments and hand thinning in foraging/non-breeding habitats in the project footprint would occur on approximately 13,238 acres, or approximately 81 percent of this habitat type. This would include 7,066 acres of mixed conifer and 6,172 acres of pine-oak, which is also 81 percent of the two habitat types (Table 57).

No temporary roads would be created in nest/roost replacement habitats or any wet mixed conifer foraging/non-breeding habitats. A total of approximately 9.02 miles of temporary roads would be located in foraging/non-breeding habitats to implement mechanical treatments. This includes approximately 4.80 miles of decommissioned roads with existing road beds and approximately 4.22 miles of new temporary roads. Of these miles of new temporary roads, approximately 0.38 miles would be used to access three of the proposed processing sites: sites 9729A, 399, and 6096/6097. All temporary roads would be rehabilitated after use, minimizing the effects of these features on owl habitats.

Protected Activity Centers

The process to determine which acres in PACs would be mechanically treated or hand thinned included several steps. First, all acres on slopes less than 30 percent in PACs were identified in the project footprint. Next, we delineated those acres in close proximity to the reservoir and East Clear Creek and key infrastructure such as C.C. Cragin Dam and State Route 87, or located on the south and west sides of PACs, which is the prevailing wind direction in the project footprint. Finally, field visits were conducted to these locations in spring 2017 by District staff and the USFWS biologist, District silviculturists, and the District fuels specialist to assess the need and effectiveness of mechanical treatments in contributing to the reduction of crown fire potential in these areas to protect watersheds, key infrastructure and designated nest cores. This effort identified approximately 1,636

acres in 16 PACs, or approximately eight percent of the PAC habitat in the project footprint, for mechanical treatment. Table 60 provides information about the 16 PACs proposed for mechanical treatment including acres to be treated and general descriptions of the types of treatments proposed.

Table 60. Summary of Mexican spotted owl protected activity centers proposed for mechanical treatment in the Cragin Watershed Protection Project footprint.

PAC Name	Habitat Type	Acres Proposed for Treatment (% of total)	Total Acres Proposed for Treatment (% of total)	Proposed Treatment Type / Purpose
Blue Ridge	Mixed Conifer	0	13 (2%)	Hand thinning of ladder fuels around the Blue Ridge Campground.
	Pine – Oak	13 (2%)		
Budapest	Mixed Conifer	188 (32%)	188 (32%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	0		
Clearcut	Mixed Conifer	0	142 (28%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	142 (28%)		
Dirty Neck	Mixed Conifer	0	222 (36%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	222 (36%)		
Fred Haught	Mixed Conifer	0	78 (13%)	Create openings in the contiguous canopy of the even-aged stands of pines planted following the 1969 Crackerbox Fire.
	Pine – Oak	78 (13%)		
Hoot	Mixed Conifer	0	161 (28%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	161 (28%)		
Immigrant	Mixed Conifer	34 (6%)	34 (6%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	0		
Mid Miller Canyon	Mixed Conifer	0	91 (15%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	91 (15%)		
Miller Canyon	Mixed Conifer	48 (8%)	48 (8%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	0		
Mud Springs	Mixed Conifer	95 (16%)	95 (16%)	Hand thinning of ladder fuels along FR 308 which is south and west of the nest core.
	Pine – Oak	0		
Panda	Mixed Conifer	45 (7%)	45 (7%)	Hand thinning of ladder fuels along FR 95, which is west of nest core and perennial water in Bear Canyon.
	Pine – Oak	0		
Pinchot	Mixed Conifer	0	100 (17%)	Reduce ladder fuels along roads and create openings in areas with a contiguous canopy.
	Pine – Oak	100 (17%)		

PAC Name	Habitat Type	Acres Proposed for Treatment (% of total)	Total Acres Proposed for Treatment (% of total)	Proposed Treatment Type / Purpose
Potato Lake	Mixed Conifer	0	136 (29%)	Reduce ladder fuels along the ridge on the south edge of the PAC and create openings in areas with a contiguous canopy in the southwest corner.
	Pine – Oak	136 (29%)		
Quien Sabe	Mixed Conifer	0	35 (6%)	Create openings in the contiguous canopy as adjacent to perennial water in Bear Canyon and nest core.
	Pine – Oak	35 (6%)		
Telephone Ridge	Mixed Conifer	74 (12%)	124 (20%)	Hand thinning of ladder fuels along FR 139A, which is immediately adjacent to nest core.
	Pine – Oak	50 (8%)		
Turkey	Mixed Conifer	0	126 (21%)	Create openings in the contiguous canopy of the even-aged stands of pines planted following the 1969 Crackerbox Fire.
	Pine – Oak	126 (21%)		
Total Acres	**Mixed Conifer**	**483 acres**	**1,636 acres***	
	Pine – Oak	**1,153 acres**		

* Sum of acreage in table is slightly different than total acres as a result of rounding errors

Proposed treatments in PAC habitats can be divided into three categories: hand thinning of ladder fuels, creating openings in areas where the canopy is contiguous, and a combination of both. Hand thinning of ladders fuels only would occur on approximately 277 acres in four PACs (Blue Ridge, Mud Springs, Panda, and Telephone Ridge). Approximately 13 of these acres would be around the Blue Ridge campground in the Blue Ridge PAC to create defensible space around the campground. The remaining 264 acres of proposed hand thinning would occur along FR 308 in Mud Springs PAC, FR 139A in Telephone Ridge PAC, and along FR 95 in Panda PAC and be focused on reducing ladder fuels adjacent to these major roads so that risk of wildfire ignition is reduced in these areas. Proposed treatments in approximately 243 acres of the Fred Haught, Quien Sabe, and Turkey PACs would be focused on creating small openings (less than 1 acre) in the canopy of areas that are currently comprised of similar age trees. By creating discontinuity in the canopy, the risk of uncharacteristic wildfires in these areas would be reduced. On the remaining approximately 1,116 acres in eight PACs (Budapest, Clearcut, Dirty Neck, Hoot, Immigrant, Mid Miller Canyon, Miller Canyon, and Potato Lake), a combination of reducing ladder fuels and creating openings would occur. Prescriptions for treatments in PAC habitats would be designed in conjunction with USFWS and District biologist and retain key habitat components including hardwoods, large trees, snags, and logs, and high canopy cover.

As described previously, no new temporary roads would be needed to implement mechanical treatments proposed in PACs, so no effects to PAC habitats would occur from the creation of new roads. Clearing of vegetation on approximately 0.49 miles of decommissioned roads in the Hoot and Potato Lake PACs and creation of skid trails and landings would occur during implementation of mechanical treatments. Potential effects would be minimized by using existing road beds for limited

miles of temporary roads and openings and disturbed areas as landings in PAC habitats and through required rehabilitation of these features after treatments are completed.

Based on the above analysis, short-term negative effects on key owl habitat components in the project footprint would be expected from mechanical treatments and related activities, but these treatments would be beneficial in the long-term as the risk of uncharacteristic wildfire would be reduced. The increased risk of injury or death from collisions with log trucks would be expected to have a localized effect to Mexican spotted owls in the analysis area.

Prescribed Fire

Table 61 below summarize the post-treatment crown fire potential by cover type for PAC and recovery habitats in the project footprint. Treatments would reduce the potential for active crown fire in both cover types in recovery and PAC habitats. In recovery habitats, modeling determined the potential for active crown fire would decrease from 8 to zero percent in mixed conifer and from 13 to zero percent in pine oak with the majority of the acres shifting to surface fire. In PAC habitats, fire modeling shows the potential for active crown fire would decrease from 15 to three percent in mixed conifer and 12 to zero percent in pine oak with the majority of the acres shifting to surface fire. In both owl habitat types, the largest decreases in the potential for active crown fire would occur along the ridges and flatter areas where drier, more open habitats were historically found and mechanical treatments would occur. In those 16 PACs where mechanical treatments and fire would both occur, the modeling found the potential for active crown fire decreased from 9 to zero percent, while decrease in the in the 16 PACs where only fire would occur was 18 to three percent. Many of the acres that fire modeling identified as having active crown fire potential under existing conditions in the 16 PACs where only prescribed fire would occur are located on steeper slopes not suitable for mechanical treatment methods proposed in the preferred alternative. Appendix B of the Wildlife Specialist Report contains information about the change in crown fire potential for each PAC. While these numbers show a shift in crown fire potential, the actual change on the ground would be expected to vary due environmental conditions that exist when fires occur and the amount of acres that are actually mechanically treated. Nonetheless, a shift from the potential for active crown fire to passive crown and surface fires would be expected following implementation of the preferred alternative. These changes would reduce the risk of stand-replacing, uncharacteristic wildfire in owl habitats in the project footprint and restore conditions that support low intensity, frequent fires.

Table 61. Crown fire potential in Mexican spotted owl recovery habitats post treatment in the Cragin Watershed Protection Project footprint

Forest Type	Description	(+/- % change from existing conditions)		
		Surface Fire	Passive Crown Fire	Active Crown Fire
Mixed Conifer	Nest/Roost Replacement	89% (+4)	11% (-2)	0% (-2)
	Foraging/Non-Breeding	95% (+29)	5% (-20)	0% (-9)
	Total	**94% (+25)**	**6% (-17)**	**0% (-8)**
Pine - Oak	Nest/Roost Replacement	49% (0)	51% (0)	0% (0)
	Foraging/Non-Breeding	93% (+35	7% (-22)	0% (-13)
	Total	**93% (+36)**	**7% (-23)**	**0% (-13)**

Total For All Recovery Habitats	**94% (+30)**	**16% (-20)**	**0% (-10)**

Table 62. Crown fire potential in Mexican spotted owl protected habitats post treatment in the Cragin Watershed Protection Project footprint.

Cover Type	(+/- % change from existing conditions)		
	Surface Fire	Passive Crown Fire	Active Crown Fire
Mixed Conifer	**91% (+23)**	**6% (-11)**	**3% (-12)**
Pine - Oak	**72% (+29)**	**28% (-17)**	**0% (-12)**
Totals	**84% (+25)**	**15% (-13)**	**1% (-12)**

*Five of the PACs in project footprint include small portions of the water in C.C. Cragin Reservoir within their boundaries (137 acres) and Rock Crossing PAC has 53 acres of private land. These acres were not analyzed in the fire modeling so are not accounted for in this table.

Disturbance of owls could occur as a result of prescribed fire and related activities. Smoke from initial entry and maintenance burning and pile burning may temporarily disturb Mexican spotted owls. Burning would be managed to minimize the accumulation of smoke in PACs during the breeding season (see Design Features). Short-term effects from smoke would be reduced by coordination and timing and type of burning with wind direction, topography, time of year, distance to PACs, and the limiting the number of PACs and acres in each PAC burned during the breeding season. Portions of no more than 5 PACs would be burned in any given breeding season. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignitions sites, especially in the spring. Implementation of these measures, along with the concept that the species presumably adapted and evolved with smoke from lightning-caused wildfire, smoke-related impacts on Mexican spotted owls from prescribed burning would not be expected to be substantial.

Disturbance of individuals may also occur as a result of chainsaws and other equipment used in fireline preparation and helicopters, if used during firing operations. Similar to mechanical treatments, these activities would occur in upland areas, so topography and vegetation would help minimize impacts to owls. Implementation of spring burns in PAC habitats would be coordinated with the District biologist and USFWS, but no prescribed burns would occur in PACs where owls were known or suspected to be nesting during a given breeding season. This would not only minimize the potential effects of smoke to adult owls and young, but minimize the potential for nestlings and immobile young to be affected directly by heat and flames.

As described for mechanical treatments, implementation of prescribed fire and related activities would result in changes in habitat structure and key owl habitat components. Effects from prescribed fire in pine-oak and dry mixed conifer habitats would be expected to be greater than those in wet mixed conifer habitats. Wet mixed conifer habitats are located in moister portions of the forest such as drainage bottoms and lower slopes where fire does not carry except under the most extreme conditions. In these areas, when fuel moistures are low, groups of trees would be expected to torch as a result of high density of trees and high fuel loadings, creating openings in the canopy. This has been observed in recent years on wildfires managed for multiple resources objectives throughout mixed conifer stands in the project footprint. Fires in both dry and wet mixed conifer forest types that were allowed to burn during the monsoon season including the July 2016 Crackerbox Fire along

Crackerbox Ridge and the east slopes of Miller Canyon and the August 2016 Pinchot Fire in the northern portions of Bear Canyon, were largely surface fires that consumed the duff layer, small to medium sized woody debris, and portions of larger logs. Along the ridgetops, which pine-oak and dry mixed conifer habitats, fuels were drier and ignitions occurred resulting in some of the smaller trees (less than nine inches) being killed by heat or flames, but very little torching occurred in the overstory.

Despite occurring during drier conditions when fire risk was very high, the 2017 Highline/Bear Fire largely burned at low to moderate severities with the areas of high severity confined to a limited ridgetops where ignitions were lit too intensely. This fire began as a lightning-caused wildfire managed for multiple resource objectives called the Bear Fire when conditions were wetter in early June and then was included in the management of a human-caused wildfire named the Highline Fire that originated on the Tonto National Forest. Group torching in the mixed conifer in the drainages in West Bear and Bear canyons occurred as fuels dried out, but these areas were small in size (approximately one to ten acres), occurred in less than 10% of fire perimeter and did not result in high severity effects to soils.

Since prescribed burning in wet mixed conifer stands would occur in the early spring and fall when fuel moistures would be higher, fire behavior would generally involve creeping and smoldering in ground fuels with some unburned areas. Fire severity under these conditions would be expected to be low to unburned. Single and occasional group tree torching could occur during prescribed burns in pine-oak and dry mixed conifer habitats during these same times of year. This would result in the creation of small openings typically less than an acre in size, mimicking gap processes that occur under natural conditions (historic wildfire, windfall, and historic pest and disease outbreaks). Prescribed fire would also reduce ladder fuels in owl habitats by raising the crown base heights of trees, or the lowest height of individual trees above the ground, by killing the lower branches on larger trees and crown density by killing small trees. Creating openings and reducing ladder fuels and crown density would reduce competition between trees for space, water, and sunlight and promote growth of trees of all size classes, including large trees. These changes would also increase structural diversity in owl habitats. Reducing ladder fuels and crown density would improve the resiliency of owl habitats in pine-oak and dry mixed conifer and reduce the potential effects of uncharacteristic, high severity wildfire across the project footprint over the long-term.

Conversely, openings created in owl PAC and recovery habitat and retention of desired levels of coarse woody debris and logs would improve cover and food resources for prey over the long-term. Openings would allow for an increase in sunlight reaching the forest floor and result in an increase in the density and diversity of grasses, forbs and shrubs. Although mechanical treatments would be expected to have effects to owls and their habitats and prey in the short-term (one to three years), proposed treatments would increase the structural and species diversity of overstory and understory vegetation while reducing the risk of stand-replacing uncharacteristic wildfire over the next several decades. This would benefit the species and its habitats in the long-term.

Initial entry and maintenance burning would decrease course woody debris in all PAC and recovery habitat treatments. In many portions of the project footprint, large logs and woody material are currently at high to very high densities, so prescribed fire would be unlikely to reduce densities to a level that would affect prey abundance. In those areas where snags and logs are currently at lower levels (for example, those areas were natural ignitions have been allowed to burn for multiple resource objectives in recent years in pine-oak and dry mixed conifer habitats) or the small areas where moderate to high severity impacts occur during prescribed fires, effects to snags and logs could result that would decrease key habitat components for prey, and therefore, their abundance in the short-

term (one to two years, depending on climate and moisture). Conversely, herbaceous vegetation typically responds favorably to the reduction in surface fuels and openings created by prescribed burns. Such increases would lead to an increase in forage and cover for small mammals in the project footprint. This would be expected to increase prey availability over the long-term. Design features would further minimize effects to habitat components through use of varying ignition techniques including backing fire through drainages and burning when relative humidities are higher (such as at night) to retain large trees, snags and logs and consideration of the temporal and spatial distribution of burning during implementation.

Processing Sites

None of the eight proposed processing sites would be located within 0.25 mile of any PAC in the project footprint; therefore, disturbance to breeding owls would be expected to be minimal as noise from the use of these sites would be dissipated by distance, topography and vegetation.

Three proposed sites would be located in stands identified as spotted owl foraging/non-breeding habitat: Sites 9729A, 399, and 6096/6097. The three sites would be five to nine acres in size (totaling approximately 19 acres) with Site 399 located in mixed conifer forest and the other two sites in pine-oak forest. A decrease in habitat quality for owls at these three locations and in areas immediately adjacent would be expected to occur over the next two decades from the noise associated with the use and the removal of most, if not all, vegetation at these three sites. This decrease in quality would be expected to be minimal for several reasons. First, one of the screening criteria for potential sites was the current level of disturbance in the area. Next, the sizes of three sites, both individually and combined, would be very small (approximately 16 acres) relative to the large amount of owl recovery habitat in the project footprint (17,885 acres) and they would be spatially distributed across the area. Finally, once these processing sites were no longer in use, they would be rehabilitated, resulting in a return of potential foraging/non-breeding habitat within several decades.

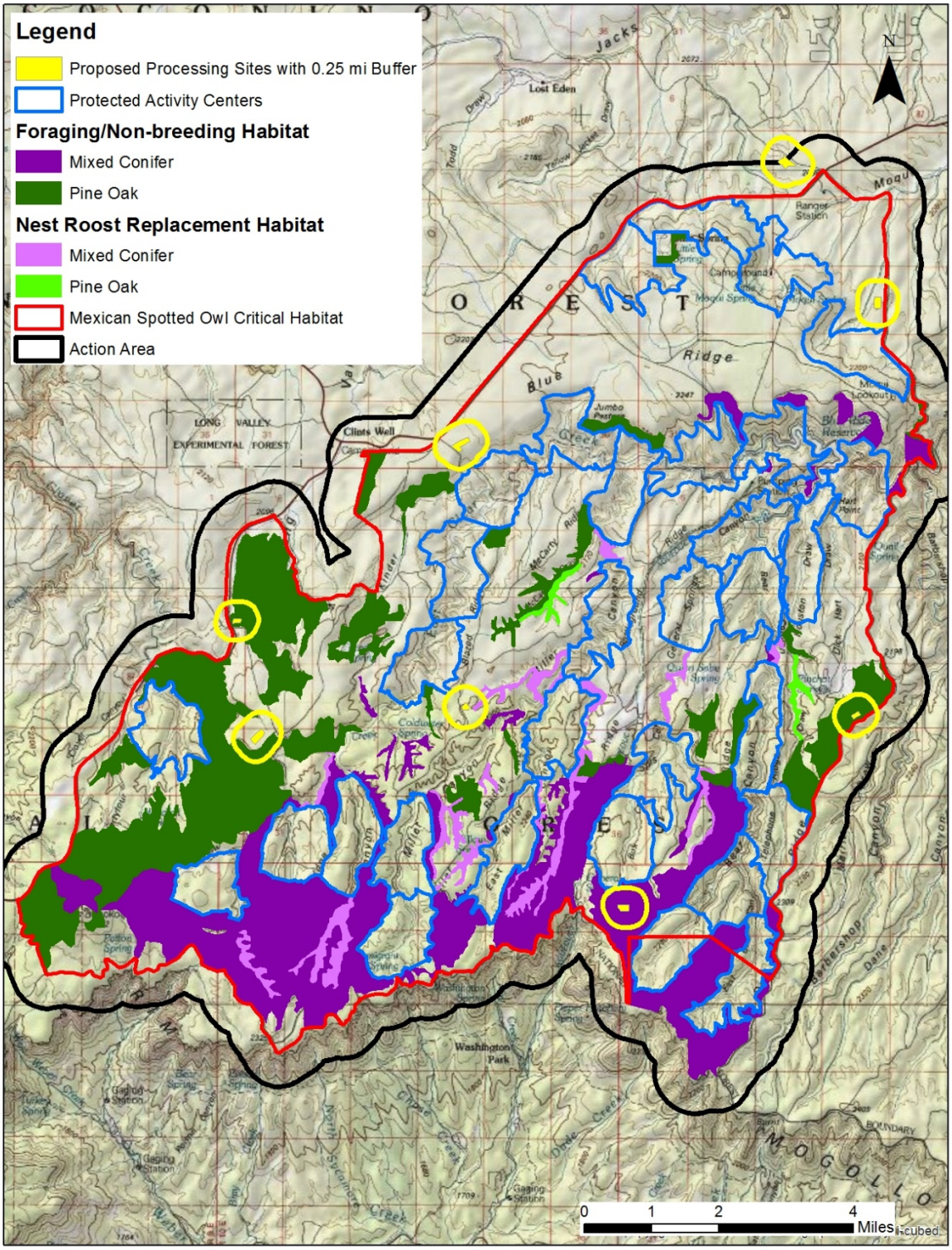


Figure 47. Proposed processing sites and their proximity to Mexican spotted owl habitats in the Cragin Watershed Protection Project footprint.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to Mexican spotted owls and protected and recovery habitats include those activities that result in disturbance to these species and changes in vegetative cover and structure and soil conditions that can impact habitats in the project footprint.

Cumulative effects to Mexican spotted owls and their habitats include those activities that result in disturbance to the species and changes in vegetative cover and structure and soil conditions that can impact nesting and foraging habitats and prey availability in the cumulative effects boundary.

Review with the Forest Service Fuels Specialist concluded that smoke from broadcast and pile burning southwest of the project would have similar short-term (three to five days) and low intensity (drift smoke) effects of smoke to individual owls. Burning inside PACs occurs outside the breeding season for most projects. Burning outside of PACs during the breeding season is conducted in a manner that minimizes smoke impacts to spotted owls. However, it is anticipated that burning activities on portions of this project could occur simultaneously with burning activities on other fuels reduction projects. While there are numerous burning operations planned in areas adjacent to the project footprint, ADEQ standards limit the total amount of burning allowed in the airshed at a given time. Thus, smoke impacts to PACs are limited and expected to be the same as those analyzed in the direct and indirect effects section for this project.

Vegetation treatments in owl habitats have previously occurred in the action area including portions of the 1,020 acres of precommercial thinning that occurred in East Clear Creek Watershed Health Improvement project (ECC). Vegetation treatments proposed in the Long-Term Ecological Assessment and Restoration Network research project and 4FRI Rim Country will also occur in both PAC and recovery habitats within and adjacent to the analysis area. Past prescribed burning has occurred on approximately 4,437 acres in the project footprint between 2004 and 2017. These treatments have or would reduce densities of trees, and remove ladder fuels from owl habitats, while increasing understory vegetation and promoting growth of larger trees. Additionally, impacts to spotted owls from both proposed and past projects include mitigations to minimize impacts to individuals such as coordination to limit entries into PACs and implementation of timing restrictions to reduce impacts to nesting birds from noise and smoke.

Decreases have or would occur in key habitat components including coarse woody debris, logs, and snags in PACs and recovery habitats from the projects mentioned above. Such decreases could combine with this project to move away from desired conditions in owl habitats in the short-term. Burn prescriptions and ignition techniques should limit overall losses of logs and snags. Burned snags would fall and provide logs and trees killed by fire would become snags. The longevity of fire-killed snags is less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less course woody debris is expected to be present as a result of prescribed burning. Thinning and burning should increase tree growth rates and self-pruning of the lower tree branches through time should gradually replenish course woody debris. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve spotted owl habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags.

Since 2009, 26,389 acres (Table 86) of the project area have been affected by wildfires. Effects from wildfires and suppression tactics are evident in PAC and recovery habitat in the project footprint and surrounding areas. Effects of these wildfires have been variable and depend on the time of year, scale of the fire, intensity, severity and associated management or suppression activities and can range from

minimal effects to improvement or reduction of key habitat components and prey availability. The occurrence of high severity fire effects in the project footprint over the last 10 years is very limited, only affecting a small fraction of the area. The largest acreage is 22 acres within a wildlife managed for multiple resources objectives. The largest area of high severity is 72 acres within the 1990 Bray Fire, which has since filled in with dense growth of young, small trees. Best management practices are incorporated into suppression activities as much as possible to minimize impacts to owls and their habitats. Short-term effects of fire to herbaceous cover typically last one to 3 years but recovery depends on factors such as climate and burn severity.

In 2018, the Tinder Fire burned through seven MSO PACs adjacent to the project area, and recovery habitat. The PACs were observed to burn at moderate and high severity causing a reduction of key habitat components, which is likely to affect the quality of this habitat for several years, and possibly decades.

Recreational activities such as motorized and non-motorized travel, camping, hunting, and fuelwood harvest have the potential to cause ground disturbance and result in loss of vegetative cover and introduction of invasive plant species. The removal of shrubs, herbaceous vegetation and coarse woody debris could result in a decrease in the quantity and quality of owl prey habitat. Conversely, improvement in vegetative cover would be expected in those areas where off-road travel is limited and road densities are reduced through closures. Invasive plant species are well-adapted to out-compete native plants, which can lead to decreases in the density and diversity of plant species in infested areas. When this decreased is combined with the toxicity of many invasive plants to wildlife, food resources for prey and, as a result, prey availability decrease. As infested areas are treated and native plants are restored, the effect to owls and their prey will be reduced.

There are additive effects of reduction of understory vegetation by wild ungulate and livestock grazing in the project footprint. Grazing would combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing in the project footprint is managed on deferred rotational and deferred rest rotation grazing systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. Prescribed burning would be coordinated with grazing schedules to minimize impacts to vegetation.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Thus while the CWPP may cumulatively contribute to a decrease in key habitat components in the short-term (1-5 years after treatments), the project is expected to counteract the increasing risk of loss and degradation of owl habitat components over the next several decades. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved over the long-term.

Determination

Since the preferred alternative could have short-term effects to PAC and recovery habitats and short-term disturbance of breeding owls, it is determined that project activities in Alternative 2 **may affect and are likely to adversely affect** Mexican spotted owl and its habitats.

Mexican Spotted Owl Critical Habitat

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, there would be no treatments in the project footprint. PCEs of Mexican spotted owl critical habitat would generally remain the same, notwithstanding natural processes. This alternative would have no direct effect on PCEs; however, dense forest conditions would continue to place PCEs at risk from uncharacteristic stand-replacing wildfire, resulting in indirect negative effects.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for PCEs of Mexican spotted owl critical habitat is the project footprint boundary plus a 0.5 mile buffer.

Under Alternative 1 there would be no direct effects to primary constituent elements that make up critical habitat; however Alternative 1 would not prevent, delay, or ameliorate predicted effects of climate change, but would likely result in a continued trajectory toward loss or degradation of PCEs as a result of high-intensity wildfire, or mortality from drought, pest, and disease. The dense forest conditions resulting from the no action alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather conditions and more frequent and severe droughts predicted for the Coconino National Forest (TACCIMO 2014), the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas with large and old trees would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Species, including the Mexican spotted owl, requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively impacted in the long-term. This would combine with the loss of habitat from adjacent high-intensity wildfires, unauthorized motor vehicle use and illegal fuelwood harvest, and the vegetation removal associated with infrastructure maintenance such as near developed areas, power lines, and water pipelines to further reduce owl habitat quality.

In 2018, the Tinder Fire burned through seven MSO PACs adjacent to the project area in critical habitat. Approximately 30% of the burn area experienced moderate and high severity fire effects causing a loss and/or degradation of primary constituent elements, which is likely to affect the quality of this habitat for several years, and possibly decades. The effects of the Tinder Fire would cumulatively combine with similar effects of a wildfire in the CWPP area. The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Temporary Roads, and Prescribed Fire

Implementation of project activities would result in impacts to PCEs of critical habitat related to forest structure and maintenance of adequate prey species. Treatments in critical habitat would be designed to maintain a range of tree species through retention of hardwoods such as Gambel oak and

maples and maintenance and a diversity of tree age classes, especially trees larger than 12 inches dbh. Trees 18 inches dbh or greater would be retained in PAC habitats and those greater than 24 inches would be retained in recovery habitats. No mechanical treatments or hand thinning would occur in nest/roost replacement habitats or nest cores. Treatments would be designed to maintain the percentage of trees greater than 12 inches dbh above 50 percent and canopy cover above 60 percent. Coarse woody debris and logs currently meet or exceed desired conditions in both habitat types (Table 63). Snags equal or greater than 18 inches dbh are on the low end of desired conditions for pine-oak habitats and below desired conditions for mixed conifer.

Table 63. Snags, logs, and tons per acre of woody debris in Mexican spotted owl critical habitat in the Cragin Watershed Protection Project footprint.

Forest Type	Average # of Snags per acre*	Average # of Logs per acre*	Average Tons per Acre of Coarse Woody Debris
Mixed Conifer	2.5	14	16
Pine Oak	1	8	12

*Snags are > 18 inches dbh and logs are > 12 inches dbh and >8 feet long.

Design features would minimize effects to large snags and logs from prescribed fires through the use of different ignition techniques including backing fire into drainages and burning during times when relative humidities are higher (such as at night). Additionally, large snags and logs would be created through burning and reductions in tree densities would encourage the growth of large retention snags.

While the preferred alternative would be expected to reduce logs and other woody debris, treatments would be designed to retain three to tens tons of woody material per acre, including logs, in pine-oak habitats. In mixed conifer habitats, treatments would be designed to retain five to twenty tons of woody material per acre in dry mixed conifer habitats, while 35 tons or greater per acre would be retained in late seral wet mixed conifer habitats. Tree and plant diversity would be expected to increase over time through retention of hardwoods and decreased competition a result of reductions in tree densities. Short-term effects to understory vegetation would be expected immediately post-treatment (1-3 years depending on precipitation), but shrubs and herbaceous vegetation would be expected to increase following prescribed burns, depending on climate and moisture, and through creation of small openings. Such increases in understory vegetation would increase cover and food resources for owl prey species.

Processing Sites

Three of the proposed processing sites would be located in critical habitat: Sites 9729A, 399, and 6096/6097. Use of these sites would result in the removal of most, if not all, PCEs related to forest structure and maintenance of adequate prey to facilitate operations. Once the sites were no longer in use, they would be rehabilitated. Despite the loss of PCEs at these sites, the spatial distribution and size of the sites both individually (five to nine acres) and combined (approximately 19 acres) would be very small (<0.01%) relative to the large amount of critical habitat in the project footprint; therefore effects to critical habitat from the proposed processing sites would be limited.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to PCEs of Mexican spotted owl critical habitat include those activities that result in changes in vegetative cover and structure and soil conditions in the project footprint.

For details, see the cumulative effects section for Mexican spotted owls above. Vegetation treatments proposed for the Rim Country project will occur within and adjacent to the analysis area. Critical habitat was identified in pine-oak and mixed conifer habitats as part of the Rim Country analysis and in past project analyses such as ECC. Implementation of these projects are designed to minimize impacts to PCEs. Decreases would occur in coarse woody debris, logs, and snags and could combine with this project to move away from desired conditions in the ponderosa pine in the short-term. Burn prescriptions and ignition techniques should limit overall losses of logs and snags. Burned snags would fall and provide logs and trees killed by fire would become snags. The longevity of fire-killed snags is less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less course woody debris is expected to be present as a result of prescribed burning. Thinning and burning should increase tree growth rates and self-pruning of the lower tree branches through time should gradually replenish course woody debris. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve PCEs related to forest structure and maintenance of adequate prey and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags.

There are additive effects of reduction of understory vegetation by wild ungulate and livestock grazing in the project footprint. Grazing would combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing in the project footprint is managed on deferred rotational and deferred rest rotation grazing systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. Prescribed burning would be coordinated with grazing schedules to minimize impacts to vegetation.

In 2018, the Tinder Fire burned through seven MSO PACs adjacent to the project area in critical habitat. Approximately 30% of the burn area experienced moderate and high severity fire effects causing a loss and/or degradation of primary constituent elements, which is likely to affect the quality of this habitat for several years, and possibly decades. The Proposed Action Alternative would contribute to the loss and degradation of primary constituent elements such as large trees, snags and downed logs in MSO critical habitat in the short term (1-5 years), but would counteract the effects of the Tinder Fire over the next several decades by increasing the rate of growth for large trees, which would eventually become snags, and downed logs.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under the Proposed Action Alternative. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved over the long-term.

Determination

Since the preferred alternative could have short-term effects to snags, logs and other woody debris, and residual plant cover through mechanical treatments and prescribed burning, it is determined that project activities in Alternative 2 **may affect and are likely to adversely affect** primary constituent elements of Mexican spotted owl critical habitat.

Chiricahua Leopard Frog

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, conditions in potential Chiricahua leopard frog habitats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to these habitats.

However, the potential for substantial indirect effects to potential leopard frog habitats would exist through the failure to reduce current fuel load conditions that could result in uncharacteristic stand – replacing wildfire. As described in the Soils and Watershed Report, a stand – replacing fire under the current (no action) forest structure could affect aquatic habitats in the project footprint. The loss of forest and, potentially riparian, vegetation would increase overland flow of water and soil erosion and potentially result in high sediment loads into drainages, springs, and other potential habitat. Deposition of ash and other pollutants from such a fire could result in an increase in nutrient (i.e., nitrogen and phosphorus) loading to water bodies, leading to an increase in temperature, pH, turbidity, and algal growth and reduction in dissolved oxygen (Earl and Blinn, 2003; Ranalli, 2004). Flooding, landslides, and debris flows resulting from standing replacing fire can alter stream channel characteristics, and can cause debris dams, which can subsequently breach and create a pulse flow, can scour drainages, and modify or remove riparian and aquatic vegetation. These changes in habitat conditions would also result in decreases in prey availability.

Based on the potential changes described above, Alternative 1 could result in substantial short-term and long-term indirect effects to potential Chiricahua leopard frog habitats in the project footprint.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for Chiricahua leopard frog is the seven sub-watersheds with greater than 5% of their area overlapping the proposed project footprint: Miller Canyon, Bear Canyon, East Clear Creek-Blue Ridge Reservoir, East Clear Creek-Clear Creek, Windmill Draw-Jacks, Long Valley Draw, and Clover Creek. See the Soil and Watershed Specialist Report for more details.

As described for in detail for aquatic habitats in the Fisheries Specialist Report, cumulative effects to potential Chiricahua leopard frog habitats are those effects from past, other present, and reasonably foreseeable future projects that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature and the availability of food resources. This includes forest restoration projects such as Rim Country, ECC, wildfires, and activities that introduce or assist in the spread of diseases and non-native aquatic species. Localized, short-term decreases in the quality of potential leopard frog habitats would be expected from such activities. The ability to retain sustainable and resilient ecosystems would be further compromised by the impacts of climate change and vulnerability to high-severity fires. Conversely, improvement in aquatic habitat would be expected in those areas where off-road travel is limited and road densities are reduced under ongoing implementation of the travel management rule regulations and restoration activities are implemented under the Long Valley Meadow Restoration Project, ECC, Rim Country and other projects, and treatment and control of non-native aquatic species occur.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put potential Chiricahua leopard frog habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Temporary Roads

Proposed mechanical treatments and other related activities such as creation of temporary roads in Alternative 2 would not substantially impact vegetative cover or increase the movement of sediment or debris into potential leopard frog habitats. Potential decreases in water quality through changes in stream temperature and turbidity or dissolved oxygen availability would be minimized through implementation of design features, BMPs, and standard timber contract clauses such as designation of AMZs on perennial and seasonal streamcourses, springs, wetlands, and areas with riparian vegetation and prohibition of skid trails, new temporary roads (except at designated crossings), landings, and machine piling of slash in these zones. Additionally required rehabilitation of landings, skid trails, and temporary roads, the limited area and spatial separation of disturbance that occurs during typical timber harvesting activities and requiring that equipment not be operated when ground conditions are such that excessive damage such as soil rutting may occur would also minimize effects to key habitat components such as riparian and aquatic vegetation and prey availability in the project footprint. Rehabilitation of disturbed areas after completion of activities may include, but would not be limited to, reshaping the ground to promote dispersed drainage, installation of features such as water bars to shed water, and spreading of slash to protect areas where mineral soil is exposed. Any effects to potential Chiricahua leopard frog habitats from mechanical treatments and related activities would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of mechanical treatments in the project footprint would have beneficial effects to potential leopard frog habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires would minimize effects to water quality and key habitat components for this species. Mechanical treatments would also benefit forest health and watershed condition in potential habitats through improved soil stability and porosity related to the increase in understory vegetation that would be three to five years following treatment.

Based on the information above, potential negative impacts from mechanical treatments and related activities on potential leopard habitats would be expected to be of short duration, limited to localized areas and be minimized by BMPs and design features. Implementation of mechanical treatments would be expected to benefit this species over the long-term by reducing the risk of high severity wildlife fire and improving forest resiliency and watershed condition in the project footprint.

Prescribed Fire

Proposed broadcast burning (initial entry and maintenance) and pile burning in Alternative 2 would not affect vegetative cover or substantially increase the movement of sediment or debris into potential Chiricahua leopard frog habitats in the project footprint.

Timing of broadcast burns would be spring and fall when conditions typically produce low soil burn severity, although spatial variations in burn severity ranging from high to unburned depends on surface fuel loads. Broadcast burns do not generally cause excessive erosion or sediment, ash, or debris transport since soil cover is retained in a discontinuous pattern across the landscape. Design features such as considering the spatial distribution and size of burns in a given watershed during prescription development and using varying ignition techniques to retain adequate levels of logs and woody debris would minimize potential impacts to water quality and key habitat components as described for mechanical treatments. Any impacts to potential leopard frog habitats in the project

footprint from broadcast burns would be short-term (one to two years) as an increase in understory vegetation would be expected, especially in areas where openings are created and large amounts of woody material are removed. This increase in herbaceous and shrub cover would help stabilize soils and minimize the movement of sediments and other debris.

Pile burning sites under Alternative 2 would not occur in AMZs, would be spatially and temporally distributed across the project footprint and constitute a very small portion of the project footprint (i.e., less than 5 percent), so effects to water quality and key habitat components of potential leopard frog habitat would be expected to be minimal.

As described for mechanical treatments, implementation of prescribed fire would benefit potential leopard frog habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory trees and encouragement of herbaceous cover.

Processing Sites

Under Alternative 2, the eight proposed processing sites would be located flat upland areas with all but two sites located 0.25 mile from any potential leopard frog habitat. The proposed site at the junctions of Forest Roads 6096 and 6097 is located approximately 0.10 mile north of an unnamed stock tank and the proposed site along Forest Road 9033H is located approximately 0.03 mile northwest of Cobble Tank. Both stock tanks provide very low quality habitat for leopard frogs as they lack vegetation along their banks and aquatic vegetation. Additionally, the area around Cobble Tank is heavily disturbed from high amounts of recreation use. The potential for erosion after removal of vegetation and use of these sites would be minimized through use of aggregate on bare soil and required rehabilitation of sites after completion of use. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site. As a result, minimal effects to potential habitats for this species would be expected from the proposed processing sites.

In summary, proposed activities in Alternative 2 would be expected to have minimal negative impacts to potential Chiricahua leopard frog habitat in the project footprint. Implementation of BMPs including the use of filter strips or AMZs and design features such as retention of downed logs and other woody debris and consideration of spatial and temporal distribution of activities across a watershed would minimize potential negative impacts. Vegetation treatments and prescribed fire activities would reduce the risk of uncharacteristic stand-replacing wildfire, increase forest resiliency, and improve watershed condition. Such changes would benefit potential leopard frog habitats in the project footprint.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to potential Chiricahua leopard frog habitat include those activities that result in result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature and the availability of food resources. See the Soil and Watershed Specialist and Fish and Aquatic Habitats Reports and EA for more details.

While additive effects of small levels of sedimentation would be expected from Alternative 2 in the short-term (1-3 years after treatment), negative effects from project activities to potential Chiricahua leopard habitats would be minimized through implementation of BMPs and design features and of short duration, limited in size, and spatially and temporally distributed across the analysis area. These

potential effects would not cumulatively result in long-term negative effects to potential leopard frog habitat in the project footprint. Under Alternative 2, implementation of project activities would result in long-term benefits to the species by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic stand-replacing wildfire and restoring forest resiliency.

Long-term reductions in effects to potential habitat would combine with efforts underway to implement travel management regulations by limiting off-road travel and decreasing road densities through closures such as through annual projects to block motor vehicle use in frog potential habitat in the project area (including Baker Lake and Potato Lake), and through ongoing or future efforts including the Long Valley Meadow Restoration Project and Mogollon Rim Spring Restoration Project. This would result in a long-term cumulative reduction in potential sediment impacts to CLF potential habitat in the project area.

Therefore, the potential impacts of project activities under Alternative 2, when combined with past, present and reasonably foreseeable future projects in the cumulative effects boundary, would be expected to benefit potential Chiricahua leopard frog habitats.

Determination

Based on the above analysis, it is determined that project activities in Alternative 2 **may affect, but are not likely to adversely affect** potential habitat for the Chiricahua leopard frog.

Forest Sensitive Species

Bald Eagle

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, there would be no changes in the project footprint. Habitat conditions for bald eagles would generally remain the same, notwithstanding natural processes. This alternative would have no direct effect on this species; however, dense forest conditions would continue to place bald eagles and potential nesting, roosting, and foraging habitats at risk from uncharacteristic stand-replacing wildfire, resulting in indirect negative effects.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for bald eagles is the C.C. Cragin project footprint boundary.

The main cumulative effect to this alternative would be from the increasing risk to eagle habitat from wildfire and other disturbances caused by climate change. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing likelihood of high-intensity, stand replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss of large trees and other habitat elements of bald eagle habitat.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put bald eagles and their potential habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Mechanical treatments, prescribed fire and related activities could result in disturbance (smoke, auditory or visual) to bald eagles within or adjacent to the project footprint. Currently, there are no document nests or winter roosts in the project footprint, so noise generated from these activities would not be expected to result in disturbance to eagles. Birds foraging at C.C. Cragin reservoir, along East Clear Creek or along Highway 87 could potentially be disturbed by treatments, construction of temporary roads, maintenance of existing roads, use of helicopters for aerial ignitions, and other activities, but potential impacts would be expected to be minimal as they would occur in limited areas distributed across the project footprint for a short duration of time (one to two years for mechanical treatments and several days for smoke and noise associated with prescribed burns).

Activities proposed under Alternative 2 would impact the quality of potential winter roosting habitat for bald eagles in the project footprint. Potential roosting habitat is located on those slopes that support old growth stands with large ponderosa pines in close proximity to potential foraging habitat at the reservoir and along Highway 87. Since these areas are located on steeper slopes in drainages, there would be no impacts from mechanical treatments in potential roost sites.

Prescribed burns would occur in these areas under this alternative, improving the quality of potential habitat by reducing competition and enhancing the growth of large trees through the removal of smaller trees in the understory and mid-story. Design features such as use of ignition techniques designed to minimize the severity of prescribed fire have been incorporated to reduce the potential impacts to bald eagles and their habitats, while reducing the risk of uncharacteristic stand-replacing wildfire by reducing fuel loads and ladder fuels. No impacts would occur to potential nesting habitat on the cliff ledges in the project footprint as a result of Alternative 2 and design features including the retention of large snags during mechanical treatments would minimize impacts to snags that could provide potential nesting habitat.

Proposed treatments would not substantially impact vegetative cover or increase the movement of sediment or debris into potential eagle foraging habitat such as C.C. Cragin Reservoir and East Clear Creek. As described for Chiricahua leopard frogs, implementation of watershed BMPs, timing of prescribed burns in the spring and fall, retention of logs and woody debris, consideration of the spatial distribution and size of burns, and other design features would minimize impacts to prey availability by minimizing impacts to water quality and riparian vegetation. Any potential negatives impacts to prey would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Processing Sites

The eight proposed processing sites would have no effect on bald eagle habitat in the project footprint as none of them would be located in or immediately adjacent to the drainages that support potential roosting habitats. No nest or winter roosts have been documented or immediately adjacent to the project footprint, so noise from the use of these sites would not result in impacts to these activities. As discussed in other sections of this report, to minimize erosion and the potential movement of sediments into nearby drainages and waterways from the use of the proposed sites, aggregate would be used to cover areas of exposed soil. Aboveground fuel storage tanks would have to be manufactured, installed, and operated in accordance with Federal, state, and local requirements and a site-specific stormwater pollution prevention plan would be required to comply with state requirements. Following the completion of use of a processing site, rehabilitation would be required.

As a result, no impacts to prey availability and potential foraging areas near these locations would be expected from the proposed processing sites.

Eagles foraging at the reservoir or along East Clear Creek would not be impacted by noise from any of the proposed processing sites, since the closest site on FR 9033H is more than 0.25 mile from East Clear Creek and more than 2 miles from the reservoir with topography and vegetation to help dissipate the noise. This site is approximately 0.25 mile from Highway 87, so could noise could potentially impacts eagles foraging near the junction. Such impacts would be reduced as sound would be expected to dissipate as the distance from the junction increases.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to bald eagles and their habitats include those activities that result in disturbance to individuals and losses of large trees and snags that can impact potential winter roosting and nesting habitats.

It is anticipated that burning activities in portions of the project footprint could occur simultaneously with nearby burning activities on other fuels reduction projects such as the proposed Rim Country Forest Restoration Project, which partially overlaps with this project. ADEQ standards would limit the total amount of burning allowed in an airshed at a given time, thus limiting additive smoke impacts to bald eagles.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to minimize impacts to eagles and their potential habitats through mitigations that limit disturbance and retain key habitat features such as large trees and snags. Decreases in snags as a result of prescribed burning in these projects would be expected and could combine with CWPP to move away from desired conditions in the short-term (less than 10 years). Burn prescriptions and ignition techniques should limit overall losses of snags and trees killed by fire would become snags, while maintenance burning should provide pulses of snags through time. Thinning and burning would decrease trees densities, increase tree growth rates and decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve potential eagle habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Individual tree growth would improve, resulting in larger average tree sizes. Habitat elements such as old or large trees, snags and permanent waterways would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in impacts on bald eagles and potential nesting, winter roosting, and foraging habitats in the cumulative effects boundary.

Determination

Based on the above analysis, Alternative 2 may impact individual bald eagles and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Northern Goshawk

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, there would be no treatments in the project footprint. Habitat conditions for goshawks would generally remain the same, notwithstanding natural processes. This alternative would have no direct effect on this species. Over the next 20 years, basal areas and ladder fuels would continue to increase, allowing dense forest conditions to continue. As described in the Silviculturist specialist report, basal areas in PFAs compared to general forest areas outside of PFAs would be expected to decrease from 13 to 10 percent over this time period. While this would still be within desired conditions for PFAs in the Forest Plan, it would be moving away from desired conditions. Additionally, such conditions would continue to place goshawks, PFA habitats and potential nesting and foraging habitats outside of PFAs at risk from uncharacteristic stand-replacing wildfire, resulting in indirect negative effects.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for northern goshawks is the C.C. Cragin project footprint boundary plus a 0.5 mile buffer.

Alternative 1 would continue to maintain even-aged conditions in portions of the goshawk habitat in the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. Recent research has found that greater heterogeneity in habitat attributes mitigated the effects of changing climatic conditions on reproductive probabilities based on more diverse prey communities during and following drought (Salafsky 2015). As a result, this alternative would cumulatively combine with the predicted effects of climate change to facilitate conditions that provide for less resilience to goshawk survival and reproduction rates at the landscape level.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing likelihood of uncharacteristic stand-replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss in basal of mid-aged to old trees and other key habitat elements such as canopy cover in PFAs and potential goshawk habitat.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put goshawks and their habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Temporary Roads

Under Alternative 2, mechanical treatments, temporary roads and other related activities could potentially disturb northern goshawks and have impacts on PFAs and potential nesting and foraging habitats in the project footprint. Disturbance to some raptors has been found to cause nest

abandonment or changes in home range (Anderson et. al. 1990). For goshawks, research has found the effects of motorized vehicles on individuals to be a "minor stressor" (Slausen and Zielinski 2008). Noise studies of nesting goshawks found that logging trucks did not elicit a discernible response when they passed within 0.3 mile of active nests (Grubb et al. 1998). The observed response from these birds was limited to, at most, looking in the direction of the hauling road where the truck was traveling. Sources of potential noise disturbance related to project implementation include mechanical treatments, construction of temporary road and maintenance of existing ones, loading and hauling of logs from landings, and road rehabilitation. None of these activities would occur in nest stands and known nests in the project footprint are located along the slopes of drainages, so direct impacts to nesting goshawks would be expected to be minimal when working in adjacent to PFAs as topography and vegetation would help dissipate noise. No project activities would occur in the PFAs during the breeding season unless surveys confirm goshawks are not nesting that year, further minimizing the potential impacts of noise disturbance. The Jim Bob Ubar PFA is located outside of the project footprint, so no activities would occur within the PFA. As a result, no impacts to the goshawks or the habitat in the PFA would be expected.

As previously mentioned, no mechanical treatments would occur in designated nest stands, but approximately 434 acres in other portions of three PFAs would be treated. This includes Bluebench (167 acres), D.L. Miller (199 acres) and Miller Canyon (68 acres) PFAs, which are all acres of ponderosa pine habitat. Treatment would also occur on approximately 22,434 acres of ponderosa pine habitats outside of goshawk PFAs and spotted owl protected and recovery habitats. Treatments in the PFAs and ponderosa pine habitats would be focused on removing smaller trees to reduce competition with mid-aged and old trees and potential ladder fuels and creating openings in areas with contiguous, single-storied canopies to increase understory vegetation and move toward desired conditions of an increase in uneven-aged or multi-storied structure. Treatments would also be designed to increase or maintain basal areas in mid-aged to old tree groups in PFAs 10 to 20 percent higher than ponderosa pine habitats outside PFAs. Immediately post-treatment, basal areas in PFAs would be expected to decrease from 83 to 75 square feet, while basal areas in ponderosa pine habitats would decrease from 125 to 61 square feet. Under Alternative 2, proposed treatments would move towards desired conditions as basal areas in PFAs would be approximately 19 percent higher than in ponderosa pine habitats in the rest of the project footprint.

Under Alternative 2, activities associated with mechanical treatments such as skid trails and landings would result in the removal of vegetative cover and potential impacts to avian and mammalian prey of goshawks immediately following treatment. These impacts would be expected to be short-term, generally one to two years depending on climate and moisture, and would occur in limited areas across the project footprint at different times, thereby reducing impacts to this species. Treatments would also improve foraging habitat in the project footprint. The creation of forest openings of varying sizes and rehabilitation of temporary roads after treatments would be expected to increase herbaceous and shrub cover and prey availability. The reduction of dense forest canopy and increased growth in the understory vegetation would result in indirect beneficial impacts to goshawks, while reducing the risk of uncharacteristic stand-replacing wildfire.

Construction of temporary roads and maintenance of existing roads could have impacts on goshawk habitat and prey availability. No temporary roads would be constructed in PFAs under Alternative 2, so no impacts would occur in occupied goshawk habitat. Up to approximately 17 miles of temporary roads could be created in ponderosa pine habitats outside of PFAs to facilitate mechanical treatments across the project footprint. While removal of existing vegetation including herbaceous vegetation and trees would occur during construction of these features, all temporary roads would be rehabilitated following completion of mechanical treatments, so potential effects to prey and

availability would be expected to be of short duration. Additionally, removal of large trees would be limited by the old and large tree implementation plan, so impacts to potential nest trees would be minimized. Maintenance of existing roads would mostly occur on the existing road prism, which does not support vegetation, but creation or improvement of features to facilitate the drainage of water could results in loss of herbaceous cover. Such areas would be small in size (less than 0.1 of an acre) and spread across the landscape, so would be unlikely to result in impacts to prey availability.

Table 64. Miles of roads in northern goshawks post-fledging family areas identified for implementation of the Cragin Watershed Protection Project.

Post-fledging Family Area Name	Miles				
	Open Roads on the MVUM	Administrative Use Only Roads	Temporary Roads		Total
			Decommissioned	New	
Bluebench	**1.00**	**0.92**	**0**	**0**	1.92
D.L. Miller	**1.19**	**0.43**	**0**	**0**	1.62
Houston Draw	**0**	**0**	**0**	**0**	0
Miller Canyon	**0**	**1.09**	**0**	**0**	1.09
Totals:	2.19	2.44	0	0	4.63

Prescribed Fire

Under Alternative 2, there are potential direct effects to goshawks from smoke and noise associated with prescribed burning. Smoke and noise could impact nesting and feeding behaviors of goshawks if smoke and noise persisted for more than a few days. Noise associated with creation or preparation of fireline would be limited to upland areas along roads and would dissipate as a result of topography and vegetation as it moves toward known nests. Impacts from smoke would be expected to be reduced during the breeding season as ventilation during the spring is better than in the fall (see Fire, Fuels, and Air Quality Specialist Report for more detail). These activities as well as ignitions using helicopters during the breeding season could disturb individual birds, but impacts would be expected to be of short duration (one to two days) and low (smoke and chainsaws) to moderate (helicopters) intensity. Implementation of activities would be temporally and spatially distributed limiting the overall impact of noise and smoke to northern goshawks. Impacts from smoke would also be reduced by the coordination of timing and type of burning with wind direction, topography, time of year and distance to the goshawk nests.

Similar to mechanical treatments, prescribed fire and related activities would have impacts on vegetative cover and structure. All acres in PFAs and ponderosa pines outside of PFAs would be treated with fire under this alternative. This could result in impacts to goshawk habitat and prey availability. These impacts would be expected to be short-term, generally one to two years depending on climate and moisture, and would occur in limited areas across the project footprint at different times, thereby reducing impacts to this species and its prey. Treatments would also improve nesting and foraging habitat through the reduction in tree densities and creation of openings, which would result in an increase in herbaceous and shrub cover and prey availability and reducing in inter-tree competition. Prescribed fire could result in the mortality of some large trees and downed logs. Implementation of design features would strive to retain large trees, snags, and logs through timing of treatments and ignition techniques, while reducing the risk of uncharacteristic stand-replacing fire.

Processing Sites

None of the seven proposed processing sites in the project footprint nor the site on FR 211 just to the north would be located within 0.25 mile of the four PFAs in the project footprint or the one PFA immediately adjacent. As a result, no direct impacts to nesting goshawks would be expected from the use of these sites. Of the seven sites in the project footprint, four of the sites are located in ponderosa

pine, two are in pine-oak, and one in mixed conifer, so the use of these seven sites could potentially have impacts on goshawks foraging outside of PFAs and prey availability. While most, if not all, vegetation would be removed from these sites to facilitate their use, many of these locations currently support low quality foraging habitat because most of the processing sites are located in areas with previous vegetation disturbance. Following the completion of use of a processing site, rehabilitation would be required. Noise could potentially impact goshawks in and adjacent to these sites, but such impacts would be expected to be greatest when the sites are first used and would decrease as the distance from the proposed sites increases and sound dissipates due to vegetation and topography. The proposed processing sites represent a very small reduction in potential foraging habitat (approximately 64 acres or less than 0.01 percent of the acres proposed for treatment in the project footprint) and are spatially distributed across the project footprint. As a result, impacts to northern goshawks, foraging habitat, and prey availability in and near these locations would be expected to minimal.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to northern goshawks and their habitats include those activities that result in disturbance to these species and changes in vegetative cover and structure and soil conditions that can impact nesting and foraging habitats in the project footprint.

It is anticipated that burning activities in portions of project footprint could occur simultaneously with burning activities on other fuels reduction projects such as the proposed Rim Country Forest Restoration Project, which partially overlaps with this project. ADEQ standards would limit the total amount of burning allowed in an airshed at a given time, thus limiting additive smoke impacts to goshawks.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to minimize impacts to goshawks and their habitats through mitigations that limit disturbance and retain key habitat features such as large trees. Thinning and burning would decrease trees densities, increase tree growth rates and decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve potential goshawk nesting habitat.

There are additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. The activities would combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing in the project footprint occurs on 57,444 acres within the project area and is managed on deferred rotational and deferred rest rotation grazing systems designed to allow forage a chance to recover from livestock grazing, and thus would have a very limited effect on goshawk and their prey. Current efforts are underway to limit off-road travel through the implementation of travel management regulations and decrease road densities through closures and invasive plant populations are treated as they are found, reducing the potential for cumulative impacts to prey habitat and availability.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Individual tree growth would improve, resulting in larger average tree sizes. Habitat elements such as old or large trees would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on northern goshawks, PFAs, and foraging habitats in the cumulative effects boundary.

Determination

Based on the above analysis, Alternative 2 may impact individual northern goshawks and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

American Peregrine Falcon

Alternative 1– No Action

Direct and Indirect Effects

Under the Alternative 1, there would be no changes in the project footprint. Habitat conditions for peregrine falcons would generally remain the same, notwithstanding natural processes. This alternative would have no direct effect on this species; however, dense forest conditions would continue to place peregrine falcons and potential nesting and foraging habitats at risk from uncharacteristic stand-replacing wildfire, resulting in indirect negative effects.

Peregrine falcons are most adapted to open habitats and not found in closed forests. Under this alternative, even-aged forests with closed stands would likely continue to exist without a high-intensity wildfire, resulting in less favorable habitat attributes for foraging.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for peregrine falcons is the C.C. Cragin project footprint boundary.

Alternative 1 would maintain even-aged conditions across a majority of the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. This would result in a cumulative effect on prey availability to falcons, which could result in reduced survival or reproduction rates over the next two decades.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulatively add to the increasing likelihood of high-intensity, stand replacing wildfire.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put peregrine falcons and their habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Mechanical treatments, prescribed fire and related activities could result in disturbance (smoke, auditory or visual) to peregrine falcons within or adjacent to the project footprint. While there are no

documented nests in the project footprint, there is one previously documented nest that could potentially be directly impacted by project activities. Noise generated from proposed activities near the known location along the southeastern corner of the project footprint west of the headwaters of Dude Creek could potentially impact nesting birds. To minimize impacts, no mechanical treatments would occur within 0.25 mile of this nest during the breeding season (March 1st – August 15th), when it is active. Additionally, falcons foraging at C.C. Cragin Reservoir or along East Clear Creek could potentially be disturbed by treatments, road construction and maintenance, use of helicopters for aerial ignitions, and related activities. Potential impacts would be expected to be minimal as these activities would occur in limited areas distributed across the project footprint for a short duration of time (one to two years for mechanical treatments and several days for smoke for prescribed fire).

Under this alternative, proposed treatments and other related activities would have no impacts on falcon nesting habitat as there are no known nests in the project footprint. Additionally, potential habitat on the cliff faces around the reservoir and East Clear Creek in the project footprint are too steep for mechanical treatments. Those slopes that support large rock outcrops and cliffs have limited amounts of vegetation so impacts from prescribed fire would be expected to be minimal.

Proposed treatments would not substantially impact vegetative cover or increase the movement of sediment or debris into potential falcon foraging habitat such as C.C. Cragin Reservoir and East Clear Creek. As described for Chiricahua leopard frogs, implementation of watershed BMPs, timing of prescribed burns in the spring and fall, retention of logs and woody debris, consideration of the spatial distribution and size of burns, and other design features would minimize impacts to prey availability by minimizing impacts to water quality and riparian vegetation. Any potential negative impacts to prey would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Processing Sites

Under Alternative 2, the eight proposed processing sites would be located more than 2.5 miles from the closest known peregrine falcon nests; therefore, no impacts to nesting falcons would be expected. Additionally, falcons foraging at the reservoir or along East Clear Creek would not be impacted by noise from these sites, since the closest site, located along Forest Road 9033H, is more than 0.25 mile from East Clear Creek and more than 2 miles from the reservoir with topography and vegetation to help dissipate the noise. As discussed in other sections of this report, to minimize erosion and the potential movement of sediments into nearby drainages and waterways from the use of the proposed sites, aggregate would be used to cover areas of exposed soil. Above ground fuel storage tanks would have to be manufactured, installed, and operated in accordance with Federal, state, and local requirements and a site-specific stormwater pollution prevention plan would be required to comply with state requirements. Following the completion of use of a processing site, rehabilitation would be required. As a result, no impacts to prey availability and potential foraging areas near these locations would be expected from the proposed processing sites.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to peregrine falcons and their habitats include those activities that result in disturbance to these species and changes in the openness of vegetation and potential movement of sediment into the reservoir and East Clear Creek that can impact potential nesting and foraging habitats.

It is anticipated that burning activities in portions of project footprint could occur simultaneously with burning activities on other fuels reduction projects such as the proposed Rim Country Forest

Restoration Project, which partially overlaps with this project. ADEQ standards would limit the total amount of burning allowed in an airshed at a given time, thus limiting additive smoke impacts to peregrine falcons.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to decrease tree densities and create more open habitats, potentially improving foraging habitats for this species. Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative.

There are additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. These activities would combine with short-term loss of understory vegetation from prescribed fire and logging operations and potentially result in an increase in erosion and movement of sediment into waterways. This could result in temporary impacts to foraging habitats such as the reservoir. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Current efforts are underway to implement travel management regulations by limiting off-road travel and decreasing road densities through closures such as through annual projects to block motor vehicle use in meadows in the project area (including Baker Lake and Potato Lake), and through ongoing or future efforts including the Long Valley Meadow Restoration Project and Rim Country Spring Restoration Project. Invasive plant populations are treated as they are found, reducing the potential for cumulative impacts to foraging habitats.

The amount of impacts from mechanical treatments, prescribed burns, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on peregrine falcons and potential nesting and foraging habitats in the project footprint.

Determination

Based on the above analysis, Alternative 2 may impact individual American peregrine falcons and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Navajo Mogollon Vole

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, conditions in potential vole habitats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to potential habitats or disturbance of individuals. Potential habitat would continue to exist in the project footprint, although most of the forested area within the project is currently in a moderately-closed to closed condition, which provides low quality habitat for this species. Higher

quality potential habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect negative effect to the species. Additionally, dense forest conditions would continue to place Navajo Mogollon voles and potential habitats at risk from uncharacteristic stand-replacing wildfire.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for Navajo Mogollon vole is the project footprint.

Alternative 1 would continue to maintain dense forest conditions in the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. Recent research has found that greater heterogeneity in habitat attributes mitigated the effects of changing climatic conditions on reproductive probabilities based on more diverse prey communities during and following drought (Salafsky 2015). As a result, this alternative would cumulatively combine with the predicted effects of climate change to facilitate conditions that provide for less resilience to survival and reproduction rates at the landscape level.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing likelihood of uncharacteristic stand-replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss of meadow habitats.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put Navajo Mogollon voles and potential habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Mechanical treatments, prescribed fire and temporary roads could result in disturbance (smoke, auditory or visual) to voles in the project footprint. Potential impacts would be expected to be minimal as they would occur in limited areas distributed across the project footprint for a short duration of time (one to two years for mechanical treatments and several days for smoke from prescribed burns). The construction of temporary roads could result in more long-term displacement of one or more voles, should roads be built on or immediately adjacent to vole inhabited areas.

Under Alternative 2, activities associated with mechanical treatments and prescribed burns including temporary roads would result in the removal of cover and food resources in potential vole habitat immediately following treatment. These impacts would be expected to be short-term, generally lasting one to two years after project implementation depending on climate and moisture, and would occur in limited areas across the project footprint at different times, thereby reducing impacts to this species. Treatments would also improve vole habitat in the project footprint. Openings created by mechanical treatments, rehabilitation of temporary roads and prescribed fire would be expected to increase herbaceous cover and encourage healthier understory habitats, including cool-season grasses which has been documented as the main source of the species diet. The creation of small openings and increased growth in the herbaceous vegetation on the forest floor would result in indirect

beneficial impacts to the vole, while treatments reduce the risk of uncharacteristic stand-replacing wildfire.

Processing Sites

The eight proposed processing sites would potentially have impacts on voles and potential habitat. While most, if not all, vegetation would be removed from these sites to facilitate their use, many of these locations currently support low quality to no habitat for this species. Many of these sites were selected for this analysis because they are located in previously disturbed areas to minimize impacts of the sites. Following the completion of use of a processing site, rehabilitation would be required. Noise could potentially impact voles in areas near adjacent to these sites, but such impacts would be reduced as sound dissipates as the distance from the proposed sites increases. The proposed use of the eight sites would represent a very small reduction in potential vole habitat which are spatially distributed across the project footprint. As a result, impacts to voles and potential habitat in and near these locations would be expected to minimal.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to Navajo Mogollon voles and its habitats include those activities that result in disturbance to these species and changes in vegetative cover and structure and soil conditions that can impact voles and potential habitat in the project footprint.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to retain or enhance key habitat features such as meadows. Thinning and burning would decrease trees densities and conifer encroachment in meadows and create openings. While short-term decrease in herbaceous cover would be expected immediately after treatment, the density and diversity of plant species would increase depending on climate and moisture.

There are also additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. These activities would also combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Current efforts are underway to implement travel management regulations by limiting off-road travel and decreasing road densities through closures such as through annual projects to block motor vehicle use in meadows in the project area (including the areas around Baker Lake and Potato Lake), and through ongoing or future efforts including the Long Valley Meadow Restoration Project, Long Valley Workstation Meadow Restoration Project, and Rim Country Spring Restoration Project.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Habitat elements including

meadows and grassy openings would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, temporary roads, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on voles and potential habitat in the project footprint, and would be expected to result in a long-term improvement of potential vole habitat within the project area.

Determination

Based on the above analysis, Alternative 2 may impact individual Navajo Mogollon voles and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Allen's Lappet-browed Bat

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, conditions in potential habitat for Allen's lappet-browed bats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to potential habitats or disturbance of individuals. Potential habitat would continue to exist in the project footprint, although most of the forested area within the project is currently in a moderately-closed to closed condition, which limits forest openings for foraging. Higher quality potential habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect negative effect to the species. Additionally, high tree densities would remain, limiting growth of large diameter trees and thereby limiting replacement snags for roosting. In the event of an uncharacteristic stand-replacing fire, widespread loss of snags would occur and, generally, those snags remaining after a high severity wildfire have decreased longevity and value to bats as roosts. Dense forest conditions would continue to place Allen's lappet-browed bats and potential habitats at risk from uncharacteristic stand-replacing wildfire.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for Allen's lappet-browed bat is the project footprint boundary.

Alternative 1 would continue to maintain dense forest conditions in the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. Recent research has found that greater heterogeneity in habitat attributes mitigated the effects of changing climatic conditions on reproductive probabilities based on more diverse prey communities during and following drought (Salafsky 2015). As a result, this alternative would cumulatively combine with the predicted effects of climate change to facilitate conditions that provide for less resilience to survival and reproduction rates at the landscape level.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing

likelihood of uncharacteristic stand-replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss of perennial water and meadow habitats.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put Allen's lappet-browed bats and potential foraging and roosting habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Under Alternative 2, mechanical treatments, prescribed fire and temporary roads could potentially disturb bats if they are roosting in snags in the project footprint and result in the loss of roosting habitat. Disturbance of bats would be expected to be minimal as they would occur in limited areas distributed across the project footprint for a short duration of time (one to two years for mechanical treatments and several days for preparation for and smoke from prescribed burns). Allen's lappet-browed bats rely on snags for ephemeral roosts and are thought to select taller snags closer to forest roads as maternity roosts and so are vulnerable to increased harvest of these structures along roads (Solvesky and Chambers 2009, Wisdom and Bate 2008). However, design features include retention of snags through site prep, implementation planning, and ignition techniques. Additionally, most project activities under this alternative would promote growth of larger trees through reducing tree densities, while reducing the risk of uncharacteristic stand-replacing fire. These larger trees provide more recruitment snags over the long-term. The Baker Butte treatment would involve the removal of as many as 35 large trees to improve visibility for the fire lookout at this location. Due to its limited size (approximately 27 acres or less than 0.01 percent of the project footprint), impacts from this treatment on potential roosting habitat for bats would be expected to be minimal.

Under Alternative 2, activities associated with mechanical treatments and prescribed burns including temporary roads would result in the removal of vegetative cover and potential impacts to insect prey immediately following treatment. These impacts would be expected to be short-term, generally one to two years after project implementation depending on climate and moisture, and would occur in limited areas across the project footprint at different times, thereby reducing impacts to this species. Treatments would also improve bat foraging habitat in the project footprint. The creation of forest openings would occur through mechanical treatments and prescribed fire and rehabilitation of temporary roads and prescribed fire would be expected to increase herbaceous cover and insect prey availability. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to bats, while treatments reduce the risk of uncharacteristic stand-replacing wildfire.

Proposed project activities under Alternative 2 would not substantially impact vegetative cover or increase the movement of sediment or debris into water sources in the project footprint that provide foraging habitat for bats. Implementation of BMPs such as designation of AMZs and rehabilitation of landings, skid trails, and temporary roads and the limited area and spatial separation of disturbance that occurs during proposed project activities would minimize potential impacts to springs, creeks, lakes, and stock tanks in the project footprint. Any potential negatives impacts to aquatic foraging habitats would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of treatments in Alternative 2 would have beneficial effects to bat foraging habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased

movement of sediments and debris that can result from wildfires minimizes impacts to water quality and prey availability at water sources in the project footprint, thereby benefitting this species and its foraging habitats.

Processing Sites

The eight proposed processing sites would potentially have impacts on Allen's lappet-browed bats and potential habitat. Most, if not all, vegetation would be removed from these sites to facilitate their use, so removal of any snags or large trees could result in impacts to roosting bats. Additionally, bats roosting in snags in areas adjacent to these sites could be disturbed, but such impacts would be reduced as sound dissipates as the distance from the proposed sites increases. Removal of snags and large trees at the proposed eight sites may occur to some level as exceptions to the old and large tree implementation plan, and would represent a very small reduction in potential bat roosting habitat in the project area, and these sites are well distributed spatially. As a result, impacts to roosting bats and snags in and near these locations would be expected to minimal, and would not prevent the project area from meeting or moving toward Forest Plan desired conditions.

The eight proposed processing sites would potentially have impacts on foraging habitat for this species. Most, if not all, vegetation would be removed from these sites to facilitate their use, reducing prey availability while these sites are in use. Large trees would be removed if they were safety concerns or imposed operational constraints. Conversely, after rehabilitation of a processing site occurs and vegetative cover re-establishes, the resulting openings would create foraging opportunities for this species. As described for Chiricahua leopard frogs, only two of the proposed processing sites are located within a 0.25 mile of aquatic habitats. Erosion during use of sites would be minimized after removal of vegetation through use of aggregate and upon completion of use of the site through required rehabilitation. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site and into these potential foraging habitats. As a result, impacts to foraging sites for Allen's lappet-browed bats from the proposed processing sites would be expected to be minimal.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to Allen's lappet-browed bats and its habitats include those activities that result in result in disturbance and changes in vegetative cover and structure and water conditions that impact roosting habitat and prey availability in the project footprint.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to retain or enhance key habitat features such snags and meadows. Decreases in snags as a result of prescribed burning in these projects would be expected and could combine with CWPP to move away from desired conditions in the short-term. Burn prescriptions and ignition techniques should limit overall losses of snags and trees killed by fire would become snags, while maintenance burning should provide pulses of snags through time. Thinning and burning would decrease trees densities and conifer encroachment in meadows and create openings. While short-term decrease in herbaceous cover would be expected immediately after treatment, the density and diversity of plant species would increase depending on climate and moisture.

There are also additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. These activities would also combine with short-term

loss of understory vegetation from prescribed fire and logging operations and potentially result in an increase in erosion and movement of sediment into waterways. This could result in impacts to foraging habitats such perennial water in the reservoir and drainages. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Habitat elements including snags, meadows, and perennial waterways would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, temporary roads, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on bats and potential roosting and foraging habitat in the project footprint.

Determination

Based on the above analysis, Alternative 2 may impact individual Allen's lappet-browed bats and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Spotted Bat

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, conditions in potential habitat for spotted bats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to potential foraging habitats or disturbance of individuals. Potential foraging habitat would continue to exist in the project footprint, although most of the forested area within the project is currently in a moderately-closed to closed condition, which limits forest openings for foraging. Higher quality potential habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect negative effect to the species. Dense forest conditions would continue to place spotted bats and potential foraging habitats at risk from uncharacteristic stand-replacing wildfire.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for spotted bat is the project footprint boundary.

Alternative 1 would continue to maintain dense forest conditions in the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. Recent research has found that greater heterogeneity in habitat attributes mitigated the effects of changing climatic conditions on reproductive probabilities based on more diverse prey communities during and following drought (Salafsky 2015). As a result,

this alternative would cumulatively combine with the predicted effects of climate change to facilitate conditions that provide for less resilience to survival and reproduction rates at the landscape level.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing likelihood of uncharacteristic stand-replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss of forested habitats.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put spotted bats and potential foraging habitat in the project footprint at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Under Alternative 2, disturbance of roosting spotted bats would be expected to be minimal as project activities would not be expected to impact cliffs or steep slopes near cliffs in the project footprint.

Mechanical treatments, prescribed burns and related activities including creation of temporary roads would result in the removal of vegetative cover and potential impacts to insect prey immediately following treatment. These impacts would be expected to be short-term, generally one to two years depending on climate and moisture, and would occur in limited areas across the project footprint at different times, thereby reducing impacts to this species. Treatments would also improve bat foraging habitat in the project footprint. The creation of forest openings would occur through mechanical treatments and prescribed fire and rehabilitation of temporary roads and prescribed fire would be expected to increase herbaceous cover and insect prey availability. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to bats, while treatments reduce the risk of uncharacteristic stand-replacing wildfire.

Proposed project activities under Alternative 2 would not substantially impact vegetative cover or increase the movement of sediment or debris into water sources in the project footprint that provide foraging habitat for bats. Implementation of BMPs such as designation of AMZs and rehabilitation of landings, skid trails, and temporary roads and the limited area and spatial separation of disturbance that occurs during proposed project activities would minimize potential impacts to springs, creeks, lakes, and stock tanks in the project footprint. Any potential negatives impacts to aquatic foraging habitats would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of treatments in Alternative 2 would have beneficial effects to bat foraging habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes impacts to water quality and prey availability at water sources in the project footprint, thereby benefitting this species and its foraging habitats.

Processing Sites

The eight proposed processing sites would potentially have impacts on foraging habitat for spotted bats. Most, if not all, vegetation would be removed from these sites to facilitate their use, reducing prey availability while these sites are in use. Conversely, after rehabilitation of a processing site occurs and vegetative cover re-establishes, the resulting openings would create foraging opportunities for this species.

As described for Allen's lappet-browed bats, impacts to aquatic foraging sites for spotted bats from the proposed processing sites would be expected to be minimal. Only two of the proposed processing sites are located within a 0.25 mile of a water source. Measures such as the use of aggregate on the sites to minimize erosion, rehabilitation after completion of use, and required elements to comply with state laws would minimize the movement of sediments and pollutants off-site and into these water sources. As a result, potential impacts to prey availability would be expected to be minimal.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to spotted bats and its foraging habitats include those activities that result in disturbance and changes in vegetative cover and structure and soil and water conditions that impact prey availability in the project footprint.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to retain or enhance key habitat features such as forest openings. Thinning and burning would decrease trees densities and create openings. While short-term decreases in herbaceous cover would be expected immediately after treatment, the density and diversity of plant species would increase depending on climate and moisture.

There are also additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. These activities would also combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Habitat elements including forest habitats and openings would be more sustainable as forest resiliency improved over the long-term. This project would combine with other projects such as the Long Valley Meadow Restoration Project, Long Valley Workstation Restoration Project, East Clear Creek Watershed Improvement Project to increase herbaceous cover and resiliency in the project area.

The amount of impacts from mechanical treatments, prescribed burns, temporary roads, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on spotted bats and potential foraging habitat in the project footprint.

Determination

Based on the above analysis, Alternative 2 may impact individual spotted bats and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Pale Townsend's Big-eared Bat

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, conditions in potential habitat for pale Townsend's big-eared bats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to potential foraging habitats or disturbance of individuals. Potential foraging habitat would continue to exist in the project footprint, although most of the forested area within the project is currently in a moderately-closed to closed condition, which limits forest openings for foraging. Higher quality potential habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect negative effect to the species. Dense forest conditions would continue to place this species and its potential foraging habitats at risk from uncharacteristic stand-replacing wildfire.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for pale Townsend's big-eared bat is the project footprint boundary.

Alternative 1 would continue to maintain dense forest conditions in the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. Recent research has found that greater heterogeneity in habitat attributes mitigated the effects of changing climatic conditions on reproductive probabilities based on more diverse prey communities during and following drought (Salafsky 2015). As a result, this alternative would cumulatively combine with the predicted effects of climate change to facilitate conditions that provide for less resilience to survival and reproduction rates at the landscape level.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing likelihood of uncharacteristic stand-replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss of perennial water and meadow habitats.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put pale Townsend's big-eared bats and potential foraging habitat at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Under Alternative 2, disturbance of roosting Townsend's big-eared bats would be expected to be minimal as project activities would not be expected to the karst caves in the project footprint. To protect these sensitive sites, a 'no treatment buffer' of varying sizes would be implemented around these features, which would limit disturbance as well as ground and vegetation impacts within up to 300-feet of these features

Mechanical treatments, prescribed burns and related activities including creation of temporary roads would result in the removal of vegetative cover and potential impacts to insect prey immediately following treatment. These impacts would be expected to be short-term, generally one to two years depending on climate and moisture, and would occur in limited areas across the project footprint at different times, thereby reducing impacts to this species. Treatments would also improve bat foraging habitat in the project footprint. The creation of forest openings would occur through mechanical treatments and prescribed fire and rehabilitation of temporary roads and prescribed fire would be expected to increase herbaceous cover and insect prey availability. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to bats, while treatments reduce the risk of uncharacteristic stand-replacing wildfire.

Proposed project activities under Alternative 2 would not substantially impact vegetative cover or increase the movement of sediment or debris into water sources in the project footprint that provide foraging habitat for bats. Implementation of BMPs such as designation of AMZs and rehabilitation of landings, skid trails, and temporary roads and the limited area and spatial separation of disturbance that occurs during proposed project activities would minimize potential impacts to springs, creeks, lakes, and stock tanks in the project footprint. Any potential negatives impacts to aquatic foraging habitats would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of treatments in Alternative 2 would have beneficial effects to bat foraging habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes impacts to water quality and prey availability at water sources in the project footprint, thereby benefitting this species and its foraging habitats.

Processing Sites

The eight proposed processing sites would potentially have impacts on foraging habitat for this species. Most, if not all, vegetation would be removed from these sites to facilitate their use, reducing prey availability while these sites are in use. Large trees would be retained per the old and large tree implementation plan, unless they meet exceptions categories that allow removal of these trees for safety purposes or to address operational constraints. After rehabilitation of a processing site occurs and vegetative cover re-establishes, the resulting openings would create foraging opportunities for this species.

As described for Allen's lappet-browed bats, impacts to aquatic foraging sites for pale Townsend's big-eared bats from the proposed processing sites would be expected to be minimal. Only two of the proposed processing sites are located within a 0.25 mile of a water source. Measures such as the use

of aggregate on the sites to minimize erosion, rehabilitation after completion of use, and required elements to comply with state laws would minimize the movement of sediments and pollutants off-site and into these water sources. As a result, potential impacts to prey availability would be expected to be minimal.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to Townsend's big-eared bats and its foraging habitats include those activities that result in disturbance and changes in vegetative cover and structure and soil and water conditions that impact prey availability in the project footprint.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to enhance or protect key habitat features such as meadows, perennial water and karst features. Thinning and burning would decrease trees densities and conifer encroachment in meadows while creating openings. While short-term decrease in herbaceous cover would be expected immediately after treatment, the density and diversity of plant species would increase depending on climate and moisture.

There are also additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. These activities would also combine with short-term loss of understory vegetation from prescribed fire and logging operations and potentially result in an increase in erosion and movement of sediment into waterways. This could result in impacts to foraging habitats such perennial water in the reservoir and drainages and meadow habitats. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational grazing system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Habitat elements, including meadows and perennial waterways, would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, temporary roads, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on pale Townsend's big-eared bats and potential habitat.

Determination

Based on the above analysis, Alternative 2 may impact individual pale Townsend's big-eared bats and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Western Red Bat

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, conditions in potential habitat for western red bats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to potential habitats or disturbance of individuals. Higher quality potential habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect negative effect to the species. In the event of an uncharacteristic stand-replacing fire, widespread loss of hardwoods would occur, resulting in a decrease in roosting habitat for this species. Dense forest conditions would continue to place western red bats and potential habitats at risk from uncharacteristic stand-replacing wildfire.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for western red bat is the project footprint boundary.

Alternative 1 would continue to maintain dense forest conditions in the project footprint. Over the next several decades climate change is likely to result in more frequent periods of drought, and more periods of drought with greater intensity. Recent research has found that greater heterogeneity in habitat attributes mitigated the effects of changing climatic conditions on reproductive probabilities based on more diverse prey communities during and following drought (Salafsky 2015). As a result, this alternative would cumulatively combine with the predicted effects of climate change to facilitate conditions that provide for less resilience to survival and reproduction rates at the landscape level.

Indirect effects of this alternative include an increased likelihood of habitat loss and/or degradation from high-intensity wildfire as well as slowly increasing inter-tree competition. Climate change is expected to result in increased temperatures, more frequent periods of severe drought, and potential vegetation-type shifts that would result in a loss of high-elevation forest types or a shift of forest types to higher elevations over the next several decades (Anderson-Teixeira et. al. 2013, Notaro et. al. 2012, Williams et. al. 2013). This effect of climate change would cumulative add to the increasing likelihood of uncharacteristic stand-replacing wildfire and inter-tree competition to intensify the effects of drought and increase the risk of loss of hardwoods, perennial water and meadow habitats.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put western red bats and potential foraging and roosting habitats in the project footprint at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Under Alternative 2, mechanical treatments, prescribed fire and temporary roads could potentially disturb red bats roosting in hardwoods in the project footprint and result in the loss of roosting habitat. Disturbance of bats would be expected to be minimal as they would occur in limited areas distributed across the project footprint for a short duration of time (one to two years for mechanical treatments and several days for preparation for and smoke from prescribed burns). Additionally,

design features for this alternative include no mechanical treatments in drainages and retention of hardwoods. Although the construction of temporary roads could result in the removal of a small number of oaks, especially in areas where there is a need to avoid the removal of large-diameter trees. Project activities would reduce tree densities and promote a diversity of trees and growth of larger trees, while reducing the risk of uncharacteristic stand-replacing fire.

Proposed project activities under Alternative 2 would not substantially impact vegetative cover or increase the movement of sediment or debris into water sources in the project footprint that provide foraging habitat for red bats. Implementation of BMPs such as designation of AMZs and rehabilitation of landings, skid trails, and temporary roads and the limited area and spatial separation of disturbance that occurs during proposed project activities would minimize potential impacts to springs, creeks, lakes, and stock tanks in the project footprint. Any potential negatives impacts to aquatic foraging habitats would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of treatments in Alternative 2 would have beneficial effects to bat foraging habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes impacts to water quality and prey availability at water sources in the project footprint, thereby benefitting this species and its foraging habitats.

Processing Sites

The eight proposed processing sites would potentially have impacts on western red bats and potential roosting habitat. Most, if not all, vegetation would be removed from these sites to facilitate their use, so the potential removal of oaks could result in impacts to roosting bats. Large trees would be retained per the old and large tree implementation plan, unless they meet exceptions categories that allow removal of these trees for safety purposes or to address operational constraints. Additionally, bats roosting in trees in areas adjacent to these sites could be disturbed, but such impacts would be reduced as sound dissipates as the distance from the proposed sites increases. Removal of large oaks suitable for roosting at the proposed eight sites would be minimized. Additionally, these sites would represent a very small reduction in potential bat roosting habitat in the project footprint and spatially distributed across the project footprint. As a result, impacts to roosting bats in and near these locations would be expected to minimal.

The eight proposed processing sites would potentially have impacts on foraging habitat for this species. As described for Chiricahua leopard frogs, only two of the proposed processing sites are located within a 0.25 mile of aquatic habitats. Erosion during use of sites would be minimized after removal of vegetation through use of aggregate and upon completion of use of the site through required rehabilitation. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site and into these potential foraging habitats. As a result, impacts to foraging sites for red bats from the proposed processing sites would be expected to be minimal.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to western red bats and its habitats include those activities that result in result in noise disturbance and changes in vegetative cover and structure and soil and water conditions that impact roosting habitat and prey availability in the project footprint.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary and could impact foraging and roosting habitats for red bats. These project are designed to retain or enhance key habitat features such maples, aspen, and meadows. Burn prescriptions and ignition techniques should limit overall losses of maples and encourage growth of aspen with maintenance burning providing pulses of aspen regrowth through time. Thinning and burning would decrease trees densities and conifer encroachment in meadows and create openings. While short-term decreases in herbaceous cover would be expected immediately after treatment, the density and diversity of plant species in meadows and openings would increase depending on climate and moisture.

There are also additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. These activities would also combine with short-term loss of understory vegetation from prescribed fire and logging operations and potentially result in an increase in erosion and movement of sediment into waterways. This could result in impacts to foraging habitats such perennial water in the reservoir and drainages. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational grazing system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Habitat elements including maples, aspen, meadows and perennial waterways would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, temporary roads, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on red bats and potential roosting and foraging habitat.

Determination

Based on the above analysis, Alternative 2 may impact individual western red bats and its habitats, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Northern Leopard Frog

Alternative 1– No Action

Direct and Indirect Effects

Conditions in potential northern leopard frog habitats would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be implemented nor would temporary roads or processing sites be created, there would be no direct effects to these habitats.

However, the potential for substantial indirect effects to potential leopard frog habitats would exist through the failure to reduce current fuel load conditions that could result in uncharacteristic stand – replacing wildfire. As described in the Soils and Watershed specialist report, an uncharacteristic,

stand – replacing fire under current forest structure could affect aquatic habitats in the project footprint. The loss of forest and, potentially riparian, vegetation would increase overland flow of water and soil erosion and potentially result in high sediment loads into drainages, springs, and other potential habitat. Deposition of ash and other pollutants from such a fire could result in an increase in nutrient (i.e., nitrogen and phosphorus) loading to water bodies, leading to an increase in temperature, pH, turbidity, and algal growth and reduction in dissolved oxygen (Earl and Blinn, 2003; Ranalli, 2004). Flooding, landslides, and debris flows resulting from standing replacing fire can alter stream channel characteristics, and can cause debris dams, which can subsequently breach and create a pulse flow, can scour drainages, and modify or remove riparian and aquatic vegetation. These changes in habitat conditions would also result in decreases in prey availability.

Based on the potential changes described above, Alternative 1 could result in substantial short-term and long-term indirect effects to potential northern leopard frog habitats in the project footprint.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for northern leopard frog is the same as for Chiricahua leopard frog.

As described for in detail for aquatic habitats in the Fisheries Specialist Report, cumulative effects to potential leopard frog habitats are those effects from past, other present, and reasonably foreseeable future projects that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature and the availability of food resources. This includes forest restoration projects such as Rim Country and ECC and activities that introduce or assist in the spread of diseases and non-native aquatic species. Localized, short-term decreases in the quality of potential leopard frog habitats would be expected from such activities. The ability to retain sustainable and resilient ecosystems would be further compromised by the impacts of climate change and vulnerability to high-severity fires. Conversely, improvement in aquatic habitat would be expected in those areas where off-road travel is limited and road densities are reduced under ongoing implementation of the travel management rule regulations and restoration activities are implemented under ECC, Rim Country and other projects such as the Long Valley Meadow Restoration and Rim Country Spring Restoration projects, and treatment and control of non-native aquatic species occur.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put potential northern leopard frog habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Temporary Roads

Proposed mechanical treatments and other related activities such creation of temporary roads in Alternative 2 would not substantially impact vegetative cover or increase the movement of sediment or debris into potential leopard frog habitats. Implementation of BMPs such as designation of AMZs and rehabilitation of landings, skid trails, and temporary roads and the limited area and spatial separation of disturbance that occurs during typical timber harvesting activities would minimize potential decreases in water quality through changes in stream temperature and turbidity or dissolved oxygen availability. BMPs and design features would also minimize impacts to key habitat components in the analysis area such as riparian and aquatic vegetation and prey availability. All temporary roads created would be rehabilitated after use. Under Alternative 2, any potential negatives impacts to potential northern leopard frog habitats from mechanical treatments and related activities

would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of mechanical treatments in Alternative 2 would have beneficial effects to potential leopard frog habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes impacts to water quality and key habitat components for this species. Mechanical treatments also would benefit forest health and watershed condition in potential habitats through improved soil stability and porosity related to the increase in understory vegetation in the three to five years following treatment.

Based on the information above, potential negative impacts from mechanical treatments and related activities on potential leopard habitats would be expected to be of short duration, limited to localized areas, and be minimized by BMPs and design features. Implementation of mechanical treatments would be expected to benefit this species over the long-term by reducing the risk of high severity wildlife fire and improving forest resiliency and watershed condition in the project footprint.

Prescribed Fire

Proposed broadcast burning (initial entry and maintenance) and pile burning in Alternative 2 would not impact vegetative cover or substantially increase the movement of sediment or debris into potential northern leopard frog habitats in the project footprint.

Timing of broadcast burns would be spring and fall when conditions typically produce low soil burn severity, although spatial variations in burn severity ranging from high to unburned depends on surface fuel loads. Broadcast burns do not generally cause excessive erosion or sediment, ash, or debris transport since soil cover is retained in a discontinuous pattern across the landscape. Design features such as considering the spatial distribution and size of burns in a given watershed during prescription development and retaining logs and woody debris would minimize potential impacts to water quality and key habitat components as described for mechanical treatments. Any potential impacts to potential leopard frog habitats in the project footprint from broadcast burns would be short-term (one to two years) as an increase in understory vegetation would be expected, especially in areas where openings are created and large amounts of woody material are removed, that would stabilize soils and minimize the movement of sediments and other debris.

As described for mechanical treatments, implementation of prescribed fire would benefit potential leopard frog habitats through a reduction in the threat of uncharacteristic stand-replacing wildfire and improvement of forest resiliency in upland areas. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory trees and encouragement of herbaceous cover.

Pile burning sites under Alternative 2 would be spatially and temporally distributed across the project footprint and constitute a very small portion of the project footprint (i.e., less than 5 percent), so impacts to water quality and key habitat components of potential northern leopard frog habitat would be expected to be minimal.

Processing Sites

As described for Chiricahua leopard frogs, only two of the proposed sites are located within a 0.25 mile from potential leopard frog habitat in the form of a stock tank. Both stock tanks provide very low quality habitat for leopard frogs as they lack vegetation along their banks as well as aquatic vegetation. Additionally, the area around Cobble Tank is heavily disturbed from heavy recreation use.

Erosion during use of sites would be minimized after removal of vegetation through use of aggregate and upon completion of use of the site through required rehabilitation. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site. As a result, minimal to no impacts to potential habitats for this species would be expected from the proposed processing sites.

In summary, proposed activities in Alternative 2 would be expected to have minimal negative impacts to potential northern leopard frog habitat in the project footprint. Implementation of BMPs including the use of filter strips or AMZs and design features such as retention of downed logs and other woody debris and consideration of spatial and temporal distribution of activities across a watershed would minimize potential negative impacts. Vegetation treatments and prescribed fire activities would reduce the risk of uncharacteristic stand-replacing wildfire, increase forest resiliency, and improve watershed condition. Such changes would benefit potential leopard frog habitats in the project footprint.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to potential northern leopard frog habitat include those activities that result in result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature and the availability of food resources.

While additive effects of small levels of sedimentation would be expected from Alternative 2 in the short-term (1-3 years after treatment), negative effects from project activities to potential northern leopard frog habitats would be minimized through implementation of BMPs and design features and of short duration, limited in size, and spatially and temporally distributed across the analysis area. These potential effects would not cumulatively result in long-term negative effects to potential leopard frog habitat in the project footprint.

Under Alternative 2, implementation of project activities would result in long-term benefits that would combine with the effects of recent projects or planned projects by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic stand-replacing wildfire and restoring forest resiliency. Long-term reductions in effects to potential habitat would combine with efforts underway to implement travel management regulations by limiting off-road travel and decreasing road densities through closures such as through annual projects to block motor vehicle use in frog potential habitat in the project area (including Baker Lake and Potato Lake), and through ongoing or future efforts including the Long Valley Meadow Restoration Project, the Long Valley Workstation Meadow Restoration Project and Mogollon Rim Spring Restoration Project. Therefore, the potential effects of project activities under Alternative 2, when combined with past, present and reasonably foreseeable future projects, would be expected to benefit potential northern leopard frog habitats.

Determination

Based on the above analysis, Alternative 2 may impact potential northern leopard frog habitat, but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Bald and Golden Eagle Protection Act

The bald eagle is also protected under the Bald and Golden Eagle Protection Act. See the Forest Sensitive Species section for details about potential effects to this species.

Determination

The Proposed Action Alternative will not result in take of bald eagles as defined under the Bald and Golden Eagle Act.

Management Indicator Species

Table 65, below depicts the acreage of habitat for each MIS at both the forest-wide and project scales.

Table 65. Effects to the quality of MIS habitats by alternative in the CWPP footprint.

Species	Indicator Habitat	Forest-wide Habitat Acres*	Project Footprint Habitat Acres	Effects to Habitat Quality (acres / percent change)	
				Alternative 1	Alternative 2
Mexican Spotted Owl	Mature/Old Growth Ponderosa Pine – Gambel Oak	318,868	15,016	0	+7,186 (+2%)
	Mature/Old Growth Mixed Conifer (both with Frequent Fire and	86,738	22,050	0	+7,388 (+9)
Pygmy Nuthatch	Mature/Old Growth Ponderosa Pine	78,123	4,058*	0	+2,904 (+4%)

*Forest-wide habitat acres and trends were derived from the acres of ERUs in the MIS Report for the 2018 Forest Plan Final Environmental Impact Statement (USFS 2018). The same percentages used to determine acres of mature/old growth indicator habitats for pygmy nuthatch at the Forest level were used to determine to acres of indicator habitat at the project level (9.8 percent of ponderosa pine habitat).

Mexican Spotted Owl

See the Mexican spotted owl section of the federally listed species analysis for more information.

Alternative 1– No Action

Direct and Indirect Effects

Habitat conditions for Mexican spotted owl would remain in their current condition, notwithstanding natural processes. Alternative 1 would have no direct effect on owl population or forest-wide indicator habitat trends. However, dense forest conditions would still occur and the high risk of uncharacteristic wildfire would persist, potentially resulting in an indirect negative effect on indicator habitat for the species if a wildfire were to occur.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for Mexican spotted owl is all of the acres of mixed conifer and pine-oak habitat on the Forest.

Under Alternative 1 there would be no direct impacts to owl habitats; however Alternative 1 would not prevent, delay, or ameliorate predicted effects of climate change, but would likely result in a continued trajectory toward increased stressors on owl and habitat. The dense forest conditions resulting from this alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather

conditions and more frequent and severe droughts predicted for the Coconino National Forest (TACCIMO 2014), the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Closed canopy forest conditions or old or large trees, snags, and logs would be negatively impacted in the long-term. This would combine with the loss of habitat from high-intensity wildfires, unauthorized motor vehicle use and illegal fuelwood harvest, and the vegetation removal associated with infrastructure maintenance such as near developed areas, power lines, and water pipelines to further reduce owl habitat quality.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time.

Alternative 2– Proposed Action

Direct and Indirect Effects

Activities proposed under Alternative 2 would not affect the quantity of mixed conifer in the project footprint, but would affect the quality of habitat on 14,593 acres of mixed conifer and pine-oak habitats (Table 65). The quality of most of these acres would be improved through the removal of small and intermediate sized trees using mechanical treatments and prescribed fire. This would reduce competition with larger trees in these areas and increase tree growth and cone production, while reducing the risk of uncharacteristic stand – replacing wildfire. Approximately 19 acres (or less than 0.001 percent) of owl habitat in the project footprint could be used as processing sites. Most vegetation would be removed from these sites, except for large trees protected under the old and large tree implementation plan, reducing the quality of habitat in the short-term. Since these sites would be rehabilitate after use, habitat quality would be expected to improve over the long-term.

Vegetation treatments in Alternative 2 would result in a slight increase in the quality of mixed conifer (nine percent) and pine-oak (two percent) habitats on the Forest over the next several decades.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to mixed conifer and pine-oak habitats include those activities that result in that result in a change in the quantity or quality of this habitat type on the Forest.

Vegetation treatments including 4FRI, Flagstaff Watershed Protection Project, ECC, and others will occur on the Forest, affecting approximately 600,000 acres of mixed conifer and ponderosa pine habitat over the next two decades. Decreases would occur in key habitat components including coarse woody debris, logs, and snags in PACs and recovery habitats from all of these projects. Such decreases could combine with this project to move away from desired conditions in owl habitats in the short-term. Burn prescriptions and ignition techniques should limit overall losses of logs and snags. Burned snags would fall and provide logs and trees killed by fire would become snags. The longevity of fire-killed snags is less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less course woody debris is expected to be present as a result of prescribed burning. Thinning and burning should increase tree growth rates and self-pruning of the lower tree branches through time should gradually replenish course woody debris. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve the quality of

owl habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags.

Effects from wildfires and suppression tactics affect the quality of owl habitats on the Forest. Effects depend on the time of year, scale of the fire, intensity, severity and associated management or suppression activities and can range from minimal effects to improvement or reduction of key habitat components and prey availability. Best management practices are incorporated into suppression activities as much as possible to minimize impacts to owls and their habitats. Short-term effects of fire to herbaceous cover typically last one to 3 years but recovery depends on factors such as climate and burn severity.

Recreational activities such as motorized and non-motorized travel, camping, hunting, and fuelwood harvest have the potential to cause ground disturbance and result in loss of vegetative cover and introduction of invasive plant species. The removal of shrubs, herbaceous vegetation and coarse woody debris could result in a decrease in the quality of prey habitat. Conversely, improvement in vegetative cover would be expected in those areas where off-road travel is limited and road densities are reduced through closures. Invasive plant species are well-adapted to out-compete native plants, which can lead to decreases in the density and diversity of plant species in infested areas. When this decrease is combined with the toxicity of many invasive plants to wildlife, food resources for prey and, as a result, prey availability decrease. As infested areas are treated and native plants are restored, the effect to habitat quality will be reduced.

There are additive effects of reduction of understory vegetation by wild ungulate and livestock grazing on the Forest. Grazing would combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational grazing system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Individual tree growth would improve, resulting in larger average tree sizes. Closed canopy forest conditions, un-even age forest structure, old or large trees, snags, and logs would be more sustainable as forest resiliency improved over the long-term. This would maintain owl habitat quality.

When combined with past, present and reasonably foreseeable future projects in these habitats across the Forest, the potential increase in habitat quality under Alternative 2 would not result in a measureable change in forest-wide trends for mixed conifer and pine-oak habitats or Mexican spotted owl populations.

Pygmy Nuthatch

Alternative 1– No Action

Direct and Indirect Effects

Habitat conditions for pygmy nuthatch would remain in their current condition, notwithstanding natural processes. Alternative 1 would have no direct effect on nuthatch population or forest-wide indicator habitat trends. However, dense forest conditions would still occur and the high risk of

uncharacteristic stand – replacing wildfire would persist, potentially resulting in an indirect negative effect on indicator habitat and snags for the species if a wildfire were to occur.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for pygmy nuthatch is all of the acres of mature/old growth ponderosa pine habitat on the Forest.

While there would be no direct impacts to nuthatch habitats, Alternative 1 would not prevent, delay, or ameliorate predicted effects of climate change. As described for Mexican spotted owl, dense forest conditions are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather conditions and more frequent and severe droughts, the potential impacts of these risks to the ecosystem would be increased. As tree density increases, many areas would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Closed canopy forest conditions or old or large trees and snags would be negatively impacted in the long-term. This would combine with the loss of habitat from high-intensity wildfires, unauthorized motor vehicle use and illegal fuelwood harvest, and the vegetation removal associated with infrastructure maintenance such as near developed areas, power lines, and water pipelines to further reduce nuthatch habitat quality.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time.

Alternative 2– Proposed Action

Direct and Indirect Effects

Activities proposed under Alternative 2 would not affect the quantity of mature/old growth ponderosa pine in the project footprint, but would affect the quality of habitat on approximately 2,904 acres. The quality of these acres would be improved through the removal of smaller trees using mechanical treatments and prescribed fire. Proposed treatments would be designed to retain snags and old and large trees and reduce competition and increase tree growth, while reducing the risk of uncharacteristic stand – replacing wildfire. Proposed processing sites would have no effect on pygmy nuthatches or indicator habitat as none of the sites would be located in mature/old growth ponderosa pine habitat.

Activities under this alternative would result in a slight increase (2%) in the quality of mature/old growth ponderosa pine habitat on the Forest.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to mature/old growth ponderosa pine habitat and large snags include those activities that result in a change in the quantity or quality of indicator habitats on the Forest.

Vegetation treatments including 4FRI, Flagstaff Watershed Protection Project, ECC, and others will occur on the Forest, affecting almost 600,000 acres of ponderosa pine habitat over the next two decades. Decreases would occur in key habitat components including snags as a result of mechanical and prescribed fire treatments from all of these projects and could combine with this project to move away from desired conditions in indicator habitats in the short-term. Burn prescriptions and ignition techniques in addition to the incorporation of the old and large tree retention requirements in the large

majority of these acres analyzed for treatments should limit overall losses of snags and large trees. Burned snags would fall and provide logs and trees killed by fire would become snags, while maintenance burning should provide pulses of snags through time. Thinning and burning should increase tree growth rates and decrease density-related mortality of larger and older trees over the next several decades. Improving recruitment into the larger size classes would improve the quality of nuthatch indicator habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags.

Effects from wildfires and suppression tactics affect the quality of nuthatch indicator habitats on the Forest. Effects depend on the time of year, scale of the fire, intensity, severity and associated management or suppression activities and can range from minimal effects to improvement or reduction of key habitat components. Best management practices are incorporated into suppression activities as much as possible to minimize impacts to large trees and snags.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Individual tree growth would improve, resulting in larger average tree sizes. Closed canopy forest conditions, un-even age forest structure, old or large trees and snags would be more sustainable as forest resiliency improved over the long-term. This would maintain nuthatch habitat quality.

When combined with past, present and reasonably foreseeable future projects in this habitat across the Forest, the potential increase in habitat quality under Alternative 2 would not result in a measureable change in forest-wide trends for mature/old growth ponderosa pine habitat, large snags or pygmy nuthatch populations.

Migratory Birds

Alternative 1– No Action

Direct and Indirect Effects

Under Alternative 1, there would be no changes in the project footprint. Habitat conditions for birds would generally remain the same, notwithstanding natural and ongoing processes including herbivory of vegetation by wild ungulates, livestock grazing, and other Forest activities. This alternative would have no direct effect on migratory birds. However, dense forest conditions would continue to place forest-dwelling migratory birds and their habitats including the Maple Draws IBA at risk from uncharacteristic stand – replacing wildfire, resulting in indirect negative effects.

Cumulative Effects - No Action

The spatial boundary of the cumulative effects analysis for migratory birds is the C.C. Cragin project footprint boundary.

Under Alternative 1 there would be no impacts to migratory birds and their habitats as no activities would occur; however this alternative would not prevent, delay, or ameliorate predicted effects of climate change, but would likely result in a continued trajectory toward increased stressors on migratory birds. The dense forest conditions resulting from the no action alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather conditions and more frequent and severe droughts predicted for the Forest (TACCIMO 2014), the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As

tree density increases, many areas would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Species, including many species of migratory birds, requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively impacted in the long-term. This would combine with the loss of habitat from adjacent high-intensity wildfires, unauthorized motor vehicle use and illegal fuelwood harvest, and the vegetation removal associated with infrastructure maintenance such as near developed areas, power lines, and water pipelines to further reduce migratory bird habitat quality.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time.

Alternative 1, when added to past, present and reasonably foreseeable future actions, would put migratory birds and their habitats, including the Maple Draw IBA, at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments, Prescribed Fire, and Temporary Roads

Under this alternative, approximately 30,170 acres of ponderosa pine habitat would be mechanically treated or hand thinned, with approximately 7,325 acres (or 18 percent of the acres of pine habitat) identified as pine-oak. All of the approximately 41,412 acres of ponderosa pine habitat in the project footprint would be proposed for burning. Eleven species have been identified as species of concern in pine/pine-oak habitats: band-tailed pigeon, Cassin's finch (winter only), common nighthawk, cordilleran flycatcher, flammulated owl, Grace's warbler, Lewis's woodpecker, Mexican whip-poor-will, olive warbler, olive-sided warbler, and Virginia's warbler. Through mechanical treatments and prescribed fire, this alternative would create openings and reduce tree densities across the project footprint, increasing understory vegetation including grasses, forbs, and shrubs and prey availability. Prescribed burns would temporarily increase insect abundance, resulting in beneficial effects for migratory birds. The project footprint would continue to support multi-storied, uneven-aged mature/old growth forest and create stands of younger age classes, while reducing the risk of uncharacteristic stand – replacing wildlife and the associated effects to migratory birds and their habitats.

Alternative 2 would mechanically treat approximately 7,549 acres of mixed conifer habitat in the project footprint and burn all of the approximately 22,050 acres of this habitat. All of these acres are characterized as Mexican spotted owl habitat, so treatments would be designed to maintain habitat components important for owls such a diversity of trees species and forest structure, large trees and snags, hardwoods such as maples and aspen and logs and other woody debris. These habitat components are also important for the 10 migratory bird species associated with mixed conifer forests in the project footprint: band-tailed pigeon, cordilleran flycatcher, evening grosbeak, flammulated owl, Grace's warbler, MacGillivray's warbler, Mexican whip-poor-will, olive warbler, olive-sided warbler, and red-faced warbler. As described for ponderosa pine, proposed treatments would create openings, reduce tree densities, and create younger stands of trees, while maintaining or enhancing canopy cover, forest structure, and mature/old growth vegetation stages. These conditions would benefit migratory birds and their habitats, while reducing the risk of uncharacteristic stand – replacing wildfire.

In the Maple Draws IBA, approximately 9,755 acres, or 54 percent of the acres of the IBA in the project footprint, would be mechanically treated. Mechanical treatments would not occur on slopes steeper than 40 percent, therefore, minimizing impacts to soils and understory vegetation in these unique drainages. Both mechanical treatments and prescribed burns would reduce tree densities and create small openings in the canopy reducing competition amongst the retained trees and allowing sunlight to reach the understory, promoting growth of herbaceous and woody vegetation. Large trees would be retained throughout the IBA as described in the old and large tree implementation plan. Approximately 86% of the acres that would be mechanically treated in the IBA are either inside a PAC or in habitat that will be managed for Mexican spotted owls. Desired conditions for treatments in these areas include retention of hardwood species such as maples, aspen, and oaks as well as snags and other woody debris; higher canopy cover; and a heterogeneity in forest structure. Additionally, to the extent practicable, timing of burns and ignition techniques would be used to minimize the severity of prescribed fire. This would help retain the unique species composition and forest composition in the IBA, while reducing the risk of the negative effects from uncharacteristic stand – replacing wildfires.

Creation of temporary roads could result in short-term effects to vegetative cover and prey abundance in both habitats. Removal of vegetation would be required to create the approximately 21 miles of temporary roads needed to facilitate mechanical treatments in the project footprint. Except in those area were trees need to be removed, this activity would result in short-term (one to three years) impacts to migratory birds, their habitats, and prey availability. Potential impacts would be expected to be minimal as these roads would be spatially distributed across the project footprint and limited to specific areas for limited number of years. Additionally, temporary roads would be rehabilitated and made impassable to vehicles once they are no longer needed for mechanical treatments.

Processing Sites

The eight proposed processing sites would potentially have impacts on migratory birds in both ponderosa pine and mixed conifer habitats. While most, if not all, vegetation would be removed from these sites to facilitate their use, many of these locations currently support low quality ponderosa pine habitat. To minimize impacts of the sites, most were selected for this analysis because they are located in previously disturbed areas. Following the completion of use of a processing site, rehabilitation would be required. The proposed use of the eight sites would represent a very small reduction in habitat for migratory birds (less than 0.01 percent of the project footprint) and are spatially distributed across the project footprint. As a result, impacts to migratory birds and potential ponderosa pine habitat in and near these locations would be expected to minimal.

Of the eight proposed sites, only one would be located within the Maple Draws IBA near the junction of Forest Roads 95F and 396. This approximately 8.6 acre site is located in ponderosa pine habitat in the uplands west of Fred Haught Canyon above any of the nearby drainages that support maples. As discussed in other sections of this report, to minimize erosion and the potential movement of sediments into nearby drainages and waterways from the use of these sites, aggregate would be used to cover areas of exposed soil. Aboveground fuel storage tanks would have to be manufactured, installed, and operated in accordance with Federal, state, and local requirements and a site-specific stormwater pollution prevention plan would be required to comply with state requirements. Following the completion of use of a processing site, rehabilitation would be required. As a result, no effects to the migratory birds or the unique habitats in the drainages adjacent to this location would be expected from use of this proposed site.

Cumulative Effects - Proposed Action

The spatial boundary and cumulative effects described for Alternative 1 would be the same for Alternative 2. Cumulative effects to migratory birds and their habitats include those activities that result in changes in vegetative cover and structure and soil conditions that can impact habitats in the project footprint.

Vegetation treatments proposed for the Rim Country EIS, ECC, and Clints Well will occur in the cumulative effects boundary. These project are designed to minimize impacts to migratory birds and their habitats through mitigations that limit disturbance and retain key habitat features such as large trees and snags. Thinning and burning would decrease trees densities, increase tree growth rates and decrease density-related and disturbance-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve migratory bird habitat.

There are additive effects of reduction of understory vegetation by wild ungulate and livestock grazing, recreation activities such as motorized travel and dispersed camping and introduction/spread of invasive plant species in the project footprint. The activities would combine with short-term loss of understory vegetation from prescribed fire and logging operations. Livestock grazing that occurs throughout a majority of the project area is managed on a rotational grazing system and takes into account use of forage by wild ungulates. It is designed to allow forage time to recover between use and livestock grazing is adjusted after wildfire or prescribed fire treatments to minimize cumulative effects on understory vegetation, and thus the cumulative effects of these activities on understory vegetation is minimal.

Current efforts are underway to implement travel management regulations by limiting off-road travel and decreasing road densities through closures such as through annual projects to block motor vehicle use in potential migratory bird habitat. The Rim Country Spring Restoration Project may improve small areas of habitat for migratory birds cumulatively contributing to habitat quality for migratory bird species within the project area over the next several decades.

Risks associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions related to climate change would be improved by implementing the treatments proposed under the action alternative. Individual tree growth would improve, resulting in larger average tree sizes. Habitat elements such as old or large trees would be more sustainable as forest resiliency improved over the long-term.

The amount of impacts from mechanical treatments, prescribed burns, processing sites, and related activities that would occur from implementation of Alternative 2, when added to past, present and reasonably foreseeable future actions, would not result in a measureable increase in effects on migratory birds and their habitats in the cumulative effects boundary.

Determination

Alternative 2 would potentially result in unintentional take of individuals, but would not lead to a decline in migratory bird populations.

Fish and Other Aquatic Resources

Public comments on the preliminary EA requested that the inter-disciplinary team develop a monitoring plan for aquatic habitat and include it in the EA. The purpose of the monitoring plan would be to measure potential impacts to aquatic habitat in treated areas and inform prescriptions for future treatments in the context of adaptive management. The Coconino National Forest supports

working with partners toward the development and implementation of an aquatic habitat management plan for Cragin and other projects on the same landscape. We would disagree with the assertion that this monitoring strategy be written into the Environmental Assessment as this would unnecessarily tie the monitoring strategy to the Cragin project, when it is likely to be more useful in a broader setting where the monitoring strategy can evolve and so that the strategy can incorporate similar efforts in the broader landscape such as Rim Country EIS, the first 4FRI EIS, and implementation of ongoing projects (e.g. East Clear Creek Watershed Health).

There is well established literature that reducing fire intensity reduces risks to downstream aquatic habitat. The CWPP Proposed Action includes a number of design features and best management practices such as the delineation of AMZs, and criteria to limit the intensity of prescribed burns that are expected to address potential effects to aquatic habitat. While an Aquatic Habitat Monitoring strategy may be helpful in fine tuning treatments, it is not necessary to limit the project effects. The Forest Service supports a multiagency effort to develop such a monitoring effort, but it is not the appropriate scale to be applied only to the Cragin project, and can be accomplished with more flexibility and efficiency outside of the NEPA process.

The following section describes the affected environment and effects of the alternatives relating threatened, endangered, and Forest Service sensitive fish species, aquatic management indicator species, and other priority fish species that may occur or may have habitat in the project area.

Affected Environment

Aquatic Habitats

As described in detail in the Soils and Watershed Specialist Report, not all sub-watersheds overlapping the proposed project footprint were included in the effects analysis. For the analysis of aquatic habitats, only those sub-watersheds with greater than 5% of their area overlapping the proposed project footprint were considered. These include Miller Canyon, Bear Canyon, East Clear Creek-Blue Ridge Reservoir, East Clear Creek-Clear Creek, Windmill Draw-Jacks, Long Valley Draw, and Clover Creek.

Flow permanency of stream courses is characterized as perennial, intermittent, or ephemeral. Perennial streams generally flow continuously but portions may go dry during periods of drought. Ephemeral streams flow only in direct response to precipitation, whereas intermittent streams fall somewhere in between. No clear boundary delineates these various classes of stream courses, leading to the use of such terms as “wet-intermittent” and “dry-intermittent” to refer to those intermittent systems that are more like perennial streams or ephemeral streams, respectively. Additionally, perennial streams may not have continuous flowing water throughout the year but may have perennial pools of water or segments of perennially flowing water interrupted by dry reaches. These streams are referred to as “perennial-interrupted”.

Streams in the project footprint with perennial water as determined by the presence of fish species and/or periodic observations include East Clear Creek, Miller Canyon, East Miller Canyon, Kehl Canyon, General Springs Canyon, Houston Draw, and Bear Canyon.

Approximately 986 acres of riparian areas were identified in the analysis area as described in the Soil and Watershed Specialist Report. These generally occur as thin strips along portions of major perennial or intermittent drainages including East Clear Creek, Potato Lake Draw, Cienega Draw, Poverty Draw, Kehl Canyon, Miller Canyon, East Miller Canyon, Crackerbox Canyon, General Springs Canyon, Houston Draw, Bear Canyon, and Dick Hart Draw.

Macroinvertebrates are identified as an ecological indicator in the Forest Plan. Analysis of potential effects to this indicator species will be included in the analysis of aquatic habitats.

Special Status Fish Species

Four special status species of fish are known to occur in the analysis area: Little Colorado spinedace, roundtail chub, Little Colorado River sucker, and bluehead sucker. Table 66 contains a list with the names, status, and brief description of the occurrence of each species within and near the project area. More detailed information about the habitat for each species in the project area is discussed in the Fish and Aquatic Habitat Specialist Report.

Table 66. Threatened, Endangered, Proposed, Sensitive, and Other Special Status Fishes within the Cragin Watershed Protection Project Analysis Area.

Species	Status	Description of Habitat in the Project Area
Little Colorado spinedace (*Lepidomeda vittata*)	Threatened, CH	Known to occur in Kehl, West Bear, Bear, and canyons, and in Barbershop Canyon immediately adjacent to the project area. Spinedace are also in East Clear Creek 13 miles from the upper end of C.C. Cragin Reservoir upstream to Potato Lake and approximately 3.0 miles from Forest Road 95 upstream to the C.C. Cragin Reservoir Dam. Future reintroduction sites include Miller Canyon. Critical habitat in project area designated along East Clear Creek in two locations: approximately 13 miles from the upper end of C.C. Cragin Reservoir upstream to Potato Lake and approximately 2.6 miles from Forest Road 95 upstream to the C.C. Cragin Reservoir Dam Potential habitat for the species includes portions of Bear, General Springs, Miller Canyon, and Barbershop canyons as well as East Clear Creek above the reservoir and below the junction with Barbershop Canyon.
Roundtail chub (*Gila robusta)*	SEN	Have not been located in the project area during surveys, but suitable habitat does exist in the perennial waterways waterways in drainages including Bear Canyon, East Clear Creek, and Miller Canyon. No critical habitat has been proposed for this species at this time.
Little Colorado River sucker (*Catostomus spp.*)	SEN, WGCN	Known to occur in East Clear Creek (within the C.C. Cragin Reservoir and both upstream and downstream of the reservoir), Bear, West Bear, Miller, and General Springs canyons.
Bluehead sucker (*Catostomus discobolus*)	WGCN	Known to occur throughout East Clear Creek (within the C.C. Cragin Reservoir and both upstream and downstream of the reservoir), Bear, West Bear, Kehl Canyon, Miller Canyon, and General Springs Canyon

CCS = Candidate Conservations Species. CH = Has Critical Habitat Designated by USFWS; SEN = Forest Service Sensitive Species (USFS, Southwestern Region, Regional Forester's List – last updated September 18, 2013); WGCN = Wildlife of Greatest Conservation Need in Arizona (AZGFD, 2005) Comprehensive Wildlife Conservation Strategy).

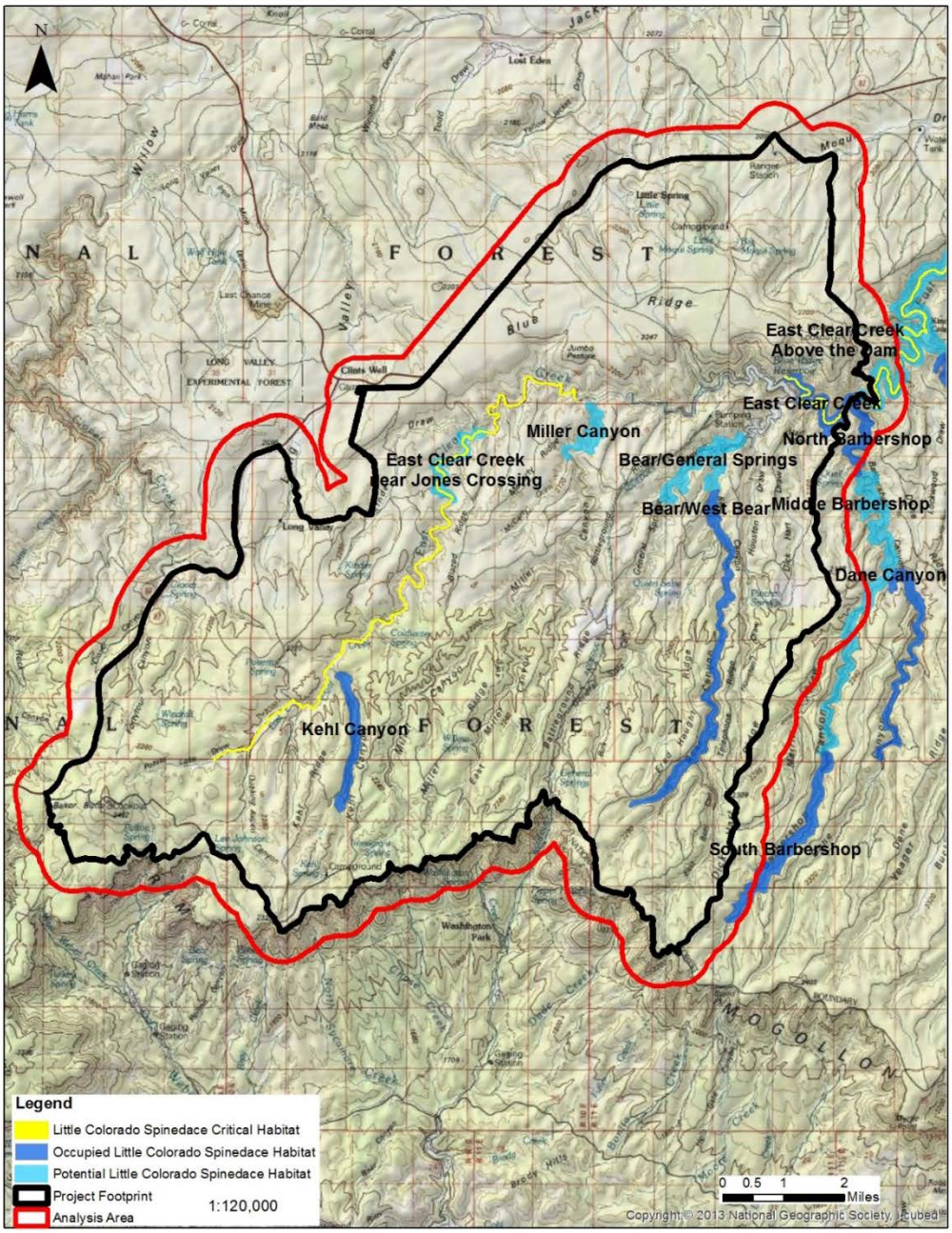


Figure 48. Habitat for Little Colorado spinedace in the Cragin Watershed Protection Project analysis area.

Environmental Consequences

General Effects of Vegetation Management and Prescribed Fire on Aquatic Habitats

Direct Effects

Direct effects of vegetation management on aquatic habitats would be expected to be minimal with implementation of the design features. These includes designation of AMZs (SW 9 and 10), all

channel crossing locations by mechanized equipment, and skid trails to avoid crossing stream channels (ephemeral and intermittent) (SW 13 and SW 15). While prescribed fire has the ability to directly affect stream channels, the proposed action does not include ignitions in riparian areas or along stream channels. To minimize impacts, fire will only be allowed to back downslope into these areas and no direct ignitions will occur. When fire is allowed to burn in riparian areas, there is the potential for some ash to enter the stream and localized erosion can occur, however, since prescribed burns occur when fuel moistures are higher, these effects would be minor in degree and extent.

Indirect Effects

Most effects to aquatic habitat and the species they support are indirect effects that result from changes in upland terrestrial habitats. These can lead to changes in sediment and water transport into a watershed which include: increased sediment, loss of riparian vegetation, altered macroinvertebrate assemblages, lowering of groundwater tables and decreased perennial flows, increased stream temperature, larger peak flows, stock tank impacts, and changes in channel form (Bisson et al., 2003, Swank et al., 1989).

Sedimentation and erosion are natural processes and ecosystems have evolved to handle the natural background levels and the episodic events of fire (Bisson et al., 2003). However, when land management activities alter the natural levels in a watershed, deleterious effects to the habitat and biota can occur. This can be compounded when a systems natural resiliency has been degraded by past activities, such as fire suppression, drought, road building, grazing, etc. Vegetation management can contribute to the deterioration of soil stability and porosity, and increasing erosion and compaction. These factors can lead to increased sedimentation into streams and changes in the hydroperiod[13].

Sediment may adversely impact fish by changing fish behavior, altering fish physiology, impairing growth, shifting blood chemistry, inducing gill trauma, reducing disease resistance, increasing egg mortality, and direct mortality of juveniles and adults if strong enough (Anderson ,1996; Argent and Flebbe, 1999; Bisson and Bilby 1982). Behavior modifications can include increased frequency of the cough reflex, avoidance of suspended sediment, reduction in feeding, and temporary disruption of territoriality. The severity of changes in fish behavior is associated with the timing of disturbance, the level of stress, and the importance of the habitat from which the fish may be excluded (Anderson, 1996; Bisson and Bilby, 1982; Rice et al., 2001). Other indirect effects on fish from sediment can occur by modifications to stream habitat. These changes include altered channel morphology, loss of spawning habitat, loss of rearing habitat, changes in the food supply (macroinvertebrate assemblage), and decreased over wintering habitat (Lisle, 1989; Miller and Benda, 2000; Wood and Armitage 1997).

Watershed hydroperiod can be altered by vegetation treatments and fire through the loss of soil productivity and an increase in soil compaction. Reductions in soil productivity can limit vegetation response post treatment, resulting in a potential decrease in the uptake of precipitation by plants. Increased soil compaction decreases the amount of water infiltration into the soil. Both of these factors compound to lead to higher surface runoff and higher flood pulses in stream channels (Swank et al., 1989; Ziemer et al., 1991). The erosive energy of floods can cause stream channel incision which causes water to drain from floodplains into the channel resulting in lower ground water tables (Agee and Skinner 2005, Lertzman et al. 1998, Ziemer et al. 1991). This results in a narrowing or loss of riparian vegetation since they are left in drier soils. Additionally, with less water entering upslope and riparian soils less water is available to provide late season flows. Therefore, the higher flows

[13] Hydroperiod: the period in which a soil area is waterlogged.

during precipitation events are often followed by low or no flow during the drier weather periods (Rinne and Miller, 2006).

The effects of hydroperiod alterations listed above can result in deleterious effects to aquatic species. Lower water tables that reduce or eliminate riparian vegetation affect macroinvertebrate communities. Riparian vegetation provides food sources for macroinvertebrates and the quantity and quality of this vegetation plays a critical role in regulating the macroinvertebrate assemblage that is present in the system (Gregory et al., 1991). In turn, macroinvertebrates are a primary food source for fish and alterations to the food web at the lower levels will have repercussions to these higher-level consumers. Additionally, riparian plant communities with rooted plants retard streambank erosion, filter sediments out of the water, build and stabilize streambanks and streambeds, and provide shade and nutrients for aquatic species. In fact healthy riparian areas act as sponges during high water periods and raise water tables maintaining stream water during dry seasons, resulting in more flow throughout the year (Elmore and Kauffman ,1994; Kauffman et al., 1997). The loss of riparian vegetation therefore can result in a negative feedback loop where conditions continue to break down until active management is undertaken to repair or retard degraded areas.

Cumulative Effects

Cumulative effects to aquatic species and their habitats would result from changes in vegetative cover, soil conditions, and contaminants that affect water quality and the availability of food resources. This can occur through accelerated erosion and increased movement of sediment as well as increased transport of contaminants such as oil and E. coli. Additionally activities that introduce or assist in the spread of non-native aquatic species such as bullfrogs, crayfish, and warm-water fish, invasive plant species including tamarisk and diseases would contribute to cumulative effects on aquatic species and their habitats.

Major land use activities that may impact aquatic habitats in the cumulative effects boundary include fuels reduction/forest restoration activities (i.e., use of prescribed fire, mechanical thinning, and other methods of vegetation management to improve forest health and/or reduce fire risk) such as the Four Forest Restoration Initiative (4FRI), East Clear Creek Watershed Health Project, fuelwood harvest, wildfire, roads and road maintenance, grazing, recreation, special uses, treatment of invasive plant species, travel management road closures, climate change, management of adjacent lands including agriculture and residential and commercial development. Most of these activities would be expected to result in localized decreases in the quality and quantity of suitable fish and freshwater invertebrate habitat within the cumulative effects boundary. Conversely, improvement in aquatic habitat would be expected in those areas where off-road travel has been recently limited and road densities are reduced under travel management, restoration activities are implemented under 4FRI or other projects, and treatment and control of invasive animal and plant species occurs.

The Tinder Fire burned an approximate 16,300 acre area in the East Clear Creek - Clear Creek Watershed just outside of the project area. Approximately 30 percent of the burn area burned at moderate to high severity, which, due to the very steep sided slopes of East Clear Creek, is likely to result in heavy sedimentation in aquatic habitats in the section of this stream northeast of the project area for at least one to two years.

Alternative 1 – No Action

Direct and Indirect Effects

Under Alternative 1, aquatic habitat conditions would remain in their current condition, notwithstanding natural processes. Since no mechanical treatments or prescribed burns would be

implemented nor would temporary roads or processing sites be created, there would be no direct effects to aquatic habitats.

However, the potential for substantial indirect effects to aquatic habitats would exist through the failure to reduce current fuel load conditions that are conducive to an uncharacteristic stand-replacing wildfire. As described in the Soils and Watershed Report, a stand-replacing fire under the current forest structure could affect aquatic habitats in the analysis area. The loss of forest and, potentially riparian, vegetation would increase overland flow of water and soil erosion and potentially result in high sediment loads into streamcourses in the analysis area. Deposition of ash and other pollutants from such a fire could result in an increase in nutrient (i.e., nitrogen and phosphorus) loading to water bodies, leading to an increase in temperature, pH, turbidity, and algal growth and reduction in dissolved oxygen (Earl and Blinn, 2003; Ranalli, 2004). Flooding, landslides, and debris flows resulting from stand replacing fire can alter stream channel characteristics, and can cause debris dams, which can subsequently breach and create a pulse flow, can scour drainages, and modify or remove riparian and aquatic vegetation. These changes in habitat conditions would result in decreases in macroinvertebrate assemblages and population of fish and other aquatic vertebrates.

Based on the potential changes described above, Alternative 1 could result in substantial short-term and long-term indirect effects to aquatic habitats in the analysis area.

Cumulative Effects - No Action

Cumulative effects to aquatic habitats include those activities that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature, and the availability of food resources. This includes projects such as the East Clear Creek Watershed Health project (ECC), the Four Forest Restoration Initiative (4FRI), and the Long-Term Ecological Assessment and Restoration Network (LEARN) research project. Additionally activities that introduce or assist in the spread of diseases and non-native aquatic species such bullfrogs, crayfish, and warm-water fish would contribute to cumulative effects.

Most of these activities would be expected to result in localized, short-term decreases in the quality of aquatic habitats in perennial waters in the analysis area including East Clear Creek, Miller Canyon, East Miller Canyon, Kehl Canyon, General Springs Canyon, Houston Draw, and Bear Canyon. Conversely, improvement in aquatic habitat would be expected in those areas where off-road travel is limited and road densities are reduced under travel management, restoration activities are implemented under ECC and other projects, and treatment and control of invasive plant species occur. See the Soils and Watershed Report for a detailed discussion of cumulative effects to soils, water condition, and water quality.

Alternative 1 would not prevent, delay, or ameliorate predicted effects of climate change, but would likely result in a continued trajectory toward increased stressors on aquatic habitats. The dense forest conditions resulting from the no action alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather conditions and more frequent and severe droughts predicted for the Coconino National Forest (TACCIMO 2014), the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Closed canopy forest conditions, soil conditions, and water availability would be negatively impacted in the long-term, which would eventually translate to aquatic habitats that are more susceptible to disturbances.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time. The recent Tinder Fire is expected to result in substantial impacts to the East Clear Creek portion northeast of the project area for the next 1-5 years. A high severity fire in the CWPP area would cumulatively contribute to the degradation of aquatic habitat in East Clear Creek of the next several years.

The trends described above for aquatic habitats would persist under current environmental conditions and continue to put these habitats at greater risk.

Alternative 2– Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Related Activities

Under Alternative 2, no mechanical treatments or hand thinning would occur in or immediately adjacent to aquatic habitats in the analysis area. These treatment types would be limited to upland areas. Mechanical treatments, hand thinning and other related activities in areas adjacent to aquatic habitats would not affect riparian vegetation or substantially increase the amount of sediment or debris reaching these habitats in the analysis area; therefore, no substantial changes in water quality, stream temperatures, channel morphology or macroinvertebrate assemblages would be expected. Potential effects would be minimized by the limited area and spatial separation of disturbance that occurs during typical timber harvesting activities and the implementation of design features, including best management practices (BMPs) and standard timber contract provisions.

Designation of AMZs would occur around all perennial and most, if not all, intermittent streamcourses in the analysis area (Figure 49). This includes all aquatic habitats that could support fish in the analysis area. In these zones, ground disturbing activities such as landings, temporary roads, and skid trails and piling of slash would be restricted. Additionally, all fueling or repair of vehicles and staging of vehicles and equipment would be prohibited in these zones. AMZs widths would be determined by the District hydrologist and adjusted based on the steepness of up gradient hillslopes. Also, operation of equipment and vehicles would not occur when ground conditions are such that excessive damage would result, minimizing the potential effects to soils and resulting erosion. This is a standard clause in timber contracts and would be visually monitored through such indicators as soil rutting.

Potential effects to aquatic habitats from activities in adjacent areas would also be limited by the size and distribution of areas effected by mechanical treatments across the landscape. Areas of operation are generally small in size and are frequently isolated from other areas of disturbance with areas of limited or no disturbance in adjacent areas. Any runoff generated from heavily disturbed areas such as landings typically infiltrates in the adjacent undisturbed areas, reducing the potential movement of sediments and other pollutants into aquatic habitats. Additionally, any potential effects would be expected to be of short duration as the greatest amount of erosion occurs the first year after mechanical treatments.

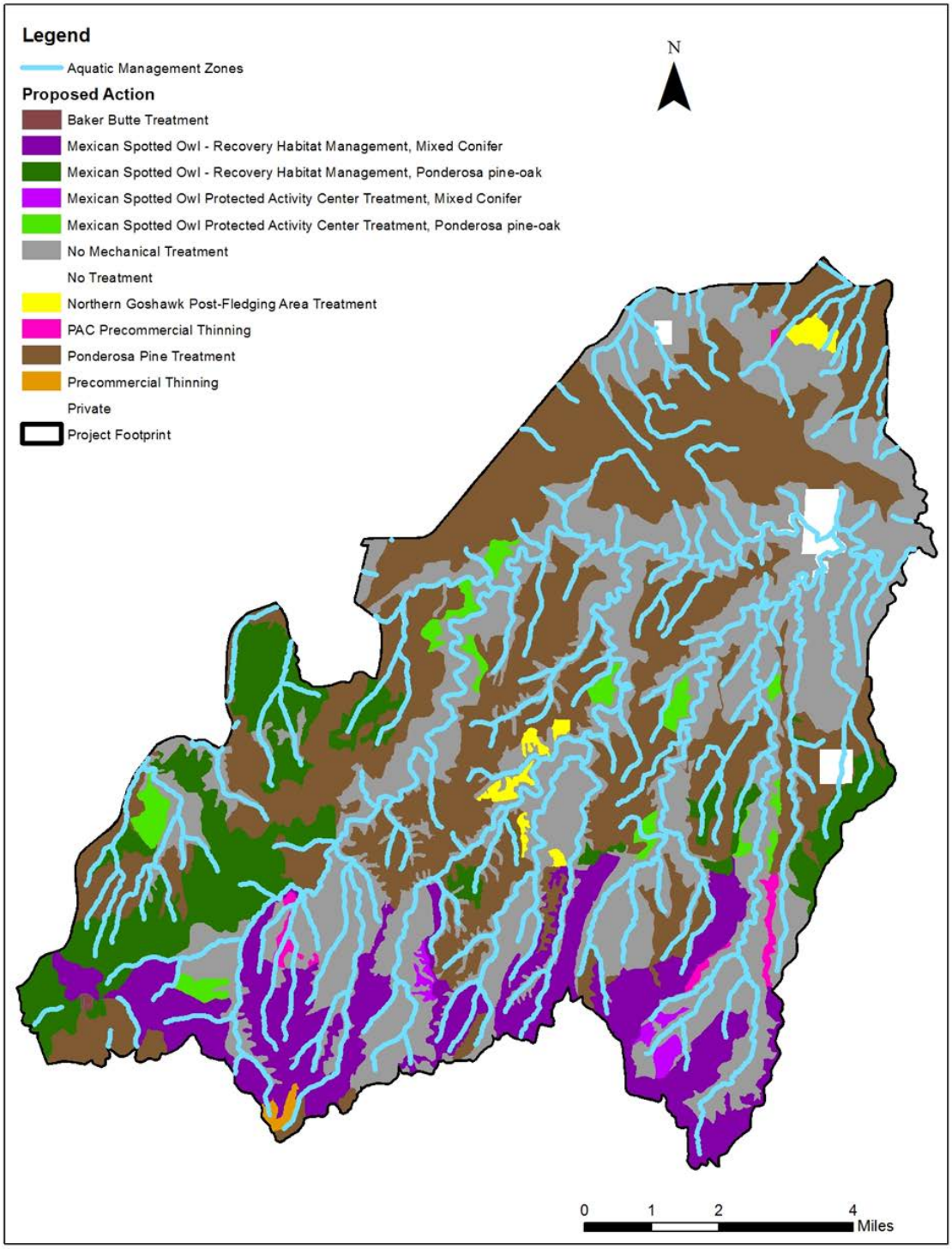


Figure 49. Aquatic management zones in relation to proposed mechanical treatments in the Cragin Watershed Protection Project footprint.

The likeliest source of sediment into aquatic habitats from project activities related to mechanical treatments would be the road system, landings, and skid trails. This includes existing Forest Service system roads and temporary roads created in areas where roads do not currently exist. An estimated 402 miles of existing system roads in the analysis area would be needed for mechanical treatments

and hauling in the analysis area. The existing system roads in the analysis area use hardened crossing such as bridges and culverts to span aquatic habitats. Additionally, approximately 43 miles of temporary roads would be needed. This includes approximately 22 miles of decommissioned roads that would be re-opened and an estimated 21 miles of new temporary roads of which approximately one-third would be located on existing road beds. None of these temporary roads would be located in or immediately adjacent to aquatic habitats nor would any landings or skid trails. To minimize effects from the road system, BMPs require that temporary roads are required to be scarified, adequately drained, and potentially re-seeded after harvesting is complete, reducing the likelihood of long-term water quality impacts from these features. BMPs also require locating landings and skid trails in previously disturbed areas and existing openings to the extent practicable and rehabilitation of these features after use. Since system roads span aquatic habitats using hardened crossings, no temporary roads, skid trails or landings would be located in aquatic habitats and BMPs would be implemented to minimize the movement of sediments, short-term and long-term effects to water quality, from these features would be expected to be minimal.

Implementation of mechanical treatments in Alternative 2 would have beneficial effects to aquatic habitats. Reduction of tree canopy and fuel loads would reduce the threat of uncharacteristic, stand-replacing wildfire and improve forest resiliency in upland areas. This would reduce the potential for changes in aquatic habitats through the loss of upland and riparian vegetation, an increase in sediments and debris, and changes in stream channel morphology, temperature, water flow, and macroinvertebrate assemblages as a result of wildfire. Mechanical treatments also benefit forest health and watershed condition through an increase in understory vegetation within one to five years following treatment. Such increases improve soil stability and porosity in upland habitats, therefore reducing the potential movement of sediments and debris into aquatic habitats.

Based on the information above, potential negative effects from mechanical treatments and related activities on aquatic habitats would be expected to be of short duration, limited to localized areas, and be minimized by BMPs. Implementation of mechanical treatments would be expected to benefit aquatic habitats over the long-term by reducing the risk of high severity wildlife fire and improving forest resiliency and watershed condition in the analysis area.

Prescribed Fire

The elements of prescribed fire proposed under Alternative 2 (initial entry and maintenance broadcast burns and pile burns) would not substantially affect riparian vegetation, stream temperatures, channel morphology, or macroinvertebrate assemblages or increase movement of sediment, debris, or other pollutants into aquatic habitats in the analysis area. Potential effects would be minimized by the implementation of resources protection measures and BMPs including timing and spatial distribution of treatments and use of varying ignition techniques such as backing fire into drainages and burning at night or during other times when humidities are higher.

Broadcast burns are proposed on approximately 99% of the 64,433 acres in the project footprint under this alternative. Timing of broadcast burns would be in the spring and fall when conditions typically produce low soil burn severity, although spatial variations in burn severity ranging from high to unburned depends on fuel loads. Broadcast burns do not generally cause excessive erosion or sediment, ash, or debris transport since soil cover is retained in a discontinuous pattern across the landscape. Since 2009, several wildfires managed for multiple resource objectives and prescribed burns have occurred in or adjacent to aquatic habitats in Bear, Barbershop, General Springs, Miller, and Bear canyons during the monsoon or fall. These fires have resulted in mostly low severity surface fires, and similar to an initial entry prescribed burn, reduced surface and ladder fuels.

A large portion of the forest adjacent to aquatic habitats proposed for burning in the analysis area are located in mixed conifer habitats. As described in the Fire and Fuels Specialist Report, mixed conifer habitats are located in moister areas where fire does not carry except under the most extreme conditions, resulting in low severity effects except under the most extreme conditions. Resource protection measures such as considering the spatial distribution and size of burns in a given watershed during prescription development and using varying ignition techniques to retain logs and woody debris would also minimize potential effects to aquatic habitats. Any potential effects from prescribed burns in the analysis area would be short-term (one to two years) as understory vegetation would be expected to increase during that time, especially in areas where openings are created and large amounts of woody material are removed. This increase in herbaceous and shrub cover would help stabilize soils and minimize the movement of sediments and other debris into aquatic habitats.

Pile burning sites under the preferred alternative would be spatially and temporally distributed across the analysis area, constitute a very small portion of the analysis area (i.e., less than 5 percent), and would not occur in AMZs, so effects to riparian vegetation, water quality, and other key habitat components of aquatic habitat would be expected to be minimal.

Under Alternative 2, implementation of prescribed fire would benefit aquatic habitats through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. Similar to mechanical treatments, reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes effects to water quality in aquatic habitat. This would reduce the potential for changes in aquatic habitats through the loss of upland and riparian vegetation, an increase in sediments and other pollutants, and changes in stream channel morphology, temperature, water flow, and macroinvertebrate assemblages as a result of wildfire. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory and encouragement of herbaceous cover. Such changes would reduce the potential movement of sediments into aquatic habitats and retain and/or potentially improve riparian vegetation and macroinvertebrate assemblages.

Based on the information above, potential negative effects to aquatic habitats from prescribed fire under Alternative 2 would be expected to be minimal.

Processing Sites

Under Alternative 2, eight sites within or immediately adjacent to the analysis area have been proposed for processing of biomass and range in size from 5 to 15 acres. These sites were screened so as to be located outside of sensitive areas including drainages, riparian areas, and meadows and in relatively flat areas. While the majority of vegetative cover would be removed from these sites, areas of exposed soil would have to be covered with aggregate to minimize erosion and facilitate use of the site. Aboveground fuel storage tanks would have to be manufactured, installed, and operated in accordance with Federal, state, and local requirements and a site-specific stormwater pollution prevention plan would be required to comply with Arizona Pollutant Discharge Elimination System requirements. This plan would have to identify best management practices that minimize or prevent soil erosion and contamination. Following the completion of use of a processing site, rehabilitation would be required including, but not necessarily limited to removal of aggregate, restoration of pre-disturbance site grades, de-compaction of soil for seedbed preparation, and seeding and mulching of the site with native grasses and forbs. As a result, no effects to aquatic habitats from the proposed processing sites would be expected.

In summary, proposed activities in Alternative 2 would be unlikely to have substantial negative effects to riparian vegetation, stream temperatures, channel morphology, or macroinvertebrate assemblages or result in increased movement of sediment, debris or other pollutants into aquatic habitats in the analysis area. Implementation of BMPs including the use of filter strips or AMZs and design features such as retention of downed logs and other woody debris and consideration of spatial and temporal distribution of activities across a watershed would minimize potential effects in the analysis area. Vegetation treatments and prescribed fire activities would reduce the risk of uncharacteristic stand-replacing wildfire, increase forest resiliency, and improve watershed condition. Such improvements would benefit aquatic habitats in the analysis area.

Cumulative Effects - Proposed Action

Activities considered in this cumulative effects analysis are the same as described for Alternative 1. See the Soil and Watershed Specialist Report and EA for more details.

These potential effects would not cumulatively result in long-term negative effects to riparian vegetation, stream temperatures, channel morphology, or macroinvertebrate assemblages or result in increased movement of sediment, debris or other pollutants into aquatic habitats in the analysis area. Under Alternative 2, implementation of project activities would result in long-term benefits to aquatic habitats by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic, stand-replacing wildfire and restoring forest resiliency. These effects are expected to counteract changes brought by climate change by limiting the increasing risk of crown fire from climate change, and ameliorating the potential loss of vegetation and resulting sedimentation expected from increasing temperatures and more frequent and higher intensity droughts over the next several decades. Therefore, the potential effects of project activities under Alternative 2 when combined with past, present and reasonably foreseeable future projects in the cumulative effects boundary would be expected to benefit aquatic habitats.

Little Colorado Spinedace

Alternative 1 – No Action

Direct and Indirect Effects

Constituent elements of critical habitat for Little Colorado spinedace consist of clean, permanent flowing water with pools and a fine gravel or silt-mud substrate. Under Alternative 1, these elements of critical habitat would remain in their current conditions in East Clear Creek, notwithstanding natural processes. As described for Aquatic Habitats and Federally Listed, Proposed, and Candidate Species, no direct effects to these elements would occur as a result of Alternative 1 since no mechanical treatments or prescribed burns would be implemented nor would any temporary roads or processing sites be created.

The potential for substantial indirect effects to components of critical habitat in the analysis area from an uncharacteristic stand-replacing wildfire under current forest conditions would occur. The potential changes in vegetation, water quality, and stream channel conditions described for Aquatic Habitats as a result of such a fire would result in decreases in the quality of critical habitat by increasing turbidity and movement of spawning substrates. Additionally, increased movement of sediments and debris and the creation of debris dams could affect the flow of water in perennial streams and the size and quantity of pools. Such changes would result in substantial short-term and long-term indirect effects to constituent elements of designated Little Colorado spinedace habitat in East Clear Creek in the analysis area.

Cumulative Effects - No Action

Similar to what was described for Federally Listed, Proposed, and Candidate Species, cumulative effects to constituent elements of Little Colorado spinedace critical habitat are those effects from past, other present, and reasonably foreseeable future projects that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality. This includes forest restoration projects such as ECC. Localized, short-term decreases in water quality in East Clear Creek would be expected from such projects.

Improvement in constituent elements would be expected in those areas where off-road travel is limited and road densities are reduced in East Clear Creek as travel management and other restoration activities are implemented. However these small improvements, would likely be well overshadowed by the increasing risk to critical habitat from major disturbance events. The ability to retain sustainable and resilient ecosystems would be primarily compromised by the effects of climate change and vulnerability to high-severity fires.

The Tinder Fire of May 2018 burned in the East Clear Creek drainage affecting several miles of potential spinedace habitat, and burning 40% of the East Clear Creek – Clear Creek watershed that drains into this waterway. Under the No Action alternative, risk of high intensity wildfire would remain and increase over the next several decades. High intensity wildfire in the Cragin Project area could affect an additional 16.3% of the watersheds draining into potential spinedace habtat, further contribute to habitat degradation of the East Clear Creek drainage from wildfire.

The trends described above for constituent elements of designated critical habitat for Little Colorado spinedace would persist under current environmental conditions and continue to put these habitats at greater risk.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Related Activities

As described for Aquatic Habitats, no mechanical treatments or hand thinning would occur in occupied or potential habitats for the species under Alternative. Mechanical treatments and hand thinning would occur on approximately 1,357 acres in upland areas within 0.25 mile of occupied habitats and 601 acres in upland areas within 0.25 mile of potential habitats. Appendix A of the Fisheries and Aquatic Habitat Specialist Report contains figures the location and types of treatments in the areas adjacent to spinedace habitats in the analysis area. Mechanical treatments, hand thinning and other related activities in areas adjacent to spinedace habitats would not affect riparian vegetation or substantially increase the amount of sediment or debris reaching spinedace habitats in the analysis area; therefore, no substantial changes in water quality, stream temperatures, channel morphology or macroinvertebrate assemblages would be expected. Potential effects would be minimized by the limited area and spatial separation of disturbance that occurs during typical timber harvesting activities and the implementation of BMPs and standard timber contract provisions.

Designation of AMZs would include all occupied and potential spinedace habitats in the analysis area. Ground disturbing activities such as landings, temporary roads, and skid trails and piling of slash would be restricted in these zones as would all fueling or repair of vehicles and staging of vehicles and equipment. Additionally, operation of equipment and vehicles would not occur when ground conditions are such that excessive damage would result, minimizing the potential effects to soils and resulting erosion.

As described for Aquatic Habitats, potential effects to spinedace habitats from activities in adjacent areas would be limited by the size and distribution of areas affected by mechanical treatments across the landscape. Areas of operation are generally small in size and are frequently isolated from other areas of disturbance and any runoff generated from heavily disturbed areas such as landings typically infiltrates in the intervening areas, reducing the potential movement of sediments and other pollutants into spinedace habitats. Any potential effects would be expected to be of short duration as the greatest amount of erosion occurs the first year after mechanical treatments.

The likeliest source of sediment into occupied or potential spinedace habitats from mechanical treatments would be the road system, landings, and skid trails. Approximately 1.67 miles, or less than 1 percent, of roads currently open to the public on the MVUM needed to implement the project in the analysis area are located in the spinedace habitats (Table 67). This includes approximately 0.77 miles of FR 95 in occupied spinedace habitat in Bear Canyon and approximately 0.58 miles of FR 95 and approximately 0.32 mile of FR 141 along East Clear Creek in potential spinedace habitats. These roads would be used as haul routes and are maintained for use by all passenger vehicles. Bridges span the crossings at both locations on East Clear Creek and there is a culvert at the Bear Canyon crossing. No administrative use only roads needed to implement the project would be located in occupied or potential spinedace habitats. Since no mechanical treatments would occur in spinedace habitats in the analysis area, there would be no temporary roads (new or existing) in spinedace habitats. Approximately 2.53 miles of decommissioned roads in upland areas within 0.25 mile of spinedace habitats would be needed to implement mechanical treatments, but no new temporary roads would be created within 0.5 mile of either occupied or potential habitats. Additionally, while they would be expected to occur in adjacent uplands where treatment would occur, no skid trails or landings would be located in spinedace habitats due to the lack of mechanical treatments in these areas.

Implementation of BMPs in areas adjacent to spinedace habitats including requiring adequate drainage of all roads, rehabilitation of temporary roads after treatment, and locating landings and skid trails in previously disturbed areas would minimize impacts of roads and other features. With a very limited miles of roads and no skid trails or landings in occupied or potential spinedace habitats and the implementation of BMPs, short-term and long-term effects to water quality from these features would be expected to be minimal. As a result, effects from these activities to Little Colorado spinedace and its habitats would be expected to be minimal.

Implementation of mechanical treatments in the analysis area would have beneficial impacts to Little Colorado spinedace and its habitats. The proposed action would reduce the threat of uncharacteristic, stand-replacing wildfire and improve forest resiliency in upland areas through reductions in tree densities, ladder fuels, and fuel loads. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes effects to water quality and key habitat components for Little Colorado spinedace. Proposed mechanical treatments would also benefit overall forest health and watershed condition as understory vegetation would be expected to increase within one to five years following treatments. Such increases would improve soil stability and porosity in upland habitats, therefore reducing the potential movement of sediments and debris into occupied and potential spinedace habitats.

Based on this analysis, potential effects to Little Colorado spinedace and its habitats from mechanical treatments and related activities in the analysis area would be expected to be minimal.

Table 67. Miles of roads identified for use during mechanical treatments in occupied and potential Little Colorado spinedace habitat and a 0.25 mile buffer in the CWPP analysis area.

Name	Miles					
	Location	Open Roads on the MVUM	Administrative Only Use Roads	Temporary Roads		Totals
				Decommissioned	New	
Occupied Habitat	In habitat	0.77	0	0	0	**0.77**
	0.25 mile buffer	14.10	3.84	2.30	0	**20.24**
Potential Habitat	In habitat	0.90	0	0	0	**0.90**
	0.25 mile buffer	4.03	5.98	0.23	0	**10.24**
	Totals:	**18.24***	**9.82**	**2.53**	**0**	**30.59***

*There is 1.56 miles of overlap in the Open Roads on the MVUM between the 0.25 mile buffers for occupied and potential habitat, so it was subtracted for the overall totals to avoid double counting.

Prescribed Fire

As described for Aquatic Habitats, proposed broadcast burning (initial entry and maintenance) and pile burning in Alternative 2 would not affect vegetative cover or substantially increase the movement of sediment or debris into occupied or potential Little Colorado spinedace habitats in the analysis area, therefore limiting potential negative effects to habitat quality and individuals.

Timing of broadcast burns would be spring and fall when conditions typically produce low soil burn severity, although spatial variations in burn severity ranging from high to unburned depends on surface fuel loads. Broadcast burns do not generally cause excessive erosion or sediment, ash, or debris transport since soil cover is retained in a discontinuous pattern across the landscape. Design features such as considering the spatial distribution and size of burns in a given watershed during prescription development and retaining logs and woody debris would minimize potential effects to water quality and key habitat components as described for mechanical treatments. Any potential effects to Little Colorado spinedace and its habitats in the analysis area from broadcast burns would be short-term (one to two years) as an increase in understory vegetation would be expected, especially in areas where openings are created and large amounts of woody material are removed, that would stabilize soils and minimize the movement of sediments and other debris.

Under Alternative 2, implementation of prescribed fire would benefit Little Colorado spinedace and its habitats through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes effects to water quality and key habitat components of Little Colorado spinedace habitat. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory trees and encouragement of herbaceous cover.

Pile burning sites under Alternative 2 would be spatially and temporally distributed across the analysis area and constitute a very small portion of the analysis area (i.e., less than 5 percent), so

effects to water quality and key habitat components of Little Colorado spinedace habitat would be expected to be minimal.

Processing Sites

Under Alternative 2, the eight proposed processing sites would be located in flat upland areas at least 0.25 mile from occupied or potential spinedace habitat. Erosion during use of sites would be minimized after removal of vegetation through use of aggregate material and after use through required rehabilitation. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site. As a result, no effects to Little Colorado spinedace and its habitats from the proposed processing sites would be expected.

In summary, proposed activities in Alternative 2 would be unlikely to have substantial negative effects to Little Colorado spinedace or water quality and key components of occupied or potential habitat in the analysis area. Implementation of BMPs including the use of filter strips or AMZs and design features such as retention of downed logs and other woody debris and consideration of spatial and temporal distribution of activities across a watershed would minimize potential effects in the analysis area. Vegetation treatments and prescribed fire activities would reduce the risk of uncharacteristic stand-replacing wildfire, increase forest resiliency, and improve watershed condition. Such changes would benefit Little Colorado spinedace and its habitats in the analysis area.

Cumulative Effect - Proposed Action

Activities considered in this cumulative effects analysis are the same as described for Alternative 1. For more detail, see the Soil and Watershed Specialist Report.

While additive effects would be expected from Alternative 2, negative effects from project activities to Little Colorado spinedace and its habitats would be minimized through implementation of BMPs and design features and of short duration, limited in size, and spatially and temporally distributed across the analysis area. These potential effects would not cumulatively result in long-term negative effects to Little Colorado spinedace or water quality and key components of occupied or potential habitat for the species in the analysis area.

The Tinder Fire of May 2018 burned in the East Clear Creek drainage affecting several miles of potential spinedace habitat, and burning 40% of the East Clear Creek – Clear Creek watershed that drains into this waterway. Under Alternative 2, implementation of project activities would result in long-term benefits to the species by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic, stand-replacing wildfire and restoring forest resiliency. This alternative would slightly counteract the effects of the Tinder Fire by reducing the potential for high intensity wildfire in the Cragin Project area, which could affect an additional 16.3% of the watersheds draining into potential spinedace habitat, further contribute to habitat degradation of the East Clear Creek drainage from wildfire.

Fire risk reduction effects from this alternative are expected to counteract changes brought by climate change by limiting the increasing risk of crown fire from climate change, and ameliorating the potential loss of vegetation and resulting sedimentation expected from increasing temperatures and more frequent and higher intensity droughts over the next several decades. Therefore, the potential effects of project activities under Alternative 2, when combined with past, present and reasonably foreseeable future projects in the cumulative effects boundary, would be expected to benefit Little Colorado spinedace and its habitats.

Determination

Based on the above analysis, it is determined that project activities in the Proposed Action Alternative **may affect, but are not likely to adversely affect** the Little Colorado spinedace and its habitats.

Little Colorado Spinedace Critical Habitat

Alternative 1 – No Action

Direct and Indirect Effects

Constituent elements of critical habitat for Little Colorado spinedace consist of clean, permanent flowing water with pools and a fine gravel or silt-mud substrate. Under Alternative 1, these elements of critical habitat would remain in their current conditions in East Clear Creek, notwithstanding natural processes. As described for Aquatic Habitats and Federally Listed, Proposed, and Candidate Species, no direct effects to these elements would occur as a result of Alternative 1 since no mechanical treatments or prescribed burns would be implemented nor would any temporary roads or processing sites be created.

The potential for substantial indirect effects to components of critical habitat in the analysis area from an uncharacteristic stand-replacing wildfire under current forest conditions would occur. The potential changes in vegetation, water quality, and stream channel conditions described for Aquatic Habitats as a result of such a fire would result in decreases in the quality of critical habitat by increasing turbidity and movement of spawning substrates. Additionally, increased movement of sediments and debris and the creation of debris dams could affect the flow of water in perennial streams and the size and quantity of pools. Such changes would result in substantial short-term and long-term indirect effects to constituent elements of designated Little Colorado spinedace habitat in East Clear Creek in the analysis area.

Cumulative Effects - No Action

Similar to what was described for Federally Listed, Proposed, and Candidate Species, cumulative effects to constituent elements of Little Colorado spinedace critical habitat are those effects from past, other present, and reasonably foreseeable future projects that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality. This includes forest restoration projects such as ECC. Localized, short-term decreases in water quality in East Clear Creek would be expected from such projects.

Improvement in constituent elements would be expected in those areas where off-road travel is limited and road densities are reduced in East Clear Creek as travel management and other restoration activities are implemented. However these small improvements, would likely be well overshadowed by the increasing risk to critical habitat from major disturbance events. The ability to retain sustainable and resilient ecosystems would be primarily compromised by the effects of climate change and vulnerability to high-severity fires

The trends described above for constituent elements of designated critical habitat for Little Colorado spinedace would persist under current environmental conditions and continue to put these habitats at greater risk.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Related Activities

As described for Aquatic Habitats, no mechanical treatments or hand thinning would occur in designated critical habitat for the species under Alternative 2. Mechanical treatments and hand thinning would occur on approximately 1,233 acres in upland areas within 0.25 mile of occupied habitats. Appendix A of the Fisheries and Aquatic Habitat Specialist Report contains figures with the location and types of treatments in the areas adjacent to spinedace critical habitat in the analysis area. Similarly, four roads open to the public on the MVUM, FRs 95, 141, 147, and 308, that we serve as haul routes for the project cross segments of East Clear Creek. FRs 95 and 141 have bridges and FRs 147 and 308 have culverts. No other types of roads would be located in critical habitat.

Approximately 0.57 miles of decommissioned roads would be needed to implement mechanical treatments in the uplands with 0.25 mile of critical habitat, but no new temporary roads would be created within 0.25 miles of critical habitat. As described for Little Colorado spinedace and its habitats, proposed mechanical treatments, hand thinning, and related activities in the project footprint would not substantially reduce vegetative cover, and therefore, not result in an increase in the movement of sediment or other debris into East Clear Creek. An AMZ would be designated around East Clear Creek, so no ground disturbing activities such as landings, temporary roads, and skid trails or piling of slash would in critical habitat or on the slopes immediately adjacent. Implementation of other resource protection measures, BMPs, and standard timber contract clauses and the limited area and spatial separation of disturbance associated with timber harvesting activities would minimize potential effects to elements of critical habitat including water quality, permanent flowing water, pools, and fine gravel or silt-mud substrates. Any potential negatives effects to components of critical habitat from mechanical treatments and related activities would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Implementation of mechanical treatments in the analysis area would have beneficial effects to elements of critical habitat through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. These treatments also would benefit forest health and watershed condition in critical habitat through improved soil stability and porosity related to the increase in understory vegetation in the one to five years following treatment.

Based on this analysis, potential effects to primary constituent elements of critical habitat for Little Colorado spinedace from mechanical treatments and related activities in the analysis area would be expected to be minimal.

Prescribed Fire

Proposed broadcast burning (initial entry and maintenance) and pile burning in the proposed action would not substantially affect vegetative cover or increase the movement of sediment or debris into East Clear Creek or its tributaries in the analysis area. Potential negative effects to constituent elements of spinedace critical habitat would, therefore, be expected to be minimal.

Although soil burn severity depends on surface fuel loads, timing of broadcast burns in the proposed action would be spring and fall when conditions typically produce low soil burn severity. Resource protection measures such as considering the spatial distribution and size of burns in a given watershed during prescription development and using varying ignition techniques to retain adequate levels of logs and woody debris would minimize potential effects to constituent elements as described for

mechanical treatments. Any potential effects to Little Colorado spinedace and its habitats from prescribed fire in the analysis area would be short-term (one to two years) as an increase in understory vegetation would be expected post-treatment that would stabilize soils and minimize the movement of sediments and other debris into East Clear Creek and its tributaries.

Pile burning would not occur in AMZs centered on critical habitat. Additionally, this activity represents a very small portion of the analysis area (less than 5 percent) and would be spatially and temporally distributed across the area. As a result, potential effects of pile burning to constituent elements of critical habitat would be expected to be minimal.

Under the proposed action, implementation of prescribed fire would benefit elements of spinedace critical habitat in the analysis area through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. After implementation of proposed treatments in critical habitat and adjacent areas within 0.25 mile, fire modeling predicts a decrease in the potential of active and passive crown fire from 67 and 28 percent to 58 and 11 percent in critical habitat. The percentage of potential for surface would be expected to increase, with modeling predicting a change from 5 to 30 percent. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes effects to constituent elements including water quality, permanent flowing water, pools, or fine gravel or silt-mud substrates. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory trees and encouragement of herbaceous cover.

Based on this analysis, potential effects to constituent elements of critical habitat for Little Colorado spinedace from prescribed fire in the analysis area would be expected to be minimal.

Processing Sites

The eight proposed processing sites in the proposed action would be located in flat upland areas at least 0.5 mile from designated critical habitat in the analysis area. The potential for erosion after removal of vegetation and use of these sites would be minimized through use of aggregate on bare soil and required rehabilitation of sites after completion of use. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site. As a result, no effects to constituent elements would be expected from the proposed processing sites.

Cumulative Effects - Proposed Action

Activities considered in this cumulative effects analysis are the same as described for Alternative 1. For more detail, see the Soil and Watershed Specialist Report.

While additive effects would be expected from Alternative 2, negative effects from project activities to constituent elements of Little Colorado spinedace critical habitat would be minimized through implementation of BMPs and design features and the short duration, limited size, and spatial and temporal distribution of project activities across the analysis area. These potential effects would not cumulatively result in long-term negative effects to critical habitat for the species in the analysis area. Under Alternative 2, implementation of project activities would result in long-term benefits to elements of spinedace critical habitat by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic, stand-replacing wildfire and restoring forest resiliency. These effects are expected to counteract changes brought by climate change by limiting the increasing risk of crown fire from climate change, and ameliorating the potential loss of vegetation and resulting sedimentation expected from increasing temperatures and more frequent and higher intensity droughts

over the next several decades. Therefore, the potential effects of project activities under Alternative 2, when combined with past, present and reasonably foreseeable future projects in the cumulative effects boundary, would be expected to benefit constituent elements of spinedace critical habitat in the analysis area.

Determination

Based on the above analysis, it is determined that project activities in the Proposed Action Alternative **may affect, but are not likely to adversely affect** designated critical habitat for Little Colorado spinedace.

Roundtail Chub and Little Colorado River Sucker

Alternative 1 – No Action

Direct and Indirect Effects

Under Alternative 1, habitat conditions for Little Colorado River sucker and roundtail chub would remain in their current condition, notwithstanding natural processes. As described for Aquatic Habitats, no direct effects to these species and their occupied or potential habitats would occur as a result of Alternative 1 since no mechanical treatments or prescribed burns would be implemented nor would any temporary roads or processing sites be created.

The potential for substantial indirect effects to these species and their occupied or potential habitats in the analysis area from an uncharacteristic stand-replacing wildfire under current forest conditions would occur. The potential changes in vegetation, water quality, and stream channel conditions described for Aquatic Habitats as a result of such a fire would result in decreased quality of habitat by increasing turbidity and temperature and reducing food and dissolved oxygen availability and key habitat components such as riparian and aquatic vegetation and other sources of cover and spawning substrates. Additionally, increased movement of sediments and debris and the creation of debris dams could affect stream channel morphology and the quantity of perennial streams and pools, reducing the amount of habitat available to these species and macroinvertebrate assemblages in the analysis area. These changes could result in alterations in behavior as well as loss of individuals or populations. Such changes would result in substantial short-term and long-term indirect effects to Little Colorado River sucker and roundtail chub populations in the analysis area.

Cumulative Effects - No Action

As described for Aquatic Habitats, cumulative effects to Little Colorado River sucker, roundtail chub and their habitats are those effects from past, other present, and reasonably foreseeable future projects that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature and the availability of food resources. This includes forest restoration projects such as ECC and activities that introduce or assist in the spread of diseases and non-native aquatic species. Localized decreases in the quality of occupied habitats in the analysis area including East Clear Creek within C.C. Cragin Reservoir and both upstream and downstream of the reservoir, Bear Canyon, West Bear Canyon, Miller Canyon, and General Springs Canyon would be expected.

The ability to retain sustainable and resilient ecosystems would be further compromised by the effects of climate change and vulnerability to high-severity fires. Improvement in aquatic habitat would be expected in those areas where off-road travel is limited and road densities are reduced under travel

management and other restoration activities are implemented and treatment and control of invasive plant species occur.

The potential positive cumulative effects from restoration projects would likely be overshadowed by the risks and effects caused by climate change over the coming decades. Climate change is expected to result in higher risk of crown fire, greater frequency and duration of drought, and increased establishment and spread of invasive species all of which would degrade sucker and chub habitat and increase environmental stressors on these species. The trends described above for Little Colorado River sucker, roundtail chub, and their occupied or potential habitats would persist under current environmental conditions and continue to put these species and their habitats at greater risk.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Related Activities

As described for Little Colorado spinedace, proposed mechanical treatments and other related activities in Alternative 2 would not affect vegetative cover or substantially increase the movement of sediment or debris into occupied or potential habitats for roundtail chub or Little Colorado River sucker in the analysis area, therefore limiting potential negative effects to habitat quality and individuals. Implementation of BMPs and design features in the analysis area and the limited area and spatial separation of disturbance associated with timber harvesting activities would minimize potential effects to water quality and key habitat components of habitats for the two species such as cover and gravel and cobble substrates for spawning. Under Alternative 2, any potential negatives effects to roundtail chub, Little Colorado River sucker and their habitats from mechanical treatments and related activities would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

As described for Little Colorado spinedace, implementation of mechanical treatments in Alternative 2 would have beneficial effects for both species and their habitats through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. These treatments also would benefit forest health and watershed condition in occupied and potential habitats through improved soil stability and porosity related to the increase in understory vegetation in the one to five years following treatment.

Based on the information above, potential negative effects from mechanical treatments and related activities on roundtail chub, Little Colorado sucker and their habitats would be expected to be of short duration, limited to localized areas, and be minimized by BMPs and design features. Implementation of mechanical treatments would be expected to benefit this species over the long-term by reducing the risk of high severity wildlife fire and improving forest resiliency and watershed condition in the analysis area.

Prescribed Fire

As described for Little Colorado spinedace, proposed broadcast burning (initial entry and maintenance) and pile burning in Alternative 2 would not affect vegetative cover or substantially increase the movement of sediment or debris into chub and sucker habitats in the analysis area, therefore limiting potential negative effects to habitat quality and individuals.

Although soil burn severity depends on surface fuel loads, timing of broadcast burns in Alternative 2 would be spring and fall when conditions typically produce low soil burn severity. Design features

such as considering the spatial distribution and size of burns in a given watershed during prescription development and retaining adequate levels of logs and woody debris would minimize potential effects to water quality and key habitat components as described for mechanical treatments. Any potential effects from broadcast burns to roundtail chub, the Little Colorado River sucker, and their habitats in the analysis area would be short-term (one to two years) as an increase in understory vegetation would be expected that would stabilize soils and minimize the movement of sediments and other debris.

Under Alternative 2, implementation of prescribed fire would benefit roundtail chub, Little Colorado River sucker, and their habitats through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes effects to water quality and key habitat components of occupied and potential habitat. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory trees and encouragement of herbaceous cover.

Pile burning sites under Alternative 2 would be spatially and temporally distributed across the analysis area and constitute a very small portion of the analysis area (i.e., less than 5 percent), so effects to water quality and key habitat components of roundtail chub and Little Colorado River sucker habitat would be expected to be minimal.

Processing Sites

As described for Little Colorado spinedace, the eight proposed processing sites in Alternative 2 would be located in flat upland areas at least 0.25 mile from occupied and potential chub or sucker habitats. Erosion during use of sites would be minimized after removal of vegetation through use of aggregate and after use through required rehabilitation. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site. As a result, no effects to roundtail chub, Little Colorado River sucker and their habitats from the proposed processing sites would be expected.

In summary, proposed activities in Alternative 2 would be unlikely to have substantial negative effects to roundtail chub and Little Colorado River sucker or water quality and key components of occupied or potential habitats in the analysis area. Implementation of BMPs including the use of filter strips or AMZs and design features such as retention of downed logs and other woody debris and consideration of spatial and temporal distribution of activities across a watershed would minimize potential effects in the analysis area. Vegetation treatments and prescribed fire activities would reduce the risk of uncharacteristic stand-replacing wildfire, increase forest resiliency, and improve watershed condition. Such changes would benefit roundtail chub, Little Colorado River sucker, and their habitats in the analysis area.

Cumulative Effects - Proposed Action

Activities considered in this cumulative effects analysis are the same as described for Alternative 1. For more detail, see the Soil and Watershed Specialist Report.

While additive effects would be expected from Alternative 2, negative effects from project activities to roundtail chub, Little Colorado sucker, and their habitats would be minimized through implementation of BMPs and design features and the short duration, limited size, and spatial and temporal distribution of project activities across the analysis area. These potential effects would not cumulatively result in long-term negative effects to the two species or water quality and key components of occupied or potential habitat for the species in the analysis area. Under Alternative 2,

implementation of project activities would result in long-term benefits to these species by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic, stand-replacing wildfire and restoring forest resiliency. These effects are expected to counteract changes brought by climate change by limiting the increasing risk of crown fire from climate change, and ameliorating the potential loss of vegetation and resulting sedimentation expected from increasing temperatures and more frequent and higher intensity droughts over the next several decades. Therefore, the potential effects of project activities under Alternative 2, when combined with past, present and reasonably foreseeable future projects in the cumulative effects boundary, would be expected to benefit roundtail chub, Little Colorado River sucker, and their habitats.

Determinations

Based on the above analysis, Alternative 2 may impact individual roundtail chub but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Based on the above analysis, Alternative 2 may impact individual Little Colorado River sucker but is not likely to result in a trend toward Federal listing or loss of viability of the species.

Bluehead Sucker

Alternative 1 – No Action

Direct and Indirect Effects

Under Alternative 1, habitat conditions for bluehead sucker would remain in their current condition, notwithstanding natural processes. As described for Aquatic Habitats, no direct effects to this species and its habitats would occur as a result of Alternative 1 since no mechanical treatments or prescribed burns would be implemented nor would any temporary roads or processing sites be created.

The potential for substantial indirect effects to this species and its habitats in the analysis area from an uncharacteristic stand-replacing wildfire under current forest conditions would occur. The potential changes in vegetation, water quality, and stream channel conditions described for Aquatic Habitats as a result of such a fire would potentially result in decreases quality of habitat by increasing turbidity and temperature and reducing food and dissolved oxygen availability and key habitat components such as riparian and aquatic vegetation and other sources of cover and spawning substrates. Additionally, increased movement of sediments and debris and the creation of debris dams could affect stream channel morphology and the quantity of perennial streams and pools, reducing the amount of habitat available to these species and macroinvertebrate assemblages in the analysis area. These changes could result in alterations in behavior as well as loss of individuals or populations. Such changes would result in substantial short-term and long-term indirect effects to bluehead sucker populations in the analysis area.

Cumulative Effects - No Action

As described for Aquatic Habitats, cumulative effects to bluehead sucker and its habitats are those effects from past, other present, and reasonably foreseeable future projects that result in changes in vegetative cover, soil and stream channel conditions, and contaminants that affect water quality, temperature and the availability of food resources. This includes forest restoration projects such as ECC and activities that introduce or assist in the spread of diseases and non-native aquatic species. Localized, short-term decreases in the quality of occupied habitats in the analysis area including East Clear Creek within the C.C. Cragin Reservoir and both upstream and downstream of the reservoir, Bear Canyon, West Bear Canyon, Kehl Canyon, Miller Canyon, and General Springs Canyon would

be expected. The ability to retain sustainable and resilient ecosystems would be further compromised by the effects of climate change and vulnerability to high-severity fires. Improvement in aquatic habitat would be expected in those areas where off-road travel is limited and road densities are reduced under travel management and other restoration activities are implemented and treatment and control of invasive plant species occur.

The potential positive cumulative effects from restoration projects would likely be overshadowed by the risks and effects caused by climate change over the coming decades. Climate change is expected to result in higher risk of crown fire, greater frequency and duration of drought, and increased establishment and spread of invasive species all of which would degrade bluehead sucker habitat and increase environmental stressors on these species. The trends described above for bluehead sucker and its habitats would persist under current environmental conditions and continue to put this species and its habitats at greater risk.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Mechanical Treatments and Related Activities

As described for the other fish species, proposed mechanical treatments and other related activities in Alternative 2 would not affect vegetative cover or substantially increase the movement of sediment or debris into bluehead sucker habitats in the analysis area, therefore limiting potential negative effects to habitat quality and individuals. Implementation of BMPs and design features in the analysis area and the limited area and spatial separation of disturbance associated with timber harvesting activities would minimize potential effects to water quality and key habitat components of occupied and potential bluehead sucker habitat such as gravel-sand and gravel-cobble substrates for spawning and algae and invertebrates to scrape off rocks. Under Alternative 2, any potential negatives effects to this species and its habitats from mechanical treatments and related activities would be expected to be of short duration as the greatest amount of erosion occurs the first year after treatment.

Similar to the other fish species, implementation of mechanical treatments in Alternative 2 would have beneficial effects to bluehead sucker and its habitats through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. These treatments also would benefit forest health and watershed condition in occupied and potential sucker habitats through improved soil stability and porosity related to the increase in understory vegetation in the one to five years following treatment.

Based on the information above, potential negative effects from mechanical treatments and related activities on bluehead sucker and its habitats would be expected to be of short duration, limited to localized areas, and be minimized by BMPs and design features. Implementation of mechanical treatments would be expected to benefit this species over the long-term by reducing the risk of high severity wildlife fire and improving forest resiliency and watershed condition in the analysis area.

Prescribed Fire

As described for the other fish species, proposed broadcast burning (initial entry and maintenance) and pile burning in Alternative 2 would not affect vegetative cover or substantially increase the movement of sediment or debris into occupied or potential bluehead sucker habitats in the analysis area, therefore limiting potential negative effects to habitat quality and individuals.

Although soil burn severity depends on surface fuel loads, timing of broadcast burns in Alternative 2 would be spring and fall when conditions typically produce low soil burn severity. Design features such as considering the spatial distribution and size of burns in a given watershed during prescription development and retaining adequate levels of logs and woody debris would minimize potential effects to water quality and key habitat components as described for mechanical treatments. Any potential effects from broadcast burns to bluehead sucker and its habitats in the analysis area would be short-term (one to two years) as an increase in understory vegetation would be expected that would stabilize soils and minimize the movement of sediments and other debris.

Under Alternative 2, implementation of prescribed fire would benefit bluehead sucker and its habitats through a reduction in the threat of uncharacteristic, stand-replacing wildfire and improvement of forest resiliency in upland areas. Reducing the potential of decreased vegetative cover and increased movement of sediments and debris that can result from wildfires minimizes effects to water quality and key habitat components of occupied and potential sucker habitat. Prescribed fire also benefits forest health and watershed condition through restoring soil nutrient cycling through reduction of overstory trees and encouragement of herbaceous cover.

Pile burning sites under Alternative 2 would be spatially and temporally distributed across the analysis area and constitute a very small portion of the analysis area (i.e., less than 5 percent), so effects to water quality and key habitat components of bluehead sucker habitat would be expected to be minimal.

Processing Sites

Similar to the other fish species, the eight proposed processing sites in Alternative 2 would be located in flat upland areas at least 0.25 mile from occupied or potential sucker habitat. Erosion during use of sites would be minimized after removal of vegetation through use of aggregate and after use through required rehabilitation. Other measures such as specific requirements for aboveground fuel storage tanks and a site-specific stormwater pollution prevention plan would also minimize the movement of sediments and pollutants off-site. As a result, no effects to bluehead sucker and its habitats from the proposed processing sites would be expected.

In summary, proposed activities in Alternative 2 would be unlikely to have substantial negative effects to bluehead sucker or water quality and key components of occupied or potential habitats in the analysis area. Implementation of BMPs including the use of filter strips or AMZs and design features such as retention of downed logs and other woody debris and consideration of spatial and temporal distribution of activities across a watershed would minimize potential effects in the analysis area. Vegetation treatments and prescribed fire activities would reduce the risk of uncharacteristic stand-replacing wildfire, increase forest resiliency, and improve watershed condition. Such changes would benefit bluehead sucker and its habitats in the analysis area.

Cumulative Effects - Proposed Action

Activities considered in this cumulative effects analysis are the same as described for Alternative 1. For more detail, see the Soil and Watershed Specialist Report.

While additive effects would be expected from Alternative 2, negative effects from project activities to bluehead sucker and its habitats would be minimized through implementation of BMPs and design features and the short duration, limited size, and spatial and temporal distribution of project activities across the analysis area. These potential effects would not cumulatively result in long-term negative effects to bluehead sucker or water quality and key components of occupied or potential habitat for the species in the analysis area. Under Alternative 2, implementation of project activities would result

in long-term benefits to the species by improving soil and vegetative conditions and water quality by reducing the risk of uncharacteristic, stand-replacing wildfire and restoring forest resiliency. These effects are expected to counteract changes brought by climate change by limiting the increasing risk of crown fire from climate change, and ameliorating the potential loss of vegetation and resulting sedimentation expected from increasing temperatures and more frequent and higher intensity droughts over the next several decades. Therefore, the potential effects of project activities under Alternative 2, when combined with past, present and reasonably foreseeable future projects in the cumulative effects boundary, would be expected to benefit bluehead sucker and its habitats.

Botany and Rare Plants

The following section describes the effected environment and effects of the alternatives for the botany resource, which includes Regional Forester's sensitive species and the Mogollon Rim Botanical Area.

Affected Environment

Arizona sneezeweed

Arizona sneezeweed is a perennial herb that grows up to 4 feet tall with several stems. Flower heads consist of yellow to orange 3-lobed ray flowers and purplish-brown globular disk flowers and bloom July through September. Hundreds of individuals may exist in a single population. The habitat for Arizona sneezeweed includes springs, seeps, wet areas, meadows and grasslands.

Although not all potential habitat in the project area has been surveyed, approximately five populations have been documented near springs and in meadows in the western portion of the project area.

Bebb's Willow

Bebb's willow is a Region 3 sensitive species for Coconino National Forest. In most areas, its current distribution is limited to single plants or a few plants growing together but willows were more abundant and widespread historically (see Watershed Report). There tends to be poor recruitment for Bebb's willow forest-wide, leading to mostly older plants in areas where they exist. Many of these plants are in decline due to various causes including grazing, water diversion and drought.

In the project area, this species has been documented at the following springs: Hi Fuller, Keller, Kehl, Willow, and an unnamed spring in Middle Kehl Canyon.

Mogollon Rim Botanical Area

The Mogollon Rim Botanical Area is entirely within the project boundary. The 360 acres site was established in 1987 with the adoption of the Forest Plan, and this designation as a special area remains in the 2018 revised forest Plan. This botanical area represents a unique plant community where white fir and big tooth maple are the dominant tree species.

The botanical area was impacted by the Packrat Fire in 2002. There were areas of severe fire effects within the botanical area that resulted in stand replacing fire in its white fir component. The botanical area also has numerous unauthorized OHV trails in it. Unauthorized motor vehicle use is inconsistent and in conflict with the intent of the botanical area. Fencing and signage has been used to address this issue in recent years. There are three exclosures within the botanical area to protect big tooth maple.

Figure 50. Uplands of Mogollon Rim Botanical Area showing results of Packrat Fire (2002).

Figure 51. Example of white fir/big tooth maple in Botanical Area

Environmental Consequences

Alternative 1– No Action

This discussion applies to all resources including the Region 3 sensitive plants: Arizona sneezeweed and Bebb's willow, and the Mogollon Rim Botanical Area.

Direct and Indirect Effects

The purpose and need of this project would not be achieved. As a result, the desired conditions for Region 3 Forest Service Sensitive plants and the Mogollon Rim Botanical Area. There would be no reduction in the risk of uncharacteristic wildfire in the area and no reduction of risk to water supplies, communities and infrastructure from fires and flooding. Steps to reestablish a fire adapted, resilient ecosystem that would be part of this project would not occur, although management of wildfire to meet resource objectives may occur throughout portions of the project area depending on natural fire ignition patterns and conditions. Region 3 sensitive plants within the project area, the Mogollon Rim Botanical Area and the analysis species that are addressed in this report would remain at risk for damage or loss from uncharacteristic wildfire and the resulting post-fire flooding that would result would not be addressed.

Table 68. Resource indicators and measures for Alternative 1

Resource Element	Resource Indicator (Quantify if possible)	Measure (Quantify if possible)	(Alternative 1)
Arizona sneezeweed	Occurrences (5) and habitat	Occurrences/acres	There would be no effects from management so mitigation would not be needed for existing plants but the risks of uncharacteristic fire would not decrease.
Bebb's willow	Occurrences (5) and habitat	Occurrences/acres	There would be no effects from management so mitigation would not be needed for existing plants but the risks of uncharacteristic fire would not decrease
Mogollon Rim Botanical Area	Components such as maple and white fir. Reintroduction of fire.	Steps toward restoration of the natural fire regime	There would be no measureable change to these components. Fire is a natural disturbance and allowable within the botanical area so one of the consequences is that no movement toward the restoration of fire on the landscape in or near the botanical area would occur. The portion of the area not already subjected to fire would remain at higher risk of damage from uncharacteristic wildfire.

Cumulative Effects - No Action

This discussion applies to all resources including the Region 3 sensitive plants; Arizona sneezeweed and Bebb's willow, and the Mogollon Rim Botanical Area.

There would be no reintroduction of low-intensity fire from the management actions proposed in this project. As a result, the risk of uncharacteristic wildfire would continue to increase over time as would the risk of severe fire in the project boundary. Tree density would continue to increase to the detriment of the understory vegetation leading to a decrease in forage for animals. This uncharacteristic vegetation would also continue to move away from the desired condition of establishing a more resilient and fire adapted ecosystem. Diversity in the plant community would continue to decrease in the project area over the next several decades.

Over time, the risk of uncharacteristic wildfire resulting from increasing vegetation density and fire-prone structure would cumulatively combine with a risk of increasing fire severity and intensity that is likely to occur based on changing climate conditions. This would result in a cumulative increased risk of population impacts to sensitive species including mortality of individual or discrete populations of sensitive plant species that occur in the project area. Furthermore, the cumulative risk of disturbance combined with other effects of climate change such as severe drought and increased competition by invasive species, could result in cumulative environmental stressors and project-area population declines.

Within the CWPP area the following past, and ongoing actions are considered to have cumulative impacts to Region 3 sensitive plants, Arizona sneezeweed and Bebb's willow, and the Mogollon Rim Botanical Area: wildfires, prescribed burning, vegetation treatments, noxious/invasive weed treatments, trail and road maintenance, recreation and special use permits, OHV use, watershed restoration and livestock grazing. Future foreseeable actions occurring in the CWPP area include changes to motor vehicle designations on the Coconino National Forest and the Rim Country EIS. Please see the Cumulative Effects Activities Section for specific project listings.

Alternative 2– Proposed Action

General Effects of the Proposed Action on Sensitive Plants

Direct and Indirect Effects

This alternative would reduce the risk of uncharacteristic wildfire within the project area to water resources and other wildland urban interface features (WUI), to reduce the risk of catastrophic post-fire flooding and to re-initiate the introduction of a fire adapted, resilient ecosystem.

None of the resources addressed in this report were the focus for development of the proposed action, but sensitive plants discussed here would benefit from management actions such as reduction of the risk of uncharacteristic fire, associated post-fire flooding and reinitiating a fire-adapted, resilient ecosystem. Since these species evolved in landscapes primarily formed from recurring low-intensity wildfire, they are likely to have the highest likelihood for survival and reproduction under similar conditions, which are supported under this alternative. Mitigation measures have been incorporated as design features to avoid damage to sensitive plants and the Mogollon Rim Botanical Area. Locations of sensitive plants would be determined during project layout and planning so that design features can be implemented (SP1).

Sensitive plants would be avoided during logging, slash pile construction and pile burning (SP2, SP3). Temporary roads, skid trails, landings and other ground disturbances would be located to avoid sensitive plants (SP4). During layout and tree marking, openings and interspaces could be located where sensitive plants are so that equipment and activities would not disturb them (SP5). Springs and channels that have high likelihood of sensitive plant populations like Arizona sneezeweed and Bebb's willow would be surveyed prior to implementation of activities and protected where they occur (SP6,

SP7). Watershed BMPs would also be protective of sensitive plants (SP8). Prescribed burning would be managed as low intensity/severity burning to promote native species (SP9).

The design features for the botanical area have the purpose of maintaining the existing conditions and natural processes of the ecosystem (MRBA1). Off-road driving, timber harvest and firewood cutting are prohibited (MRBA2, MRBA3). Prescribed burning is allowed as long as it is conducted to maintain the area and mimic natural fire processes (MRBA4). Sensitive species in the area are to be surveyed in potential activity areas prior to burning (MRBA5).

Arizona Sneezeweed

Direct and Indirect Effects

Potential management activities that would affect Arizona sneezeweed include activities associated with tree removal such as felling, skidding and piling, prescribed fire activities such as fire-line construction and pile burning and activities associated with road construction such as road construction, maintenance and closing but these effects can be mitigated by following design features in Appendix B.

Risks from tree removal include damage or loss of individual plants and effects to the habitat such as disturbance and compaction from tree felling, skidding and piling. These effects can be mitigated by avoiding known locations when possible and by using best management practices (BMPs) such as those included in this report and for other resources including soil and watershed, timber and fire to minimize the effects to the habitat (SP1-9).

Beneficial effects of tree removal include reduction of risk for high severity fire in areas where tree density is high, reduction of competition for nutrients among plants and reduction of shade from tree canopies leading to more sunlight on the forest floor which would allow more sunlight and other resources to reach understory vegetation including Arizona sneezeweed.

For the purposes of this analysis prescribed fire treatments are assumed to be mostly low to moderate severity. In that context the action of burning itself may remove the above ground portions of the plants but will not have the same effects as an uncharacteristic wildfire with high severity that would destroy the below ground portions of Arizona sneezeweed and impact the soil supporting Arizona sneezeweed. Beneficial effects of burning include reduction of the risk of high severity fire entering the habitat of Arizona sneezeweed within the project area, recycling of nutrients during burning and moving toward the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem (SP-9).

Management actions such as the construction of fire line in drainages that damages plants or alters habitat is a management activity that would lead to loss of plants and damage to habitat. These effects would be avoided by not digging fire line in the areas of concern and avoiding plants (if present) during line construction (SP1 and SP2).

The effects of pile burning from management activities created during tree removal are similar to those of severe wildfire and include loss of plants, adverse effects to soil and high levels of disturbance. These effects are generally limited to slash piling sites and immediate areas adjacent to these sites. Mitigation for this is to avoid piling slash in drainages, seeps springs and wet areas which is the habitat for Arizona sneezeweed (SP2, SP3, and SP6).

The effects of using road beds present in the project area as temporary roads and road maintenance are similar to the management actions for tree removal and fire and include loss of plants and

alteration of habitat. These effects would be mitigated by avoiding plants in areas where existing roadbed are used as temporary roads or where existing roads are bladed or improved to accommodate management actions. Soil and water BMPs and design features will also be protective of this plant where it is located in stream channels or in meadow or spring areas (SP9).

There is no Arizona sneezeweed on any of the processing sites, and thus there would be no effects to this species from the development and operation of processing sites.

Cumulative Effects to Arizona Sneezeweed

Past actions within the project area have contributed to shaping the existing condition. These include recreational activities, grazing, fire exclusion, activities associated with wildfire suppression, road and trail maintenance and past timber harvests.

The areas containing potential habitat for Arizona sneezeweed are often some of the most desirable areas for certain recreational activities including dispersed camping. This has resulted in past heavy use of areas such as meadows that may have potentially contained plants and would have contributed to loss of plants and soil compaction in affected areas.

The effects of off-road travel for dispersed camping were mitigated with the approval of the Travel Management Plan in 2011. The decision closed most areas of the forest to off-road motor vehicle travel, reduced the number of miles of roads open to public travel and restricted motorized camping to certain areas. These actions likely reduced the impacts from motor vehicle use in areas that provide habitat for Arizona sneezeweed in the project area. Routine road and trail maintenance may destroy individual plants but are not expected to contribute to large losses of plants.

Past fire exclusion has contributed to increased fire risk through the interruption of the natural fire regime. The results have been increased risk of severe fire in many areas of the project area and invasion of grassland and meadow areas by conifer trees. The increased risk of severe fire increases the risk of habitat damage or loss for Arizona sneezeweed. Invasions of meadows and grasslands by conifer trees decreases the amount of potential habitat for Arizona sneezeweed by transforming meadows and grasslands into forested areas.

There have been several large wildfires within the project area. Wildfires can be sources of high levels of disturbance depending on fire severity. However, most of the fires in the project area have been managed for multiple resource objectives. These fires generally burned at lower fire severity in the areas they affected and resulted in progress toward the reintroduction of fire in the landscape. As a result, they reduced the fire risk to understory vegetation including Arizona sneezeweed and its habitat through the reduction of the threat of uncharacteristic fire and post-fire flooding.

Broadcast, maintenance and pile burning has occurred over 18,794 acres of the analysis watersheds in the past 10 years and over 4,736 acres within the project area. This has resulted in movement toward the reintroduction of fire on the project area, reduction of severe wildfire and benefits to understory plants including Arizona sneezeweed through the reduction of risk of uncharacteristic fire and the risk of post-fire flooding.

The LEARN Mixed Conifer study is a treatment jointly conducted by the MRRD and Ecological Restoration Institute of Northern Arizona University. This is a research-based treatment that would include thinning and prescribed fire on approximately 67 acres in the project area (Block 1 of the study), which was included in the East Clear Creek Watershed Health Environmental Assessment (EA).

The East Clear Creek Watershed Health EA decision notice was signed in July 2006 and several efforts to improve watershed conditions in a portion of the larger 5th code Upper Clear Creek watershed. The analysis area for this project and the CWPP project area overlap by about 26,000 acres. There are no surveys indicating that the areas that will be treated in this overlapping area were surveyed for Arizona sneezeweed. This could result in the loss of some individuals or groups but would not lead to a large reduction of habitat for the plants.

Actions to improve watershed condition generally benefits those species dependent on it. Many of the actions in the East Clear Creek project focus on restoring meadows and riparian areas and reducing vehicle travel into sensitive areas that would provide long term benefits for Arizona sneezeweed and its habitat, but could result in short term losses of plants. Soil disturbance for these projects was a short term effect and has decreased to minimal (Soil and Watershed analysis) but were beneficial for the potential habitat of Arizona sneezeweed over the next two decades.

There are three allotments in the CWPP area but only two of these are being actively grazed by livestock. The Bar-T-Bar and Hackberry/Pivot Rock are actively grazed while the Buck Springs Allotment was deferred from grazing in 2009. The past effects of livestock grazing in the project area on Arizona sneezeweed are unknown but would include such effects as trampling of plants and habitat, soil compaction and introduction of noxious or invasive weeds. Deferral of the Buck Springs Allotment would reduce these effects in the areas in that allotment through the absence of cattle. However, the effects of wildlife grazing in all areas of the project will continue. Grazing by cattle is under the authority and control of the Forest Service but wildlife grazing is not.

The Rim Country Project, the second phase of the Four Forest Restoration Initiative overlaps the Cragin project area. Scoping and analysis of this project began earlier this year. Areas analyzed by Rim Country Project within this project boundary will focus on resources not covered in this project such as restoring springs, stream channels and riparian areas (~170 acres), grasslands and meadows (~800 acres). The timing of implementation of these activities is unknown but will be complementary to the activities of Cragin Project by providing for a wider spectrum of enhancements to natural resources focusing on restoration compared to the goals of the Cragin Project that focus on fuels reduction and reducing the risk of uncharacteristic wildfire.

These activities such as grazing, dispersed camping, and past wildfire that included ground disturbance or severe disturbance in areas with Arizona sneezeweed habitat would combine with ground-based mechanical treatments in this alternative to result in a cumulative impact to individual Arizona sneezeweed affected by these activities Over the long-term this alternative would also result in a cumulative improvement to Arizona sneezeweed habitat by reducing the risk of high-severity wildfire and increasing sunlight and other resources for understory vegetation. This would combine with the effects of travel management, East Clear Creek and other treatments in the project area that would reduce the risk of high-severity disturbance in the sneezeweed habitat over the next two decades.

Determination

The implementation of management actions in Cragin Watershed Protection Project may **impact individuals** of Arizona sneezeweed (*Helenium arizonicum*), but these actions are not likely to result in a trend toward federal listing or loss of viability.

Bebb's Willow

Direct and Indirect Effects

The effects of management actions on Bebb's willow are similar to those for Arizona sneezeweed and include the risk of losses of plants from timber harvest activities and prescribed fire but these risks are minimal since most Bebb's willow locations are in meadows, springs or stream channels, which are protected from mechanical treatments. Prescribed fire may top kill existing plants but in the years following prescribed fire may be beneficial to Bebb's willow by promoting sprouting and aiding in long distance dispersal of seeds under some conditions (Tesky, 1992). Mitigation measures to minimize or prevent these impacts include construction of fire lines around the Bebb's or by avoiding the areas during ignition (SP6, SP7, and SP9).

Indirect effects of the management activities include the reduction of the risk of uncharacteristic wildfire in the project area. This will reduce the risk of damage to the habitat for Bebb's willows and to the soil and watershed resources on which it depends. Effects of uncharacteristic fires include losses of plants, damage to habitat through soil heating or drying, erosion and siltation. All of these could negatively affect the quality and quantity of habitat for Bebb's willow.

Another indirect effect of this alternative is the reduction of the risk of post-fire flooding which can remove plants and damage habitat in drainages, springs and meadow habitat that may contain Bebb's willows.

The effects of temporary road construction or general road maintenance on Bebb's willow are similar to those for Arizona sneezeweed and include damage or losses to plants and impacts to habitat if they occur in or near roadways that are used during the project; however, no locations near roadways have been found to date within the project area and BMPs to locate temporary roads outside of streams and riparian areas would limit impacts on this species.

There are no occurrences of Bebb's willow on any of the eight in woods processing sites.

Cumulative Effects to Bebb's Willow

The boundary of this analysis is the project boundary. The timeframe is ten years past and twenty years into the future. Past actions within the project area have contributed to shaping the existing condition. These include recreational activities, grazing, fire exclusion, activities associated with wildfire suppression, road and trail maintenance and past timber harvests. Many of the effects to Bebb's willow are similar to those for Arizona sneezeweed and will not be repeated here. See the cumulative effects section for Arizona sneezeweed.

Bebb's willows are highly palatable and browsed by a variety of animals including wildlife and domestic livestock. As a result, plants can be severely damaged especially if isolated or in poor condition. Topography at some of the sites may restrict the grazing pressures.

Bebb's willow was much more common in the project area in the past. An aerial photo interpretation by Pajkos (1992) documented widespread riparian communities in several of the major drainages that were severely reduced or totally lost by 1990 (see Soil and Watershed Report). The current occurrences of Bebb's willows are likely just fragments of past riparian communities. Riparian plants such as Bebb's willow contribute to stream bank infiltration and groundwater infiltration (DeBano et al, 2003). Restoration of these communities would require a substantial investment of resources and is outside the scope of this project but the management activities proposed in this project will

contribute indirectly to the stability of the stream courses and springs in the area by reducing the risk of severe fire and flooding that could degrade these areas.

Watershed restoration was addressed as part of the East Clear Creek Watershed Health EA (2006) and a large portion of it overlaps the project area. Management actions initiated by that decision will benefit overall watershed health in areas where the projects overlap and will indirectly benefit the health and function of springs and other water resources in the project area.

The 4FRI Rim Country EIS is a landscape analysis that began in 2016. It continues the ecosystem restoration effort on about 1,240,000 acres on the Mogollon Rim and Red Rock Ranger Districts of the Coconino NF, the Black Mesa and Lakeside Districts of the Apache-Sitgreaves NF, and the Payson and Pleasant Valley Districts of the Tonto NF. The areas covered in the C.C. Cragin Project will be analyzed for restoration activities such as spring restoration and watershed improvements (about 970 acres). These would benefit riparian species including Bebb's willow.

Cumulatively, this alternative would include prescribed fire, which could top kill individuals. This effect combined with current grazing pressure from wild or domestic ungulates may result in negative effects to Bebb's willow, specifically in a portion of the six locations that are accessible. While prescribed fire is expected to increase understory vegetation abundance and provide food sources other than Bebb's willow, it is possible that plants top-killed during fire and then sprouting may be totally consumed thereby eliminating the beneficial effects of prescribed fire.

Other activities such as 4FRI Rim Country, Long Valley Meadow Restoration, and East Clear Creek Watershed Health EA would combine with the effects of this alternative to cumulatively augment and improve the quality of Bebb's willow habitat throughout the project area over the next two decades through spring and stream restoration activities. Implementation of design features would reduce the risk of this happening (SP6-SP9).

Other activities such as 4FRI Rim Country, Long Valley Meadow Restoration, and East Clear Creek Watershed Health EA would combine with the effects of this alternative to cumulatively augment and improve the quality of Bebb's willow habitat throughout the project area over the next two decades through spring and stream restoration activities.

Determination

The implementation of management actions in Cragin Watershed Protection Project **may impact individuals** of Bebb's willow (*Salix bebbiana*), but is these actions are not likely to result in a trend toward federal listing or loss of viability.

Mogollon Rim Botanical Area

Direct and Indirect Effects

There are no effects to Mogollon Rim Botanical Area from management actions from timber harvest and related activities because none will occur. None of the proposed processing sites are located in or near the botanical area and so no effects will occur.

The area is slated for broadcast burning followed by maintenance burning. Risks from these activities include mortality to some components of the botanical area. Fire may top-kill big tooth maples but sprouting can occur from the root-crown depending on the severity of the fire. Larger stems may tolerate low severity burning while smaller stems may be killed (Tollefson, 2006). White fir is shade tolerant and more prevalent in areas where fire has been excluded for long-periods. High rates of

mortality can occur in young fir trees due to the presence of resin on branches, the flammable morphology of the needles and twigs, and thin bark. Larger trees are only moderately fire resistant due to the presence of low hanging limbs and shallow roots (Zouhar, 2001).

Effects of burning treatments can be mitigated by burning the area under conditions that allow for low to moderate severity. Because of the cool, moist conditions characteristic of the white fir/ big tooth maple habitat type, fires are mostly low intensity, erratic, and infrequent, resulting in a diversity of stand structures within the habitat type (Muldavin, et al 1996). Burning under conditions that result in low to moderate severity would allow this to occur in the botanical area during treatment.

There will be no effects to the botanical area from road maintenance, use of existing road beds, temporary roads or in woods processing sites because there are none in the area.

This alternative would support the long-term protection of the botanical features unique to the Mogollon Rim Botanical Area by reducing the risk of high severity wildfire over the next several decades.

Cumulative Effects to the Mogollon Rim Botanical Area

The boundary of this analysis is the project area. The time frame is from 2002 to twenty years into the future. This timeline was chosen for this resource because it allows for discussion of the effects of the Packrat Fire on the condition of the Mogollon Rim Botanical Area.

The Packrat Fire (2002) burned into the botanical area killing portions of the overstory and contributing to the presence of noxious or invasive weeds in the area (see photos in Existing Condition section). The fire burned 240 acres of the 339 acre botanical area. Guidance for botanical areas states that natural events such as fire are not rehabilitated so the effects of the fire will be allowed to recover naturally.

There are a series of exclosures in and near the botanical area that were presumably constructed to protect big tooth maple regeneration but the establishment date, condition of the fences and success of regeneration is not known.

There are nearby areas of this habitat type that are not within the botanical area boundary but there are no plans to change the delineation of the botanical area at this time. Some of these areas will be treated during tree removal activities so the species composition may shift slightly.

Additional cumulative effects are similar to those for Arizona sneezeweed. Please refer to that section above.

Noxious and Invasive Weeds

The following section describes the effected environment and effects of the alternatives relating to noxious or invasive weeds.

Affected Environment

Surveys for noxious or invasive weeds in the project area focused on roads, campsites and areas of disturbance. Highway 87 has many species of noxious or invasive weeds along its right-of-way including Russian knapweed, camelthorn, Dalmatian toadflax and Scotch thistle. These are perennial plants that are difficult to control and have only limited occurrences in areas within the project but outside of the right-of way. Within the project area, the most abundant weed species are bull thistle

and cheatgrass. Bull thistle tends to appear on disturbed sites where bare soil is created such as in slash piles or fire areas but tends to decrease in abundance over time as other species become established on the area. Most of the documented occurrences of bull thistle are in the western portion of the project area. Most of the documented locations of cheatgrass are also in the western portion of the project area, along roadways, sometimes covering several acres. There are also a few scattered occurrences of field brome, a non-native annual grass.

See the Botany and Weeds Specialist report for more detail on noxious weed locations within the project area.

Table 69 below shows the weed species, objective for treatment as defined in the Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds (2005) and Region 3 category for prioritization of treatment.

Table 69: Noxious or invasive weeds in the project area

Scientific Name	Common Name	Objective
Acroptilon repens	Russian knapweed	Eradicate/control
Alhagi maurorum	Camelthorn	Eradicate/control
Bromus tectorum	Cheatgrass	Contain/control
Centaurea diffusa	Diffuse knapweed	Contain/control
Centaurea maculosa	Spotted knapweed	Eradicate/control
Cirsium vulgare	Bull thistle	Contain/control
Onopordum acanthium	Scotch thistle	Contain/control
Linaria dalmatica	Dalmatian toadflax	Contain/control

Environmental Consequences

Alternative 1– No Action

Direct and Indirect Effects

There would be no additional surveys and no treatment of noxious or invasive weeds except as part of annual monitoring and treatments or as part of implementing other approved activities in the project area such as road maintenance, grazing, facilities management, watershed restoration etc. As a result, the opportunities to detect and treat weeds would not occur. The threat of severe disturbance that could occur as a result of uncharacteristic fires would not be reduced and could result in more noxious or invasive weed invasions and increased rate-of-spread of existing populations. This alternative would result in an increased risk of high severity fire on the landscape, and there is clear evidence that for large and small scales at all wildfires, fire severity is the most consistent predictor of post-fire non-native species cover (Hunter et al. 2006).

Noxious or invasive weed survey and treatment have occurred in the project boundary and along Highway 87 for several years. If the no action alternative were selected survey and treatment for other projects such as Highway 87 and those areas in the East Clear Creek analysis area would continue. For example, task orders that part of the first Four Forest Restoration Initiative that were authorized by the ECC analysis would continue as would the noxious or invasive weed surveys and treatments are mitigations for those treatments.

Cumulative Effects - No Action

The cumulative effects boundary for noxious or invasive weeds includes the project area plus surrounding major arteries of transportation such as Highway 87 and utility corridors that enter the project area. These were included because of their importance in providing corridors for dispersal of noxious or invasive weeds. The timeframe for noxious or invasive weeds is ten years prior and twenty years into the future.

The distribution of noxious or invasive weeds on the project has been shaped by past management actions and natural occurrences in the project.

There is no recent history of timber harvest within the project boundary. The last recorded timber sale occurred in 2001. The effects of disturbance from management activities dissipated and are no longer major effects on the landscape. It is mentioned here because disturbance from timber related activities is usually one of the major influences considered when addressing projects such as this one. Future timber harvest activities in the project area include management actions authorized in the East Clear Creek Watershed Health EA (2006).

Activities such as firewood cutting have occurred in the past and will continue into the future. Fuel wood cutters can introduce weeds into the area through their actions. These actions occur under permit but the forest has limited control over where these activities will occur.

There have been several large wildfires (see Table 86) and numerous smaller ones within the project area. Wildfires can be sources of high levels of disturbance depending on fire severity. Severely disturbed areas can be more easily invaded by noxious or invasive weeds than less severely disturbed or undisturbed areas.

Fire exclusion has contributed to the risk of noxious or invasive weed invasion by promoting overstocked forests with little or no resilient understory community. The lack of native vegetation to compete with noxious or invasive weeds increases the risk of weed invasion. Fire exclusion also increases the risk of severe stand replacing fires and its accompanying severs disturbance.

There are three grazing allotments in the project boundary. The past effects of grazing and the associated activities are not completely known but may include temporary reduction of the native plant community in certain areas which would allow for plants such as the noxious or invasive weeds discussed above to enter the plant community and introduction of weeds through feed or manure. Human actions associated with range management such as driving in the area and transporting livestock have also been part of the past actions.

A wide variety of recreation activities occur within the boundary of the project area including hiking, camping, hunting and recreational driving. Users can introduce noxious or invasive weeds from other areas on vehicles and personal equipment. The effects of livestock such as horses or pack animals used in recreation are similar to those in grazing and include temporary reduction of the native plant community in localized areas where animals are allowed to graze and introduction of weeds through feed or manure. Trampling and compaction can also occur if the same campsites are used repeatedly.

In the past there were no restrictions on cross-country travel whether for recreation or other purposes. Most cross-country travel was prohibited with the implementation of the Travel Management Rule (TMR) in 2011. TMR also reduced the number of roads open to public travel, reducing the risk of dispersal of noxious or invasive weeds in some areas.

Highway 87 forms a portion of the project boundary. Major highways tend to be corridors for weed dispersal by providing a source to vector weeds into the area. Management activities associated with the highway can create disturbance and spread existing weeds. Examples include past activities such as blading of road ditches where equipment passed through existing weed infestations, spreading them along the road corridor. Other sources includes contaminated road fill (soil) containing weed seeds used in the area. Vehicle travel along the roadway also contributes to the introduction of noxious or invasive weeds.

The majority of herbicide treatment in the project area has occurred along the highway corridor and will continue into the future but some herbicide treatment may occur within the project area.

The No Action alternative's effect on vegetation would also support the increased risk of establishment and spread of invasive species within the project area. This effect may cumulatively combine with increased propensity for invasive species to establish and spread under more extreme environmental conditions expected with climate change (Middleton, 2006).

Alternative 2– Proposed Action

This action would generally be beneficial for dealing with noxious or invasive weeds by providing for survey and treatment of weeds in the project area. Management actions will cause disturbance in the area. Disturbance has been shown to increase the risk of noxious or invasive weeds, but these effects can be mitigated through the use of best management practices for noxious or invasive weeds and treatment of some species.

Direct and Indirect Effects

In general, noxious or invasive weeds compete with native plants for natural resources such as sunlight and soil moisture. They can degrade wildlife habitat by reducing available forage. Some noxious or invasive weeds are poisonous and can kill or injure animals. Plants such as cheatgrass can reduce the amount of native grasses available and affect the fire regime and interval of certain areas by creating a bed of fine, flashy fuel.

Effects of management activities to noxious or invasive weeds include ground-disturbing activities that have the potential to increase the acreage and/or density of the existing noxious or invasive weed infestations within the project area. Management activities such as timber harvest and related activities would be sources of disturbance that can contribute to the establishment and spread of noxious or invasive weeds. Treatments that reduce the tree canopy and lower the stand density will affect all understory plants, including noxious or invasive weeds by allowing more sunlight, and increasing available nutrients on the site. The increased availability of resources and decrease in competition can provide favorable conditions for noxious or invasive weeds and lead to increases in the size and density of existing populations. Pretreating or avoiding existing populations during implementation will help mitigate the risk.

Equipment brought from off-site to be used on the project can be sources of noxious or invasive weed introductions. These should be cleaned before entering the project area and should be cleaned again if moving from a "weedy" area to a less weedy one. The cleaning should focus on the areas that harbor seeds and plant fragments such as tires and undersides of vehicles.

Management actions proposed for the project include broadcast or pile burning. The effects of prescribed burning include disturbance that can contribute to expansion of existing noxious weed populations. Prescribed burning may have direct and indirect effects to understory vegetation depending on fire severity, including existing noxious or invasive weed populations. It is expected

that most broadcast and maintenance burning will be of low severity, but fire severity may be higher in limited areas depending on variables such as management goals, weather, fuel conditions and topography. In these cases moderate to high severity may occur but will be limited

Management actions related to road maintenance, construction and decommissioning and the eight proposed processing sites can contribute to noxious weed introductions and spread. Some of these effects are similar to timber operations where equipment used in the operations can introduce or spread weeds. Cleaning equipment can help reduce these threats. Moving soil or contaminated fill or aggregate is a major source of weed movement. If material is needed for construction or maintenance of roads or aggregate is needed to stabilize soils a processing site or landing, care should be taken to use materials that contain little to no weeds. Monitoring of disturbed sites is helpful for detecting new infestations or spread.

This alternative would also generally be beneficial for the prevention and treatment of noxious or invasive weeds over the long-term by providing for survey and treatment of weeds in the project area and by facilitating improved understory vegetation and diversity to limit invasive species (NW2). Management actions will cause disturbance in the area, which will kill understory vegetation in portions of the project area and result in small areas with bare soil (up to 10-15% of areas with mechanical thinning according to the Soil and Water Report). Disturbance has been shown to increase the risk of noxious or invasive weed establishment, especially within the short-term (1-5 years after project implementation). These effects can be mitigated through the use of best management practices for noxious or invasive weeds and treatment of some species. Weed infestations would be treated prior to project activities (NW1). Vehicles and equipment would be clean prior to entry into the forest and would be cleaned before leaving a weed infected area (NW4, NW5). Weed prevention and control measures would be incorporated into contracts and treatment practices and staging areas, landings, and turnaround sites would be located outside of weed-infested areas (NW3, NW6).

Prescribed fire would be managed to help control existing weed infestations (NW7). Slash piles, which can be a site for weed growth, would be located in previously disturbed areas to the extent possible and would be monitored for weeds after treatment (NW8, NW9). Water sources used for dust abatement would be designated from weed-free locations (NW10). Rehabilitation of disturbed sites would occur, if determined necessary, soon after activities are completed so that weeds do not become well-established (NW11). Rock materials sources would be inspected for weeds and to ensure the rock is weed-free before use. If materials sources have weeds, the source must be treated before use. Monitoring would occur for three years after rock materials are placed in an area to ensure that if weeds occur they are detected and controlled quickly (NW12). Over the long-term, fuels reduction treatments have shown that thinning and prescribed fire treatments similar to those included in this alternative may increase non-native species cover on a small proportion of the treatment area (<10%), but this decreases by half over the next 5-10 years as invasive species are outcompeted by native vegetation (Stoddard et al. 2011).

Cumulative Effects - Proposed Acton

The cumulative effects boundary for noxious or invasive weeds includes the project area plus surrounding major arteries of transportation such as Highway 87 and utility corridors that enter the project area. These were included because of their importance in providing corridors for dispersal of noxious or invasive weeds. The timeframe for noxious or invasive weeds is ten years prior and twenty years into the future.

The distribution of noxious or invasive weeds on the project has been shaped by past management actions and natural occurrences in the project.

Activities such as firewood cutting have occurred in the past and will continue into the future. Fuel wood cutters can introduce weeds into the area through their actions. These actions occur under permit but the forest has limited control over where these activities will occur.

Wildfires can be sources of high levels of disturbance depending on fire severity. Severely disturbed areas can be more easily invaded by noxious or invasive weeds than less severely disturbed or undisturbed areas. Table 86 shows the wildfires that have burned within the project area in the past several years. Most of these have been managed for multiple resource benefits resulting in lower severity that uncontrolled wildfires. This has resulted in lower disturbance than might have occurred had the fires burned as uncontrolled fires so are less likely to contribute to noxious or invasive weed invasions.

Fire exclusion has contributed to the risk of noxious or invasive weed invasion by promoting very dense forests with little or no resilient understory community. The lack of native vegetation to compete with noxious or invasive weeds increases the risk of weed invasion. Fire exclusion also increases the risk of severe stand replacing fires and its accompanying severs disturbance.

There are three grazing allotments in the project boundary. Only two allotments are currently managed for livestock grazing totaling almost 30,000 acres within the project area. The past effects of grazing and the associated activities are not completely known but may include temporary reduction of the native plant community in certain areas (especially near water sources) which would allow for plants such as the noxious or invasive weeds discussed above to enter the plant community and introduction of weeds through feed or manure. Human actions associated with range management such as driving in the area, constructing livestock improvements, and transporting livestock have also been part of the past actions.

A wide variety of recreation activities occur within the boundary of the project area including hiking, camping, hunting and recreational driving. Users can introduce noxious or invasive weeds from other areas on vehicles and personal equipment. The effects of livestock such as horses or pack animals used in recreation are similar to those in grazing and include temporary reduction of the native plant community in localized areas where animals are allowed to graze and introduction of weeds through feed or manure. Trampling and compaction can also occur if the same campsites are used repeatedly.

In the past there were few restrictions on off-road motorized travel whether for recreational or other purposes. Most off-road motorized travel was prohibited with the implementation of the Travel Management Rule (TMR) in 2012. Implementation of the 2012 travel plan also reduced the number of roads open to public motorized travel, reducing the risk of dispersal of noxious or invasive weeds in some areas.

Over the last five years, the Mogollon Rim Ranger District Weeds Crew has implemented invasive weed pesticide treatments within the road right-of-way along SR Highway 87 totaling about 922 acres per year in 2012 and 2015 and 200 acres in 2016 and about 815 acres of survey in 2017. Both sides of the highway were surveyed and treated. No records of pesticide treatments and accomplishments were found for SR Highway 87 prior to 2012.

Highway 87 forms a portion of the project boundary. Major highways tend to be corridors for weed dispersal by providing a source to vector weeds into the area. Management activities associated with the highway can create disturbance and spread existing weeds. Examples include past activities such as blading of road ditches where equipment passed through existing weed infestations, spreading them along the road corridor. Other sources includes contaminated road fill (soil) containing weed

seeds used in the area. Vehicle travel along the roadway also contributes to the introduction of noxious or invasive weeds.

In the short-term, meaning during project implementation and within 1-6 years afterwards the disturbance and increase in hauling from this alternative would cumulatively combine with other activities to facilitate the establishment and spread of invasive species populations in the project area. However, over the long-term, invasive species populations that establish as a result of mechanical treatments or road maintenance will decrease or disappear over most of the project area as a result of competition from native species and invasive weed treatments. There will continue to be a small portion of the project area where invasive species establish a foothold and continue to maintain stable or growing populations as a result of continues disturbance from recreations (trails and dispersed camping), unauthorized motor vehicle use, ungulate grazing, and or administrative use and access.

Recreation, Lands, and Wild and Scenic Rivers

The following section describes the affected environment and effects of the alternatives relating to recreation, lands, and wild and scenic rivers.

Affected Environment

Recreation

Recreation Trends

Over the last two decades, Arizona has seen a dramatic increase in population. The entire state of Arizona has grown almost 75% from 1990 to 2010 (U.S. Census Bureau, 2015), which is more than double the rate of the average population growth in the country. In addition, the last several decades have seen increases in the number of people participating in outdoor activities; between 2000 and 2007, these participants increased by 4.4% (Cordell, et al., 2008). It is clear that an increasing population, along with growing participation in outdoor activities, contributes to increased visitation to the Coconino National Forest and the analysis area relative to the past.

Visitation to the Coconino National Forest has increased concomitantly with population growth in Arizona. Data on visitation is collected by National Forests every five years and is referred to as National Visitor Use Monitoring (NVUM). Data collected in 2010 shows the Coconino National Forest has about 2.8 million visitors per year (USDA Forest Service, 2016c). During this time period, the Coconino National Forest had the most visitors of all the National Forests in Arizona except for the Tonto National Forest, with about 2.5 million visitors each year. Adjacent National Forests, like the Kaibab, Prescott, and Apache-Sitgreaves had substantially lower visitors; all under 1 million visitors.

Looking at the NVUM data it is clear that the Coconino National Forest is the most popular national forest in the southwestern region, but the data also shows that the forest serves an interesting niche. The Coconino National Forest is heavily used by non-local visitors; it is estimated that 60% of the 2.8 million visitors come a long distance (over 100 miles) to visit the National Forest (USDA Forest Service, 2016c). While locations such as the Sedona area and the Kachina Peaks are likely the most visited on the Forest, use in the CWPP analysis area seems to mirror this niche. Large amounts of visitors come from other areas (primarily the Phoenix metropolitan area) to visit the area largely for the change of scenery and ideal climate and relief from extreme summer temperatures in nearby major metropolitan areas.

Recreation Activities within the Project Area

There are a number of USFS trails and developed recreation facilities within the CWPP analysis area including developed campgrounds. The Recreation Opportunity Spectrum (ROS) classification within the analysis area includes Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM), Roaded-Natural (RN) and Rural (R). The recreation facilities within the CWPP are shown on Figure 52 and are summarized on Table 70.

Table 70. Summary of recreation facilities in CWPP analysis area

Name	Type	Size	Facilities
Blue Ridge	Campground	8 Sites	1 Vault Toilet, Water System, & Trash Service
Rock Crossing Campground	Campground	36 Sites	5 Vault Toilets, Water System, & Trash Service
Kehl Springs	Campground	8 Sites	1 Vault Toilet
Moqui	Group Campground	3 Sites, 50 people each (150 Total)	2 Vault Toilets, Water System, Amphitheater, & Trash Service
Long Valley Work Center	Group Campground	1 Site accommodates 300 people	1 Vault Toilet & Trash Service
C.C. Cragin Reservoir *Also known as Blue Ridge Reservoir*	Boating Site	50 Vehicles	Paved Boat Ramp, 1 Vault Toilet, & Trash Service
General Springs	Trailhead	Arizona National Scenic Trail (AZNST) access	Historic Cabin for viewing
Jumbo	Trailhead	AZNST access	
Hay Meadow	Trailhead	AZNST access	
Arizona National Scenic Trail	Trail	14.4 Miles in Analysis Area	Shares route with Fred Haught Trail for 2.8 Miles
Fred Haught	Trail	6.4 Miles	Part of the Cabin Loop Trail System
U-Bar	Trail	7.3 Miles total ; 2.1 Miles in Analysis Area	Part of the Cabin Loop Trail System
Houston Brothers	Trail	7.1 Miles	Part of the Cabin Loop Trail System
Rock Crossing	Trail	2.2 Miles	Three segments accessing different arms of Blue Ridge Reservoir
General Crook National Recreation Trail	Trail	14.1 Miles in Analysis Area	Historic Route shares segments with Rim Road (Forest System Road 300)

Trails

Portions of several Forest System Trails are within the project area. All system trails are designated for non-motorized users: hikers, equestrians, and mountain bikers. Three of the trails in the project area make up the unique Cabin Loop Trail System, Fred Haught, U-Bar and Houston Brothers. These historic trails link three historic Forest Service guard station cabins along the Mogollon Rim. The Cabin Loop system is popular with backpackers because of the loop opportunities and abundance of water at springs and in deep forested canyons.

Arizona National Scenic Trail

The Arizona National Scenic Trail (AZNST) traverses 14.4 miles through the project area from South to North on its way from Mexico to Utah. The trail is intended to be a primitive, long distance trail highlighting the state's topographic, biologic, historic, and cultural diversity. The trail receives use by day hikers and overnight backpackers, as well as by through-hikers attempting to hike or ride all of the more than 800 miles of trail across the state of Arizona. The Arizona Trail Association is an active volunteer organization which maintains the trail and performs a variety of stewardship actions, including advocacy for the trail. There are three trailheads in the CWPP analysis area that provide access to the AZNST (see Table 70).

General George Crook National Recreation Trail

The General Crook National Recreation Trail (GCNRT) traverses the southern edge of the project area. The GCNRT follows the historic route of General George Crook of the US Army from Fort Whipple in Prescott, to Fort Apache. The route was established in the 1870s to serve as a supply and patrol road. Some sections of the trail have been replaced by modern Forest System Roads, but the trail still provides for spectacular views over the Mogollon Rim and invites adventurers to explore this historic route.

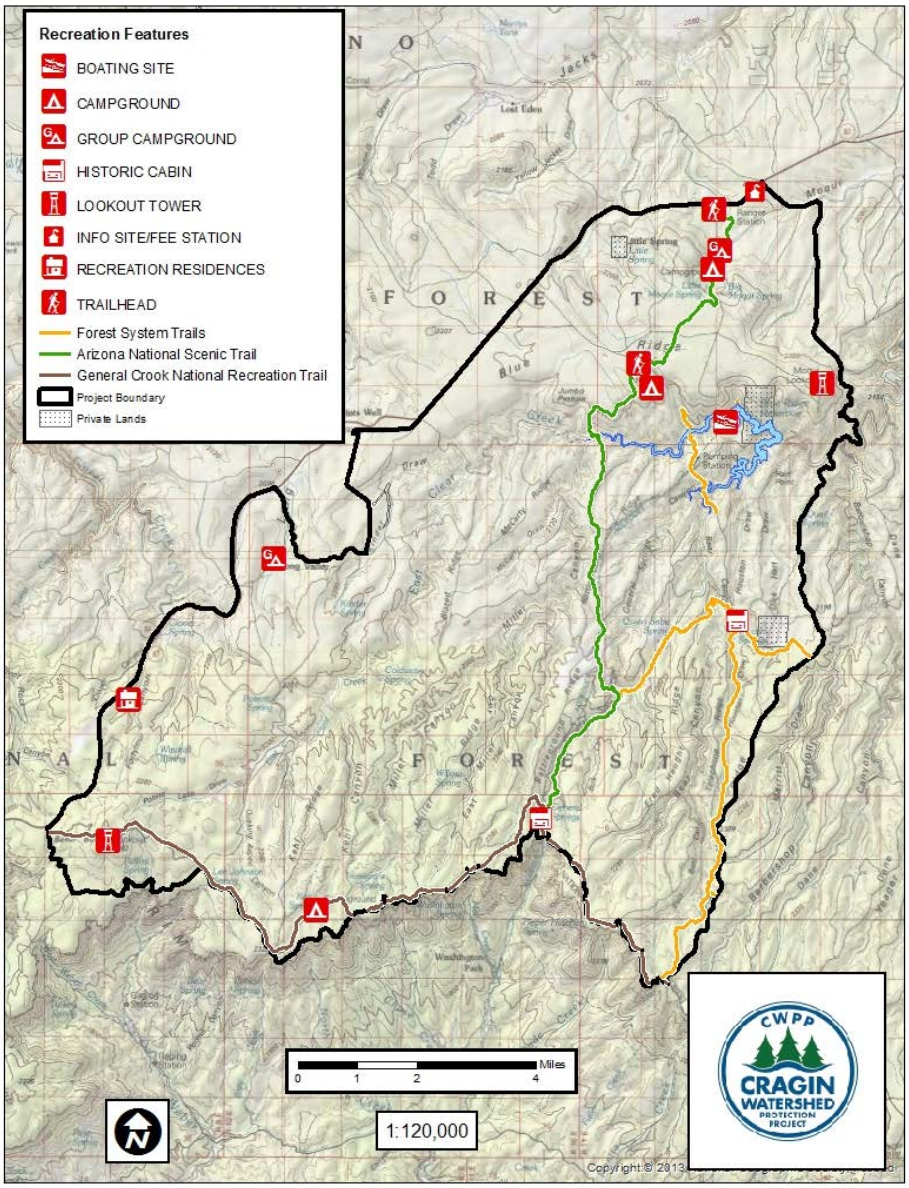


Figure 52. Map of recreation facilities and trails in CWPP analysis area

Dispersed Recreation

Perhaps the most widespread form of recreation in the project area could be described as dispersed recreation. The Forest Plan defines dispersed recreation as the type of outdoor recreation that tends to be spread out over the land and in conjunction with roads, trails, and undeveloped waterways. Activities are often day-use oriented and include hunting, fishing, gathering of forest products, boating, hiking, off-road vehicle use, cross-country skiing, mountain biking, and rock climbing.

Dispersed Camping

Some parts of the project area are extremely popular for camping, including Blue Ridge, Long Valley, Mogollon Rim, and several other areas. Visitors to the area camp using a variety of shelters, including large Recreational Vehicles (RVs), live-in toy haulers, and tents. Many campers come from the Phoenix metro area to escape extreme summer temperatures and enjoy the cool weather provided by the high elevation of the project area.

Dispersed camping requires no additional facilities other than road or trail access, though the relatively unconstrained nature of dispersed camping can cause resource impacts such as soil compaction and erosion, loss of vegetation, increased fire risk, displacement of wildlife, and accumulation of trash and human waste. The number of dispersed campers in the analysis area is also difficult to estimate. A 2015 inventory of dispersed campsites revealed approximately 477 separate campsites in the analysis area (Figure 53). The figure below appears to show that the dispersed campsites are common across the entire area with concentrations of campsites along the first 1-2 miles near main forest roads that are accessible from Highway 87.

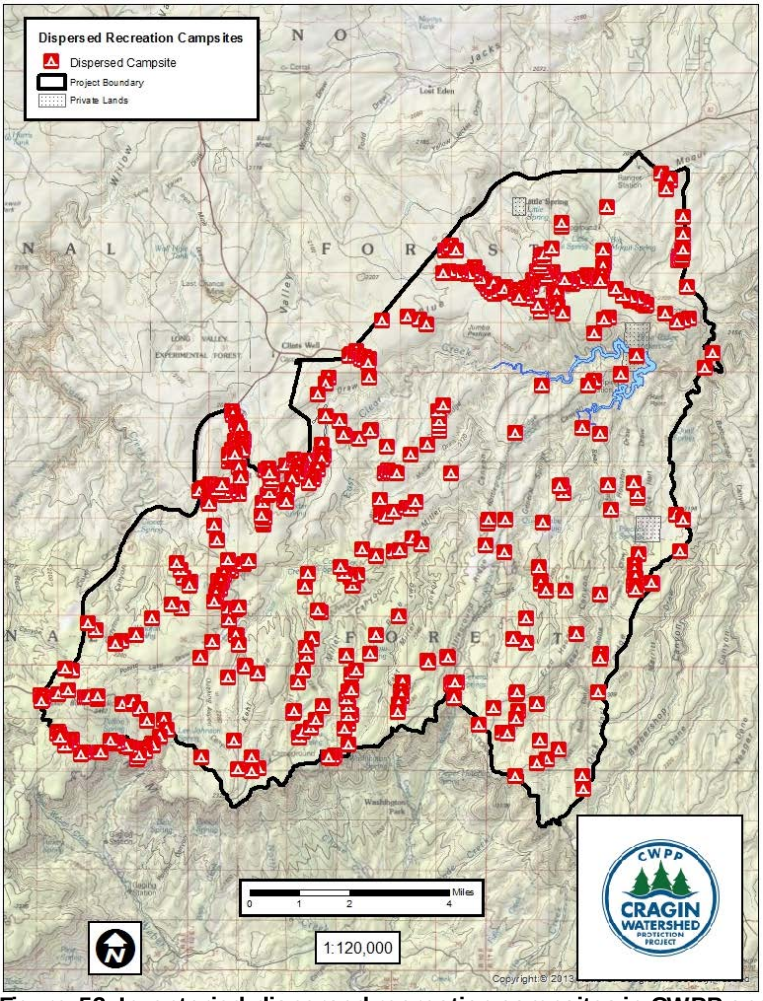


Figure 53. Inventoried dispersed recreation campsites in CWPP analysis area

Motor Vehicle Use

In November 2005, the USDA Forest Service announced new Federal Regulations called the Travel Management Rule (TMR), requiring each National Forest to establish a designated system of roads, trails, and areas by vehicle type and time of year. Designated roads, trails, and areas would then be identified on a Motor Vehicle Use Map (MVUM), made available to the public for free (36 CFR 212.56).

The Coconino National Forest identified a system of National Forest System roads, trails, and areas designated for motor vehicle use that minimize impacts to natural and cultural resources. The results

appear in the Environmental Impact Statement for Travel Management on the Coconino National Forest, with a Record of Decision signed in September, 2011 (USDA Forest Service 2011a). The Environmental Impact Statement and Record of Decision designated restrictions and closures of certain Forest System roads. Implementation of these new restrictions began in May, 2012, and are reflected in the Coconino National Forest MVUM, which identifies roads open to motorized use by the public. Unauthorized motor vehicle use of restricted trails and roads has continued while Forest visitors adjust to the MVUM and policy, and while the Forest works to physically close roads and improve signage. Efforts where there have been physical road closures to address unauthorized use has generally been successful at decreasing unauthorized motor vehicle uses in these areas.[14]

As Arizona's population has grown, the state has also seen a dramatic increase in ownership and use of personal Off-Highway Vehicles (OHVs). Arizona Trails – 2010 reported a 623% increase in sales of off-highway motorcycles and ATVs in Arizona between the years 1995 to 2006 (McVay et al. 2010). The growth in ownership and use of OHVs has greatly influenced how users recreate in the analysis area. Visitors are extremely mobile, require large areas for camping to accommodate trailers and "toy haulers", and their recreating patterns directly relate to the road system in the analysis area.

Driving for pleasure is a common activity in the CWPP analysis area. This includes visitors driving both OHVs and regular vehicles. Visitors drive to points of interest in the area, including two active fire lookout towers, Baker Butte and Moqui Towers, which often offer tours of the towers when they are staffed. Vistas off the Mogollon Rim are also popular destinations, as visitors can see hundreds of miles southward into the Basin and Range geologic province of Arizona. In addition, three historic Forest Service guard stations offer interesting historic destinations in the analysis area, Pinchot Cabin, General Springs Cabin and Long Valley Work Center.

Hunting

The Arizona Game and Fish Department (AZGFD) manages all hunting within the CWPP analysis area. The entire analysis area is within Game Management Unit (GMU) 5A. AZGFD manages the following species in GMU 5A; Antelope, Black Bear, Deer, Elk, Merriam's Turkey, Mountain Lion, Band-tailed Pigeon, Tree Squirrel, and Cottontail Rabbit. Big game hunting is extremely desirable in the analysis area. Elk hunts generally start in September and run into December each year. Unlike other areas of the Coconino National Forest, GMU 5A is closed to motorized big game retrieval to protect sensitive riparian resources associated with the East Clear Creek drainage.

Recreation Special-Uses

The CWPP analysis area is popular for activities that require a recreation special use authorization. Many authorizations are for reoccurring activities like Outfitting and Guiding and some are for facilities such as Recreation Residences. In addition, four areas have been designated for temporary activities like Recreation Events and Non-Commercial Group Use (NCGU). Activities are summarized in Table 71.

[14] There are several examples of roads and areas closed to unauthorized motor vehicle use in recent travel management monitoring reports: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd538873.pdf, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd478752.pdf, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3817495.pdf

Table 71: Special Use activities within the CWPP analysis area

Name / Activity	Type of Special Uses	Number of Users	General Location	Comments
Forty-Four Springs Cabins	Recreation Residences	3 Cabins	Accessed Via Highway 87	
Mogollon Monster 100 Mile Race	Recreation Event	~ 150 Participants	Cabin Loop Trails, FSR 300 & 218	Foot Race on Tonto NF and Coconino NF usually in Late September
Camp Colley	Outfitter / Guide	Varies	Varies	Activities associated with a youth camp on non-forest land
Oak Grove	Rec Events and NCGU	Up to 300	Milk Ranch Point FSR 218 / 218A	Approved site for temporary group use
Dick Hart Ridge	Rec Events and NCGU	Up to 300	Dick Hart Ridge FSR 139 / 139G	Approved site for temporary group use
Long Valley Draw	Rec Events and NCGU	Up to 300	Long Valley Draw FSR 147A, 6101	Approved site for temporary group use

Recreation Opportunity Spectrum

The Forest Service uses the Recreation Opportunity Spectrum (ROS) to provide a framework for defining classes of outdoor recreation environments, activities, and experience opportunities (USDA Forest Service, ROS Primer and Field Guide 2011b). The ROS is a land classification system that categorizes national forest land into six classes, each class being defined by its setting and by the the desired opportunities and characteristics the setting offers. The six ROS classes are: Primitive (P), Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM), Roaded Natural (RN), Rural (R), and Urban (U). A second set of ROS classes has been identified for federal Designated Wilderness areas, however, no areas with Wilderness classifications would affected by the proposed project. Opportunities for experiences along the spectrum represent a range from very high probability of solitude, self-reliance, challenge and risk, to a very social experience where self-reliance, challenge and risk are relatively unimportant.

The purpose of the ROS is to identify desired conditions across the Forest so that different parts of the forest may facilitate different recreational experiences. The ROS represents management objectives which may not always reflect actual user experiences. ROS zones for the Coconino National Forest are shown below (Table 72).

Table 72. ROS settings and characteristics (USDA Forest Service, 1986)

ROS Setting	Evidence of Human Contact and Human Use	Social Encounters
Rural and Roaded Natural	Highest contact with other visitors and highest evidence of use compared to other ROS settings	Social encounters are higher within ½ mile of trailheads, paved roads, and residential areas.
Semiprimitive Motorized and Semiprimitive Non-motorized	Lower contact with other visitors and lower evidence of human use than in Rural and Roaded Natural but higher levels than Primitive or Wilderness ROS settings.	Social encounters are higher within ½ mile of trailheads and at destination features such as water, natural formations, cultural features, vistas.

ROS Setting	Evidence of Human Contact and Human Use	Social Encounters
Primitive	Lower contact with other visitors and lower evidence of human use than in Semiprimitive Motorized and Semiprimitive Non-motorized but higher levels than Wilderness ROS settings.	Social encounters are higher within ½ mile of trailheads and at destination features such as water, natural formations, cultural features, vistas.
Wilderness	Lowest contact with other visitors and lowest evidence of use compared to other ROS settings.	Social encounters are higher within ½ mile of trailheads.

The large majority of the CWPP project area falls into the SPM and RN classes. Approximately 38,741 acres or 60% of the project area is SPM. RN makes up 21,871 acres or 34%. SPNM makes up 5.6% of the area, primarily in the steep canyons that run inland from the Mogollon Rim. Rural (R) and private lands make up the remainder of the area, each less than 1% (Figure 54). With the recent Forest Plan Revision, the Coconino National Forest updated ROS maps that represent the desired conditions for ROS classes across the Forest. Not all acres on the Forest currently meet these desired conditions. The desired conditions are meant to guide project design, alternative development, and assessment of potential project impacts. ROS classifications are also used to determine if project activities will help meet or move toward desired conditions for recreation opportunities at the Forest level.

A spectrum of high-quality outdoor recreation settings and opportunities will be available in the project area. Roaded Natural and Semi-Primitive Motorized ROS areas will provide high scenic and recreational values and in Semi-Primitive settings will provide more natural appearing settings. The national forest system lands in the project area provide high quality recreation opportunities and settings that compliment and support local communities' tourism industries, and contribute to local residents' quality of life. Management activities on national forest system lands are consistent with recreation setting objectives that provide opportunities for the public to engage in a variety of developed and dispersed recreational activities, in concert with other resource management and protection needs.

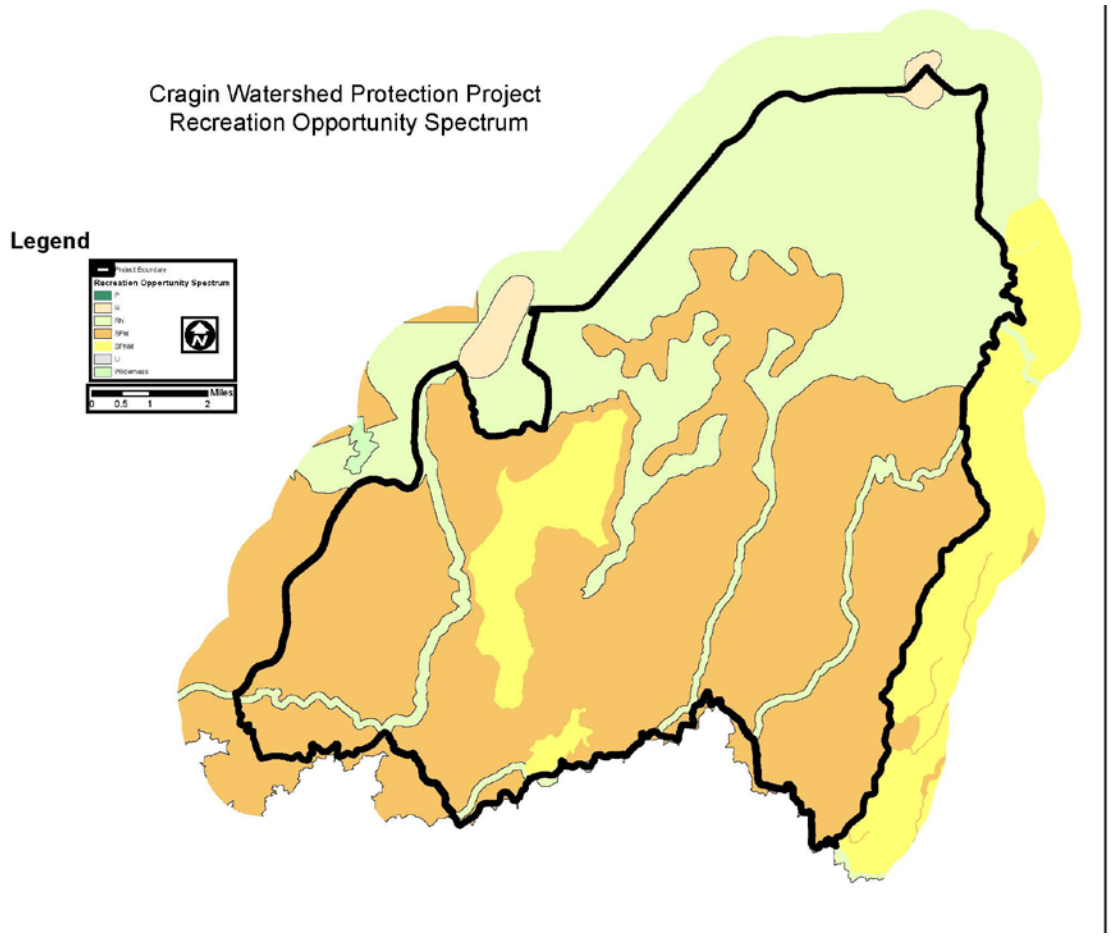


Figure 54. Recreation Opportunity Spectrum (ROS) in the CWPP analysis area

Approximately 60% of the analysis area is designated SPM. Under this designation:

- Access can include non-motorized and motorized trails, and primitive roads.
- Remoteness is more evident than in areas classified as RN.
- Human encounters can range from under 6, up to 15 parties met per day, or less than 3, up to 6 parties seen at a campsite per day.
- Information facilities provided on-site range from very limited to nonexistent.
- On-site protection facilities range from rustic or rudimentary to nonexistent.
- SPM management direction stipulates that limited to no site hardening occurs at / on recreation sites and locations that fall within this designation.

As mentioned, 34% of the project area is classified as RN. Under this designation:

- Access in the analysis area can range from full access via road or trail to neither road nor trail being an available opportunity.
- Individuals can experience either full remoteness where they perceive themselves as removed from the sights and sounds of human activity (more than 1 ½ hour walk) or in other locations where they are not out of sight and sound of other humans.

- Experiences may range from encountering very few other recreationists, to experiencing moderate to frequent contact with other recreationists in developed sites or when on roads and trails.
- Some locations will offer on-site information that is noticeable but is presented in a manner that harmonizes with the natural environment, and other locations may not offer any on-site information.
- Recreationists will find some sites that offer no facilities for user comfort while other sites may offer some facilities that are rustic and built out of native materials. These facilities offer some on-site protection from the natural elements.
- Visitors' impacts range from unnoticeable with no site hardening to subtle site hardening.

Wild and Scenic Rivers

The Wild and Scenic Rivers System was established in 1968. Candidate rivers are identified for study and consideration by either an act of Congress or by a federal agency through its land management planning process. In 1993, the Coconino National Forest underwent preliminary analysis for Wild and Scenic Rivers (USDA Forest Service, 1993).

Based on the 1993 analysis, there are no river or creek segments in the CWPP analysis area that have been determined to be potentially eligible as Wild and Scenic Rivers (W&SR). However, there are two stream segments adjacent to, and downstream of, the analysis area that have been evaluated for potential W&SR designation: East Clear Creek and Barbershop Canyon. The segment of East Clear Creek that has been evaluated extends northeast of the project area, downstream from the Forest System Road 96 bridge. The evaluated segment of Barbershop Canyon extends south-southwest of the Forest System Road 96 bridge along the eastern border of the project area (Figure 55).

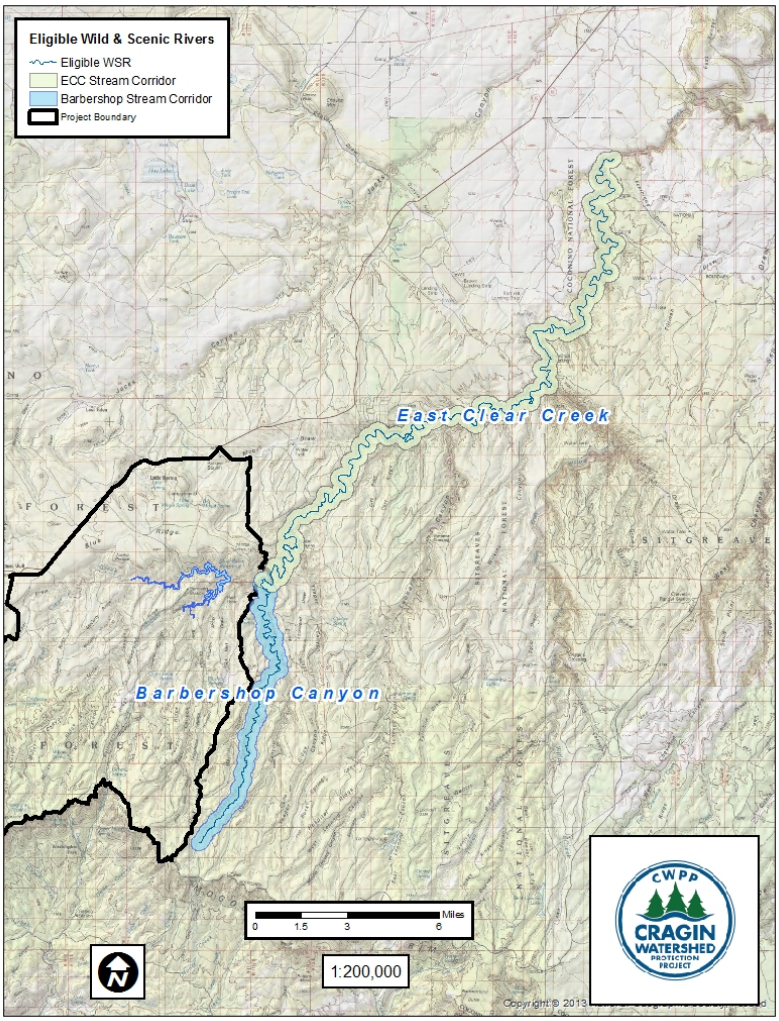


Figure 55. Eligible Wild & Scenic Rivers in CWPP analysis area

Inventoried Roadless Areas

The U.S. Department of Agriculture adopted a final rule to establish prohibitions on road construction, road reconstruction and timber harvesting in inventoried roadless areas (IRAs) on National Forest System lands, effective March 13, 2001, 36 CFR 294; Federal Register Vol. 66 No. 9 pp. 3244-3273. East Clear Creek contains inventoried roadless areas. About 1.5 acres of the East Clear Creek IRA is contained within the CWPP boundary. This acreage is based on boundary line differences and is not actually IRA that will be treated with mechanical treatments.

Lands and Lands Special Uses

There are several parcels of non-federal land within the project area. Some are owned and managed by entities such as Salt River Project (hydropower facilities). There are also several isolated parcels of private land, including some that have improvements as listed in Coconino County's GIS parcel viewer database (https://gismaps.coconino.az.gov/ParcelViewer/). Private land information and acreage is summarized below (see Table 73).

Table 73: Summary of non-forest lands within the CWPP analysis area

Location Township (T) North, Range (R) East, Section (S)	Owner	Acres	Number of Parcels	Number of Parcels with Improvements	General Location Information
T 13, R 10, S 4 & 9	Private	21.16	18	10	Goddard
T13, R10, S 5 & 6	Private	65.25[15]	21	4	Clints Well
T13, R 11, S 21	Private	162.6	10	2	Dick Hart
T 14, R 11, S 18	Private	59.3	1	1	Little Spring
T 14, R 11, S 33	Private	140.11	14	2	Blue Ridge Road 751B
T 14,R 11, S 33	Salt River Project	246	1	Hydropower improvements	C.C. Cragin Hydropower facilities, powerlines, dam, etc.

Lands special use authorizations include permits, term permits, leases, and easements that authorize occupancy and use of National Forest System lands. Recent years show an increasing demand for lands special uses. Proposals for powerlines, rights-of-way, communication sites, water transmission lines, and roadways have increased steadily and will continue to do so in future years.

There are several lands special use permits located within the project area (Table 74). Some are short-term in nature including three research permits (one for butterflies, one for birds, and one with the Ecological Restoration Institute at NAU). Longer-term permits and land uses include those for Arizona Public Service power lines, TDS/Arizona Telephone telecommunication lines, Arizona Department of Transportation State Highway 87 and a maintenance yard (just outside the project area on FR 211), a Coconino County Sheriff's Office/Coconino County Public Works/Blue Ridge Fire District communication facilities, the Happy Jack Fire Service facility, Department of Commerce weather monitoring site and Yavapai County ALERT and Natural Resource Conservation Service SNOTEL/precipitation gauge weather stations and snow course. Short-term special uses such as for commercial filming exist infrequently and may occur within the CWPP analysis area. Many of these permits support the local communities and the general public.

These existing uses are scattered throughout the project area and along its boundaries. Existing vegetation clearing along power lines and highway corridors create linear clear zones because of the limited right of way. There is an existing ADOT/Coconino County maintenance yard at forest road 211 which is permitted but outside the project boundaries where there are residences and equipment storage and operations.

Salt River Project (SRP) and the Bureau of Reclamation (BOR)(operated by SRP) have improvements located both on private land and on federal land associated with the hydropower facility at the C.C. Cragin Reservoir, including the dam, spillways, power lines, pipelines, and other ancillary facilities associated with the project. These facilities are administered under the direction of the C.C. Cragin Dam and Reservoir legislation HR 489 enacted November 7, 2011, Public Law 108-451, 118 Stat. 3533.

[15] 2.03 Acres are outside the CWPP analysis area on the North side of Highway 87

Table 74: Summary of Lands Special Uses in the CWPP Analysis Area

Permit Holder / Owner	Use Type
Arizona Department of Transportation (ADOT)	Road Easement
Arizona Public Service Electric Company (APS)	Power line
Ecological Restoration Institute – Northern Arizona University (ERI)	Research
TDS Telecom	Buried Fiber Optic Cable
University of Montana	Research
Happy Jack Fire Services	Warehouse and Storage Yard
Coconino County Sherriff's Office (CCSO)	Private Mobile Communication Radio
Dale Halbritter	Research
USDA, Natural Resources Conservation Service (NRCS)	Weather Station
Yavapai County Flood Control District	Weather Station
Department of Commerce	Monitoring site
Faulkner	Private road permit
Blue Ridge Fire District	PMRS communication site
Coconino County Public Works	PMRS Communication site

Forest Service Administrative Sites

There are three Forest Service Administrative sites within the CWPP area: Blue Ridge Ranger Station (49 acres), Baker Butte Lookout Tower (3 acres) and Moqui Lookout Tower (2 acres). Blue Ridge Ranger Station includes several office buildings, employee housing, trailer pads, bunkhouses, septic ponds, equipment shops, warehouses and engine bays. Baker Butte Lookout Tower includes the tower, weather station, radio communication facilities, a cabin used for employee housing one vault toilet and a corral. Moqui Tower includes the tower, radio communication facilities, a storage building and a vault toilet.

Environmental Consequences

Alternative 1– No Action

Direct and Indirect Effects

Under this alternative, recreation, lands, and Wild and Scenic River (W&SR) and Inventoried Roadless Area resources would be managed as they are currently without any impacts from vegetation treatments and prescribed burning proposed in the CWPP. Although electing the no-action alternative would not result in impacts to these resources from prescribed burning or thinning, this alternative would not reduce the risk of uncharacteristic wildfire that could cause significant resource damage, damage to recreation and lands infrastructure, and subsequent flooding. Wildfires ignited by lightening could be managed for resource benefit given conditions allow, however, the use of this strategy to decrease future crown fire risk is unpredictable and unlikely to affect a majority of the project area.

Recreation Resources

The threat of uncharacteristically severe wildfire continues to increase with ongoing, un-managed growth of vegetation. Uncharacteristic wildfire would severely impact recreation values and experiences in the analysis area. Research has demonstrated the negative effects wildfire can have on recreation activities. Vaux, et al. (1984) found that "intense fires may have detrimental effects on recreation values" (p.1). Recent wildfires in other areas on the Coconino National Forest (Schultz Fire in 2010 and Slide Fire in 2014) and adjacent national forests (Rodeo-Chediski Fire in 2002) demonstrate the significant impacts of uncharacteristic wildfire on recreation. In both cases, recreation facilities had to be closed to the public, with many remaining closed for months or even years. After the Slide Fire, Slide Rock State Park in Oak Creek Canyon was closed for several months during the period of highest visitation, and eventually opened after a very expensive early warning system for potential flash floods was installed.

During NVUM, visitors were asked what they would do if they were unable to visit this national forest due, for example, to closures related to wildfire damage and rehabilitation. The majority of visitors (53.9%) responded that they would have gone elsewhere for the same activity and 30% reported they would travel less than 25 miles to find an alternate location (USDA Forest Service, 2016c). This suggests that if the CWPP analysis area was closed due to wildfire or related effects, visitors would seek alternative locations to enjoy the same recreation activities in the vicinity. This could lead to overcrowding in nearby areas, resulting in resource damage and undesirable recreational experiences. Alternatively, this indicates that nearly one-third of would-be Forest visitors would not be willing or able to travel to an alternative location for an activity if it is further than 25 miles from the CWPP analysis area.

Developed Recreation Facilities

Developed recreation facilities, such as campgrounds and group event sites, could be negatively impacted if there is no action to reduce the risk of uncharacteristic wildfire. The changes to landscape character and visual quality following a severe fire would significantly diminish the quality of recreation experiences and activities in affected areas. Impacts of severe wildfire on other recreation-related infrastructure such as restrooms, kiosks, bulletin boards, and trail signs, would be substantial and would result in high costs to repair and/or replace damaged facilities. Historic sites such as lookout towers and guard stations could not be replaced if destroyed.

Trails

While the Schultz Fire severely damaged several trails, subsequent flooding was more destructive and caused more significant damage than the fire itself. Large debris flows caused by rainfall on the denuded slopes destroyed major sections of the Little Bear Trail. In other areas, trails sections were rendered unpassable and invisible due to large boulders and tree trunks transported by the floodwaters and debris flows. Much of this flood damage occurred on trails that cross steep slopes or drainages. The economic cost and effort to reopen these trails has been immense. Little Bear trail was closed from the fire in 2010 until October 2016. The Deer Hill trail was also closed and only reopened at the end of November, 2017.

The CWPP project area contains parts of two National Trails, the Arizona National Scenic Trail (11.6 miles) and the General Crook National Recreational Trail (14.1 miles). In addition, parts of several system trails including the Barbershop, Rock Crossing, Huston Brothers, Fred Haught and U-Bar trails (18.0 miles total) fall within the project area (Figure 52). Some trails in the CWPP analysis area share characteristics with the trails that were damaged in the Schultz Fire. The U-Bar, Huston Brothers, and Fred Haught trails all traverse steep slopes and cross numerous drainages, and could be

greatly impacted by uncharacteristically severe wildfire and subsequent flooding. Wildfire and/or flood damage to segments of trails within the project area would require closures of impacted sections until they could be properly repaired and determined safe for use. In the interim, potentially lengthy re-routes would have to be established for visitors wishing to hike any affected trails, especially for the state-wide Arizona National Scenic Trail.

Several research papers and lessons from the Schultz Fire reveal that the no-action alternative, which has no vegetation management actions to reduce the risk of wildfire, could have negative and unpredictable effects on trails and trail users if an uncharacteristically-severe wildfire occurred in the CWPP analysis area.

Overall, trail users respond negatively and show decreased short-term return rates to areas that have experienced uncharacteristic wildfire, such as the Schultz Fire and Slide Fire (Hesseln, et al., 2003; Starbuck, et al., 2006; Bawa 2017). In New Mexico, Hesseln, et al. (2003) found that visitation to areas recovering from crown fires, by both hikers and mountain bikers, decreased through time. Similarly, Starbuck, et al. (2006) showed that unrestored areas in the five national forests of New Mexico that experienced uncharacteristic fire were unappealing to bikers and hikers. According to the study's model, decreases in post-fire recreational visitation by hikers and bikers resulted in estimated losses of $51.65 million in output, $23.31 million in earnings, and a loss of 1,240 jobs.

While short-term effects of uncharacteristic wildfires on recreation are almost uniformly negative, longer-term effects may differentially impact certain user groups. Fire-damaged trees can take many years to fall, and it is likely that any affected trail system would experience increased numbers of downed trees across trails for many years, despite routine maintenance. Crossing downed logs on trails is more burdensome for mountain bikers, who must stop, dismount, and lift their bikes over fallen trees, than it is for hikers, who may be able to simply step over these obstacles. Hesseln, et al. (2003) found that the value of net benefits for hikers increased during the 40 years following crown fire, whereas the net benefits for mountain bikers declined over the same period. This demonstrates that different intensity fires may impact groups engaged in different recreation activities in different ways.

Overall trail users respond negatively and have a decreased return to forested areas that have experienced uncharacteristic wildfire. "The lack of mature trees and the large numbers of downed trees make the area unattractive to hikers and mountain bikers" (Starbuck et al. 2006, p. 63). So the No Action Alternative which has no vegetation management actions or prescribed burning treatments to reduce the risk of wildfire could have negative effects on trails and trail users if an uncharacteristic wildfire was to occur in the CWPP analysis area.

C.C. Cragin Reservoir Use

Many of the same post-wildfire factors that would degrade the water quality for municipal use, would negatively impact recreational use of the reservoir. Because wildfire season in northern Arizona typically occurs in May-June and is immediately followed by the summer monsoon season, post-fire erosion and runoff into streams, including the C.C. Cragin Reservoir, could cause drastic decreases in water quality through sedimentation and nutrient loading. Rinne (1996) found that toxic ash flows in headwater streams following the Dude Fire on the Tonto National Forest directly killed the majority of trout that were present. Subsequent hydrologic events and downstream displacement can lead to local extirpation of fish species, with effects on fish populations lasting longer than one year. Ash and slurry flows also negatively impact macroinvertebrates, which are a primary food source for many fish species. Physical effects of sedimentation, such as the accumulation of fine sediment in substrates, and the filling of pools, which can act as refugia during droughts, also increase fish

mortality over the longer-term in affected streams (Rinne, 1996). Under the no-action alternative, the combined effects of an uncharacteristic wildfire could all but eliminate recreational fishing in the reservoir and other streams in the analysis area for months, if not years. Increased turbidity from fine sediments and algal growth from eutrophication would both contribute to diminished water clarity, which would likely lead to depressed visitation to the reservoir for swimming, paddling, and water play.

Similar to municipal water users that depend on C.C. Cragin Reservoir for drinking water the reservoir could have negative effects towards recreation users from the No Action Alternative. If the risk of wildfire was not reduced and an uncharacteristic wildfire happened in the CWPP analysis area there would be increased erosion and sediment into the reservoir. High-severity wildfires can result in an increase in nutrient loading (i.e., nitrogen and phosphorus) to water bodies resulting in an increase in algal growth and reduction in dissolved oxygen leading to fish kill (Rinalli 2004). A fish kill would eliminate recreational fishing at the reservoir. This popular activity could be impacted for several years. Swimming, paddling, and water play could similarly be impacted by the No Action Alternative.

Dispersed Recreation

Following the Rodeo-Chediski fire in 2002, dispersed camping in the burned area was prohibited for nearly 7 years. The major reasons for this restriction was to protect visitors and property from damage due to falling trees and flooding, and to reduce recreation impacts to fragile fire-damaged soils. The time it takes a fire-damaged tree to fall is unpredictable and depends on several factors including weather, topography, burn-severity, and flooding. Trees that have been killed or damaged by fire may be unstable and parts or all of such trees can easily become dislodged and can fall onto forest visitors, vehicles, or camping equipment.

Dispersed camping is extremely popular in the CWPP analysis area and an uncharacteristic wildfire could result in closing a fire area to camping and other activities. This would impact thousands of visitors every summer that visit the project area to camp in the desirable summer temperatures. Even after the initial threat of and hazards of fire damaged trees has passed, visitors may avoid the area because it would be less appealing because of the loss of trees, shade, and desirable dispersed camping locations. Shelby et al. (2004) found that camping in areas impacted by wildfire were universally lower quality levels than those for hiking after the same period. So effects to dispersed camping from the No Action Alternative could be very adverse. Should a wildfire result in large, long-term closures for safety or resource protection purposes, activities such as camping, hunting, and other recreational uses would be lost or severely degraded during both short-term (1-5 years) and long-term (5+ years) timeframes.

Recreation Special Uses

Although the No Action Alternative would not have any impacts from vegetation management or prescribed burning on Recreation Special Use activities, the risk of uncharacteristic wildfire would not be reduced. Uncharacteristic wildfire could impact recreation special uses because sites (recreation events) would likely be unsafe and less appealing for recreation special use activities after such a fire and would likely result in closures (short-term and long-term) depending on severity.

Impacts to recreation residences at Forty-Four Springs could be extreme. In similar post-wildfire situations, such as after the 2005 Cave Creek Complex Fire on the Tonto National Forest, eleven recreation residences were destroyed by wildfire. After five years of planning, ten residences were approved for reconstruction and the permits for three residences were either revoked or expired

without renewal. Thus, this alternative could result in a long-term decrease of recreational use and opportunity in the project area.

Wild and Scenic Rivers

The No Action Alternative is not expected to have effects on the eligibility of designation and classification of Barbershop Canyon or East Clear Creek as a Wild and Scenic Rivers, including its free flows or its ORV's as there would be no vegetative or prescribed burning management activities in the stream corridor. Uncharacteristic wildfire under this alternative would have a higher risk over time of resulting in long-term adverse effects to resources such as fish and scenic beauty, identified as the outstandingly remarkable values for these river segments.

Inventoried Roadless Area

Under this alternative there would be no activities implemented and no direct effects to roadless areas on the Coconino National Forest. Indirect effects could include an increased risk of high intensity wildfire within the 1.5 acres in the East Clear Creek roadless area, which could affect one or more of the indicators identified for this portion of the roadless area. However, the amount of the roadless area affected within the project area would be so small compared to the roadless area boundary (0.09 percent) that these effects would likely be of no consequence when considered at the scale of the roadless area being affected.

Recreation Opportunity Spectrum

ROS will remain within Land Management Plan guidelines unless stand replacement wildfire affects a large proportion of the analysis area. Locations and results of unplanned fire ignitions are impossible to predict, however, it is fairly likely that an uncharacteristic wildfire would move conditions away from desired conditions for semi-primitive areas where the evidence of humans is meant to be limited (semi-primitive areas). Uncharacteristic wildfire would likely include a number of alterations to the forest environment such as cutting of dead roadside hazard trees, increased signage to warn of post-fire dangers, re-constructed roads, or recently constructed dozer or hand-built fire line. All of these would result in short and some long-term effects that would move conditions away from desired conditions identified for semi-primitive areas.

Lands and Lands Special Uses

Under a No Action Alternative, no management activities would occur to reduce the risk of uncharacteristic wildfire. Wildfires ignited by lightening could be managed for resource benefit given conditions allow, however, the use of this strategy to decrease future crown fire risk is unpredictable and unlikely to affect a majority of the project area. Increased fire danger, and the potential for increased intensity and severity of wildland fires would impact lands special uses by threatening the structures that are authorized both in the short term and the long term. Impacts could include destruction of these facilities by fire, or possibly the closure of fire-damaged areas for rehabilitation. There may be short-term, temporary effects in the form of restricted access to sites during fire suppression or post-fire rehabilitation activities. Existing utility corridors and roadway corridor vegetation clearing will remain somewhat linear in appearance inconsistent with scenery objectives.

Many of these authorized land uses serve and support local communities. If infrastructure is damaged by wildfire, there could be a delay in providing utilities such as power, phone, and water. Emergency service providers could be delayed in providing for health and safety if communication equipment is damaged.

The potential threat of wildfire to the use of C.C. Cragin Reservoir as a domestic and municipal water supply is exemplified by the 2003 Hayman Fire in Colorado. This wildfire burned over 137,000 acres impacting watersheds that provide domestic and municipal water to several cities along Colorado's Front Range including Denver. Over a two year period following the fire, water providers spend $25 million removing sediment from a reservoir that serves as a source of potable water (Graham, 2003). The Cragin water project facilities are all susceptible to direct fire damage. Damage from an uncharacteristic wildfire could leave the communities which depend on C.C. Cragin water supplies with reduced water supplies or without water.

Private property has the potential to be impacted as a result of wildfires in the area as fires may burn at a higher intensity and severity and would be more difficult to control. In general, the No Action alternative is not anticipated to result in a change in land uses, private land impacts or boundary line management. Existing land uses would continue to be managed under the current forest plan direction and under the terms of their authorizations and other laws, policies and regulations such as power line clearance requirements and vegetation management along highway corridors for safety purposes and utility reliability.

Forest Service Administrative Sites

The two lookout sites and the ranger station complex all have the potential to be impacted as a result of wildfires and destruction, damage or temporary closure would impact the ability to provide some or all of the fire and public services that the facilities and the employees that work out of them provide to the forest and local area. The No Action alternative is not anticipated to result in a change of operations and management associated with these sites unless there is an uncharacteristic wildfire that directly impacts them.

Cumulative Effects - No Action

This alternative would mainly result in indirect effects of increasing risk of loss or degradation of recreational and lands infrastructure and opportunities. Uncharacteristic wildfire could impact recreation and lands because sites (recreation events) would likely be unsafe and less appealing for recreation special use activities after such a fire and would likely result in closures (short-term and long-term) depending on severity. Such a fire would also have severe impacts to permitted lands and could destroy infrastructure, limit access to private lands, and degrade water quality in the reservoir and other waters such as the eligible Wild and Scenic Rivers.

This alternative would cumulatively contribute to these same risks identified as indirect effects. The increased risk of uncharacteristic wildfire resulting from this alternative would contribute to the issue of limited recreational access and opportunities on the National Forest. Over the last several years, there have been a number of large high-intensity wildfires such as the Slide Fire, Wallow Fire, Schultz Fire, General Fire, and others; which have resulted in area closures and loss of temporary access and recreational use. Given an increasing likelihood of wildfire and a greater likelihood of high-intensity wildfire throughout the southwest under predicted climate change scenarios, the increased risk of wildfire under this alternative would cumulatively increase these effects of risk to permitted infrastructure, limited recreational access, and loss of recreational opportunities and access in project area and surrounding areas. This alternative would also cumulatively combine with the increasing risk of high intensity fire from climate change to result in an elevated risk to lands and events managed under short-term or long-term special use permits.

Increasing population growth is also expected to drive increasing recreational demand, which would further result in decreasing recreational access and opportunity. By 2020, the Coconino National Forest is expected to experience an addition 338,000 national forest visits per year compared to

current use (English et al. 2014). Closures resulting from wildfires within or near the project area would combine cumulatively to further reduce the available supply of recreation opportunities and access compared to the demand and would result in fewer visits to the national forests in some cases and increased crowding and degradation of user experiences in surrounding areas that forest users travel to as a substitute recreational experience.

Alternative 2– Proposed Action

Direct and Indirect Effects

Design features in Appendix B of the EA have been developed for recreation and include measures specific to: public awareness; forest system trails; special use events; high use weekends and holidays; developed recreation sites and temporary closures. Design features for lands and special uses include measures specific to: utility lines and corridors, underground cables; Cragin Project pipeline and powerline; and State Highway 87. See also design features for scenery which also protects recreation resources.

Developed Recreation Sites

Any vegetation treatments or prescribed burning in developed recreation sites would generally occur in fall, winter or spring, which are low use recreational periods. All treatments in recreation sites would be designed to protect and enhance existing vegetative structure, while maintaining the character of the site. The District Recreation Specialist will help to determine boundaries or no treatment zones around constructed features that need to be protected in the campgrounds. Treatments around the perimeter of the campgrounds are encouraged (see Design Feature REC20). Facilities at developed sites and campgrounds in the project area would be protected from adverse effects from management activities, and such treatments would protect the developed sites from any short or long term risk of uncharacteristic wildfire.

Trails

Trail use is expected to remain at the low use level. The proposed action includes prescribed burning and thinning activities adjacent to the Arizona National Scenic Trail, Fred Haught, U-Bar, Huston Brothers, Rock Crossing and General Crook National Recreation Trail within the project area. Trails within the project area may be temporarily closed during prescribed burning activities; but, throughout the project, trails and trail infrastructure would be considered and protected, and effects to scenic qualities minimized to the extent practicable. Damage to trails or necessary trail maintenance resulting from the prescribed burning or mechanical treatment in the area will be rehabilitated as soon as possible.

In the proposed action, timber harvesting activities would avoid National and forest system trails if possible. Perpendicular trail crossings are considered acceptable if no other alternative exists, although any crossings will be designated and flagged with the District Trails Specialist, Recreation Planner, or Archaeologist, done sparingly, and restored to pre-project condition after use. Signage would be placed on all trails where treatments are occurring, notifying users of any project activity, temporary closures and detour routes. News releases and web site information would be prepared and released notifying the public of CWPP implementation activities such as logging or prescribed burning in the area of system trails. Detours along the trails including the AZNST or the General Crook Trail and other system trails would be well marked and publicized during project implementation. During layout and planning of logging and burning where treatments occur on or near National or forest system trails the district recreation planner and trails specialist will coordinate

with local trail stewards so that the trail and infrastructure is protected and effects to scenic qualities are minimized.

Table 75. Trails and miles of trails within treatment areas in the CWPP area.

Trail Name	Mechanical or Hand Thinning Treatment & Prescribed Burning Treatment	No Mechanical Treatment, Prescribed Burn Only	Total Miles of Trail within the Project Area
	Miles of Trail		
Arizona National Scenic Trail	8.2	3.4	11.6
Barbershop Trail	0	0.2	0.2
Fred Haught Trail	2.8	3.6	6.4
General Crook National Recreational Trail	11.8	2.3	14.1
Houston Brothers Trail	2.8	4.3	7.1
Rock Crossing Trail	0.5	1.7	2.2
U-Bar Trail	1.9	0.2	2.1
		Total Miles	***43.7***

C.C. Cragin Reservoir Use

Under the proposed action alternative, the treatments are expected to reduce the risk of fire intensity in a majority of the project area over the next several decades. This would substantially decrease the risk of loss or degradation of recreational opportunities such as recreational fishing, boating, and swimming activities in the Reservoir and other streams in the analysis area. While recreation access in the Reservoir may be closed for short periods of time during prescribed burning and thinning in the area, over the long term, visitation to the Reservoir would remain open and water quality would be sustained for swimming, paddling, and water play.

Dispersed Recreation

Vegetation treatments, prescribed burning and fuel treatments, occurring over time and space, will have little effect to the recreating public. Alternative B would support the re-integration of low-intensity fire as regulatory process on the landscape. Several cases show low-intensity wildland fires yielding virtually no effects on recreational value and in some instances imparting positive social impacts. Both Sanchez et al. (2015) and Starbuck et al. (2006) show visitations in California and New Mexico increasing under low-intensity fire scenarios. The only anticipated impact that the proposed action alternative will have on dispersed recreation is when prescribed burning coincides with hunting seasons, especially in the fall of the year, or during brief closures of campsites, roads or trails. There may also be temporary area closures while prescribed burns are being implemented, and less often closures for managed fire activities. Spring burning would affect fewer people using dispersed campsites. In total, the action alternative is not expected to significantly impact dispersed recreation within the analysis area. Treatments are planned to be staggered throughout the project area in both time and space, so that even during temporary closures from active treatments, there would be many other places to hunt, camp and recreate. Efforts would be taken to limit forest treatment activities within the project area during high-use weekends and holidays, such as Memorial Day, 4th of July, and Labor Day, especially in locations where concentrated use is expected to occur.

Temporary closures from treatments will result in the temporary loss of recreational access or opportunities and could result in decreased satisfaction of nearby recreational sites where there is

overcrowding. This is most likely to occur during high-traffic weekends from Memorial Day through Labor Day, which often includes heavy use of dispersed camping sites within the project area. It can also occur during hunting season as the project area includes a large portion of game management unit 5A, and limiting access to portions of this unit can concentrate hunters in other parts of the unit. Eight processing sites are proposed in the CWPP area totaling 79 acres. All of the sites are located from 100 to 300 feet from forest system roads to provide for visual screening. All sites area locate more than ¼ mile from developed camping areas or group special use event sites. All of the processing sites are within or are adjacent to a 300 foot wide camping corridor and access roads into the processing site would cross the camping corridors. The eight proposed processing sites were located in parts of the camping corridors that show low use with maybe one or two campfire rings present. Impacts to dispersed recreational use from the processing sites includes noise disturbance from equipment and increased truck traffic entering and leaving the site. These impacts would range from temporary over a few months that the logging operation was active to several years for the large sites (10-15 acres) that would service as focal points for in woods processing of logs etc.

The transportation system proposed for use under alternative 2 utilizes a combination of existing Forest Service system roads, decommissioned roads used as temporary roads, new temporary roads and temporary roads placed on existing road beds. No new permanent roads are proposed. Of the roughly 50 miles of proposed temporary roads, 23 miles would be new roads where none have previously existed and the remainder would be on existing roads that are no longer part of the designated road system.

Road use during the project for logging, hauling and prescribed burning would impact dispersed recreational uses such as OHV riding where project activities occur on MVUM open roads. It is expected that during certain time periods there could be an average of 16-20 hauls by logging trucks or other large load equipment per sale area per day. Dispersed camping areas along open roads that are being used by the project may be impacted by noise and dust. This effect is likely to be most acute along FRs 300, 147, 141, and 95; because these routes both include heavy dispersed campsites along the routes and are hauling routes for treatments. Thus, a large number of campsites along these routes may experience an average of 16- 20 hauling trips per day from log/biomass trucks increasing both noise and dust.

There may be temporary road closures enacted during timber sales or prescribed burning but these closures would be short term for burning and mainly on forest service administrative use roads for logging. These closures would likely be of short duration, and/or of limited area. The impacts from disturbance and closure would be a minor impact to dispersed recreational uses because they would be of limited duration or extent and there would be many other open areas to camp and recreate during this time period.

Recreation Special Uses

The proposed action would reduce the risk of uncharacteristic wildfire in areas with recreation special uses activities. Coordinated efforts would be made with sponsors of recreational special-use events such as running or mountain biking races, to minimize the impacts of such proceedings within the project area during CWPP project implementation activities. Appropriate signage will be used to inform the public of logging or prescribed burning activities (see design feature REC18). The proposed action would allow for continued recreation special uses activities at or beyond current levels throughout the project area during and beyond the timeframe of project implementation.

Recreation Opportunity Spectrum

There may be temporary impacts to recreation users at particular areas during implementation activities, mainly logging operations and hauling. There would be longer term potential impacts of increased traffic and noise near processing site locations. However since most of the project area is located within Roaded Natural and a small amount of Rural ROS settings, these impacts would be consistent with recreation opportunity objective settings for the majority of the project area.

Of the proposed 8 processing centers, approximately 51 of these are in RN and 28.3 acres are in SPM designated areas (Figure 56). Development and operation of the processing sites would not conflict with the desired conditions for SPM and RN designations where there are occasional or regular sights and sounds of human influence. The processing sites could have a broader impact on ROS experience within the immediate area where operations can be heard (0.14 to 2.4 miles around a site) and seen but these would not be inconsistent with the RN or SPM settings. During use of a processing site, the appearance of the forest would change because most of the trees would be cleared on the site. The locations of the processing sites have been designed so that there is visual screening from the main roads, thereby moderating the visual effects of the sites. Also during use there would be increased traffic and interaction between log trucks, chip vans or other vehicles and equipment in use at the site and public use of the forest. The time period of effects to ROS from the processing sites would be variable; smaller processing sites would be used over a shorter time period 5-10 years than the larger sites which could be in use from 10-20 years. After use, the areas would be completely rehabilitated and trees and vegetation would slowly be reestablished.

Of the 23 miles of proposed new temporary roads all of them are within RN or SPM designation, except for 0.09 miles of a temporary roads that slightly overlaps with an SPNM area (Figure 56). Construction of all new temporary roads would be similar to a primitive, native surface road that would be cleared and opened for one time use during timber hauling operations. The construction and use is consistent with the RN or SPM designations and after use the temporary road would be completely rehabilitated and would become naturalized within several years after use. The very slight encumbrance of the SPNM area would likely not result in long-term effects to the ability of the area to meet SPNM characteristics over the long-term.

Mechanical treatments would primarily occur in RN and SPM areas, with a small amount occurring in one of the SPNM polygons in the project area. Mechanical treatments are expected to result in short-term effects (1-2 years after treatment) where the sights and sounds of humans are more noticeable on the landscape. However, after a short period of time and subsequent treatments such as prescribed fire, the evidence of treatments fades and is not expected to affect ROS designations. As a result none of the mechanical treatments would prevent an area from meeting or moving toward ROS classifications over the long term (>1 years).

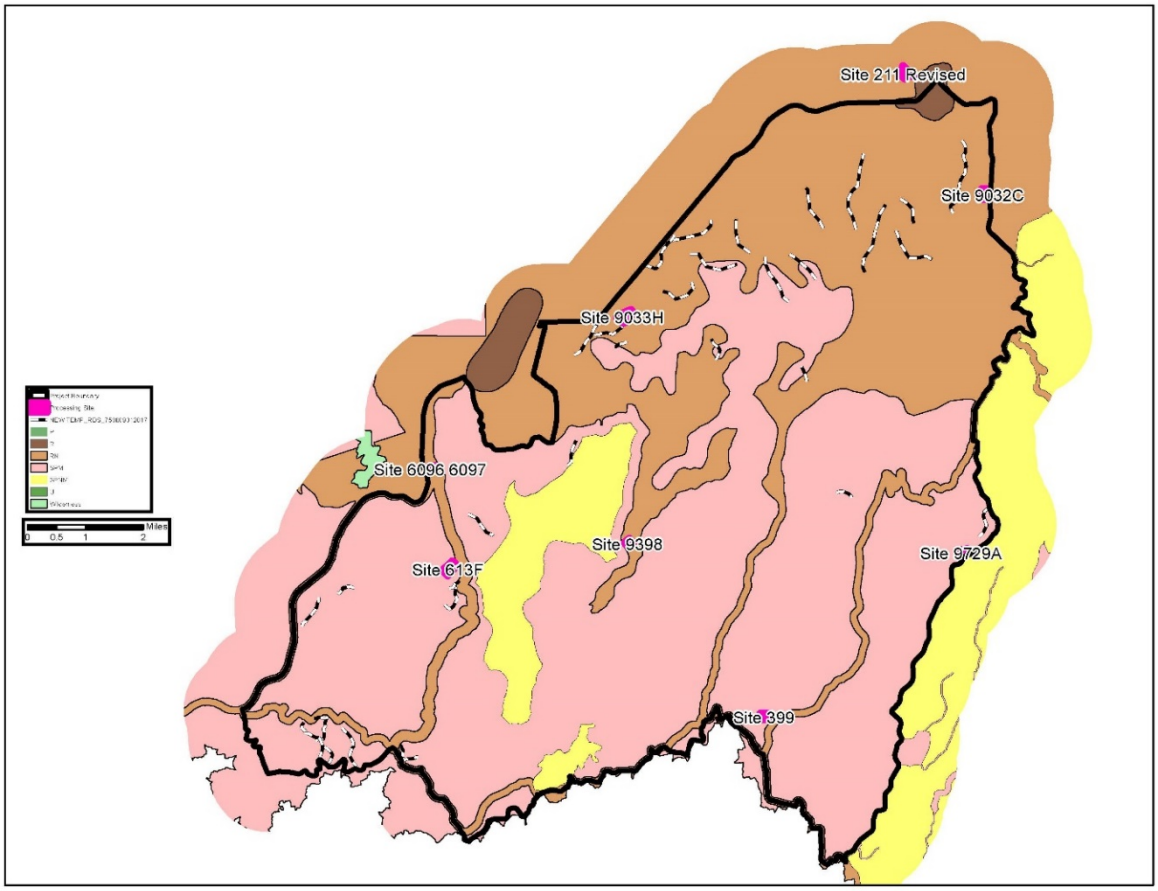


Figure 56. Temporary roads and processing areas and ROS designations in the project area.

Wild and Scenic Rivers

Under this alternative there would be prescribed burning only treatments applied to about 108 acres of the ¼ mile corridor of the Barbershop Creek and East Clear Creek Wild and Scenic Rivers (the corridors overlap). The corridor area consists of the steep cliffs of the inner gorge of the two creeks. There would be no mechanical thinning treatments. It is possible that prescribed fire treatments could result in moderate fire effects, which could possibly affect ORVs such as scenic quality, aquatic habitat or soil disturbance for one to five years. This effect would be limited because prescribed fire would not be ignited in the canyon areas and would only be ignited during appropriate weather conditions. Fire would only be implemented when conditions are within prescription and fire ignition techniques will be used to allow low-intensity fire to back into drainages and canyons to limit fire effects. The proposed action will not impact the designation or classification of East Clear Creek or Barbershop Canyon as Wild and Scenic Rivers, including its free flows and ORVs, as the mitigation measures of prescribed burning in the corridors will protect these areas and uses and prevent destruction due to uncharacteristic wildfire.

Inventoried Roadless Areas

Under this alternative there would be prescribed fire treatments applied to 1.5 acres of the 1,611 acre East Clear Creek Inventoried Roadless Area. Due to the exceedingly steep slopes on this 1.5 acres, it is possible that prescribed fire treatments could result in moderate fire effects, which could possibly affect one or more of the indicators identified for roadless areas, such as scenic quality or soil disturbance for one to five years. This effect would be limited because fire would not be ignited in the

canyon areas. Instead fire would be allowed to back into drainages and canyons as predominantly a surface fire. However, the amount of the roadless area affected within the project area would be so small compared to the East Clear Creek roadless area boundary (0.09 percent) that these effects would likely be of no consequence when considered at the scale of the roadless area being affected.

Lands and Lands Special Uses

Under the proposed action alternative, management activities including thinning and prescribed burning would occur to reduce the risk of uncharacteristic wildfire. Mechanical treatments to protect key infrastructure associated with the reservoir and drinking water pipeline would be prioritized in the first few years of project implementation specifically to reduce risk from high-intensity fire. Reduced fire danger, and the potential for reduced intensity of wildland fires, especially crown fires, would reduce the risk of loss or degradation of structures that are authorized both in the short term and the long term. Impacts could include preventing the destruction of these facilities by fire, and maintaining open areas for rehabilitation and recreation that might otherwise be closed by uncharacteristic wildfire. There may be short-term, temporary effects in the form of restricted access to sites during fire suppression or post-fire rehabilitation activities, but in the long-term, the proposed action will support the health and safety of recreationalists and surrounding communities, as well as preserve water supplies and utilities that run through the project area.

Under the proposed action alternative, the Forest Service would notify the appropriate permit holder and office whenever land management activities are going to be implemented in areas having authorized infrastructure, facilities or data sites, and coordinate planned activities with the permit holder to minimize impacts to improvements during implementation.

The proposed action will allow for vegetation treatments that can soften the edges of linear permit areas like power lines and highway corridors where necessary vegetation management of these corridors has created straight linear corridors. The proposed action may also create some additional clear zones and openings along these corridors thereby reducing additional vegetation removal by the utilities and ADOT. Increased truck traffic at forest road and highway intersections may impact the traveling public with slower vehicles entering highway corridors during the life of the project. Design features and coordination with ADOT at specific intersection will occur to address any safety issues.

Processing site locations will have higher traffic numbers during operating time periods. Design features will reduce impacts to the highway corridors and intersections. If utility connections are desired at processing sites, appropriate coordination will need to occur with the utility company and amendments to their permits would be necessary. The processing site proposed at FR211 Revised is over ¼ mile from the ADOT/Coconino County maintenance yard which includes residential use. Noise and increased activity and traffic associated with a processing site at this location could be an impact to the residence at this permit site. Other processing sites are not as close to residential development and private property however residents who live in the project area boundaries could be impacted by increased noise and traffic on forest roads and in forest areas during treatment activities as well as processing site activities.

Processing sites may be authorized under timber contract or under special use authorizations. Special use authorizations for processing sites would comply with appropriate policies related to cost recovery and land use fees and other special use regulations (36 CFR 251). A performance bond would be used to insure that all obligations are fulfilled by the contractor or permittee and would be used if needed to cleanup and rehabilitate the processing sites.

Design features include protection of private property through identification and marking of private land boundaries in the project area to avoid impacts to private land during implementation. In addition, although the alternatives do not indicate a need for right of way through private property for temporary access or hauling purposes, design features are intended to address any unanticipated easement or permits for access to avoid impacts to private property.

Utility Lines and Corridors, Underground Cables

Management activities such as prescribed burning and mechanical thinning would be coordinated with local utility contacts. Fire personnel would protect infrastructure during implementation from both physical and heat related damage to pull boxes and buried lines as well as aerial lines. Pre-activity meetings will take place with utility companies to ensure contractors are aware of the voltage and safety requirements along power line corridors. Additionally, fire crews would place project-generated slash outside of permitted utility line and pipeline rights-of-way so they would not interfere with utility corridor management. Treatments adjacent to power line corridors will reduce linear edges and create a more irregular natural appearance outside of right of ways. The proposed action may also create some additional clear zones and openings along these corridors thereby reducing additional vegetation removal by the utilities.

Cragin Project Pipeline and Overhead Powerline

In the proposed action, measures would be taken to ensure that roads are re-enforced where they cross the Cragin pipeline, if needed. Planned activities near the pipeline and powerline would be coordinated with SRP prior to implementation.

SNOTEL and Snow Course Protection

The proposed action would implement a 100 foot buffer zone around snow courses, data sensors, snow pillows or other meteorological facilities. No road construction or timber harvest is to occur within the buffer. During project implementation, management activities such as prescribed burning, or hazard tree removal within the buffer zone would be conducted in a manner that will protect site infrastructure from damage and will not diminish the value of the site, facility or the approved access to the site. The district would notify the appropriate NRCS State Snow Survey Data Collection or Water Supply Specialist Office whenever land management activities are going to be implemented in areas having authorized snow courses or data sites.

State Highway 87

The district would conduct management activities such as prescribed burning, hazard tree removal and mechanical thinning in a manner that will protect site infrastructure within the right-of-way from damage. Mechanical thinning and prescribed burning activities would be planned and coordinated with Northcentral District of Arizona Department of Transportation to ensure no interference with the safe operation of the roadway, including, requiring an operator to acquire an encroachment permit for activities within the right of way or for temporary access points to Highway 87. Treatment in the highway right of way will be subject to economics of operation and may be conducted by either ADOT or their contractors or under Forest Service contracts. The proposed action will allow for vegetation treatments that can soften the linear edges along the highway corridors where necessary vegetation management of these corridors has created straight linear corridors. The proposed action may also create some additional clear zones and openings along these corridors thereby potentially reducing the need for additional vegetation removal by ADOT.

Processing Sites

Processing site locations will have higher traffic volumes during operating time periods. Design features will reduce impacts to the highway corridors and intersections. If utility connections are desired at processing sites, appropriate coordination will need to occur with the utility company and amendments to their permits would be necessary. The processing site proposed at FR 211 (revised) is ¼ mile from the ADOT/Coconino County maintenance yard which includes residential use. Noise and increased activity and traffic associated with a processing site at this location could be an impact to the residences at this permit site. Other processing sites are not as close to residential development and private property. However, residents who live in the project area boundaries could be impacted by increased noise and traffic on forest roads and in forest areas during treatment activities as well as processing site activities. Processing sites may be authorized under timber contractors or under special use authorizations. Special use authorizations for processing sites would comply with appropriate policies related to cost recovery and land use fees and other special use regulations (36 CFR 251). Processing site FR211 (revised) is more than ¼ mile from the AZNST which tracks to the west of the proposed processing site area. Field reviews of the trail and processing site indicate that there should be no visual impacts to trail users, however noise would be heard similar to the nose from state highway 87 which is to the south of the trail. The proposed processing Site 9729A is located a quarter mile from the U-Bar trail to the northwest. At this distance noise from the processing site equipment would be heard but not seen by users on the trail.

Private Lands

In the proposed action, the Forest Service will ensure non-federal lands land boundaries are known and marked in advance of any treatments near those lands. Forest Service personnel will also evaluate potential haul routes that may be needed through non-federal land and ensure easements are in place or obtained prior to use. Potential access routes should be evaluated to determine whether easements are in place or need to be acquired.

Design features include protection of private property through identification and marking of private land boundaries in the project area to avoid impacts to private land during implementation. In addition, although the alternatives do not indicate a need for right of way through private property for temporary access or hauling purposes, design features are intended to address any unanticipated easement or permits for access to avoid impacts to private property.

In the long-term, the proposed action will support the health and safety of recreationalists and surrounding communities, as well as reduce potential impacts to water supplies, utilities and other infrastructure within and adjacent to the project area.

Forest Service Administrative Sites

The alternative proposes the Baker Butte Treatment which would cut trees that are presently impairing the landscape views from the lookout tower that are important for fire detection. The treatment would also reduce fuels and conduct prescribed burning in the 24 acres surrounding the administrative site. There would be no direct impacts to the administrative site or function with the treatments except for noise and smoke disturbance during implementation. The tower may be closed or not operating during implementation of logging or prescribed burning. Similarly, forest thinning and prescribed burning area proposed surround and within the administrative sites of Moqui Lookout and the Blue Ridge Ranger Station. Direct impacts to employees or residents would include noise and smoke impacts and increased traffic from hauling. As with the other sites described above, management activities such as mechanical thinning and prescribed burning would be planned and implemented in a manner to protect site infrastructure form damage. Project generated slash piles or burn piles would be placed to minimize disruption to site uses and functions and would be treated

during time periods of low or non-use. Structures and infrastructure such as power and phone lines would be protected from logging or burning impacts and implementation of design features for utility lines and underground cables would protect these features from physical, smoke or heat related damage.

Cumulative Effects - Proposed Action

Alternative 2– Proposed Action

The proposed action alternative would have minor, short term and temporary negative direct and indirect effects to dispersed recreation activities, hunting, and other special land uses. Over time, effects would counteract the increasing crown fire risk predicted for the project area as a result of climate change, and recreation, lands, and wild and scenic rivers would be made more resilient to wildfire effects by mechanical thinning and prescribed fire treatments. Since direct or indirect effects resulting from project activities will be mitigated by project design features, there will be no cumulative effects on recreation sites, trails, lands and special uses, East Clear Creek and Barbershop Canyon wild and scenic river eligibility and ORVs and ROS. There could be longer term use of some processing site locations under the 4FRI, or East Clear Creek Watershed Improvement treatments and therefore the authorization of these sites may combine with the effects of other projects occurring adjacent to the project area resulting in longer term effects of their use beyond the C.C. Cragin project. Those impacts would be related to noise and traffic in the vicinity of some processing sites.

Ongoing or planned projects of a similar nature to CWPP within the project boundary include the East Clear Creek Task Order timber sale (2,318 acres, approximately 1,400 acres of which overlaps the project area), maintenance burning as part of the East Clear Creek Watershed Health project and maintenance burning as part of the Blue Ridge Urban Interface Project (together about 3,000 acres). The CWPP project is analyzing the 2,318 acres of the East Clear Creek Task Order for thinning and burning treatments using the CWPP treatment design and they are included in the 41,000 acres proposed for thinning. The LEARN Mixed conifer study is being planned and will thin and burn another 56 acres in the CWPP project area. These thinning and burning projects will have similar impacts to recreation, lands and special uses as would CWPP and resource impacts would be mitigated similarly. Future foreseeable projects that involve restoration, thinning and burning and road designation and camping use are the Rim County EIS, the Long Valley Meadow Restoration Project and Changes to Motor Vehicle Designations project on the Mogollon Rim District. As part of environmental review of these projects, impacts to recreation, lands and special uses are being considered and measures are being developed to reduce or mitigate impacts. CWPP in combination with ongoing and future projects would not result in any detrimental cumulative effects to the recreation, lands, lands special uses, W&SRs, IRAs and Forest Service administrative sites.

This alternative will result in short-term closures in treatment areas with may combine with the effects of displacement of recreational users from other nearby project closures and closures resulting from wildfire or post-fire conditions. Studies have identified an increased likelihood of more frequent and more intense wildfires as a result of climate change in the southwest over the next several decades. These wildfires would result in greater and more long-term affects to permitted infrastructure, private land access, recreational access, and recreational opportunities. This alternative would be expected to reduce the impact of these events over the long term by increasing the resiliency of the landscape to adjust to wildfire events and would reduce the potential of post-fire flooding and road and trail damage from increased debris flow.

Scenery

The following section describes the affected environment and effects of the alternatives relating to Scenery.

Affected Environment

The affected environment section provides a general description of the Coconino National Forest scenic resources, and then discuss scenic integrity and scenic stability in the context of the Scenery Management System (SMS). The scale of analysis for scenery is the project area.

Scenic Integrity

The Scenic Integrity or "intactness" of national forest lands is the means by which proposed alterations to the land are evaluated. Scenic Integrity is produced from the combined inventory of scenic attractiveness, viewing distance from the observer, and concern level of forest visitors. Scenic Integrity Objectives (SIO) are established for the forest and can be applied at the forest, management area or treatment area. SIOs range from Very High, meaning the landscape character is unaltered, to Very Low, meaning the landscape character is highly altered. Intermediate levels include High (landscape character appears unaltered), Moderate (landscape character is slightly altered), and Low (landscape character is moderately altered). Another basic premise of the SMS is landscape character, which gives a geographic area its visual and cultural image. It consists of a combination of physical, biological and cultural attributes that make each landscape identifiable and unique. Landscape character embodies distinct landscape attributes that exist throughout an area (USDA Forest Service, 2000). Table 76 compares the Visual Management System rankings and terminology with the Scenery Management System.

Table 76. Scenic Integrity and Perception based on the Forest Service Scenery Management Handbook

Scenic Integrity (both Existing and Objective)	The Forest's Scenic Integrity As People Perceive It
Very High	Unaltered; landscape character is intact
High	Appears unaltered; deviations to landscape character are not evident
Moderate	Slightly altered; deviations are subordinate to landscape character being viewed
Low	Moderately altered; deviations begin to dominate the valued landscape character being viewed
Very Low	Appears heavily altered; deviations may strongly dominate the valued landscape character.
Unacceptably Low	Appears extremely altered; this level is only used to inventory existing scenic integrity. It is never an objective on National Forest System lands.

From: (USDA Forest Service, 2000)

The scenic integrity objectives (SIO) for the treatment area are illustrated in Figure 57. For the CWP project, these represent the long term goal and are incorporated in the desired conditions for watershed protection activities proposed. Approximately 33,708 acres are mapped as high SIO, and 30,723 acres are mapped with moderate SIO. Per the SMS Handbook: high scenic integrity refers to landscapes where the valued landscape character "appears" intact. Deviations may be present but must repeat the form, line, color, texture and pattern common to the landscape character so completely and at such a scale that they are not evident. Moderate scenic integrity refers to landscapes where the valued landscape character "appears slightly altered". Noticeable deviations must remain

visually subordinate to the landscape character being viewed. SIO low refers to landscapes where the valued landscape character "appears moderately altered". Deviations begin to dominate the valued landscape character being viewed.

Scenery Management System Concern Level Travelways

The CWPP project is being planned as a large scale fuels reduction project with activities planned on about 64,433 acres on the Mogollon Ranger District of the Coconino NF. The proposed vegetation thinning and prescribed fire treatments make it an appropriate candidate for SMS refinements for managing and sustaining scenic quality within an ecosystem management context. The purpose and need of this analysis is focused on fuels reduction and ecosystem sustainability. SMS Appendix J (USDA Forest Service, 2007) recognizes that disturbances across the landscape can be beneficial, and even critically important to forest health and sustainability, but they can also have detrimental impacts to scenery. Key components of SMS include landscape visibility, which addresses travelways and use areas, concern levels, and distance zones. Travelways include linear viewing platforms such as highways, roads and trails. Use areas are locations that have concentrated public viewing use such as trailheads, campgrounds, subdivisions, and commercial areas. Concern levels are classified as 1, 2 or 3, and represent the degree of scenery importance for specific viewing locations such as communities, recreation areas, roads, and trails. Concern level 1 viewing platforms are those areas where observers have a primary concern for scenery, concern level 2 routes are assigned to those areas where there is a secondary concern for scenery, and the remaining routes are considered concern level 3 during the Forest scale inventory process. This is meant to be refined at the project scale. Distance zones considered include immediate foreground (to 300 feet), foreground (300 feet to 0.5 mile), middle ground (0.5 to 4.0 miles), and background (greater than 4.0 miles). They are applied to locations for which Concern Levels are assigned.

Concern Level 1

Inventoried Concern Level 1(CL1) Travelways and Use areas in the project area include: Concern Level 1 Travelways include the following: FR300, 300E, AZ87, FR95, FR751, FR751A, FR147A, Arizona National Scenic Trail FS87A, Barbershop Trail FS91, Foot Trail FS139, Fred Haught Trail FS141, General George Crook National Recreation Trail FS130, Houston Brothers Trail, FS 171, Rock Crossing Trail FS18B/C, and U-Bar Trail FS28. Concern Level 1 Waterways include: Portions of Bear Canyon and East Clear Creek.

Concern Level 1 Recreation Use areas include the following: Baker Butte Lookout, Moqui Lookout, Moqui Group Camp and Amphitheater, Blue Ridge Campground, C.C. Cragin Reservoir & Boat Launch, East Clear Creek, Kehl Spring Campground, Long Valley Group Camp, Rock Crossing Campground, Potato Lake, McFarland Spring, Hay Meadow Trailhead, Jumbo Trailhead, Arizona Trail Trailhead at FR138 and General Springs Trailhead.

Concern Level 2

Concern Level 2 (CL2) Travel ways that have been defined include the following roads: FR141, FR95, FR751B, FR751D, FR751E, FR9033H, FR218, FR218A, FR139, FR300B, and FR139A. Concern Level 2 Waterways include: Portions of Bear Canyon and East Bear Canyon. Camping Corridors are also considered to be CL 2 and are being incorporated into the inventory at the project scale.

CL 2 Recreation Use areas include group event use sites at Aspen Spring/Dick Hart ridge at 139,139G, Oak Grove at FR 218, 218A; Long Valley Draw and the Central Arizona Motorcycle Trial Area.

The existing condition of scenic resources is a result of implementing the Land and Resource Management Plan. Management of multiple resources has, to varying degrees, altered the natural landscape character. The most obvious effects on scenic resources within the project area are from vegetation and landform alterations. Resource management activities which have altered scenic resources include but are not limited to vegetation management, common variety mineral extraction, utility corridors, roads and trails, development of recreation sites such as campgrounds, improvements associated with special use permitted sites, fire management (suppression and prescribed burning), previous wildfires, and livestock grazing.

Project Level Scenic Inventory

The Coconino National Forest's natural, cultural, and historic resources attract visitors, making the forest a regional, national, and international year-round recreation destination. One of the main attractions is the Forest's natural beauty and opportunities to experience nature. The activities having the greatest numbers of participants on the Coconino National Forest (CNF) are hiking and walking, viewing natural features, relaxing, driving for pleasure, and visiting historic sites (USDA Forest Service, 2016c).

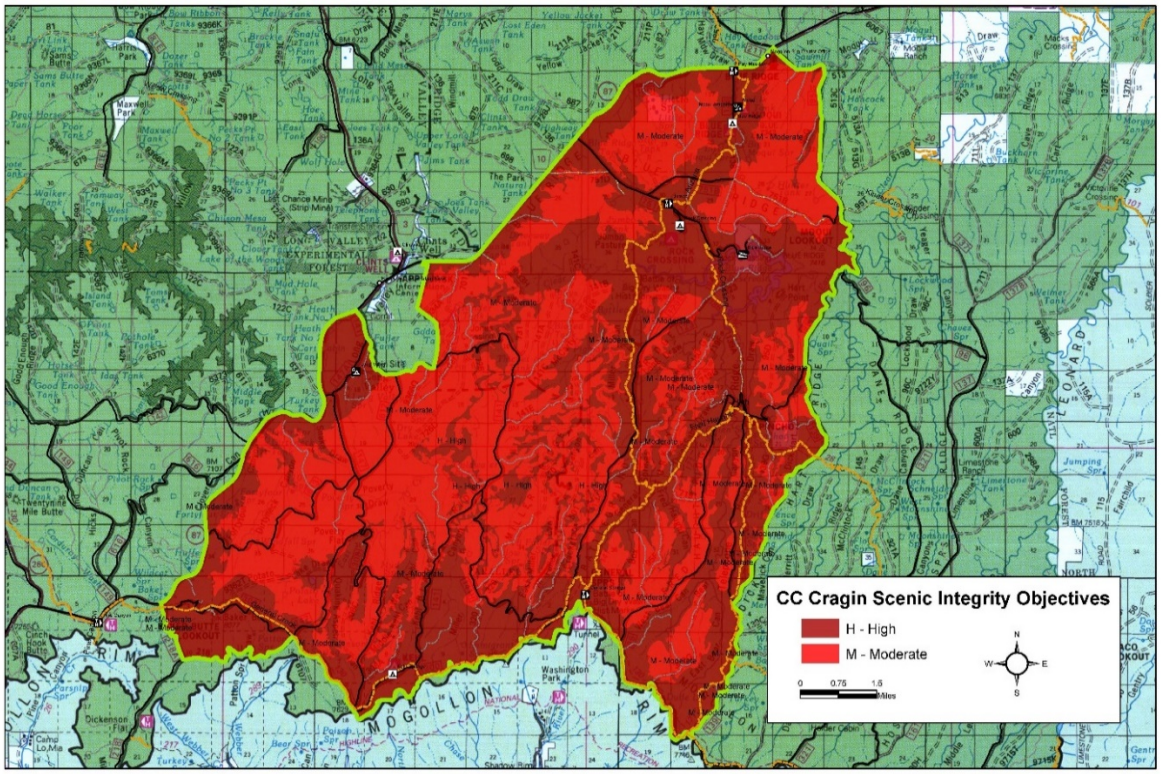


Figure 57. Scenic Integrity Objectives in the CWPP Area

The existing condition of scenic resources is a result of implementing the Coconino Forest Plan. Management of multiple resources has, to varying degrees, altered the natural landscape character. The most obvious effects on scenic resources within the project area are from vegetation and landform alterations. Resource management activities which have altered scenic resources include but are not limited to vegetation management, mineral extraction, utility corridors, roads and trails, development of recreation sites such as campgrounds, improvements associated with special use permitted sites, fire management (suppression and prescribed burning), previous wildfires, and livestock grazing.

Sense of Place

Scenery is an important component in the sense of place for an area. Forest niche information recently developed for the Forest provides a general context for the importance of inherent scenic qualities. These qualities include aesthetic, social and biophysical features (see niche descriptions). Valued scenic assets in the project area include water features such as East Clear Creek, C.C. Cragin (formerly Blue Ridge) Reservoir, and Potato Lake, geographic features like the Mogollon Rim and a series of north-south steep forested ridges and valleys. Developed recreation sites throughout the project area include campgrounds, trailheads, and trails. Two nationally designated trails, the Arizona National Scenic Trail and the General George Crook National Recreation Trail, can be found in the project area. In addition, the area is popular for dispersed recreation activities including hunting, fishing, wildlife and bird watching, camping, picnicking, snow play and other activities.

The Coconino National Forest's natural, cultural, and historic resources attract visitors, making the forest a regional, national, and international year-round recreation destination. One of the main attractions is the Forest's natural beauty and opportunities to experience nature. The activities having the greatest numbers of participants on the Coconino National Forest (CNF) are hiking and walking,

viewing natural features, relaxing, driving for pleasure, and visiting historic sites. Downhill skiing, bicycling, fishing and viewing wildlife were also very popular primary activities. The CNF received approximately 2,888,000 visits in 2010 (USDA Forest Service, 2016c).

The Coconino National Forest niche identifies four settings for the forest: High Use, Scenic Corridor, Moderate Use/Dispersed, and Secluded/Low Use (USDA Forest Service, 2008).

Landscape Character Description and Special or Distinctive Features

The project area is 55 miles south of Flagstaff, 45 miles from Camp Verde, and 125 miles northeast of Phoenix. The closest communities are Happy Jack and Clints Well. These communities and routes receive a low to high use, and visitors have high concern for scenery, especially along high use scenic corridors such as the Rim Road FR300, and AZ87 and other Concern Level 1 travel ways such as the Arizona National Scenic Trail and developed facilities in the project area. The project area is viewed at foreground, middle ground and background distances from sensitive roadways, trails, and recreation sites located within and around the boundary.

The majority of the project area is within the East Clear Creek Landscape Character Zone (LCZ) and the northeastern portion is within the Ponderosa Pine Landscape Character Zone (see Figure 58). The East Clear Creek LCZ is characterized by the Mogollon Mesa, a landform with steep drainages, sloping to the north and away from the tall, rugged, escarpment known as the Mogollon Rim, which makes up the southern boundary of the Forest and the southern limit of the Colorado Plateau. This setting provides opportunities for quiet and solitude. Canyons provide less managed settings with low disturbance that support wildlife and non-motorized recreation, except along designated roads. The Ponderosa Pine LCZ extends from the northern Coconino National Forest boundary to the northern boundary of the East Clear Creek Watershed.

Recreation opportunities in the project area include developed and dispersed recreation such as driving for pleasure, hiking, picnicking, sightseeing, boating, fishing, camping, and day use. Natural landscape is highly valued by local residents and visitors. Recreation developments contribute to the area's unique sense of place through use of native materials; mimicking line, form, color, and texture of the surrounding landscape; or use of identifiable Forest Service symbols and historic features. For a full list of recreation opportunities and recreation sites refer to the Recreation Specialist report and the recreation section of the EA.

Distinctive features and water resources in the project area include C.C. Cragin Reservoir, Potato Lake, major canyons, and scenic drainages. East Clear Creek is the major stream, with perennial flowing water in a steep canyon setting. Other major canyons include Bear Canyon, and Kehl Canyon. This area is valued for its steep drainages offering quiet and solitude, colorful maples, the reservoir for boating and fishing, and the picturesque Mogollon Rim with expansive, panoramic views.

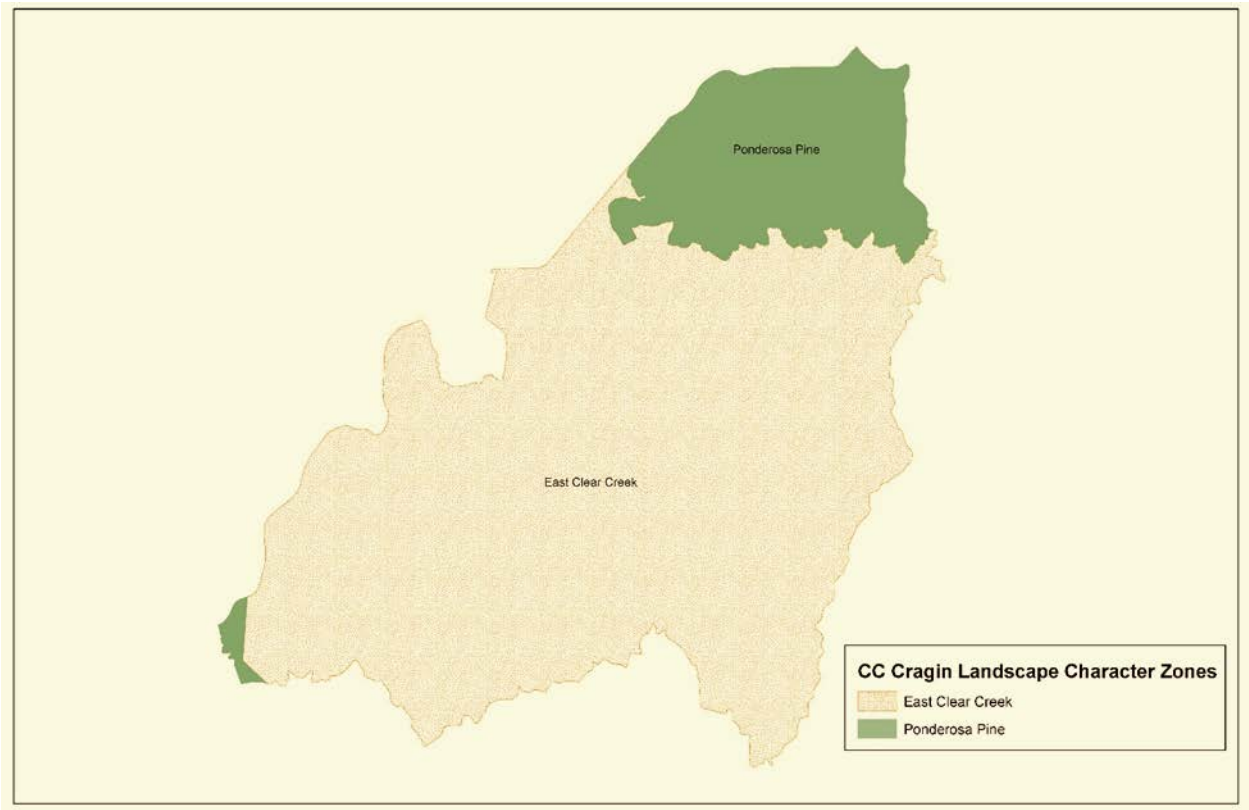


Figure 58. Landscape Character Zones in the Project Area (USDA Forest Service 2016)

Recreation opportunities in the project area include developed and dispersed recreation such as driving for pleasure, hiking, picnicking, sightseeing, boating, fishing, camping, and day use. Natural landscape is highly valued by local residents and visitors. Recreation developments contribute to the area's unique sense of place through use of native materials; mimicking line, form, color, and texture of the surrounding landscape; or use of identifiable Forest Service symbols and historic features. For a full list of recreation opportunities and recreation sites refer to the Recreation Specialist report and the recreation section of the EA.

Environmental Consequences

The spatial boundaries for analyzing the direct and indirect effects to Scenery are the Cragin Watershed Protection Project boundaries- considered the geographic scope of scenic attributes and landscape character for the CWPP area.

The temporal boundaries for analyzing the direct and indirect effects is the time anticipated necessary to complete project implementation (up to 20 years) and achieve Forest Plan Scenery objectives within 5 years of project implementation; with the exception of the processing sites which would likely take closer to 10 years post project implementation to meet Forest Plan Scenery objectives.

Alternative 1–No Action

Direct and Indirect Effects

Viewing natural features is one of the most sought after recreation activities on the Coconino NF. Almost three-quarters of visitors to the forest report participating in this activity and over 90% of users were satisfied with the condition of the scenery (USDA Forest Service 2016c). Scenic quality within the CWPP is particularly important to those who enjoy recreating at and living near the project area. Scenery also contributes indirectly to local quality of life, tourism and economic vitality, and the forest's scenic heritage.

Under the no action alternative there would be no changes in current management. If the proposed action is not implemented, the project area would continue to be mostly natural-appearing. Important scenery attributes such as open and diverse vegetation and large tree character that historically contributed to the attractiveness of the area would continue to decline over the next several decades. At some point, overstocked vegetative conditions may result in an uncharacteristically large and intense wildfire that is outside the range of historic variability and likely would result in diminished scenic quality, although the extent of this is not known.

At some point, overly dense vegetation conditions may result in large scale, high severity wildfire that is uncharacteristic in this landscape. Because stands across the project area would continue to primarily be made up of homogenous forest condition with more trees per acre than compared to historic conditions, the risk of stand replacement fire would continue to be of concern. This concern would be amplified with the increasing potential for escaped camp fires, ignitions from target shooting, fireworks or cigarettes from dispersed recreation use and private residential developments intermingled with and/or adjacent to National Forest lands.

In the event of an uncharacteristic high severity wildfire such as the Schultz Fire of 2010, Wallow Fire of 2011, or the Slide Fire of 2014, the existing landscape character would be suddenly altered with little opportunity to slow or control the change. If similar to these previous wildfires, the landscape would be changed to such a degree that very few of the objectives could be met in the short term (1-5 years) or long term (5+ years). The uncharacteristic high severity, large-scale wildfire would redefine and reshape the existing landscape character for decades if not centuries. The appearance and character of the area would shift from densely forested to patchy and open, with up to a 50% possibility of complete type conversion where the Forest changes from tree dominated to a more shrub-or-grass based cover type (Roccaforte et al. 2012). The overstory component and green canopy would be absent or drastically reduced, depending on the severity of the fire. For a few decades, the landscape would be dominated by blackened, dead standing trees; if the vegetation returns, the trees would likely fall in a dense, jack-straw pattern. With some vegetation types, climate change may hinder return to the previous vegetation type, and there could be areas of vegetation type change. Although short term, smoke from high severity wildfire would cause scenic quality to be diminished and would obscure views to scenic attributes.

In the short term following high severity fire, emergency fire suppression actions such as fire lines and emergency post-fire rehabilitation treatments could result in unnatural scars on the landscape. With rehabilitation and other mitigation measures, the immediate impacts of the suppression and emergency treatments should not be evident to the casual forest visitor within 2 to 3 years of completion, although effects from the fire itself would remain visible much longer. For two to three growing seasons, the blackened, exposed ground surfaces would be highly visible due to lack of vegetation. Sedimentation and erosion would increase and result in gullying and erosive events

especially along steep sloped areas, reducing soil productivity on a portion of the landscape and resulting in an extended time to revegetate.

Eventually these areas would be covered with spotty vegetation and potentially noxious or invasive weeds until native material became established. Within 5 years, the effects of the fire would begin to be viewed in a somewhat more positive light as grasses and forbs become re-established, and the shrubby understory and seedlings became more abundant, likely returning to 75% or more cover of the burned area (Abella and Fornwalt 2015). There is some risk that a vegetation type change could occur especially if there is wide spread drought, and/or if trends toward higher temperatures, and less annual precipitation continue. These changes would be visible throughout the treatment area in the foreground of Forest roads and trails, and as middle ground and background views from communities within the treatment area, and developed recreation sites. There would be long term (more than 20 years) impacts to major landscape attributes such as ponderosa pine forests with large, mature trees.

If wildfires burn large areas, the scenic quality would be decreased, and there would be long term negative changes (10 to 100 years) in scenic character. The scenic attributes that contribute to high scenic integrity, such as an open forest with tree groups of varying ages, sizes and shapes, large, mature trees, and healthy, diverse understory would decline or not be present.

Initial public reaction to a large-scale fire tends to be negative, as many people do not consider extensive, blackened landscapes to be natural or beneficial (Ryan 2005). These effects are often perceived by local residents as devastating to their community and way of life; non-local forest visitors may regard the effects of a catastrophic fire as interesting and something "to be seen" but also as a degradation of the scenic quality.

Under this alternative there would be little or no opportunities to enhance and improve scenic resources or achieve the desired condition described in Section 2 since there would be no thinning, prescribed fire, or other treatments related to restoration. Only management of lightning-ignited fires for resource benefit could be used to enhance and improve scenic resources over the long-term within the project area, however, opportunities to use this management tool would be less likely under a no action alternative due to the existing and continued high fire risk.

This alternative would not meet the project desired conditions or forest plan direction. For example in areas experiencing high-intensity wildfire and also in areas that may not be affected by wildfire, the management direction in the forest plan to maintain large trees, manage for a diversity of age classes of trees, and direction to maintain diversity of features on the landscape would be unachievable for the next several decades. A high-intensity wildfire could remove the primary landscape element of trees for decades, and result in a homogenous regrowth with trees or shrubs of similar age and appearance lasting for several additional decades. In an event that wildfire is suppressed or limited in the landscape, it is likely that large trees on the landscape will decline over time from increased rates of mortality from dense forest conditions, which would also limit the growth and development of large, mature trees that would replace them (Abella et al. 2007).

It would not move the treatment area toward scenic stability. Over time, scenic stability would decrease and move to very low. No action would result in continuation of current risks to scenic attributes and it is reasonable to assume that these risks increase each year and could be exacerbated by climate change.

The No Action alternative would not meet long-term scenic integrity objectives since these are dependent upon improving the condition of scenic attributes so that they are more resilient to ecological stressors. In addition, the No Action would continue the current condition outside of the

natural range of variability.

Cumulative Effects - No Action

Past Actions include wildfires greater than 10 acres that occurred from 2004 to 2017 within the cumulative effects boundary. Broadcast, maintenance and pile burning has occurred over 4,736 acres within the project area. Within the CWPP area over the last 10 years there have been a total of 17 large fires (>100 acres) intersecting and within the project area totaling 29,401 acres of which 26,151 acres are in the CWPP Boundary The largest acreage for high severity was 72 acres and that was within the Bray fire from 1990 which since has filled in with dense growth of young, small trees. The largest high severity area within a wildfire managed for resource objectives is 22 acres. Thus, while more than a third of the project area has been affected by fire, a very small percentage was of a severity that likely resulted in scenic impacts for more than 1-2 years.

The Post-Tornado Resource Protection and Recovery Project, the East Clear Creek Watershed Health Improvement Project and the Blue Ridge Urban Interface Project have been analyzed and overlap with the CWPP project. In the last 10 years there has been timber harvest activities within approximately 4% the project area, including salvage sales and pre-commercial thinning. Four timber sales, authorized through the East Clear Creek Watershed Improvement Project, are planned or are under contract in the analysis area. The Four Forest Restoration Initiative Rim Country EIS overlaps the CWPP, and may include additional restoration-related thinning treatments such as removal of conifer in meadows or near springs within the CWPP project area. These recently, ongoing, and reasonably foreseeable treatments are likely to have similar scenic effects to those areas with mechanical treatments proposed in this project.

Additional past and ongoing activities include various trail maintenance and improvement activities as well as dispersed recreational use in the CWPP project area. Additional activity in the analysis area considered for cumulative effects are those such as utility line improvements: installation, replacement, maintenance and repair of infrastructures (including vegetation removal), reservoir road and recreation facility improvements including the CWPP boat ramp, Forest Service road maintenance and reconstruction; range management and improvement projects (including fencing and tank maintenance/improvements), watershed improvement projects (including road closures and , utility and road right-of-way clearing and thinning, rock pit development and expansion (outside of the CWPP area), management of motorized use, dispersed camping, meadow restoration, and other associated restoration activities proposed within the analysis area such as the Four Forest Restoration Initiative. For a detailed list of past, ongoing and future foreseeable activities reference the cumulative effects activities section of the EA.

The cumulative effects of past management activities are visible as the existing conditions. Vegetation management practices, fire suppression, and over grazing have resulted in the current overly dense forests, even-aged forest structure, and sparse understory trees, shrubs, grasses and forbs.

The short term cumulative effects (1-5 years) of the No Action alternative combined with similar current and future restoration treatments and prescribed burning projects are expected to be negligible, unless one or more large scale, high severity wildfires occur in the project area. In these situations, it is possible that post wildfire conditions would combine to cumulatively decrease scenic quality in large sections of the project area and surrounding area. The scenic impact of a high-severity wildfire would combine with scenic impacts from adjacent land development, powerline development and maintenance, and impacts from dispersed recreation use to result in a cumulative impact so that scenic integrity is greatly diminished in areas burned for up to a decade or more. In some places there would be a chance that climate change could contribute to type changes in parts of the ponderosa pine

forest so that these characteristics would be replaced with difference landscape characteristics, which would also cumulatively impact scenic attributes.

In the absence of large, high severity wildfires, the overall conditions in the project area would be driven by the slow degradation of forest conditions and the loss of large trees and other key elements integral to scenic integrity. Long term cumulative effects of the No Action alternative and present and future vegetation management and prescribed burning projects would occur in areas where other activities such as utility line maintenance or landings from future timber sales combine with tree die-offs or other changes in Forest vegetation to reduce scenic integrity.

Alternative 2–Proposed Action

Direct and Indirect Effects

During project implementation (the next 20 years) visitors and local residents to the CWPP Project area and beyond would see an increase in logging trucks and equipment; hear the sounds of chainsaws or whole tree harvesting equipment, and see the harvest process when visible from roads, trails, or campsites in the project area. Where unavoidable, log landings, temporary roads, stumps and slash piles would likely be visually evident. Interim visual quality objectives have been assigned during project implementation according to handbook SMS handbook direction (USDA Forest Service, 1995. FSH No. 701, pp. 2-2). Proposed mitigations and design features are intended to reduce impacts to the scenery resource and ensure the project meets Scenic Integrity Objectives within a reasonable timeframe after project implementation (up to 20 years).

While the total project implementation timeline is estimated at approximately 20 years, the proposed activities would not be happening throughout the projects area all at once. Even if project implementation were to be accelerated, the proposed activities would occur in different parts of the project area over weeks or months. There may be several entries of thinning and prescribed burning into a unit or burn block over the next 20 years to achieve the overall desired conditions, but activity in a specific area would generally be limited to 1-5 years. Depending on how the slash is treated, it may require several years to cure and dry out before being burned, however, due to design features that limit how long slash may be staged in areas with high or very high scenic quality objectives, the effects of these slash piles would be limited.

Over the next two decades forest visitors will see a more open landscape, and increase in sunlight to the forest understory, and a greater visual penetration into the understory as a result of the proposed activities.

Visitors may experience delays or temporary trail closures or reroutes during implementation and may hear or have views of the thinning operation. Portions of motorized dispersed camping corridors (as identified to forest visitors on the Motor Vehicle Use Map) may be temporarily closed to use during timber management activities, prescribed burning or processing site activities. After implementation is complete and slash removed or treated, visitors would notice a less dense forest and have views into the understory, which would improve conformance for Forest Plan direction related to visual quality. Depending on the slope and aspect of viewer, the proposed thinning operations and small openings may be seen from other travelways in the near vicinity as foreground or middleground views. These would likely be short in duration and obscured by vegetation in the travel corridors, depending on the location. Stands proposed for treatment that are on steeper slopes or in higher elevations have increased likelihood of been seen from the project area and beyond; however, mechanical treatments are not identified on steep slopes, limiting this effect. Created

openings may be seen from a distance as middleground or background views. Visitors may notice a change in the color, line and texture of the forested landscape or a break in the forest canopy.

During implementation, travelers along noted travelways would likely be impacted by slowed or stopped traffic during the vegetation removal process or as a result of hauling of timber products from treatment areas and would have direct views of the treatment area during and after implementation. During implementation, travelers would likely see all associated activity of the vegetation removal process including but not limited to: various heavy equipment harvesting, transporting, chipping, spreading, and/or loading of timber and other vegetation. Similarly, all crossroads and trails, including the Arizona National Scenic Trail would also likely have direct immediate foreground views of implementation activities of the proposed treatment. Some motorized dispersed camping opportunities may not be available for periods of weeks or months during implementation. Approximately 2,798 acres of designated motorized camping corridor footprints overlap with proposed mechanical treatments. Of this area, approximately 3.1 acres would be in areas with a Very High scenic integrity objective, 2,293 acres in areas with High scenic integrity objectives, and 502 acres in areas with a Moderate scenic integrity objective. It is expected that over the long-term the mechanical treatments would move toward or meet the SIOs identified within the treatment areas. The short term effects of implementation would diminish after implementation and the treatment areas and over time would move toward the desired landscape character and be compatible with scenery goals and objectives.

Design features such as limiting stump height, treating slash completely, and feathering the edges of treatment boundaries would reduce the noticeable visual contrasts created by the tree removal activity in the long term.

There are subtle differences between the proposed mechanical treatments, but on the whole, they would be perceived very similarly by the casual observer. Retention of aspen, Gambel oak, larger diameter trees and yellow pines are included as design features or in the large and old tree implementation plans, which will minimize impacts to notable positive scenic attributes valued by the public. Improved habitat increases the likelihood of visitors viewing wildlife. Naturally appearing openings can create focal points for longer distance views by creating a contrast to the vegetated canopy. Removing dense “dog hair” thickets provides views into the understory, particularly when combined with proposed burning operations. Irregular leave tree spacing and a mosaic of openings and uneven-aged structure is recognized as preferred landscape and is compatible with desired future condition for scenery.

Of the approximately 37,764 acres proposed to mechanical vegetation treatments many if not all would be seen from one or more vantage point. After implementation and clean up, the landscape should be naturally appearing to the casual visitor and proposed vegetation treatments would meet forest plan scenery objectives within 1-5 years.

Table 77. Impacts to Scenic Integrity Objectives (SIO). Does not include 220 acres of water and 557 acres of private lands

Treatment Description	Very High SIO	High SIO (acres)	Moderate SIO (acres)
Baker Butte	0	27	0
MSO Recovery Mixed Conifer	57	5684	1380
MSO Recovery Pine-Oak	0	3357	2816
MSO PAC Mixed Conifer	0	269	1

MSO PAC Pine-Oak	0	479	606
Northern Goshawk PFA	0	242	191
PAC Precommercial Thin	0	231	45
Ponderosa Pine	0	11242	11084
Precommercial Thinning	0	106	3

Affected inventoried Concern Level 1 & 2 Travelways in close proximity to the cutting boundaries: CL1 Fred Haught Trail FS141, CL2 FR141, and CL2 FR139A. Numerous CL3 Travelways are in close proximity to the thinning boundaries and likely have views of the proposed activities. Approximately 210 acres of the Central Arizona Motorcycle Trial Special Use area is within areas identified for mechanical treatment. The trial area is permitted under special use permits for an event a few days each year. The treatments are expected to result in minimal visual effects that would impact this permitted use or other permitted uses in the area primarily as a result of design features to avoid recreational trails as skid trails and other design features to minimize the visual effects of treatments. These uses, however, may be prohibited or postponed for a year or two when treatments are being implemented in the permitted areas.

Table 78. Concern Level 1 and 2 Use Areas within or surrounded by project activity areas. Developed sites affected by a treatment are marked with an X.

Use Areas	Mechanical Vegetation Treatments, Activity Fuels and Broadcast and Maintenance Burning Treatments	Prescribed Burning Only Treatments	No Treatment
Developed recreation sites, identified by point data rather than polygons			
Concern Level 1			
Baker Butte Lookout Tower	X	-	-
Blue Ridge Campground	-	X	-
Blue Ridge Boat Launch	-	-	X
Blue Ridge Reservoir	-	-	X
General Springs Trailhead	-	X	-
Hay Meadow Trailhead, FR138	X	-	-
Jumbo Trailhead, FR751	X	-	-
Kehl Springs Campground	X	-	-
Long Valley Campground*	X	-	-
McFarland Spring	-	X	-
Moqui Group Campground	X	-	-
Moqui Amphitheater	X	-	-
Moqui Lookout Tower	X	-	-
Potato Lake	-	X	-
Rock Crossing Campground	X	-	-
Special use group or event areas identified by polygons and acreage			
Concern Level 2			
Central Arizona Motorcycle Trial Area	210	11.7	0

Aspen Spring, FR139, FR139G SUPA area	89.8	0	1.03
Oak Grove SUPA Area	16.8	0	0
Long Valley Draw SUPA Area	256.3	0	0

Baker Butte Treatment

The Baker Butte Treatment includes a more intensive treatment than in other areas of the project area and is located in an area with high scenery objectives, such as the Baker Butte lookout tower. As a result, additional analysis has been included to address the potential scenic impacts of this treatment.

The Baker Butte tree removal and thinning treatment is designed to improve the view of the landscape from the tower for fire detection purposes and to reduce hazardous fuels. The approximately 27 acres proposed for treatment includes the removal several large trees (it is an exception in the large and old tree implementation plans), which would be noticeable to the casual observer in the foreground in the short term. Approximately 20.8 acres are modeled visible in the foreground of CL1 travelways and approximately 6.4 acres are modeled visible as CL1 middleground views. Approximately 6.6 acres of the proposed thinning are in the current motorized camping corridor footprint associated with FR300. However, due to terrain and vegetation, the majority of dispersed camping takes place on the other side of FR300, and would not be directly affected by this alternative.

During removal operations, visitors to the nearby vicinity, including those camping may see or hear equipment being utilized for tree removal. The tree removal may be noticeable from the tower site itself, FR300, FR300B, and the General Crook National Recreation Trail FS130. Design features such as limiting stump height and treating slash completely will reduce the noticeable visual contrasts created by the tree removal activity in the long term. The New Mexican locust stands are a somewhat unique feature and would be retained for scenery where possible. Post implementation, the proposed action would not likely be a dominant deviation from the desired landscape character when seen. The Baker Butte Fire Lookout tower may be more visible as foreground or middleground views after tree removal. Fire Lookout towers are generally valued elements of the landscape and are generally noted as a positive cultural feature on the landscape by the public.

Precommercial Thinning

The majority of the proposed thinning in precommercial thinning areas has a Forest Plan SIO of high, as they occur in stands adjacent to main travel routes in the project area. The approximately 386 acres proposed for precommercial thinning adjacent to some of the campgrounds and private lands would likely be subtly noticeable to the casual observer in the short term (1-3 years after treatment). Visitors in the near vicinity to proposed treatment areas including Moqui Campground and the associated loop roads: FR138M, FR138L, FR138N, FR138K, and Blue Ridge Campgrounds: and loop road FR138B, nearby drainage Moqui Draw, the Arizona National Scenic Trail FS87A, FR10D, FR138, FR157, the East Clear Creek corridor, CWPP Reservoir, Foot trail FS139, and the private land adjacent to proposed treatment areas, may notice piles created by crews or hear chainsaws and other motorized equipment during the tree thinning operation. The hand piling of slash would reduce the scale of the piles and thus be less visible when seen compared with mechanical treatments. These short term impacts would likely diminish over time with the inclusion of design features and completion of proposed burning activities.

Initial Entry Burn

Removal of existing deviations such as slash from former logging activities and some logs and down wood from previous managed wildfires and prescribed burns will be achieved through initial entry burns. Short-term visual distractions (from days to up to 2 years) include smoke, burn scars, blackened or scorched understory, burnt soil, and dead and dying vegetation from the burn. Long-term improvements to forage habitat, species composition and diversity allow for enriched wildlife viewing, hunting opportunities and is overall compatible with desired scenic character.

Pile and Broadcast Burning of Activity Fuels

This management of activity fuels generated from timber harvest will occur as a secondary burn to the initial entry as mitigation for slash produced from thinning activities. This clean-up burn is essential for improving the aesthetic acceptability of these areas. Mitigations especially in the log landing areas where large slash piles have accumulated should have piles burned completely in order to achieve SIOs. In the short-term remnants from burning including burnt stumps, burnt soil, blackened trees as well as smoke will create visual deviations. Long term improvements in soil and vegetation health will encourage a more sustainable stand of forest allowing for improved scenery.

Road Management, Maintenance, and Use

Visitors to designated roads in the project area will see an increase in activity associated with the timber operations in the vicinity, including larger trucks hauling timber. They may also notice and benefit from the improved road surfacing necessary as part of implementation. Opening existing closed routes and decommissioned routes currently closed to the public for the administrative use for timber operations would likely be a notable deviation from desired landscape character in the short term, depending on how visible these routes are. Temporary roads, skid routes and landings would have the potential to impact scenery if in view of open roads, trails or visitor use areas. If temporary roads and log landings are in view, the SIO will be lowered to Low as an interim objective until the piles are completely burned and roadbed restored to natural conditions- likely 3-5 years in duration. New temporary road construction proposed for timber harvesting is estimated about 22 miles. About 9 of these new temporary roads are in High SIO and almost 13 miles are in Moderate SIO. In addition, there could be an additional 2 miles of roads constructed to provide access to processing areas, 1.1 miles of this would be in High SIO and 0.7 would be in moderate SIO. None of the proposed temporary roads for the project would be located in areas with Very High SIO.

Processing Sites

Eight processing sites are proposed for use in the CWPP (Table 79). Processing site location and siting considerations included the following: flat uplands less than 5% slope; distant from streams and ephemeral channels, meadows, springs and karst features; more than ¼ mile distant from MSO PACs and NOGO PFAs, more than ¼ mile from campgrounds and group event recreation sites; and more than ¼ mile from private lands, residences or offices (except for one site, Site 211, which is across a forest roads from a local fire station). Processing sites were also located to provide for a buffer of 100 or 300 feet from Forest roads and state highways to provide for screening from Concern Level 1 and 2 travel ways. The Proposed processing sites have the following Scenic Integrity Objectives:

Table 79. Scenic Integrity Objectives for Processing Sites

Site Name	SCENIC INTEGRITY OBJECTIVES	Sum of Acres
Site 211 Revised	H - High	12.3
	M - Moderate	2.7

Site 6096 & 6097	H - High	5.0
Site 613F	M - Moderate	14.8
Site 9032C	M - Moderate	10.4
Site 9033H	H - High	11.2
	M - Moderate	3.9
Site 9398	M - Moderate	5.5
Site 399	H - High	1.6
	M - Moderate	7.1
Site 9729A	H - High	4.8
Total		**79.3**

When we were considering the processing sites in the field even the ones the overlapped designated motorized camping corridors, the designated motorized camping corridor location site was minimally being used. For example, the motorized camping corridor of Site 211 Revised is not being used and doesn't have any hardened camping areas. Where the camping corridor overlaps with the proposed processing site it is a small acreage as compared to the available camping corridor outside of the processing site area and in the local area.

The visibility of the proposed processing sites were considered from foreground, middleground and background perspectives. The highest level of detail would likely be perceived from the foreground perspective. However, due to the size and scale of the sites, particularly those with larger acreage, there is a potential for the proposed openings and associated infrastructure to be seen from a distance from sensitive viewing platforms such as the Arizona Trail, however, the potential is low based on field-based surveys of the Processing site and Arizona Trail at the FR211 location. Low interim SIOs would be assigned to these locations during implementation.

During implementation, the proposed processing sites would likely be noticeable to the casual observer and depending on the perspective of the viewer, may be a dominant component of the view. Visitors would notice the lack of vegetation and the aggregate surface. Built structures such as fencing, sanitation facilities, office trailers, fuel storage containers, or other temporary built structures would likely be noticeable to the casual observer. Heavy equipment such as circular or band saws, various sizes and types of front-end loaders, log loaders and chippers, timber processors, planers and mechanized cut to length systems, associated conveyers and log sorting bunks for accumulation and storage of logs may be highly visible from sensitive viewing platforms. For safety, most of the equipment would likely be a yellow color to ensure visibility for the workers, this would create a notable contrast for visitors. The concentration of logs for sorting and drying would be evident to visitors to the near vicinity. Design features for above ground features shall be non-reflective and treated to be Forest Service brown or for a rusty appearance, or as approved by FS landscape architect or other FS official. This will ensure that SIOs are met post implementation and impacts to Scenery are minimized during implementation to the extent practicable.

Due to the potential for the soils to be heavily compacted form the operations at these sites, recovery post implementation may take up to 10 years, depending on the duration and extent of usage of the processing site. The SIOs would be met after the sites have be restored to a naturally appearing landscape character- likely 10 years post implementation. Design features for the processing sites include measures for reclamation and rehabilitation of the site including scarifying the soil and seeding the area (see Appendix B).

Cumulative Effects - Proposed Action

Past Actions include wildfires greater than 10 acres that occurred from 2006 to 2016 within the cumulative effects boundary (21,601 acres within the CWPP boundary). Broadcast, maintenance and pile burning has occurred over 4,736 acres of the CWPP boundary. Over the past decade, there has been a combined 3,995 acres of mechanical treatments authorized through the ECC project in addition to the 530 acres treated under the Blazed Ridge/Little Spring Tornado Recovery Stewardship contract. About 4,295 acres of forest (2,753 acres within the CWPP boundary) are targeted for thinning as part of the East Clear Creek 4FRI task order which was issued in 2014. These treatments would result in similar scenic effects as the proposed action where they occur and would reduce the risks associated with the no action alternative where they occur in the CWPP project area. Cumulatively, these timber activities affect approximately 6% of the project area, including salvage sales and pre-commercial thinning.

Other past and ongoing activities include various trail and other infrastructure maintenance and improvement activities in the CWPP project area. Additional activity in the analysis area considered for cumulative effects are those such as utility line improvements: installation, replacement, maintenance and repair of infrastructures (including vegetation removal), reservoir road and recreation facility improvements including the CWPP boat ramp, Forest Service road maintenance and reconstruction; range management and improvement projects (including fencing and tank improvements), watershed improvement projects (including road closures and , utility and road right-of-way clearing and thinning. Rock pit development and expansion, management of motorized use, Long Valley Meadow Restoration, Long Valley Work Station Meadow Restoration, the Rim Country EIS are proposed within the CWPP and surrounding the project area. A detailed list of past, ongoing and future activities is found in Chapter 3 of the EA.

The cumulative effects of past management activities are visible as the existing conditions. Vegetation management practices, fire suppression, and over grazing have resulted in the current overly dense forests, even-aged forest structure, and sparse understory trees, shrubs, grasses and forbs. There have been small, restoration-based projects such as the Long Valley Meadow Restoration Project, which was implemented in 2017, which has had the effect of reducing conifer encroachment in meadows to counteract some of the aforementioned changes, but they have been very limited in size within the project area.

The short term cumulative effects (1-5 years) of Alternative 2 combined with similar current and future restoration treatments and prescribed burning projects are expected to be widespread. There will be evidence of restoration treatments, fuels reduction treatments and prescribed burning, and the scenic quality would be decreased in some areas. For example, in areas where restoration treatments result in skid trails or removal of vegetation for staging areas or log decks, there could be a cumulative impact to scenic attributes where activities such as dispersed recreational use, grazing, or adjacent private land or infrastructure development is also occurring. In general these cumulative impacts to scenic attributes will be localized in scale (1-10 acres) and are most likely to be of short-term duration (1-5 years).

In the long term (5 to 20 or 30 years), and there would be large and widespread improvement in the resilience and sustainability of scenic attributes that make up the landscape character of the ponderosa pine and mixed conifer forests. Forest users would experience a more open forest with tree groups of varying ages, sizes and shapes, large, mature trees, and healthy, diverse understory. In many places, the scenic integrity objectives stated in the Forest Plan would be met. This would combine with other activities such as the 4FRI Rim Country project, East Clear Creek Watershed Improvement Project Long Valley Meadow Restoration Project, and Long Valley Work Station Meadow Restoration Project

to help meet or move toward desired conditions for scenery and counteract the effects of climate change that is expected to increase the frequency and intensity of disturbance events such as wildfire, which would reduce scenic integrity and move away from desired conditions for scenery.

When natural stressors such as wildfires or insect outbreaks occur, or human activities such as new utility corridors, or development of a new recreation site, or a new private subdivision is developed, the cumulative effects of Alternative 2 and other projects would result in small and localized changes in the scenic character of the ponderosa pine or mixed conifer forest. When drought conditions or unusual weather events as a result of climate change occur, the forest would be healthier and more resilient to such events, thus counteracting the effects of climate change which are likely to detract from scenic attributes. The overall trend from this alternative would be toward improving landscape attributes, and sustainable landscape character and meeting or improving scenic integrity objectives.

Range

The following section describes the affected environment and effects of the alternatives relating to rangeland resources.

Affected Environment

The analysis area includes four grazing allotments: Baker Lake/Calf Pen, Buck Springs, Bar T Bar, and Hackberry/Pivot Rock. Of the four allotments, three are active and have permitted livestock grazing within the project area: Bar T Bar, Baker Lake/Calf Pen and Pivot Rock. The Buck Springs Allotment has not been grazed by livestock since 2009.

Table 80. Acreage and percentage of each livestock grazing allotment in the project area.

Allotment	Acres	Acres in CWPP Project area	Percent of Allotment in Project Area
Hackberry / Pivot Rock	78,291	22,461	28.7%
Buck Springs	45,087	24,582	54.5%
Baker Lake / Calf Pen	10,036	710	7.1%
Bar T Bar	186,310	9,685	5.2%

All three allotments use adaptive management strategies as part of grazing management. Grazing use on the active allotments is under a deferred rotation system. This means that each pasture is used each year, but at a different time during the year. This type of grazing use allows plants to grow, set seed and complete their yearly life cycles, without being grazed at the same time every year. The number of livestock can change on a yearly basis depending on precipitation, temperatures, fire and other factors.

The understory vegetation in areas under permitted grazing permits within the project area is comprised of large areas with bracken fern and New Mexican locust. The area is also host to other native and non-native plants, including Arizona fescue, blue grama, bottlebrush squirreltail, common yarrow, fleabane, and common clover. The CWPP area has continuous canopy cover with ponderosa

pine in many locations. This reduces light transfer to the forest floor, thus reducing the type and amount of understory plants that exist in the area (Jameson 1967).

Before fire suppression of the last century, low-to-moderate severity fires burned regularly within the project area, creating high quality forage and species composition, and diverse forest structure with openings between groups or clumps of trees of different ages. These characteristics are currently lacking within the project area, which has more continuous canopy cover and a lack of both openings and groups of large and old trees. The lack of fire, combined with both historic timber harvest and historic excessive livestock grazing, has brought the area to where it is now. Trees are overstocked at the landscape scale, with reduced forage for current livestock numbers and wildlife to graze or browse. A lack of openings between tree groups results in a more continuous canopy cover that causes reduced available sunlight that reaches the floor for native grasses, forbs and shrubs to thrive.

Grazing occurs in active grazing allotments from approximately May to November, before cattle are transported off the rim and down to winter range. Annual utilization monitoring is done on these areas to manage for conservative utilization, which maintains an average of between 60-70 percent of the understory vegetation after livestock grazing.

Approximately 57 miles of boundary, pasture, water-lot fences, and elk and cattle exclosure fences span the project area. The Baker Lake/Calf Pen boundary fence is shared with the Hackberry / Pivot Rock Allotment and included with the fencing calculated for this allotment. Some fences are boundary fences between neighboring allotments.

Stock tanks are scattered throughout the project area. These structures provide water for grazing livestock and wildlife, and are important in livestock distribution and movement. Some tanks are found along well traveled roads, while others are accessible by lower level roads that are authorized as “administrative use only”.

Environmental Consequences

Alternative 1– Proposed Action

Direct and Indirect Effects

In alternative 1, the no action alternative, throughout the 64,433 acre Cragin Watershed Protection Project, ponderosa pine would remain in greater densities and with more continuous canopy cover than historic conditions because no vegetation management activities would occur. Over the next two decades, forage growth will be maintained or there will be further reduction in the grazing capacity of the affected grazing allotments as forage production would decrease as canopy cover and basal area increases (Jameson 1967). This could also allow for a potential high-intensity wildfire to occur, which, in turn, would likely reduce the grazing capacity of the Bar T Bar, Baker Lake / Calf Pen and Pivot Rock Allotments by potentially causing a shift of vegetation type from forest to shrub-dominated vegetation (Savage and Mast 2005), or reducing soil productivity and thus forage growth for several years.

Present forest conditions on the allotments have reduced the overall grazing capacity, as conifers continue to shade out the understory vegetation. In addition, more conifers means more needle cast on the forest floor, which reduces areas for grasses and forbs to germinate and grow. This would generally continue across the project area, except in areas where naturally ignited wildfires would be managed at low to moderate density. The use of wildfire for resource benefit would be limited across the project area, because it would be difficult or infeasible to limit fire intensities of wildfires in much

of the project area given the current mixed structure and dense composition of trees. Thus, while there may be patches of areas that improve as a result of low or moderate intensity wildfire in the project area, the majority of the project area is expected to continue on a trend of decreasing forage production as canopy cover and needle cast continue to slowly increase and limit forage production.

Over time, as more trees continue to grow and increase in density, the potential for an uncharacteristic wildfire increases. A large wildfire of high burn intensity and severity would reduce forage in the short-term (1-3 years), and would likely lead to post-fire erosion, which would decrease soil productivity in areas with moderate and high-severity burn throughout the allotment. Reduction of soil productivity would likely reduce forage production and plant vigor in the short-term (1-2 years) in areas with high-severity fire where the soil loses all organic matter and becomes water repellant (Orem and Pelletier 2015, Neary et al. 2012). Large portions of the area affected by a wildfire may experience post-fire erosion, which can cause a loss of irreplaceable topsoil, reducing the productivity of the soil in these areas for several decades and possibly allowing for the establishment of invasive species populations that replace native forage species (Neary et al. 2012, Abella and Fornwalt 2015). Over the long-term (3-10 years) it is expected that a majority of areas experiencing a wildfire will experience increased forage production except in areas where there is a type conversion from forest vegetation type to shrub-dominated vegetation type, which would suppress herbaceous species available for livestock forage (Abella and Fornwalt 2015, Zhang et al. 2016).

In the case of a high-intensity wildfire, range infrastructure including fences and stock tanks could be destroyed. Fences may be burned and would require replacement prior to the reinitiation of grazing in the area. Stock tanks would likely experience an increased rate of sedimentation when downstream of areas experiencing high-intensity wildfire. This may reduce the amount of water one or more stock tanks are able to hold, or require increased maintenance such as dredging of fine sediment that has collected in the stock tank.

Cumulative Effects - No Action Alternative

The analysis area for the cumulative effects to the range resource is the CWPP project boundary. The timeline for analysis is from implementation to 20 years in the future because most long-term effects of the alternatives are assessed out to a 20 year timeframe.

Under the no action alternative, the 64,433 acre Cragin Watershed Protection Project, ponderosa pine and mixed conifer vegetation would continue to have a higher density and canopy cover across the project area than historic conditions. Through time, there will be further reduction in the grazing capacity of the affected grazing allotments as forage plants in the understory become less productive. This decreasing productivity of the understory vegetation could combine with the expected increase in the frequency and intensity of drought under a changing climate (Underwood 2015) and the growth of understory competition by invasive species to further reduce the productivity or vigor of native understory vegetation and forage species (Runyon et al. 2012).

Alternative 2– Proposed Action

Direct and Indirect Effects

Within the project area, treatments under this alternative would result in an increase in small openings as trees are removed to create a more groupy/clumpy forest structure. These opening will result in an increase in herbaceous production within the openings and at the edges of tree groups where light can penetrate into the canopy between trees. Prescribed burning will also act to improve herbaceous understory production and palatability by increasing nutrient availability to grasses and forbs.

Thinning activities and/or prescribed fire treatments could reduce the amount of forage available in the short-term (1-2 years) after treatments due to the loss of grasses and forage from disturbance from heavy machinery or loss of understory vegetation from fire. In addition areas (comprising 5-15% of the project area) experiencing direct disturbance from tree skidding, use of heavy equipment, or pile burning may support the establishment of invasive species in these areas, which would reduce in area by approximately half by 5-10 years following treatment (Stoddard et al. 2011). These activities would affect almost a fifth of the area included in the Hackberry-Pivot Rock Allotment, and less than 10% of the area included in both the Baker Lake / Calf Pen Allotment and Bar T Bar Allotment (Table 81). These short-term effects on portions of the allotments could reduce the availability of forage available for livestock in the short term (1-5 years after treatment), and a likely need to rest livestock grazing from areas within the project area within 1-2 years of treatment.

Table 81. Acreage and percentage of mechanical treatment proposed within each livestock grazing allotment in the project area

Allotment	Acres in Allotment	Acres of Allotment receiving thinning treatments	Percentage of allotment receiving thinning treatments
Hackberry / Pivot Rock	78,291	16,450	21.0%
Buck Springs	45,087	11,902	26.4%
Baker Lake / Calf Pen	10,036	710	7.1%
Bar T Bar	186,310	6,271	3.4%

This alternative is expected to improve the project areas resilience to future disturbance such as wildfire and drought over the long-term (2-20 years after treatment). For example, by reducing the fire return interval, it is expected that erosion and sediment yield would substantially decrease in case of a wildfire in the project area (Gonzalex-Caban et al. 2004). This would support resilience of forage availability in the project area over the long-term (>3 years).

The development and use of the proposed processing areas would make any potential forage unavailable to livestock grazing for approximately 20 years from their initial development. Three of the proposed processing sites would be located in the Buck Springs Allotment, which is not currently grazed and thus would have no effect on grazing capacity. Two of the proposed processing sites would occur on the Bar T Bar allotment affecting a total of 24.9 acres on the 186,310 acre grazing allotment. Three of the proposed processing areas would be located on the Hackberry-Pivot Rock Allotment, affecting a total of 24.6 acres within the 78,291 acre allotment. These processing sites would reduce the amount of forage available on these allotments by the amounts identified for the duration of their operation, which could last up to 20 years. This effect would be very small compared to the size of the allotment, and would likely not have a noticeable effect on livestock management practices.

This alternative would also include hauling on existing roads, and construction of temporary roads. Range resources would likely only be affected where there is the construction of temporary roads where there is not an existing roadbed, which would include approximately 7 miles of temporary roads. Combined this would affect approximately 13.6 acres across the project area. These temporary roads would reduce the amount of forage available on these allotments by up to 13.6 acre during the use of the roads and up to 1 to 3 years after rehabilitation of the temporary road after use. This effect would be very small compared to the size of the allotment, and would likely not have a noticeable effect on livestock management practices.

Range infrastructure including fences and stock tanks would likely not be affected by the proposed action.

Cumulative Effects - Proposed Action

As thinning projects are implemented maintenance burning will continually increase over the project area. In addition to CWPP, another 2,318 acres of thinning (East Clear Creek Task Order) is under contract in the project area to be implemented in the next 1-5 years. The LEARN Mixed Conifer study is planning to thin and burn 56 acres within the CWPP boundary in their Block #1. The cumulative effect of implementing the CWPP project in addition to the East Clear Creek Task Order and the LEARN study is that improvements are expected to additively contribute to the productivity and resilience of herbaceous understory as described in the direct and indirect effects. This would also cumulatively combine with the effects of prescribed fire and wildfire that is managed for resource benefit to improve forage resources over the next 1-10 years, on average.

Management changes to motor vehicle use occurring through the implementation of Travel Management Rule regulations has decreased the amount of off-road motor vehicle use and thus deceased the amount of grasses and forbs lost from new road establishment and damage from unauthorized motor vehicle use. This will likely counteract the amount of ground cover affected by temporary road and processing areas developed under this alternative.

Heritage Resources

The following section describes the effected environment and effects of the alternatives relating to heritage resources.

Affected Environment

The Cragin Watershed Protection Project area contains a variety of non-renewable historic and prehistoric archaeological sites that reflect past land uses. A total of 98 archaeological sites have been recorded within the project area including 52 prehistoric sites, 45 historic sites and 1 site with both prehistoric and historic components. The previous surveys verify the Forest Land Management Planning Site Density Prediction Model projection of a low site density (0-9 sites per square mile) over most of the Cragin Watershed Protection Project, with a high site density area around the base of Blue Ridge in the vicinity of Moqui Spring, Little Spring and Hunter Spring. Rock art and rock shelter sites are concentrated along East Clear Creek Canyon and adjacent side-canyons. Other sites on the top of Blue Ridge and areas to the south to the Mogollon Rim are clustered around springs, natural ponds and seasonal water catchments.

Known prehistoric sites within the project area consist of 17 lithic scatters, 26 artifact scatters, 4 field house/pit house sites, 3 rock shelters with rock art and 2 rock shelters/cavates. Most prehistoric use in the Cragin Watershed Protection Project area is concentrated around the Moqui Springs/Little Springs and Moqui Draw area in the northeast corner of the project area around the base of Blue Ridge. Many of these sites have pottery fragments, and some have pit house or field house features. Most of these sites date to the early Sinagua period and may have been related to early farming activities. The remaining prehistoric sites in the project area are clustered along East Clear Creek or adjacent canyon bottoms and near springs or small natural ponds and sinkholes. These prehistoric sites appear to be mostly Archaic Era sites likely related to hunting and gathering activities.

Historic sites within the project area include 10 cabins (mostly range related), 1 root cellar and trash scatter, 5 ranger station/guard stations, 3 fire lookouts, 2 water developments, 2 sawmills, 1 logging camp, 2 historic graves, 2 cavalry related sites, 1 Civilian Conservation Corps camp/campground, 1 corral, 1 camp with historic rock carving, 1 monument, 1 rock pile, 1 homestead and 2 trash scatters. Linear sites include 6 historic trails and wagon roads and 6 National Forest telephone lines. The multi-component site is a lithic scatter with historic trash scatter.

The Cragin Watershed Protection Project area has traditionally been used by Native American tribes as shown by prehistoric and protohistoric sites found in the area. Both the Hopi Tribe and several Apache Tribes claim ancestral ties to this area. The area also has potential for contemporary use, though such use has not been reported to the Coconino National Forest to date.

Approximately 17,234.4 acres of the project area were previously surveyed during the period 1976 through 2011 by 177 projects. The 98 sites located in the Cragin Watershed Protection Project have been analyzed to determine their historical significance to history and their potential for providing information about history and prehistory in accordance with 36-CFR-800.4(c). One site is listed on the National Register, thirty sites have been determined eligible to the National Register, sixty-three are of undetermined eligibility to the National Register and four have been determined ineligible based on recent manufacture and damage to the sites.

Environmental Consequences

Units of Measure

Clearance recommendations outlined in the Cultural Resources clearance report associated with this project, CNF Report 2015-22-A, must be observed to ensure that no significant Heritage Resources in the project area are adversely affected by project activities, as per direction in FSM 2360, the Coconino National Forest Plan (2018), and the First Amended Region 3 Programmatic Agreement (2003) (USDA Forest Service, 2003) regarding Wildland Urban Interface and Other Large-Scale Hazardous Fuels Reduction Projects.

The recommendations for protection of sites is shown in the Cultural Resources Report, (CNF Report# 2015-22-A) and in the Heritage Specialist Report.

Alternative 1– No Action

Direct and Indirect Effects

If the No Action Alternative were implemented, the only likely natural disturbance to sites would occur during a wildfire. The nature and severity of fire effects to archaeological sites is difficult to predict and is dependent upon the variables of fire intensity, duration and heat penetration into the soil. The fire intensities predicted under the No Action Alternative have the potential to destroy surface components of historic sites containing wood items (cabins, cabin remains, lumber, wood artifacts), tree features (blazes, insulator trees, corrals) as well as deform metal and shatter glass and china artifacts. Direct effects would include loss of surface features or architectural components, and the consequent loss of scientific information. Effects to prehistoric sites would include burning of surface artifacts, cracking or shattering obsidian, chert and pottery items, spalling of the surface of ground stone tools and architectural features, and alteration or destruction of obsidian hydration rinds, destroying their dating potential and the associated loss of scientific information. Effects to structural components such as rock walls or rock faces include discoloration, cracking, and spalling, making the rocks susceptible to accelerated deterioration. Implementing the No Action Alternative could also

result in severe post-fire erosion and damage to the sites from burned trees falling onto sites. Erosion effects the spatial distribution of cultural materials on the surface of a site and alters the information potential. In addition, structural loss or damage can result from severe erosion episodes.

Cumulative Effects - No Action

Cumulatively, the No Action alternative could result in conditions that Adversely Affect the integrity of historic and pre-historic sites within the project area. Potential for damage resulting from wildfires will increase with time as forest fuels accumulate and combine with the effects of climate change to increase the risk of high-intensity wildfires, decreasing the ability of firefighters to safely protect highly flammable sites such as historic cabins. Erosion and tree-fall resulting from severe fires could compromise the integrity of sites.

Alternative 2– Proposed Action

Direct and Indirect Effects

Potential direct effects to sites in the project area include ground disturbance and subsequent displacement of artifacts as a result of mechanized thinning and piling, and chipping slash. Burning slash and broadcast burning natural fuels could also have the direct affect of destroying combustible elements of historic sites such as wood cabins, features, and artifacts. Such disturbance could have the indirect affect of diminishing the research potential of unprotected sites in the project area. The archaeological clearance document for this project specifies the following: (1) Mechanized equipment is not permitted within sites; (2) Hand thinning is permitted in sites, but slash must be hand-carried outside site boundaries; (3) To preserve wood elements and heat-sensitive artifacts, burning is not permitted within sites containing such elements; (4) District archaeologist or para-archaeologist must delineate site protection areas in advance of burning so fuel concentrations can be hand removed from sites, sites can be lined and structures foamed if warranted; and (5) Additional required survey specified in the archaeological clearance document will be undertaken and additional sites identified for protection prior to implementation of ground disturbing or burning activities. District or para-archaeologist will monitor burning of site areas and will re-check sites after vegetation treatments to assess protection methods.

This will result in the project having no adverse effect on sites in the project area. Furthermore, reducing fuel loads using methods that are non-ground disturbing on and around archaeological sites are effective for reducing the severity of potential wildfire damage to these non-renewable resources. Consultations with tribes resulted in no specific concerns about the effects of the proposed treatment activities, however the Hopi and the Yavapai Apache Nation expressed a desire to see prehistoric sites protected and requested copies of the curtural resource reports related to the project. No Traditional Cultural Properties or traditional use areas are known in the project area. Tribal access would not be affected by the proposed project.

The activities described in the Proposed Action, in conjunction with the appropriate design features, will not detrimentally affect cultural resources, and could result in a protective effect on the cultural resources by reducing the potential impacts of uncharacteristic wildfire.

Cumulative Effects - Proposed Action

The cumulative effects on cultural resources for this project are the same as those described in the Direct and Indirect effects section above. The clearance conditions prescribed in the Cultural Resources clearance report and design features outlined in this report mitigate any of the project's potential adverse effects.

Climate Change

The following section describes the affected environment and effects of the alternatives relating to climate change.

Background and Trends

Climate may influence the distribution and abundance of plant and animal species through changes in resource availability, productiveness, and survivorship. The potential ecological implications of climate change trends in the Southwest indicate:

- More extreme disturbance events, including wildfires and intense rain and flashfloods and wind events (Swetnam, Allen, & Betancourt, 1999) (Ford, Chambers, Coe, & Pendleton, 2012).
- More extreme hydrologic conditions, including more frequent periods of very high stream flows, very low stream flows, and elevated stream temperatures (Stewart, Ficklin, Carrillo, & McIntosh, 2015).
- Drought stress as a result of temperature increases and a winter decrease in precipitation (Seager & Vecchi, 2010) will likely result in increased tree mortality, especially in areas with high departure from historic fire regimes. The mean forest drought-stress by the 2050s will exceed that of the most severe droughts in the past 1,000 years (Williams, et al., 2013)
- Modelling expected climate changes has determined dramatic shifts in plant species richness are projected, with biodiversity declines in the high-elevation evergreen forests, migration of some tree species to the more northern portions of their existing range and a northward shift of the Sonoran Desert (Clark, 1998) (Notaro, Mauss, & Williams, Projected vegetation changes for the American Southwest: combined dynamic modeling and bioclimatic-envelope approach, 2012).
- Mortality associated from long-term drought stress is likely to result in increased tree mortality, which has a greater effect on large trees, especially in mixed conifer vegetation and especially aspen trees, which are least drought tolerant (Ganey & Vojta, 2011) (Westerling, Hidalgo, Cayan, & Swetnam, 2006) (Millar, Stephenson, & Stephens, 2007)
- Greater vulnerability of native vegetation and species to invasive species, including insects, plants, fungi, and vertebrates (Joyce, Haynes, White, & Barbour, 2007).
- Potential decreases in overall forest productivity due to reduced precipitation (USDA Forest Service, 2008).
- Shifts in the timing of snowmelt (already observed) in the American West, which, along with increases in summer temperatures, has serious implications for the survival of fish species, and may challenge efforts to reintroduce species into their historic range (Joyce, Haynes, White, & Barbour, 2007) (Millar, Stephenson, & Stephens, 2007).
- Effects on biodiversity, pressure on wildlife populations, distribution, viability, and migration patterns, because of increasing temperatures, water shortages, and changing ecological conditions (Periman, et al., 2010).

Based on current projections, the primary regional-level effects of climate change most likely to occur in the Southwest include uncharacteristic high severity wildfire, extreme effects of insects and diseases, and drought. Studies show that forest treatments including regular prescribed burning and thinning reduce the risk of high severity wildfire and address many of the other issues created by climate change, by reducing extreme effects of fire, insects, and disease, increasing carbon sequestration, and increasing the overall forest and ecosystem resiliency.

A summary of research studies on climate change in the western US and southwest regions has provided suggestions on strategic approaches for managing forested ecosystems with a changing climate. Much of the research focuses on how forests should be managed to address the primary and secondary effects of climate change through improving overall resilience to disturbance. These studies generally advocate for active forest management to reduce tree density to historic levels and return natural disturbance processes, such as wildfire:

- D'Amato, et al. (2011)suggest managing for uneven-aged forests that maintain a large proportion of carbon stores in retained mature trees while using thinning to create spatial heterogeneity that promotes higher sequestration rates in smaller, younger trees and simultaneously enhances structural and compositional complexity.

- Erickson and Waring (2014) concluded that removing small trees in areas with old growth ponderosa pine may be critical in maintaining old ponderosa pine in the landscape, particularly under future climate change and increasing drought frequency in the western USA.

- Kane, et al. (2014) recommends treatments that reduce intraspecific competition within stands to lower risks of tree mortality in southwestern mixed conifer forests.

- Diggins et al. (2010) determined restoring the historical frequent-fire regime is sufficient to maintain the open forest conditions found after restoration treatments at this southwestern landscape. If climate change reduces tree growth and increases mortality, however, then the superior management strategy shifts to a lesser-impact regime of more widely spaced fires.

- Stephens et al. (2012) concluded that treatments, such as prescribed fire and mechanical fuel reduction treatments (e.g., thinning of small-diameter trees), which are implemented to create more fire-resistant forests probably create forests that are also more resistant and resilient to changes imposed on them by climate change. Stephens et al. (2013) advocates for restoring historical disturbance regimes, by advocating to restore resilient forest structure similar to historical patterns that survived during past high-fire periods.

- Tarancón et al. (2014) similarly found, "…treatments that included regular prescribed burning fostered low density, wildfire-resistant forests composed of the naturally dominant species, ponderosa pine. Non-fire treatments under moderate climate change were forecast to become dense and susceptible to severe wildfire, with a shift to dominance by sprouting species."

- Neill and Puettmann (2013) concluded that thinning that produced stands with lower overstory densities contributed to increased cover and diversity of wildlife forage and insect-pollinated species. They determined that thinning leads to enhanced likelihood that the selected wildlife habitat functions are maintained under climate change conditions.

- Millar et al. (2007) recommend several options for adapting forest ecosystems to climate change, including creating resistance and promoting resilience to change. Resistance

practices seek to improve forest defenses against direct and indirect effects of rapid environmental changes. In western North America these will commonly include reducing undesirable or extreme effects of fires, insects, and diseases (Agee & Skinner, 2005). Creating resistance includes reducing stresses associated with climatic events such as drought, but also creating resistance against climate-mediated disturbance such as fire (Joyce, Haynes, White, & Barbour, 2007).

- Hurteau et al. (2014) concluded,"…reducing the risk of high severity wildfire through restoration of forest structure and regular prescribed fire provides a level of stability to forest carbon stocks. Restoration of fire regimes is also expected to build system level resistance and resilience to climate change. Reducing forest density adds a level of drought tolerance, allowing for sustained tree growth and carbon sequestration during periods of reduced precipitation."

There are also a number of researchers who have asked how forests should be managed to best address the vast stocks of carbon that they hold, thus potentially affecting the rate of climate change:

- Dore et al. (2008) found that a northern Arizona ponderosa pine forest, 10 years after a stand-replacing fire, was a moderate carbon source compared with a moderate carbon sink observed in a nearby unburned stand. They concluded: Stand-replacing fire had a strong and persistent effect on ponderosa pine forests of northern Arizona. It is unlikely that the burned site will shift from being a carbon source to being a carbon sink in the immediate future due to slow vegetation recovery after fire.

- This is supported by similar studies that concluded that forests treated with prescribed fire or mechanical thinning maintain carbon stocks and primary production at much higher levels than forests struck with high-severity wildfire (Nave, Vance, Swanston, & Curtis, 2010) (Dore, et al., 2010).

- Similarly, studies have also found that unmanaged forests tend to maintain more carbon than managed forests where high-disturbance harvest-based forest management practices occur, such as clear-cutting (Davis, Hessl, Scott, Adams, & Thomas, 2009) (Chatterjee, Vance, & Tinker, 2009). This finding also applies to treatments that target removal of large trees, which continue to accumulate carbon and maintain vast carbon stocks (Luyssaert, et al., 2008) (North & Hurteau, 2011).

- In southwestern ponderosa pine forests, the implications of various management scenarios and fire regimes on long-term carbon storage vary substantially, depending on the carbon accounting system used (Sorensen, Finkral, Kolb, & Huang, 2011).

- Some studies have found that treatments that lower biomass likely result in more carbon releases compared to untreated areas, even when there is wildfire (Sorensen, Finkral, Kolb, & Huang, 2011). Other studies have found that treatments result in short-term carbon releases, but greater long-term carbon storage (North & Hurteau, 2011).

- Managed harvests and prescribed fire treatments affect short-term forest carbon budgets, but do not significantly impact average annual carbon sequestration over the long-term (Davis, Hessl, Scott, Adams, & Thomas, 2009) (Nave, Vance, Swanston, & Curtis, 2010). Many researchers have suggested that restoration-based forest treatments in the western US are likely to result in a long-term net carbon sink compared to untreated forests primarily because they result in stand structural changes make the stand resilient to severe wildfire effects

(Finkral & Evans, 2008) (Zhang, Powers, & Skinner, To manage or not to manage: The role of silviculture in sequestering carbon in the specter of climate change, 2010) (Wiedinmyer & Hurteau, 2010).

Affected Environment

The features of the ecosystem that should show responses to climate change and the effects of management on mitigating effects of climate change include overstory and understory vegetation and insect and disease conditions. Refer to the Vegetation section of this chapter for a summary of the existing vegetation and insect and disease conditions in the CWPP area. The existing conditions of the project area show that a large proportion of the area is currently susceptible to forms of crown fire. Refer to the Fire and Fuels section of this chapter for a summary of the existing conditions and information on fire modeling and fuels conditions.

Environmental Consequences

This section details the environmental consequences of vegetation treatments to forest resilience and climate change. It establishes the baseline against which the decision maker and the public can compare the effects of all action alternatives.

Alternative 1 – No Action

Direct and Indirect Effects

Under the No Action Alternative, the 64,433 acre project area would be more susceptible to high severity wildfire, tree mortality from drought, and even a conversion of forest vegetation types to vegetation types more characteristic of lower elevations as a result of climate change and the resulting expected increase of severity and frequency of drought and wildfire. Numerous studies have identified a likely link between climate change projections and an increase in area likely to be burned in a wildfire as well as a higher severity of burning given current forest conditions (Marlon et al. 2009, Westerling et al. 2006). Under the no action alternative, forest conditions would tend towards increased amounts of biomass per acre and an increased fire risk of passive and active crown fire, which when combined with the greater susceptibility to wildfire as a result of climate change would cause a substantially greater risk of high-intensity crown fire that could result in high tree mortality or stand replacing wildfire across most of the project area.

In addition to the increased likelihood of active and passive crown fire from increasing tree density and changing climate conditions, both of these factors would also increase the risk of tree mortality (especially for old and large trees) and pest and disease infestation. Kane et al. (2014) found that tree mortality resulting from drought recently experienced in northern Arizona was directly tied to intraspecific tree density. Under this alternative, tree density and drought conditions are likely to both intensify, thus making tree mortality throughout the project area more likely. Furthermore, the stress induced by intraspecific competition of trees at greater densities and the increase of severity and/or frequency of drought from climate change is likely to alter current tree host-pathogen interactions resulting in uncharacteristic amounts of tree mortality from insects and forest pathogens. There is consensus that climate change likely will stress trees and increase their vulnerability to insects, pathogens, and emerging diseases (Kilejunas et al. 2009).

The effects of increased insect and disease infestation as well as the increased risk of high-intensity wildfire is likely to result in a loss of the current forested vegetation types across much or most of the project area in the next several decades (Notaro et al. 2012). Feddema et al. (2013) found given IPCC future climate change projections there would likely be a reduction of ponderosa pine regeneration

rates by up to 43 percent after a high-severity fire. Drought reduces growth and live biomass in forests of all ages, having a particularly strong effect on seedling recruitment and survival (Anderson-Teixeira 2013).

Under this alternative, forests would continue to maintain a high tree density, which would store a high amount of carbon. However, this alternative would also result in an extremely high risk of crown fire across most of the project area. According to Hurteau et al. (2011), given the projected drying and increase in fire prevalence in this region as a function of changing climatic conditions, the higher carbon stock in the fire-excluded forest is unlikely to be sustainable. Furthermore a 5 year study of carbon stocks in northern Arizona forests found an intense wildfire that converted forest into sparse grassland shifted site carbon balance from sink to source for at least 15 years after burning (Dore et al. 2012).

In summary, the no action alternative would result in forest conditions that are less resilient to insects including uncharacteristic mortality from pests, disease, and drought. In addition, climate change projections over the next several decades would result in forest conditions increasing susceptible to a high-intensity wildfire, which could result in a transition to different vegetation types. These disturbances would result in a conversion of the forest as a carbon sink to a carbon source. A wildfire under this alternative would result in a substantial contribution to atmospheric carbon dioxide, and would result in forest conditions that would continue to contribute to atmospheric carbon dioxide for 5 to 20 years.

Cumulative Effects – No Action

The decreased forest resiliency and likely increase in atmospheric carbon resulting from the no action alternative would likely be counteracted by the approximately 2 million acres of ponderosa pine and mixed conifer vegetation that has recently been or expected to be treated with mechanical thinning and prescribed fire over the next several decades in northern Arizona.

Other activities such as population growth, continued development, and other instances of high-intensity wildfire will contribute to atmospheric carbon dioxide along with this alternative to result in a cumulative increase in atmospheric carbon, which would further support climate change and its effects.

Alternative 2– Proposed Action

Direct and Indirect Effects

Under the proposed action alternative mechanical thinning and prescribed fire treatments would reduce competition between trees and result in a reduced risk of high intensity wildfire (see silvicultural and fuels reports). This would translate to a greater resilience of forests within the project area to the effects of climate change. D'Amato et al. (2013) found that mechanical thinning enhanced drought resilience by temperate forests. Other studies specific to the southwest have concluded even more explicitly that active forest management of southwest forests are necessary for making forests more resilient to the effects of climate change. Kerhoulas et al. (2013) states, "Our findings indicate that more aggressive thinning treatments used for forest restoration stimulate growth throughout large residual trees from coarse roots to branches and also improve drought resistance, providing a greater resilience to future climate- related stress. These responses to treatment are more pronounced in large trees than small trees. Forest thinning is therefore recommended in systems that are likely to experience increased temperature and decreased precipitation as a result of climate change."

Thinning and prescribed fire treatments are likely to affect forest carbon in two ways. The thinning of trees actually decreases the amount of carbon stored in forests by physically removing the above-ground carbon stored in the wood itself. When trees and the carbon they include are removed from a location, this carbon is no longer available for contributing to atmospheric carbon during future disturbance events such as wildfire. Thinning can also affect the ability of forests to store carbon by affecting growth rates of undergrowth and any remaining trees. Volkolva et al. (2014) found that compared to the fuel-reduced forests, release of non-CO2 GHG doubled following wildfire in long-unburnt forest. Restaino and Peterson (2013) also found that average emissions from wildfire in treated stands (29.7 Mg C ha_1) are substantially lower than average emissions from untreated stands (67.8 Mg C ha_1).

Studies have found the very intensive mechanical treatments such as clear-cutting can turn forested ecosystems to carbon sources from carbon sinks because they retard the mechanisms of net primary productivity and soil integrity, which are the primary means forests use to acquire carbon from the atmosphere. According to Davis et al. (2009), clear cuts can reduce a forest's ability to sequester carbon by up to a third for several decades compared to forests with lighter treatments or no treatment (and no wildfire). The proposed action does not include clear-cuts, but includes a combination of mechanical thinning and prescribed fire treatments to reduce the density of trees throughout the project area. Thinning and prescribed fire treatments are expected to result in a release of carbon dioxide to the atmosphere both from emissions of machinery involved in the thinning activities and from the combustion of woody material from prescribed fire. This effect would likely be short-term and would only occur during the period treatments are occurring.

The proposed project also includes activities including road maintenance, road hauling, temporary road construction, and processing sites. The latter would affect areas that are currently forested on up to 79 acres across 8 sites. Tasks carried out at processing sites includes drying, debarking, chipping stems and bark, cutting logs, manufacturing and sorting logs to size, producing wood cants[2], scaling and weighing logs and creating poles from suitable sized logs. Equipment types commonly used at processing sites include circular or band saws, various sizes and types of front-end loaders, log loaders and chippers of several types and may include timber processors, planers and mechanized cut to length systems, associated conveyers and log sorting bunks for accumulation and storage of logs. Electric motors and gas or diesel generators are also used to provide power. Large processing sites are typically greater than 10 acres in size. Large sized sites allow for more flexibility in their design and allow for more area to process, grade, scale and sort logs and manufacture cants and poles and chip and haul products. Larger sites can handle surges in incoming logs and would protect workers better by providing better separation from processing and transport functions. Medium sized processing sites are 5 to 10 acres in size and log processing, equipment use and storage is more limited (Dramm et al. 2002). Landings at the timber sale area are considerably smaller than log sort yards and typically are about 0.33 acre.

These processing sites would go from being carbon sinks to carbon sources both from the loss of tree growth and production as the land is used for other purposes, and as a result of the combustion of fossil fuels occurring at these sites for log processing. The processing sites would make up a combined 0.12% of the project area. The limited, small concentrations of carbon source at processing areas makes up such a small area that the carbon emissions would not affect overall results of more long-term carbon absorption from the forest fuels reduction treatments.

Studies on lower intensity treatments have found that by decreasing tree density, the forest becomes more resilient and can even experience increased growth, which has a corresponding effect of increasing the sequestration of carbon from 9 – 30% of previous rates (Zhang et al. 2010). This,

combined with the reduced likelihood of carbon emissions as a result of reducing the risk of high-intensity wildfire means that the proposed action alternative would increase the capacity of the forest to continue to sequester carbon over the next several decades.

In summary, the proposed activities would result in short-term carbon emissions from forest management related activities, with some areas of concentrated emissions. At the scale of the project, these short-term emissions would be a small fraction of the increase in carbon absorption likely to occur at the landscape scale of the treatments in the next several decades.

Cumulative Effects – Proposed Action

The primary cumulative effects of the proposed action alternative would be to (a) contribute to forest resiliency to disturbance at the landscape scale, and (b) reduce the potential for increased carbon sequestration of forests in the project area and surrounding areas over the next several decades.

Projects such as the Four Forest Restoration Initiative, Clints Well Forest Restoration Project, Rim Country Restoration Project, and others include similar treatments which are expected to result in a reduction of the density of trees and allow for the re-introduction of a more natural low-intensity fire cycle, which would reduce the susceptibility of high-intensity wildfire and reduce inter-tree competition, which would increase the forests resiliency to disturbances such as drought, pests and diseases. In addition, these treatments would combine at the landscape scale to result in forest conditions where trees and undergrowth would have an increased rate of net primary productivity to sequester a higher amount of carbon during years with average or above average precipitation. In years with drought, the forested landscape would experience less tree mortality and a lesser amount of forest experiencing high-intensity wildfire, which would limit the amount of carbon and other GHGs contributed by forests to the atmosphere.

Air Quality

Air impacts are measured by the concentration of emissions at a given location. There are no reliable methods of predicting concentrations at specific locations in advance of a prescribed fire. This analysis attempts to compare emissions from different types of fire and where impacts may occur based on wind flow for any given day. Wildfires generally consume more of the available fuels and produce more emissions and particulate matter than prescribed fires (Liu et al. 2017).

The CWPP is in the Little Colorado River Airshed. Just to the south of CWPP is the Lower Salt River Airshed, and to the southwest is the Verde River Airshed. Smoke emitted from a wildfire or a prescribed fire will flow in direction of prevailing winds (usually SW winds move smoke to the NE) during daylight hours and smoke settles into drainages overnight with light or limited winds.

Winds from all directions will be considered during implementation of prescribed burns, but SW winds are generally the most dominant direction of wind flow. With SW winds the communities around Blue Ridge will be impacted most heavily. Further outlying communities of Winslow and Holbrook and the Navajo Nation may be impacted. The main drainage for most of CWPP is the East Clear Creek watershed. Smoke settles in this drainage and flows to the north towards Winslow. For some of the project area the drainages of West Clear Creek and Jacks Canyon could be impacted. If smoke flows down West Clear Creek it would flow the SW and could impact the lower Verde Valley. If smoke flows down Jacks Canyon it would flow to the north and could impact Winslow.

Wind directions from all other directions would be considered based on safe implementation of any given burn. Generally wind directions out of the north will flow south of project area and could

impact the towns of Strawberry, Pine and Payson and the flow down Verde River drainage. For winds with and easterly component the towns of the Verde Valley would be impacted and could flow down Fossil Creek drainage or West Clear Creek overnight.

The Arizona Department of Environmental Quality (ADEQ) gives daily approvals for all prescribed burns. They model emissions from all prescribed burning within the state and have the final authority for approval.

When the US Forest Service conducts prescribed burning, the burn boss is responsible for monitoring smoke plume trajectories and impacts. The burn boss may make changes as needed based on weather conditions and impacts.

During public scoping and during the 30-day comment period, comments were received regarding the undesirable effects of smoke from prescribed burning activities. This issue is addressed here through the analysis and disclosure of the effects of project activities on air quality.

Affected Environment

Air quality is generally good throughout the year within and surrounding the CWPP area. Most impacts from and air quality perspective outside of wildfire or prescribed fire emissions are from the greater Phoenix metropolitan area. With predominant SW winds pollutants from Phoenix flow over the CWPP and may contribute to increased emissions. With the distance from Phoenix large particulate matter is generally low. There is no large industrial facilities within close radius of CWPP so most localized emissions are from recreationalists on forest lands. They contribute emissions in the form of vehicle and use and campfires. Recreational use is dispersed and seasonal and is not a point source type of emission.

Environmental Consequences

Alternative 1– No Action

Direct and Indirect Effects

No direct changes in short-term or long-term affects to air quality would result from a No Action Alternative. However, there are two projects (Blue Ridge Urban Interface and East Clear Creek watershed Protection Project) and possibly the future implementation of the Rim Country Environmental Impact Statement that overlap portions of CWPP that would continue with prescribed burning. Additionally, natural occurring wildfires could be used to meet resource objectives if conditions are favorable.

This alternative does increase the long-term potential for a high intensity surface fire within the project area. This alternative also increases the long-term potential for uncharacteristic crown replacing wildfire within the project area. Both types of fire would generate considerable amounts of smoke and airborne particulates.

Emissions from a wildfire are generally double that of a prescribed fire (see Figure 60). Smoke emissions were calculated using FOFEM (http://www.fire.org). Wildfire emissions were calculated based on drier fuel conditions and 50% of the canopy consumed, while prescribed fire was calculated with higher fuel moistures and only 5% of the canopy consumed. A prescribed fire in forested fuels is generally a surface fire and is implemented when fuel moistures are higher and do not consume all of the forest litter. A wildfire that occurs when conditions are drier may consume more of the forest litter

and portions of the above ground canopy. Based on FOFEM predictions a wildfire also exposes 82% of the mineral soil versus 31% for prescribed fire.

In late April 2018, the Tinder Fire was ignited adjacent to the CWPP project area and quickly grew to over 10,000 acres. The smoke impacts of the fire were substantial, with visibility impairment along Interstate 40, which was over 30 miles north of the wildfire. Locations for evacuees and planned fire information meetings in the City of Winslow had to be cancelled or moved due to smoke impacts from the Tinder Fire, which was approximately 35 miles to the south. Levels of smoke from the fire resulted in particulate matter levels above the threshold considered acceptable to human health for weeks, triggering warnings for residents with preexisting health conditions to avoid going outdoors. It is likely that a wildfire in the CWPP area under this alternative could have similar effects.

Figure 59. Smoke plume from the Tinder Fire heading to the northwest toward the City of Winslow

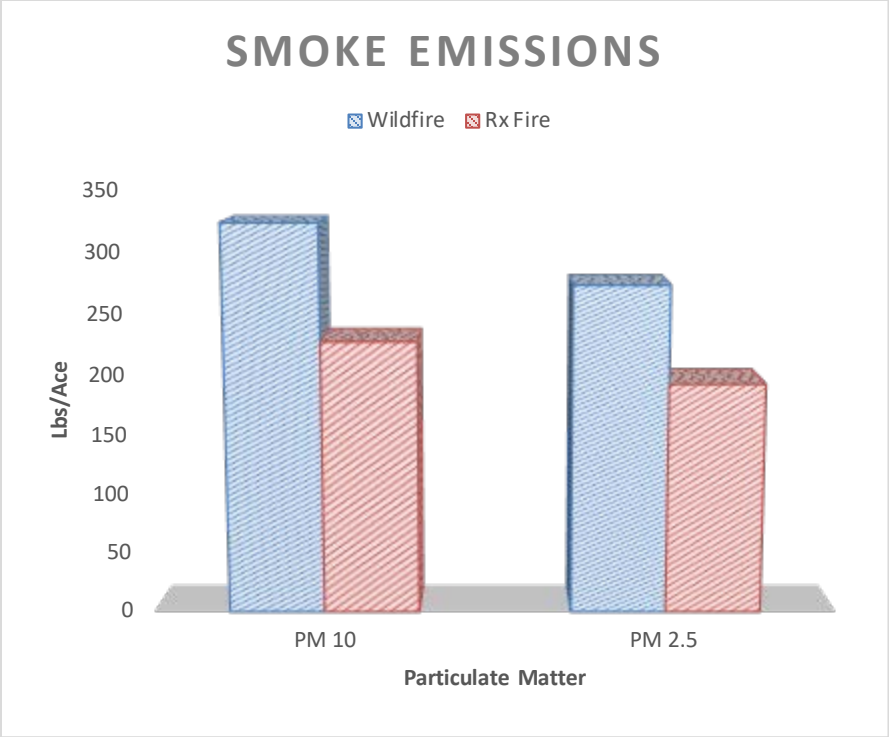


Figure 60. Smoke Emissions for particulate matter 10 and 2.5 for prescribed fire versus wildfire

Cumulative Effects – No Action

Under the No Action Alternative smoke emissions from wildfires would continue to remain high during wildfire events and occasionally be at levels that result in particulate matter that has negative impacts on human health.

The effects of climate change would also have an effect on the risk of high intensity wildfire in the project area and thus would likely cumulative contribute to the potential for harmful smoke to nearby populations. Several studies have concluded that expected changes in climate will likely result in more burned area from wildfires than in the past (Litschert et al. 2012, Marlon et al. 2009), and that there will be more wildfires of much greater intensity, especially in the spring and early summer (Westerling et al. 2006). This is of particular importance for landscapes where there has been little or no management of current fuel loads (Williams 2013), where the increased risk of high intensity wildfire would cumulatively combine with the increased risk from dense forest stands with ladder fuels and a contiguous canopy layer. This means that under the no action there would be a cumulative increase in the risk of smoke impacts to visibility and health for local populations and forest visitors.

Alternative 2– Proposed Action

Direct and Indirect Effects

Broadcast and/or pile burning would generate smoke and airborne particles, decreasing air quality on a short-term basis without exceeding air quality standards[16]. Some of these impacts can be reduced through standard smoke management practices. There are also numerous smoke reduction techniques that are utilized. These practices vary in different burn areas and time of year, but include ungulate grazing and firewood among others, to reduce combustible material prior to the application of

[16] http://www.epa.gov/oar/particlepollution/standards.html

prescribed fire. Smoke impacts can be minimized by timing and scheduling the burn to be completed during periods of favorable atmospheric conditions. However, even with favorable atmospheric conditions, residences and other areas inhabited nearby areas being treated with prescribed fire can experience undesirable levels of smoke for periods lasting several hours.

Impacts would be greatest during the actual day and night of ignitions. During the day of the burn, smoke is heaviest but is usually lifted higher into the atmosphere. Winds usually mix the smoke over a larger area so it does not impact localized areas as heavily. As night falls, so does the smoke. The smoke then settles more heavily into areas closest to the burn. Smoke would be heaviest in the early morning hours. As daytime heating increased, smoke would then begin to mix with upper level air flows. Smoke decreases each day after initial burning, but can last for several weeks after ignitions based on fuel loadings, fuel moistures and precipitation events.

Much of the smoke that is generated by broadcast burning in the Cragin Watershed Protection Project area will move to the north and east with predominant southwest wind direction. Some burns may be implemented with winds from other directions but would be done to facilitate safety along roadways or private property.

Residents in the Blue Ridge Area, and other developments in the project area will receive smoke impacts depending on their proximity to a given burn area. The smoke would be heaviest closer to the burn site but smoke can impact areas downwind over many miles. As you move further away from the actual area burned, the smoke is blended over a larger area and is more dispersed. Smoke will settle the most in the East Clear Creek drainage overnight.

The closest town is Pine, which is 3 miles to the southeast. Pine and Strawberry will likely have minimal impacts as diurnal air drainage does not normally flow towards these communities. Winslow and Holbrook, located approximately 35 miles to the north, will be mostly impacted at night as smoke settles. Nighttime flows of smoke are usually downhill, and will flow down drainage into the areas of East Clear Creek. Smoke would eventually drain into the flat terrain north of the Coconino National Forest. On average we will broadcast burn 500-1,000 acres per day, which equates to a maximum of 40 days annually. For broadcast burning we will attempt to burn half of the acres during the fall months and half of the acres during the spring months to allow for better smoke ventilation. Pile burning acreage will depend on how much activity slash is generated, but normal pile burning within a year would be about 1,000-3,000 acres. Generally 100 acres of piles are burned daily, so an additional 30 days could be spent burning piles. Piles are generally burned with higher winds and consume more efficiently, so overnight impacts are not as significant. Piles are also generally burned during the winter months when snow is present to reduce chances of “creep”. Piles are also of varying size and composition, which could affect smoke production.

The design feature to utilize spring burning where possible and burning larger blocks daily can limit the amount of days that smoke affects communities. These design features are expected to decrease the total possible days of smoke impacts. The closest downwind town to the north is Winslow which is over 35 miles to the northeast of the project area. Winslow and Holbrook can be impacted during daylight hours and from overnight diurnal flow.

By conducting ignitions during the early portion of the day, nighttime smoke impacts of burning can be minimized. This provides maximum consumption time and smoke dispersion before nighttime inversions develop. Public notification through various media and personal communication would be conducted prior to burning to allow smoke sensitive individuals the opportunity to take any necessary precautions.

The proposed action alternative would decrease smoke impacts to nearby communities over the next 20 years. Empirical studies have shown that wildfire emit high amounts of particulate matter (which is most harmful to human health), and results in an average emission factor of over twice that observed for prescribed burns (Liu et al. 2017). Prescribed fires can be a method for reducing the potential human health impacts from smoke. Researchers studying health effects of smoke from wildfire on nearby populations have suggest, "…prescribed burning may be an effective method to reduce fine particle emissions" (Liu et al. 2017) since prescribed fire decreases emissions from future wildfires (Hurteau and North 2009), and the prescribed treatment itself results in lower levels of smoke. In addition, large wildfires often occurs during May – July, when there is more visitation on the National Forest and small communities that include many summer residences such as Blue Ridge have a higher occupancy. Implementing prescribed fire would reduce the total amount of emissions and would result in smaller and more frequent smoke emissions during time periods when fewer people are likely to be exposed.

Cumulative Effects – Proposed Action

Smoke from prescribed fire treatments under the Proposed Action alternative may combine with nearby wildfires or other prescribed fire activities to result in a cumulative smoke impact. There are numerous other projects that will contribute to smoke within both the Verde River and the Little Colorado Airsheds. These impacts will include emissions from prescribed burning on adjacent areas including other national forest lands (Kaibab, Prescott Apache-Sitgreaves and Tonto National Forests), state lands, private property and other project areas on the Coconino National Forest. However, it is unlikely these smoke effects would cumulatively combine at the same time at the same location resulting in levels that would affect human health due to the coordination and regulatory oversight administered by ADEQ to specifically limit cumulative smoke effects. Thus, it is expected that smoke from prescribed fire treatments of the proposed action may slightly increase smoke accumulations occasionally in areas with human exposure, but this would be fairly limited and under thresholds at which there are acute effects to human health.

Project design features to reduce air quality emissions would be used on all projects to minimize impacts. There are no expected long-term or cumulative effects to air quality from the proposed action. The proposed action would reduce the risk of long-term potential for uncharacteristic wildfire in the project area, and resulting impacts to air quality from smoke.

Economics

The following section summarizes the economic analysis for the Cragin Watershed Protection Project. This analysis focuses on three measures: product volume, project feasibility, and financial efficiency.

Project Volume

Project volumes are estimated using the Forest Vegetation Simulator, a growth and yield computer model (Dixon, Essential FVS: A user's guide to the Forest Vegetation Simulator: Internal Rep. Fort Collins, CO, Revised: November 2, 2015, 2002). FVS with use of the Central Rockies Variant (Keyser & Dixon, Central Rockies (CR) Variant Overview- Forest Vegetation Simulator. Internal Report (Revised October 14, 2016), 2008) was used in this analysis to predict yields of forest products under various management alternatives. FVS was used to estimate direct effects to timber volumes.

Project Feasibility

Project feasibility is used to determine if a timber sale project is feasible – will it sell, given current market conditions. It relies on the Region 3 Transaction Evidence Appraisal (TEA) System. The TEA uses regression analysis of recently sold timber sales to predict bid prices. The most recent appraisal model for the area of interest was used to estimate the stumpage value (expected high bid resulting from the timber sale auction) for the timber project. The estimated stumpage value for each alternative was compared to the base rates (revenues considered essential to cover regeneration plus minimum return to the federal treasury) for that alternative. The project is considered to be feasible if the estimated stumpage value exceeds the base rates. If the feasibility analysis indicates that the project is not feasible (estimated stumpage value is less than the base rates), the project may need to be modified. The infeasibility indicates an increased risk that the project may not attract bids and may not be implemented, or the Forest Service will need to procure funding for service activities.

The analysis area for the feasibility analysis is the project area. Only costs and revenues associated with the timber sale portion of the project decision were included.

Two Microsoft Excel spreadsheets developed by the U.S. Forest Service were used in concert to determine timber sale feasibility: a Sale Economic Evaluation worksheet and a LogCost[17] 15.1 worksheet. Worksheets are available in the project file. Additional information including the software used is available from the following website:
http://www.fs.usda.gov/detail/r6/landmanagement/resourcemanagement/?cid=fsbdev2_027048

Financial Efficiency

The analysis area for the financial efficiency analysis is the project area.

The financial efficiency analysis was completed using the Forest Service Quick-Silver Software (Vasievich, Smith, & Retzlaff, 2008). Twenty years (2017 to 2037) was used as the analysis period since that is the estimated timeframe of activities to be completed and a four percent discount rate was used. Economic costs are those incurred by the Forest for implementing the activities of the proposed action. Examples of benefits as used in this analysis were the value of the forest products proposed to be offered with the harvest treatments.

Project Activity Costs

The financial efficiency analysis is specific to the timber harvest and project activities associated with the alternatives (as directed in Forest Service Manual 2400-Timber Management and guidance found in the Forest Service Handbook 2409.18). Costs for sale preparation, sale administration, regeneration, thinning and prescribed fire are included. The cost of the environmental analysis and agency labor costs are viewed as a fixed sunk cost. This cost would be the same across all alternatives. Since this analysis is an incremental analysis of the economic efficiency of implementation of the project, these costs were not included. Logging contractors typically bear the cost of temporary road construction, road maintenance, and brush disposal, therefore these costs are not reflected in the economic cost analysis. All costs, timing, and amounts were gleaned from either recent contracts or based on cost studies (USDA Forest Service, 2017) (USDA Forest Service, 2016d)

[17] LogCost is a Microsoft Excel Workbook used to estimate stump-to-truck costs and production for a variety of logging systems and equipment configurations simultaneously: Skyline, Mechanized, Tractor, Shovel and Helicopter logging systems. Variations within logging systems are also possible. Biomass harvest costs can be estimated within the Mechanized and/or Skyline logging system worksheet (including biomass haul cost). Updated September 6, 2016

(4FRI Stakeholder Group, 2010). The expected revenue for each alternative is the corresponding predicted high bid from the transaction evidence appraisal equation.

Table 82. Direct costs and assumptions for prescribed cutting and burning and associated activities.

Treatment	Assumptions	Cost per Acre *(2017 dollars)*	Acres	Present Value *(2017 dollars)*
Prescribed Burn (Two Entries 2017 and 2027)	These total costs include the cost of writing burn plans, conducting prep work, cutting hand lines, and conducting the actual burning and monitoring	100	63,656	534,6971
Timber Stand Improvement (Precommercial and Biomass Thinning)	This estimate is based on the potential thinning of all acres as defined in the proposed action. Cost based on use of mechanical equipment to perform activity (4FRI Stakeholder Group, 2010, p. 8)	300	37,609	11,508,354
Timber Sale Preparation and Administration Costs	This estimate is based on the potential to treat all acres defined in the proposed action for prescribed cutting.	275	37,624	10,553,532
Stocking Surveys	This estimate is based on the potential to perform stocking surveys to certifiy natural regeneration following the regeneration harvests identified with the proposed action as well as acreage within the processing sites.	25	7,333	126,811
Mechanical Site Preparation, Processing Site Reclamation	This estimate is based on performing site preparation activities for artificial planting and reclamation of processing sites.	100	79	5,465
Tree Planting, Processing Site Reclamation	This estimate is based on performing tree planting for the reclamation of processing sites	400	79	21,858

Incomplete and Unavailable Information

This analysis assumes all acres proposed are to be treated. Based on field reviews during implementation, treated acres and intensity will most likely change.

Forest Product Ad rates vary by timber sale and market conditions. The values used for this analysis is an average based on the most recent Southwestern Region transaction evidence appraisal.

Service costs are widely variable. For this analysis, an average price was determined from recent contracts, and other estimates for the cost of forest management activities.

The ability to profitably utilize large volumes of small diameter wood with current infrastructure and market conditions is a challenge. For this analysis, an assumption is made that sawtimber and non-saw products are utilized by the purchasers, and the biomass product (less than 6 inches) is cut, piled, and burned. If market conditions change, the expected costs and benefits of the project economics would change.

This report does not reflect the potential costs and benefits of using the proposed processing sites, just the costs associated with reclamation of them. The assumption is that the costs associated with the use of the processing sites are borne by the forest product purchaser. This analysis used a cost estimate based on a stump to truck then haul to processing facility. Use of processing sites would potentially add costs initially as forest products are moved from the landing to processing site, but processed products may have increased value or reduced costs/unit for final transport to market. For an estimate on the costs and benefits of using processing sites with the CWPP please review *The Economic Analysis of the USFS Cragin Watershed Protection Project Proposed Action for Public Scoping* (Campbell Global LLC, 2017)

Affected Environment

Values at Risk

Within CWPP there are approximately 61 private property parcels with an estimated value of $3,959,567.00 (Coconino County Parcel Viewer, 2016, https://gismaps.coconino.az.gov/parcelviewer/).

Table 83. Private property values associated with CWPP

Development	Estimated Value
	Dollars (2017)
Blue Ridge Rd 751B	934,098
Little Spring	464,573
Dick Hart	688,799
Goddard	1,037,374
Clints Well/Long Valley	834,723
Total	**$3,959,567**

Other values at risk with an undetermined value include numerous Forest Service administrative sites, facilities and infrastructure, as well as the forest resources (i.e. timber, wildlife, recreation, water, etc.). The project area also includes utility infrastructure and various C.C. Cragin Project facilities owned by the U.S. Bureau of Reclamation and operated by the Salt River Project.

Forest Products

Arizona's 2012 timber harvest was 15,346 thousand cubic feet (MCF), up 33 percent from the 2007 harvest (Hayes et al. 2012), but still just 56 percent of the 2002 harvest (Morgan et al. 2006). Since 2007, a major trend has been increased harvest of timber products other than sawlogs. Although overall harvest was up by one-third, the sawlog harvest was down by 8 percent and amounted to 66 percent of the total in 2012, compared to 95 percent of the total in 2007 (Hayes et al. 2012) (Sorenson, et al., 2016)".

With the 2015 Record of Decision for the Four Forest Restoration Initiative (4FRI) along with other recent stewardship projects, forest management activities have increased the flow of forest products to producers from the Coconino National Forest. Using a three year average from 2014 to 2016, the Coconino National Forest sold on average 148,165 CCF of forest products including sawtimber, softwood pulp and fuelwood (USDA Forest Service, 2017a). Timber sale purchasers harvested about 30,158 CCF of timber annually which was processed into wood products at regional sawmills.

Environmental Consequences

Alternative 1– No Action

Direct and Indirect Effects

Under the No Action Alternative, no merchantable timber harvest will take place, therefore no timber value exists. No costs would be incurred for sale preparation, administration, road maintenance, rehabilitation or construction. There would be no direct, indirect, or cumulative effects.

Cumulative Effects – No Action

Because no actions would be implemented there would be no new or additional economic benefits realized form employment, jobs or to local businesses form consumer purchase or to the wood products industry. There could be a potential loss of private property, buildings and infrastructure if a large stand-replacing wildfire occurred in the untreated forest of CWPP. The other timber sales under contract or in planning once implemented would contribute to the area's local economy and would benefit the forest ecosystem as well as private lands, infrastructure and values at risk.

Alternative 2 – Proposed Action

This alternative proposed prescribed cutting and burning treatments on an estimated 37,624 acres utilizing commercial thinning and precommercial thinning. About 79 acres are identified for use as processing sites which would be cleared of trees for processing, sorting, storing, and the refinement of raw material for the sole purpose of reducing logistical costs associated with timber harvest operations. Once these areas are no longer needed for the project, the sites would be reclaimed and returned to forest resource production.

Implementation of the vegetation treatments associated with the CWPP will be accomplished using ground-based logging methods, whole-tree yarding and the potential use of in-situ processing sites (5-15 acres) located within the project area. Logistical costs are reduced in the following ways:

1. Offsetting haul costs by increasing the value of material hauled either by hauling dried material or hauling secondary products.

2. Increased flexibility of meeting industry merchantability needs.

A limiting factor and large cost center for this project is the cost to haul the low value biomass and the pulpwood from project site to mill locations.

Direct and Indirect Effects

Forest Products

Economic benefits will be gained through receipts retained from the sale of timber stumpage over approximately 37,315 acres. At the time this report was written, base prices the FS charges for ponderosa pine in this area for trees 6"-8.9", 9"-11.9, and 12"+ DBH, were $1/CCF, $3/CCF, and $5/CCF respectively, totaling $1,108,677.

Table 84. Resource indicators and measures for alternative 2 direct/indirect effects.

Resource Element	Resource Indicator	Measure	Alternative 2 Direct/Indirect Effects
Forest Products	Use silvicultural activities to provide commercial wood products	Cubic Feet (ft^3) offered	250,948 CCF
Timber Sale Project Feasibility	Present Net Value	Dollars	$2,730,313
Final Efficiency	Present Net Value	Dollars	-$24,885,184

Project Feasibility

The estimated advertised rate and expected bid for Alternatives 2 indicates that the project is likely to sell (feasible). The average base rate, or minimum purchase price for all the forest products planned for harvest is $4.74 per CCF with a total base rate value of $1,108,677. The expected advertised rate representing current market value is an estimated $10.88 per CCF on average, resulting in a sale value of $2,730,313.

The estimation of project feasibility was based on a transaction evidence appraisal model, which took into account logging system, timber species and quality, volume removed per acre, lumber market trends, costs for slash treatment, and the cost of specified roads, temporary roads and road maintenance. The estimated high bid was compared to base rates (revenues considered essential to cover regeneration plus minimum return to the federal treasury). The revenue estimates in terms of present net value from the feasibility analysis are used in the financial efficiency analysis discussed below.

Financial Efficiency

Alternative 2 is financially efficient for the timber sale, but financially inefficient when all project activities are considered. As displayed in Table 84, the Proposed Action has a present net value of negative $24,885,184.

A reduction of financial PNV in any alternative as compared to the most efficient solution is a component of the economic trade-off, or opportunity cost, of achieving that alternative. As indicated earlier, many of the values associated with natural resource management are non-market benefits. These benefits should be considered in conjunction with the financial efficiency information presented here. For example, a 2013 study focused on the overall financial impact of the 15,000 acre Schultz Fire north of Flagstaff estimated a total impact of between $133 million and $147 million (Combrink et al. 2013).

This financial efficiency analysis is not intended to be a comprehensive analysis that incorporates monetary expressions of all known market and non-market benefits and costs of forest ecosystem services. Such an analysis is difficult to calculate and would not provide a meaningful comparison between alternatives (Vincent, 1999) (Krieger, 2001). Many of the values associated with natural resource management are non-market values that are not part of the financial efficiency analysis but are considered in the decision framework. Examples of non-market benefits are vegetation treatments that result in resilience to disturbances, wildlife habitat improvements and forage production. Examples of non-market costs would include soil erosion, or loss of wildlife cover and security as a result of implementation of an alternative. This Forest Product and Economics Report focuses on the market costs and benefits of implementing proposed activities of the various alternatives. The other

various specialist's reports are relied on to identify the non-market benefits and costs that implementation would produce for each resource analyzed by this environmental assessment.

In summary, management of the forest is expected to yield positive benefits, but not necessarily financial benefits. Economic effects are assessed within the managerial context of the Forest Plan, as a part of an integrated approach to multiple-use management. Net public benefits represent the sum of priced outputs (PNV) plus the net benefit of non-priced outcomes. Net public benefits cannot be expressed as a dollar value because many of the outcomes of management are not quantifiable in monetary terms (Bartuska, 2000).

Cumulative Effects – Proposed Action

The recent three year average for timber sold yearly on the Coconino National Forest is estimated at 148,165 CCF. Alternative 2 proposes to offer an additional 250,948 CCF with project activities over the life of the project. Though this timber would be sold in periodic installments over the life of the project, for this analysis an assumption is that the volume is sold in one year. The cumulative impacts to forest products sold would be a one year increase in forest product processing of up to 250,948 CCF if all processed in one year.

Environmental Justice

The Forest Service examined the environmental, economic, and social impacts of this project, and determined that none of the alternatives considered in this analysis would have a disproportionate impact on any minority or low-income population in the immediate area or within the surrounding counties. The overall economy of the four-county region is diverse, and while timber-related industry is, and will likely remain, a small component of the regional economy, if implemented, the Cragin Watershed Protection Project may positively affect poverty rates in the region by generating additional timber-related jobs over the next 20 years. Market benefits would be realized under the preferred alternative for private lands and landowners in and around the project area, by treating hazardous fuel accumulations in the Wildland-Urban Interface (approximately 16,600 acres in the project area) that could threaten their residences and properties. Other non-market benefits to the forest health and structure would be realized as well. Among others, these benefits include sustained provision of recreation opportunities for all forest users, regardless of race, ethnicity, or income.

The following section describes the effected environment and effects of the alternatives relating to environmental justice.

Affected Environment

The entire project area is within Coconino County, Arizona. Proposed treatments include the use of prescribed fire and also mechanical and hand thinning, of which the latter will yield biomass and timber products for the local timber industry. Though the project area is fully within Coconino County, residents of the surrounding counties of Gila, Navajo, and Yavapai may also be affected by increased timber-industry-related activity generated by the project. In addition, there is the potential for smoke impacts to communities in all four counties from prescribed burning treatments in the project area.

Race, Ethnicity, and Socio-Economic Conditions

According to the U.S. Census Bureau (2015), Coconino, Gila, Navajo, and Yavapai counties all differ in their racial compositions and rates of poverty compared to the state of Arizona and the nation.

Navajo County, with three reservations, has the highest concentration of residents who self-identify as American Indian, of all the counties surrounding the project area. Coconino County also has a high proportion of American Indian residents, due to the presence of five reservations within the county (approximately 39 percent of the County land area). Coconino County contains all or part of the Navajo Indian Reservation, Hualapai Indian Reservation, Hopi Indian Reservation, Havasupai Indian Reservation, and Kaibab Indian Reservation. Navajo County contains part of the Navajo Indian Reservation, Hopi Indian Reservation, and Fort Apache Indian Reservation. Gila County contains all of the Tonto Apache Reservation and parts of the Fort Apache and San Carlos Reservations. Yavapai County contains all or part of the Yavapai-Prescott Indian Reservation, the Yavapai-Apache Nation Indian Reservation, the Hualapai Indian Reservation, and the Camp Verde Indian Reservation. Yavapai County's proportion of American Indian residents is small relative to the proportions of American Indian residents in Navajo, Gila, and Coconino counties, and in the state of Arizona.

Gila County has the highest proportion of self-identified Hispanic or Latino residents out of the counties surrounding the project area, though it is only roughly half the proportion of Arizona's overall Hispanic/Latino population. In contrast, Yavapai County is generally less diverse than both the state and nation. An estimated 91.9 percent of Yavapai County residents self-identify as white. As a result, questions of environmental justice are more likely to occur in Coconino, Gila, and Navajo counties than in Yavapai County. However, a finding of low racial/ethnic diversity does not eliminate the need to consider potential disproportionate impacts of Forest Service management actions on all populations. A county may have a low overall concentration of minority residents, but still have areas, such as reservations, with high concentrations of minority residents who could be adversely affected by management actions.

The incidence of poverty in the counties surrounding the project area is not evenly distributed among racial and ethnic groups (USDC Census Bureau, 2015). In Coconino, Gila, Navajo, and Yavapai counties, the percentage of residents living in poverty who self-identify as American Indian, is between two and three times higher than the overall percentage of people living in poverty nationally. American Indian residents of all four counties, except Coconino, live in poverty at rates at least double those of Arizona's overall poverty rate. In all four counties, the proportions of American Indian residents living in poverty are significantly higher than the respective overall proportions of residents living in poverty. In Gila and Yavapai counties, the percentages of American Indians living in poverty are over twice as high as those of the overall population in those counties. The proportions of residents living in poverty who self-identify as Hispanic or Latino in all four counties range between 22.6 and 31.9 percent, with the highest proportion in Navajo and the lowest in Gila County. Poverty rates among Hispanic or Latino residents in all four counties are substantially higher than state and national poverty rates for the overall population. As with American Indian residents in each of the four counties, the proportions of Hispanic or Latino residents living in poverty are significantly higher than the respective proportions of the general population living in poverty.

Based on the minority status and poverty data presented above, Coconino, Gila, Navajo, and Yavapai counties all appear at risk for environmental justice issues. All four counties have higher overall percentages of residents living in poverty than the nation as a whole, and all but Yavapai County have substantially higher proportions of American Indian residents than either the state or nation. Among the American Indian residents of Gila and Navajo counties, poverty is roughly three times higher than the national average. While the proportion of American Indians living in poverty in Coconino County is the lowest of all four counties, it remains over twice as high as the national proportion of the general population living in poverty. Finally, though Gila County has the lowest proportion of Hispanic or Latino residents living in poverty among the four counties, the poverty rate among

Hispanic or Latino residents living there is still higher than those of the overall population of both the state and nation.

Table 85. Percentage of Persons Living in Poverty by County and Race

Percentage Of All Individuals Whose Income In The Past 12 Months Is Below The Poverty Level			
Location	**Overall Population** ***(Percent of total population)***	**American Indian** ***(Percent of total population)***	**Hispanic or Latino** ***(Percent of total population)***
United States	15.6	28.8	24.8
Arizona	18.2	38.5	28.1
Coconino County	23.8	35.3	31.6
Gila County	22.4	47.1	22.6
Navajo County	30.7	45.5	31.9
Yavapai County	16.1	38.6	28.3

Source: (USDC Census Bureau, 2015)

According to the U.S. Department of Commerce, the majority of employment (65.3 percent) across the four-county region in 2014 was in services-related industries such as retail trade (11.6 percent), health care and social assistance (11.2 percent), accommodation and food services (10.7 percent), and real estate-related services (5.7 percent). Public administration provided 19.3 percent of jobs, and non-services jobs represented 15.1 percent of regional jobs. Among non-services-related jobs, construction contributed 5.2 percent; manufacturing added 4.6 percent; farming represented 3.2 percent; mining made up 1.7 percent; and forestry, fishing, and agricultural services contributed 0.3 percent of employment (USDI Bureau of Economic Analysis, 2015).

In 1998, 1.6 percent of all jobs across Coconino, Gila, Navajo, and Yavapai counties were timber-related. By 2013, timber-related jobs represented just 0.44 percent of all jobs in the four-county region. During this period, the actual number of timber-related jobs in the region decreased by 67.9 percent, from 1,723 to 553 (USDC Census Bureau, 2015).

Environmental Consequences

Alternative 1– No Action

Direct, Indirect and Cumulative Effects

Under the No Action Alternative, the 64,433 acre project area would be more susceptible to high severity wildfire, causing increased and unpredictable smoke levels in and around the project area. The no-action alternative would not likely impact access to recreational opportunities in the near term. However, uncharacteristic wildfire in the project area could negatively impact recreational opportunities for local forest users with low incomes who may be unable to travel to other areas or forests to recreate. Wildfire smoke can result in significant air quality impacts to public health, particularly for at-risk groups, and impacts to safety and transportation through diminished visibility on roads and aviation corridors.

Alternative 2– Proposed Action

Direct, Indirect and Cumulative Effects

If implemented, the Proposed Action involving prescribed burning and mechanical thinning in the project area would reduce the risk of high severity wildfires in and around the project area. The result is low potential exposures to environmental human health hazards, namely particulates from prescribed burning. In contrast to high severity wildfire predicted in the No Action Alternative, prescribed fires provide an opportunity to adjust the timing of fire and some ability to manage the amount of smoke and its path, thereby reducing the impact of emissions on all communities and populations around the project area. Basic smoke management practices can reduce the impacts of prescribed fires on air quality while meeting hazardous fuel reduction objectives.

Additionally, market benefits would be realized under the preferred alternative for private lands and landowners in and around the project area, by treating hazardous fuel accumulations in the Wildland-Urban Interface (approximately 16,600 acres in the project area) that could threaten their residences and properties. Other non-market benefits to the forest health and structure would be realized as well. Among others, these benefits include sustained provision of recreation opportunities for all forest users, regardless of race, ethnicity, or income.

The proposed project also includes activities such as road maintenance, road hauling, temporary road construction, and processing sites. The road use and maintenance would occur mainly on existing forest system roads and could impact recreation sites and opportunities in localized areas on the forest during logging activities. The processing sites would affect areas that are currently forested on up to 79 acres across 8 sites. The processing sites would make up a combined 0.12% of the project area. The site locations are more than ¼ mile from developed recreation sites and private land developments except for one site, the 211 Site Revised which is just at a ¼ mile from two residences and the Blue Ridge Ranger Station. Road use and the processing sites would result in no measureable impact to human health or environmental conditions to minority or low income residents in the area or surrounding communities.

Cumulative Effects Activities Considered

Past, Ongoing and Reasonably Foreseeable Future Actions

Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. Past, ongoing and reasonably foreseeable future actions within the CWPP project area are identified in the tables below. Activities listed are those that occur within the CWPP boundary and within seven HUC 6 sub-watersheds in the analysis area: Bear Canyon, Clover Creek, East Clear Creek-Blue Ridge Reservoir, East Clear Creek-East Clear Creek, Long Valley Draw, Miller Canyon and Windmill Draw-Jacks Canyon.

Further discussion is provided about various actions significant in magnitude or scope. The projects listed are on the Coconino National Forest. The seven sub-watersheds considered in the cumulative effects analysis contain lands managed by the Coconino National Forest, and private lands.

This section discloses actions considered in the cumulative effects sections of each resource area evaluated in the Environmental Consequences Chapter of the EA. In most cases, past and ongoing activities are incorporated into each resource's existing conditions because they help explain the current condition of the resource. That is, past and ongoing activities are described in the context of

how these actions affect present conditions. Similarly, foreseeable future actions (such as the Rim Country EIS) are evaluated as to how they would change conditions for the resource.

Projects are listed that are considered in the cumulative effects analyses by various resources, depending on the scope of their analysis. Past actions are those that have been implemented or have completed environmental review. For most resources, the timeframe used for evaluating effects of past and future actions ranges from 5-10 years. Ongoing activities are those that have signed decisions and are ready to implement or are being implemented. Ongoing activities also include those carried out by the public, agencies or the Forest Service such as recreation, hunting or road maintenance. Reasonably foreseeable future actions are those projects that are in the planning stages and have developed a proposed action or alternatives, but a decision has not been made. Data sources for ongoing and future and foreseeable actions include the Coconino Forest's schedule of proposed actions (SOPA) databases.[18]

Past Actions

Approximately 34 wildfires (greater than 10 acres) totaling about 77,374 acres have occurred from 2006 to 2017 within the cumulative effects watershed area boundary. In 2018, the Tinder Fire occurred on the northeast boundary of the project area, affecting no acres within the project boundary, but affecting acres of portions of the cumulative effects boundary for resources such as watersheds, wildlife habitat, and aquatic habitat. Of these past wildfires, about 26,389 acres (28% of the acreage burned in the larger watershed boundary) burned within the CWPP boundary (Table 86). The large majority of the fires (25) within the watersheds have been lightning caused and were managed for multiple resource objectives (76,510 acres).

Table 86. List of past wildfires occurring within the project and analysis watersheds. 2006 - 2017

Fire Name	Year	Acres in Analysis Watersheds	Acres in CWPP Boundary
Moqui	2006	15	0
Lost Eden*	2008	1,551	0
Yeager*	2008	464*	0
Dude Lake	2009	19	19
Independence*	2009	1,371	1,371
July 4th Complex*	2009	3,084	3,084
Peoples	2009	35	0
Reservoir	2009	170	170
Rim*	2009	276	276
General*	2009	10	10
Tucker*	2009	2,611	0
Bravo*	2010	3,258	3,285
Ranger*	2010	2,138	2,138
Kehl*	2011	187	187
Scout*	2011	803	803
One Three Seven	2012	114	0
Hart	2013	38	38

[18] Coconino SOPA website: http://www.fs.fed.us/sopa/forest-level.php?110304

Fire Name	Year	Acres in Analysis Watersheds	Acres in CWPP Boundary
Reservoir	2013	124	124
General*	2014	2,086	2,086
Kinder*	2014	451	451
Pothole*	2014	2,162	0
General*	2015	2,690	2,690
Goose	2015	317	0
Rebel*	2015	2,417	0
Charlie	2016	32	0
Reservoir	2016	128	128
Pivot Rock*	2016	5,965	0
Poverty*	2016	300	300
Eden*	2016	1175	0
Jack*	2016	33,761	0
Crackerbox*	2016	922	922
Pinchot*	2016	3,864	3,864
Thunderstruck*	2016	526	0
Wolfman*	2016	59	59
Highline/Bear*	2017	4,388	4,388
Tinder**	2018	15,633	0
Total Acres		**93,131**	**26,389**

*Fires managed for multiple resource objectives

** The Tinder Fire is still not controlled as of the time of the publication of this document, and the acreage may increase over w hat is recorded here.

Broadcast, maintenance and pile burning has occurred over 18,794 acres of the analysis watersheds (see Table 87).

Table 87. List of past prescribed burning within the project area and analysis watersheds. 2006-2017.

Project Name	Year	Acres in Analysis Watersheds	Acres in CWPP Boundary
East Clear Creek Watershed Health – Broadcast Burn	2007	1,693	748
Victorine Wildland Urban Interface – Broadcast Burn	2007	210	0
Bald Mesa Fuels Reduction Project – Pile Burn	2008	208	0
East Clear Creek Watershed Health – Broadcast Burn	2008	499	0
Bald Mesa Fuels Reduction Project – Pile Burn	2010	451	0
Blue Ridge Urban Interface – Maintenance Burning	2010	1,640	603
East Clear Creek Watershed Health – Broadcast Burn	2010	1,231	1,238
Blue Ridge Urban Interface – Maintenance Burning	2011	957	957
East Clear Creek Watershed Health – Broadcast Burn	2011	1,185	1,190
Victorine Wildland Urban Interface – Maintenance Burn	2012	729	0
Victorine Wildland Urban Interface – Maintenance Burn	2013	2,453	0
Victorine Wildland Urban Interface – Maintenance Burn	2014	340	0

Project Name	Year	Acres in Analysis Watersheds	Acres in CWPP Boundary
Blue Ridge Urban Interface – Maintenance Burning	2015	2,953	0
Clints Well Forest Restoration Maintenance Burning	2016	2,668	0
East Clear Creek Watershed Health – Maintenance Burn	2016	1,577	0
Blue Ridge Urban Interface – Maintenance Burn	2017	850	0
East Clear Creek Watershed Health- Maintenance Burn	2017	681	0
Total Acres		**20,325**	**4,736**

Three projects, the Post-Tornado Resource Protection and Recovery Project, the East Clear Creek Watershed Health Improvement Project and the Blue Ridge Urban Interface Project have been analyzed and overlap with the CWPP project boundary totaling about 36,975 acres (see Table 88).

Table 88. List of completed fuels reduction and forest restoration project NEPA analyses within the project area and analysis watersheds. 2006-2017.

Project Name, Analysis Acres	Year of Decision	Acres in Analysis Watersheds	Acres in CWPP Boundary
Clints Well Forest Restoration Project, 16,809	2013	13,735	0
Post-Tornado Resource Protection and Recovery Project,1,680 on MRRD	2011	764	530
East Clear Creek Watershed Health Improvement Project, 70,000	2006	38,113	30,445
Victorine Wildland Urban Interface Project, 17,718	2006	11,327	0
Bald Mesa Fuels Reduction Project, 4,500	2005	4,500	0
Blue Ridge Urban Interface Project, 26,413	2001	~12,000	~6,000
Total Acres		***~80,439***	***~36,975***

In the last 10 years there has been timber harvest activities within approximately 2% the project area, including salvage sales and pre-commercial thinning (Table 89 below).

Table 89. List of past (completed) vegetation treatments in the project area and analysis watersheds. 2006-2016

Project Name	Year	Activity Description	Acres in Analysis Watersheds	Acres in CWPP Boundary
Victorine Wildland Urban Interface	2009	Timber Stand Improvement	475	0
Blue Ridge Urban Interface	2009	Precommercial Thinning <9" dbh	105	0
East Clear Creek Watershed Health	2009	Precommercial Thinning, 5-9" dbh	1,153	1,020
Blue Ridge Urban Interface	2014	Precommercial Thinning <9" dbh	50	0

Project Name	Year	Activity Description	Acres in Analysis Watersheds	Acres in CWPP Boundary
Blazed Ridge/Little Spring Tornado Recovery Stewardship IRTC	2012-2014	Sanitation Cut, and Yarding – Removal of Fuels	530	530
Yellow Jacket Tornado Recovery Stewardship IRTC	2012	Sanitation Cut, and Yarding – Removal of Fuels	234	0
East Clear Creek Watershed Health Holder Cabin	2015	Timber Stand Improvement & Hand Piling	38	0
Long Valley Meadow Restoration	2017	Timber Stand Improvement & Hand Piling	15	15
Total Acres			**2,6002,585**	**1,565**

Four timber sales are planned or are under contract in the project area or analysis watersheds. Acres planned for thinning total about 56 acres in the CWPP boundary and 8,546 acres in the analysis watersheds (see Table 90). The LEARN Mixed Conifer study is a treatment jointly conducted by the MRRD and Ecological Restoration Institute of Northern Arizona University. LEARN stands for **L**ong-term **E**cological **A**ssessment and **R**estoration **N**etwork.

Table 90. List of ongoing vegetation treatments, (pre-sale, laid out, or under contract) within the project area and analysis watersheds. 2006-2018

Project Name	Year	Activity Description	Total Acres	Acres in Analysis Watersheds	Acres in CWPP Boundary
Clints Well South Timber Sale	2018	Commercial Thin	5,271	4,423	0
Two Joes Timber Sale	2017	Commercial Thin	1,528	1,528	0
Windmill Timber Sale	2018	Commercial Thin	1,339	1,173	0
LEARN Mixed Conifer Study, 618 acres including 210 acres of control blocks	2018	Commercial Thin & Prescribed Burn	408	133	56
		Prescribed Burn Only	551	0	0
Total Acres			***9,097***	***7,257***	***56***

Over the last five years, the Mogollon Rim Ranger District Weeds Crew has implemented invasive weed pesticide treatments within the road right-of-way along SR Highway 87 totaling about 922 acres per year in 2012 and 2015 and 200 acres in 2016. Both sides of the highway were treated. No records of pesticide treatments and accomplishments were found for SR Highway 87 prior to 2012 (see Table 91)

Table 91. List of past integrated treatments of noxious or invasive weeds in the project area and on the Mogollon Rim Ranger District. 2012-2016

Project Name	Year	Activity Description	Acres in Analysis Watersheds
ADOT/AZ Forest Roads EA, 2004 & Integrated Treatment of Noxious and Invasive Weed EIS, Coconino/Kaibab NF, 2005	2012	SR 87 Right-of-Way from Coconino Tonto Forest Boundary north to Coconino Forest boundary, MP 273 to MP 316.7 Invasives Pesticide Application	922
	2015		
	2016	SR 87 Right-of-Way, from FH 3 Lake Mary Road to FR95, MP 290.5 to 299.8. Invasives Pesticide Application	~200
	2017	SR 87 Right-of-Way from Coconino-Tonto Forest Boundary MP 273 north to FH3 Junction MP 290.5. Invasive weed survey	815
Total Acres			**1,937**

Over the past 10 years, the district trails and fire staff along with partners and contractors including the Arizona National Scenic Trail (AZNST) stewards, Arizona Conservation Corps (formerly Coconino Rural Environmental Corps) have completed various trail maintenance and improvement activities in the CWPP project area.

Table 92. List of trail maintenance and improvement activities

Project Name	Year	Activity Description	Miles in CWPP Boundary
Mogollon Rim Ranger District Arizona State Parks Recreational Trail Program (RTP) Trail Maintenance Project	2006-2010	AZNST tread maintenance and fill replacement. Trailhead parking lot improvement and signage installation.	3
Post-fire Trails Maintenance	2010	AZNST, Fred Haught Trails	5
Mogollon Rim Ranger District RTP Trail Maintenance Project	2012	AZNST from FR123 to FR751	5.9
Mogollon Rim Ranger District RTP Trail Maintenance Project, 471501	2016	Sections of the Houston Brothers and Fred Haught Trails	5
Arizona National Scenic Trail (AZNST) Gate Improvements and Trail Realignment Decision Memo 2015	2015-2017	Modified Metal Swing Gate on FSR 138 & SR87, Moqui Campground, Blue Ridge Campground, FSR 751	4 gates 0.2
AZNST Annual Trail Maintenance by Trail Stewards	Annually	AZNST	~16 miles/year
Total Miles			**35.1**

The following table lists various types of projects implemented in the CWPP project area. The data was obtained from the SOPA database and MRRD records. The SOPA was searched beginning in year 2006 to the present.

Table 93. Projects and NEPA decisions in the project area or analysis watersheds.

Project Name	Year	Activity Description	Miles or Acres in CWPP Boundary
C.C. Cragin Dam and Facilities Repair and Maintenance			
C.C. Cragin Dam Tree and Brush Removal	2007	Cutting and removal of trees and brush growing on the downstream face of the dam.	---
C.C. Cragin Pipeline Repair	2007-2009	Repair and replacement of sections of pipeline in the General Springs canyon	---
C.C. Cragin Surge Tank Road Repair FR 705, General Springs	2014-2015	Repair to the surge tank apron, road grading, culvert and ditch armoring, road aggregate surfacing using off-forest aggregate	300 feet
C.C. Cragin Inlet Tunnel and Dam Project	2014	Lowering the reservoir pool level and inspection of the inlet tunnel and dam face and replacement of the tunnel grate.	---
C.C. Cragin Helipad Enlargement	2016	Cutting trees to enlarge the helipad at the pumping facility.	< 1 ac
C.C. Cragin Reservoir Road and Boating Facility Improvements			
C.C. Cragin Reservoir Guard Rail Installation FR 751	2006	Installation of a new guard rail along FR 751 on road leading to the boat ramp	---
Improvements at Blue Ridge (C.C. Cragin) Reservoir Project	2011-2017	Improvements to boat ramp and access road including: widening, surfacing, drainage structures, retaining wall construction, removing loose and unstable rock in cut slopes, installing rock fall prevention netting, guard rail, courtesy boat dock and signage.	---
Forest Road Maintenance and Reconstruction			
FR 95 Guardrail Installation	2008-2009	Installation of a new guard rail along FR95	---
Forest Road Reconstruction, FR 95	2011	aggregate surfacing and spot rocking and grading using Lockwood Pit crushed aggregate	8 miles
Houston Draw Aquatic Organism Passage EA, 2010. FR 95.	2013-2014	Construction contract. Installation of an arch culvert and stream restoration	---
Forest Road Reconstruction, FR 300	2010-2011	FR300, culvert replacement, road grading, surfacing using Lockwood Pit aggregate	25.5 miles
Forest Road Reconstruction, FR 95	2015	aggregate surfacing, grading and culvert cleanout, using Lockwood Pit aggregate and oversize rock	4.0 miles

Project Name	Year	Activity Description	Miles or Acres in CWPP Boundary
Forest Road Reconstruction, FR96	2015	Aggregate surfacing, grading and culvert cleanout, using Lockwood Pit aggregate	2.0 miles
Forest Road Reconstruction, FR300 and FR147	2015	FR300 & FR144, aggregate surfacing, road grading using off-forest aggregate source	4.6 miles
Lands and Recreation Special Uses Projects and Permits			
Baker Butte Summit SNOTEL Site	2009, 2017	Installation of a new SNOTEL Site with pillows, rain gauge and instrument house on FR 9386V. Installed gate on FR9386V.	< 1 ac
Baker Butte Coconino County Sherriff's Communication Lease 2015	2015	Add communication site equipment to the Coconino County Sherriff's Department equipment at Baker Butte Tower.	---
Clint's Well Underground Powerline Replacement 2015	2016	Replacement of a buried powerline from Lake Mary Road to Hwy 87 and along FR 632 and 9033Heast of Clint's Well.	---
Forty-Four Canyon Recreational Residence Tract Special Use Permit Modification 2014	2014-2016	Modification of the three existing permits to upgrade drainage, septic and waste water systems and to change ownership status.	< 3 ac
Mogollon Rim Ranger District Special Use Reauthorizations, 2014	2014	Coconino County Public works Department and Blue Ridge Fire District Mobil Radio Service, FR138, 751B	<1 ac
Mogollon Rim Ranger District Special Use Reauthorizations, 2015	2015	U.S. Department of Commerce Weather Station, FR 751B	1 ac
TDS Telecom Blue Ridge, Arizona Stimulus Project	2013	Authorizes the construction of 7.2 miles of communications lines and related facilities in the Blue Ridge Area of Happy Jack AZ.	<1 mi
TDS Telecom Special Use Permit Reissuance 2010	2010	Reissuance of permit for communications lines and facilities permit.	---
Arizona Public Service Management Plan and ROW Corridor Vegetation Clearing, BR-12 Distribution Line	2014-2015	Hazard tree and vegetation removal along the power line clear zone.	~12 miles
SR87 MP 254.6-283 Tree Thinning, Arizona Department of Transportation 2015	2016	Removal of trees and vegetation within the recovery zone in the ROW.	3.0 mi
Clover Creek Rockfall Mitigation, Arizona Department of Transportation 2017	2017	Scaling and removal of unstable boulders and loose rock along SR87 ROW, milepost 285-287.3	2.3 mi
Timber, Range and Other Projects			
Pivot Rock and Hackberry Range Allotments EA 2010	2010	Authorizes livestock grazing on the Pivot Rock Range Allotment	22,432 ac

Project Name	Year	Activity Description	Miles or Acres in CWPP Boundary
Mogollon Rim Christmas Tree Cutting Project, Wildcat Springs Area	2014 - 2017	Personal use cutting of Christmas trees in the Wildcat Springs area.	2,312 ac in Clover Watershed
Buck Springs Allotment EIS 2003	2003	Authorizes livestock grazing on the Buck Springs Range Allotment	24,617 ac
Bar T Bar Allotment EIS 2005	2005	Authorizes livestock grazing on the Bar T Bar Range Allotment	9,685 ac
Rock Pits Final EA, Coconino and Kaibab National Forests 2016	2016	Development of new and expansion of existing rock pits on the Coconino National Forest. Eight pits are on the Mogollon Rim District (Buck Butte, Bushy Knoll, Cinch Hook, Lockwood, Macks, Oak Grove, Snafu, Turkey Knob). All listed pits are outside of the CWPP area	0 ac
Coconino National Forest Travel Management EIS 2011	2012 to present	Annual Motor Vehicle Use Map, implementation of regulations and closure of undesignated roads	198 miles of open roads
Watershed Restoration			
Barbed Wire Fence Removal, Arizona Elk Society and MRRD	2016	Removal of unneeded barbed wire fencing in the Buck Springs Allotment. Aspen Spring, Houston Draw, FR95, 95B and 139A	3 mi
Road Closures and Meadow Fencing	2014-2015	Soft closures of user–created and other roads that are closed to public use. Dirty Neck, Potato Lake, East Clear Creek and Baker Butte Areas. Potato Lake gate installation. Log worm fences have been installed in the Potato Lake, Poverty Flat and Long Valley meadow areas	No Data
Stream channel and meadow restoration, Arizona Elk Society and MRRD	2017-2018	Installation of rock and log structures to re-form channels in meadows, removal of small trees in historic meadows in Long Valley, installation of log fencing to prevent motor vehicles in meadows	~3 mi

Ongoing Activities

The following actions are recurring on an annual basis and will occur into the future. Actions listed here include various recreational activities and permitted events, road and highway maintenance, and implementation of forest-wide projects such as Travel Management and treatment of noxious and invasive weeds (see Table 94).

Table 94. Ongoing activities within the CWPP project area.

Activity or Project Name	Description
Developed Recreation, Camping and Group Events	Campgrounds: Long Valley Group, Moqui Group, Blue Ridge, Rock Crossing, Kehl Springs. Group Event Sites: Long Valley Draw (FR141A, FR6101), FR139, 139G, Oak Grove, (FR218)
Trail Use: Hiking, Biking, Equestrian Uses	Trails: Arizona National Scenic Trail (14.4 mi), General Crook National Historic Trail (14.1 mi), Fred Haught (6.4 mi), U-Bar (2.1 mi), Houston Brothers (7.1 mi), Rock Crossing Trail (2.2 mi). General Springs, Jumbo and Hay Meadow Trailheads
Dispersed Recreation	Non-developed recreation activities including: hunting, fishing, camping, driving for pleasure, hiking, biking, bird-watching etc.
Hunting, Fishing	Hunting game, mainly elk, deer, turkey in Unit 5A on the Coconino National Forest. Fishing at C.C. Cragin Reservoir and on streams in the project area
Firewood Collection	Fuelwood permits and collection occur from mid-April to mid-December in the project area and throughout the Mogollon Rim Ranger District
Annual District Forest Road Maintenance	Road grading and maintenance. Only occurring on main roads (Maintenance Levels 2 & 3). FRs 95, 18, 139, 141, 141C, 141E, 141H, 147, 147A, 300, 300B 308, 612, 613, 751,751B, 300B, 719, 719F, 138, 320, 123, 123E. Total miles = 131
Annual Arizona Department of Transportation Hazard Tree Removal	Cutting and removal of hazard trees in the ROW
Annual Central Arizona Trials Event	Weekend events occurring once a year consisting of motorcycle trials including endurance and tricks on FR727 off of FR141
Mogollon Monster Run 2012-2017	Annual 106 mile running race event that takes place in September, annually. The race uses the Cabin Loop trail system, General Crook Trail, the Pine Canyon Trail and Forest Road 300
Arizona Snowmobile Tours 2016-2017	Outfitter guide permit for winter snowmobile tours in the CWPP and adjacent areas
New Mexico Backroads Tours	Outfitter guide that conducts automobile tours on FR300
Coconino National Forest Travel Management EIS 2011	Annual Motor Vehicle Use Map, implementation of regulations and closure of undesignated roads
Integrated Treatment of Noxious or Invasive Weeds ROD & FEIS, 2005	Monitoring, treatment and control of noxious and invasive weeds including spotted, diffuse and Russian knapweed, scotch thistle, dalmation toadflax and other weeds along SR 87 ROW and other infested areas in the CWPP and adjacent areas
Long Valley Meadow Restoration	Restoration of a wet meadow ecosystem using mechanized equipment to stabilize channels and installing rock and timber-based structure to better manage the flow of water and stabilize meadow soils. NEPA competed April, 2017. Project implementation began May 2017 and is ongoing
Park Knoll Rock Pit Development and Use, Clints Well Forest Restoration Project, 2013	Coconino County development and use of Park Knoll Pit which contains basalt and volcanic cinders. Permit authorized in 2017. Blasting and crushing contract

Activity or Project Name	Description
	September-October, 2017. The pit is located outside the CWPP project area off of FR698
Plan Revision for the Coconino National Forest	Draft Environmental Impact Statement, November, 2013. Final EIS and Record of Decision, 2018
Long Valley Work Station Meadow Restoration	Restoration of a wet meadow ecosystem using mechanized equipment to stabilize channels and installing rock and timber-based structures to better manage the flow of water and stabilize meadow soils. Decision April 2018. Implementation began May of 2018 and is ongoing

Present grazing management actions that are occurring within the analysis watersheds are listed in Table 95. Approximately 51% of the project area is grazed by livestock. Buck Springs Allotment has not been grazed since 2009 and is considered vacant at this time. Since 2009, the Forest Service in partnership with Arizona Elk Society and Arizona Game & Fish Department has conducted meadow thinning, stream channel restoration and fence remove projects in the allotment.

Table 95. List of present grazing actions occurring within the CWPP area and analysis watersheds

Allotment Name	Acres in CWPP	Acres in Analysis Watersheds
13 Mile Rock	0	535
Baker Lake Calf Pen	710	710
Bar T Bar	9,685	50,742
Beaver Creek	0	3,356
Buckhorn	0	4,727
Buck Springs	24,617	30,470
Hackberry/Pivot Rock	22,432	35,017
Walker Basin	0	10
Willow Valley	0	389
Total Acres	**57,444**	**125,246**

Future and Foreseeable Actions

The following future and foreseeable actions that are proposed to occur within the analysis area are on the current SOPA for the Coconino National Forest. These projects have initiated the NEPA process and have completed public scoping of the actions proposed. Only projects that are proposing activities within the CWPP project area or analysis watersheds are listed (see Table 96).

Table 96. List of future and foreseeable actions occurring within the CWPP area and analysis watersheds

Project Name	Description
Changes to Motor Vehicle Designations on the Coconino National Forest	Proposed changes to which roads, trails and areas are open to motor vehicle use on the Forest. Public scoping of the Proposed Action began November, 2015.
Four Forest Restoration Initiative Rim Country Environmental Impact Statement	A proposal to conduct restoration activities over 1.24 million acres of ponderosa pine ecosystem on parts of the Apache Sitgreaves, Coconino and Tonto National Forests. Public scoping of the Proposed Action began June, 2016.

Project Name	Description
AZ Public Service-Salt River Project ROW Vegetation Management with Herbicides (Scoped January 2015)	A proposal to allow APS and SRP to include using herbicides as a method to manage vegetation on existing APS and SRP transmission ROW within five National Forests in Arizona.
AZ National Scenic Trail Comprehensive Plan	Development of administrative and management goals, objectives, and practices for the AZNST and management corridor
APS Seven Communication Poles (including Village of Oak Creek)	At seven sites (including north of CC Cragin Reservoir) install a 65-foot, 12-sided, weathering steel pole, direct buried with 10-foot underground 800MHz antenna, a 2-foot Microwave dish, a Cambium PTP650 ODU(self-contained transceiver unit), 2 cabinets for radio/battery and access existing road.

The Four Forest Restoration Initiative Rim Country EIS Proposed Action dated June, 2016 was reviewed to determine what restoration treatments are proposed within the CWPP project boundary and the analysis watersheds. Treatments are summarized in Table 97, below. The treatment descriptions are more fully described in the Proposed Action for Rim Country EIS and the acres or miles listed below are approximate and preliminary and may change with alternative development by the time the Draft EIS is published. At this time, no road related actions are proposed such as road improvements or road decommissioning. The Rim Country IDT is going to evaluate potential project activities and include them in the draft EIS.

Table 97. Activities proposed in the Rim Country EIS within the CWPP boundary and analysis watersheds, June 2016 Proposed Action.

Activity Description	Acres or Miles in CWPP	Acres or Miles in Analysis Watersheds
Mechanical Thinning and Prescribed Fire	0 acres	~56,000 acres
Grassland Restoration	~800 acres	~3,700 acres
Aquatic Habitat Restoration	~140 miles	~230 miles
Stream Channel Restoration	~30 miles	~60 miles

CHAPTER 4: Consultation and Coordination

The Forest Service consulted the following federal, state and local agencies, tribes and individuals, during the development of this environmental assessment.

Core Interdisciplinary Team

The following people are members of the Core Interdisciplinary Team (IDT) that participated in the development and preparation of this environmental assessment.

Name	Agency	IDT Position
Linda Wadleigh	USDA Forest Service	District Ranger
Polly Haessig	USDA Forest Service	Project Manager and IDT Leader, NEPA Specialist, Geologist
Mike Dechter	USDA Forest Service	Project Manager and IDT Leader, Forest NEPA Coordinator
Jeff Thumm	USDA Forest Service	Fire and Fuels Specialist

Tom Runyon	USDA Forest Service	Soils and Hydrology Specialist
Keith Gustafson	USDA Forest Service	Silviculturist
Mary Price	USDA Forest Service	Silviculturist
Julia Camp	USDA Forest Service	Wildlife Biologist

Extended Interdisciplinary Team

The following people are members of the Extended Interdisciplinary Team (IDT) that participated in the preparation or review of all or part of this environmental assessment.

Name	Agency	IDT Position
Judy Adams	USDA Forest Service	Lands-Special Uses
Noah Bard	USDA Forest Service	GIS Specialist
Teresa Beard	USDA Forest Service	Engineering and Roads
Sarah Belcher	USDA Forest Service	Landscape Architect
Carl Beyerhelm	USDA Forest Service	GIS Specialist
Elvy Barton	Salt River Project	Cooperating Agency
Debra Crisp	USDA Forest Service	Botanist, Invasive Weeds
Charlie Ester III	Salt River Project	Cooperating Agency
Scott Francis	USDA Forest Service	Supervisory Forester, Transportation, Economics
Richard Gonzalez	USDA Forest Service	Forest Silviculturist
LaRon Garrett	Town of Payson	Cooperating Agency
Dave Gifford	USDI Bureau of Reclamation	Cooperating Agency
Hannah Griscom	Arizona Game and Fish	Habitat Specialist
Keith Gustafson	USDA Forest Service	Silviculturist
Bruce Hallin	Salt River Project	Cooperating Agency
Sean Heath	USDI Bureau of Reclamation	Cooperating Agency
Shaula Hedwall	USDI Fish and Wildlife Service	Wildlife Biologist
Tanner Henry	Town of Payson	Cooperating Agency
Craig Johnson	USDA Forest Service	Tribal Outreach and Consultation
Ron Klawitter	Salt River Project	Cooperating Agency
Patrick McGervey	USDA Forest Service	Recreation Planner
John McGlothlen	USDI Bureau of Reclamation	Cooperating Agency
Patrick Rappold	Arizona State Forestry	Timber Program Manager (Acting)
Kathy Sevy	USDA Forest Service	Range Specialist
Alexander Smith	USDI Bureau of Reclamation	Cooperating Agency
Brady Smith	USDA Forest Service	Public Affairs
Mark Swift	USDA Forest Service	Archeologist
Frank Thomas	USDA Forest Service	GIS Specialist
Brady Vandragt	USDA Forest Service	Recreation Planner
Buzz Walker	Town of Payson	Cooperating Agency
Mark Wicke	Salt River Project	Cooperating Agency

Name	Agency	IDT Position

Federal, State, and Local Agencies

Arizona Department of Environmental Quality
Arizona Game and Fish Department
USDI Bureau of Reclamation
USDI Fish and Wildlife Service
Salt River Project
Town of Payson, AZ

Tribes

Fort McDowell Yavapai Nation
Hopi Tribe
Hualapai Tribe
Havasupai Tribe
Navajo Nation
Pueblo of Zuni
Pueblo of Acoma
San Carlos Apache Tribe
San Juan Southern Paiute Tribe
Tonto Apache Tribe
Yavapai-Apache Nation
Yavapai-Prescott Tribe
White Mountain Apache Tribe

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Glossary

active crown fire–A crown fire in which the entire fuel complex becomes involved, but the crowning phase remains dependent on heat released from the surface fuels for continued spread. Also called running and continuous crown fire.

administrative use road– see definition for maintenance levels, Level 1 road

age class–A distinct aggregation (grouping) of trees that originated within a relatively distinct range of years. Typically, the range of years is considered to fall within 20 percent of average maturity (e.g. if 100 years is required to reach maturity, then there would be five 20-year age classes).

basal area–is the cross-sectional area at breast height (4.5 ft above the ground) of trees measured in square feet. Basal area is a way to measure how much of a site is occupied by trees. The cross-sectional area is determined by calculating the tree's radius from its diameter (diameter/2 = radius) and using the formula for the area of a circle (π x radius^2 = cross-sectional area). Basal area per acre is the summation of the cross-sectional area of all trees in an acre or in a smaller plot used to estimate basal area per acre. Diameter at root collar (defined below) is used to calculate the cross-sectional area of multi-stemmed trees such as juniper and oak.

biomass–Multiple definitions include: organic matter produced by plants and other photosynthetic organisms; total weight of all living organisms that can be supported at each level of a food chain or web; dry weight of all organic matter in plants and animals in an ecosystem; plant materials and animal wastes that functions as fuel for fire.

canopy–A layer of foliage, generally the uppermost layer, in a forest stand. Can be used to refer to midstory or understory vegetation in multi-layered stands.

canopy base height (CBH)–A critical factor in crown fire mitigation, and can be used as an indicator of the potential for crown fire initiation (Agee & Skinner, 2005) (Stratton, 2009). The desired condition is for CBH to be greater than 18 feet in ponderosa pine.

canopy bulk density (CBD)–for ponderosa pine and pine-oak stands. CBD is a good indicator of potential active crown fire (Stratton, 2009). The desired condition is for average CBD to be less than 0.05 kg/m in ponderosa pine.

canopy characteristics–Canopy characteristics include canopy cover, canopy base heights (CBH), and canopy bulk density (CBD) which contribute significantly towards the type of fire that can occur (Scott and Reinhardt 2001). Canopy cover, CBH, and CBD directly affect the incidence and behavior of crown fires and are used for modeling potential fire behavior (Agee & Skinner, 2005) (Scott and Reinhardt 2005).

canopy cover–Canopy cover is the degree to which the forest canopy blocks sunlight or obscures the sky. It is related to the number and size of trees. High degrees of canopy cover result in a higher potential to sustain active crown fire. Canopy covers of 50% and greater have a *very high* potential for sustaining active crown fire while canopy covers of 40-50% have a *high* potential for sustaining active crown fire.

classified road– Roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long term motor vehicle access, including state roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service.

closed road– see definition for maintenance levels, Level 1 road

clean water act (CWA)–An act that provides the structure for regulating pollutant discharges to waters of the United States. The Act's objective is "…to restore and maintain the chemical, physical, and biological integrity of the Nation's waters," and is aimed at controlling both point and non-point sources of pollution. The Environmental Protection Agency (EPA) administers the Act, but many permitting, administrative, and enforcement functions are delegated to state governments. In Arizona, the designated agency for enforcement of the Clean Water Act is the Arizona Department of Environmental Quality (ADEQ).

clump–refers to a tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees, but a stand-alone clump of trees can function as a tree group or a single structure.

condition Class (reference FRCC)– A measure of departure from reference conditions that can be used to determine how 'at risk' key ecosystem components are in the event of a disturbance event, such as fire.

conditional crown fire–A potential type of fire in which conditions for sustained active crown fire spread are met but conditions for crown fire initiation are not. If the fire begins as a surface fire then it is expected to remain so. If it begins as an **active crown fire** in an adjacent stand, then it may continue to spread as an active crown fire.

controlled burn–synonymous with prescribed fire

course woody debris (CWD)– see down woody debris

cover type–refers to a forest or woodland type, such as ponderosa pine, pine-oak, or mixed-conifer.

critical habitat– refers to specific geographic areas that are essential for the conservation of a threatened or endangered species and that may require special management considerations. Critical habitat is made up of the

physical and biological features necessary for the species' survival; these features are found in restricted and protected habitats.

crop tree– An immature tree having no serious defects in quality limiting present or prospective use of relative high vigor and containing no pathogen that may result in death or serious deterioration before rotation age. They are the trees that are favored in cultural operation or featured in management (FSH 2409.26d_Appendices).

crown base height (CBH) – the distance from the ground to the lowest green limb. The general rule of thumb is, the lower the crown base height, the easier it is for a crown fire to be initiated.

crown bulk density (CBD)– a measure of canopy fuels used in fire behavior modeling applications. Typically it is the weight of fine canopy fuels (leaves, needles, smaller branches, etc.) divided by the total canopy volume. It is related to the number and size of trees. Higher CBD results in a higher potential to sustain active crown fire. It is a measurement based on live foliage that could be consumed in an active crown fire composed of branchwood and needle mass and is based on kg/m cubed.

crown Fire– a fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as independent, conditional, or dependent (active or passive) to distinguish the degree of independence from the surface fire. Crown fires are common in coniferous forests and chaparral shrublands.

declining– the senescent (aging) period in the lifespan of plants that (for trees) includes the presence of large dead and/or dying limbs, snag-tops, large, old lightning scars, and other characteristics that indicate the later life-stages.

decommissioned road– a route that is no longer needed and has been removed from service. As it applies to roads, it means that all maintenance needs are eliminated and results in the stabilization and restoration of unneeded roads to a more natural state.

density-related mortality– based upon established forest density-vigor relationships, density- related mortality begins to occur once the forest reaches 45 to 50 percent of maximum stand density, and mortality is likely at density levels over 60 percent of maximum stand density (Long, 1985).

diameter at breast height (dbh)– A standard measure of tree diameter measured approximately 1.5 meters (4.5 feet) above the ground.

disturbance– any relatively discrete event or series of events, either natural or human-induced that causes a change in the existing condition of an ecosystem, community, or population structure and alters the physical environment. Characteristic disturbances are those whose extent, frequency, and severity fall within the natural range of variability. Uncharacteristic disturbances are outside the natural range of variability and interrupt characteristic processes and functions.

disturbance regime– a set of recurring conditions due to a variety of disturbances (e.g., fire, flooding, insect outbreak) and their interaction, which characterize an ecosystem within a historic, natural, or human induced context, within a given climate. This set of recurring conditions includes a specific range for each of the attributes of these disturbances. These attributes include: frequency, rotation period, intensity, severity, seasonality, patch size and distribution, residual structure, causal agent, the relative influence of each causal agent, and how they interact (Suffing & Perera, 2004)

diversity– the distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

down woody debris (DWD)– dead wood material on the ground in various stages of decay. There are two categories of DWD: 1) Coarse Wood Debris – dead pieces of wood greater than 3.0 inches in diameter and 2) Fine Woody Debris – dead branches, twigs, wood splinters 0.1 to 3.0 inches in diameter.

drought– periods of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore, any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, there may be a shortage of precipitation during the growing season resulting in crop damage (agricultural drought), or during the winter runoff and percolation season affecting water supplies (hydrological drought).

duff– the fermentation and humus layer lying below the litter layer and above mineral soil; consisting of partially decomposed organic matter whose origins can still be visually determined, as well as the fully decomposed humus layer. This layer does not include the freshly cast material in the litter layer, nor in the post-burn-environment ash (Brown & Smith, 2000). The top of the duff is where needles, leaves, fruits, and other castoff vegetative material have noticeably begun to decompose. Individual particles usually are bound by fungal mycelia. The bottom of the duff is mineral soil. There is a gradient, not a clear division between litter and duff.

ecological restoration– the process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration initiates or accelerates ecosystem recovery with respect to its health (productivity), processes, and functions (biodiversity, food webs, and sustainability).

environmental justice– the fair treatment and involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The White House, with Executive Order 12898, elevated environmental justice issues to the federal agency policy agenda. EO 12898 instructs each federal agency to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Clinton, 1994)

ephemeral stream– a stream that flows only briefly during and following a period of rainfall in the immediate locality.

erosion– the wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach, and remove geologic parent material or soil from one point on the earth's surface and deposit it elsewhere.

even-aged stand– a stand of trees composed of a single age class in which the range of tree ages is usually plus or minus 20 percent of rotation.

even-aged management– the application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

FARSITE– a fire growth simulation model. It uses spatial information on topography and fuels along with weather and wind files. FARSITE incorporates the existing models for surface fire, crown fire, spotting, post-frontal combustion, and fire acceleration into a 2-dimensional fire growth model.

fine scale– a 10 acre area or less at which the distribution of individual trees (single, grouped, or aggregates of groups) is described.

fire adapted ecosystem– an associated group of plant and animals that have made long-term genetic changes in response to the presence of fire in their environment.

fire ecology– The study of fire's interaction with ecosystems.

fire hazard– a fuel complex defined by volume, type, condition, arrangement, and location that determines the degree of ease of ignition and the resistance to control. Fire hazard expresses the potential fire behavior for a fuel type, regardless of the fuel type's weather-influenced fuel moisture content (Hardy, 2005).

fireline intensity– rate of heat release in the flaming front.

fire regime– a set of recurring fire conditions that characterize an ecosystem, within a historic, natural, or human induced context, within a given climate. This set of recurring conditions includes a specific range of attributes. Sugihara et al. (2006) use the following attributes: seasonality, frequency (fire return interval), intensity, severity, size, spatial complexity, and fire type. An accurate description of a fire regime will include the full range of fire events, including those that are rare and connect to the larger disturbance regime which contains the fire regime as a subset. There are five fire regimes:

> ***fire regime I***– 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced)
>
> ***fire regime II***– 0 to 35 year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced)
>
> ***fire regime III***– 35 to 100 year frequency and low/mixed severity
>
> ***fire regime IV***– 35 to 100 year frequency and high severity
>
> ***fire regime V***– 100+ year frequency and high severity.

fire regime condition class– A general description of fire's role in the ecosystem. Fire regime is characterized by fire frequency, seasonality, intensity, duration, scale and regularity/variability (Agee, Fire ecology of Pacific Northwest Forests, 1993). Characteristic vegetation and fuel conditions are considered to be those that occurred within the natural (historical) fire regime. Uncharacteristic conditions are considered to be those that did not occur within the natural (historical) fire regime, such as invasive species (e.g. weeds, insects, and diseases), "high graded" forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that maintains grassy fuels across relatively large areas at levels that would not carry a surface fire. Determination of the amount of departure is based on comparison of a composite measure of fire regime attributes (vegetation characteristics; fuel composition; fire frequency, severity and pattern) to the central tendency of the natural (historical) fire regime. The amount of departure is then classified to determine the fire regime condition class. A simplified description of the fire regime condition classes and associated potential risks are shown in the table below (NIFC, 2003):

Fire Regime Condition Class	Description	Potential Risks
Condition Class 1	Within the natural (historical) range of variability of vegetation characteristics, fuel composition, fire	Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not

Fire Regime Condition Class	Description	Potential Risks
	frequency, severity and pattern, and other associated disturbances.	mimic the natural fire regime and associated vegetation and fuel characteristics. Composition and structure of vegetation and fuels are similar to the natural (historical) regime. Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) are low.
Condition Class 2	Moderate departure from the natural historical regime of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances.	Fire behavior, effects and other associated disturbances are moderately departed (more or less severe. Composition and structure of vegetation and fuel are moderately altered. Uncharacteristic conditions range from low to moderate.
Condition Class 3	High departure from the natural (historical) regime of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances	Fire behavior, effects and other associated are highly departed (more or less severe). Composition and structure of vegetation and fuel are highly altered. Uncharacteristic conditions range from moderate to high. Risk of loss of key ecosystem components are high.

fire return interval– the number of years between two successive fires in a designated area (i.e., the interval between two successive fires); the size of the area must be clearly specified (McPherson, Wade, & Phillips, 1990).

fire risk– in the context of technical risk assessments, the term "risk" considers not only the probability of an event, but also includes values and expected losses. Within wildland fire, 'risk' refers only to the probability of ignition (both man- and lightning-caused) (Hardy, 2005)

fire type– flaming front patterns that are characteristic of a fire.

first order fire effects– effects resulting directly from the fire, such as fuel consumption and smoke production.

forage– browse and herbage which is available and can provide food for animals or be harvested for feeding; or to search for, or consume, forage.

forbs– A broadleaved, herbaceous plant (e.g., columbine).

forest health– the perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time.

forest roads– As defined in Title 23 Section 101 of the United States Code (23 U.S.C. 101), any road wholly or partially within, or adjacent to, and serving the National Forest System and which is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources.

free thinning–the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position (Helms, 1998).

FSVeg– field sampled vegetation, a USDA Forest Service national database.

fuel loads– the amount of combustible material present per unit area.

fuelwood– wood cut into short lengths or hogged (hog fuel) for burning. (SAF, 1983)

group– refers to a cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. Size of tree groups is typically variable depending on forest type and site conditions and can range from fractions of an acre (a two-tree group) (i.e. ponderosa pine, dry mixed conifer) to many acres (i.e. wet mixed conifer, spruce fir). Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped.

group selection– a cutting procedure which creates a new age class by removing trees in groups or patches to allow seedlings to become established in the new opening.

habitat– place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. Often described for individual species, e.g., spotted owl habitat, it is usually used as a generalization of where an animal may live.

hazard trees– a tree hazard refers to any potential tree failure due to a structural defect that may result in property damage or personal injury.

heritage strategy– a strategy developed in consultation with the Arizona State Historic Preservation Officer to assist in reaching a "No Adverse Effect" determination for the project (see heritage specialist report).

heterogeneity– for the purposes of this analysis, heterogeneity refers to having bio-diversity in terms of habitat and forest structure across the landscape.

hiding cover– hiding cover is defined as "vegetation capable of hiding 90 percent of a standing deer or elk from human view at a distance of 200 feet or less." High tree crown closure also provides hiding cover from aerial predators.

historic range of variation (HRV) – refers to ecosystem composition, structure, and process for a specified area and time period. Historic range of variation (HRV) is often used to determine our best estimate of "natural" conditions and functions, and thus is often our best estimate of the natural range of variation (NRV). Ecosystems change over time. It is assumed that native species have adapted over thousands of years to natural change and that change outside of NRV may affect composition and distribution of species and their persistence.

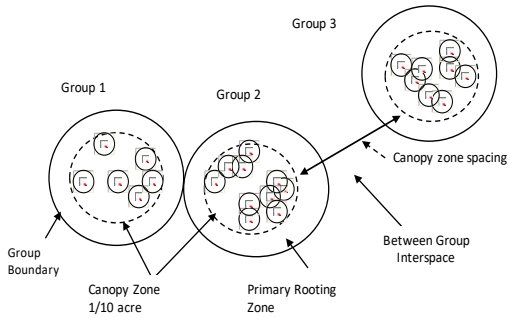
hydrologic condition– The current state of the processes controlling the yield, timing, and quality of water in a watershed (FSM 2521.05).

hydroperiod– a hydroperiod can be defined as the number of days per year that an area of land is dry or the length of time that there is standing water at a location (Gaff, DeAngelis, Gross, Salinas, & Shorrosh, 2000).

impaired waters– under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish

priority rankings for waters on the lists and develop TMDLs for these waters. See the water quality and riparian specialist report for additional information.

interspaces– openings in the forest that occur between groups. They are generally composed of grass-forb-shrub communities but could also be areas with scattered rock or exposed mineral soil. Interspaces do not include meadows, grasslands, rock outcroppings, and wetlands. These openings may be planned for regeneration (i.e. 10% in VSS1), or maintained as openings based upon site quality and desired conditions. Openings (not planned for regeneration) typically range from 10 percent in more productive sites to 70 percent in the less productive sites.



invasive– any species which can establish, persist, and spread in an area, and be detrimental or destructive to native ecosystems, habitats, or species and difficult to control or eradicate.

ladder fuel– fuel, such as branches, shrubs, or an understory layer of trees, which allow a fire to spread from the ground to the canopy.

landscape scale– is an assemblage of mid-scale units, typically composed of variable elevations, slopes, aspects, soils, plant associations, and disturbance processes. An area at this scale is comprised of multiple mid-scale units, most often 10 or more.

large tree– A large tree as defined in the revised Mexican Spotted Owl Recovery Plan (2012) is a tree greater than 18-inch dbh.

litter– the top layer of the forest, shrubland, or grassland floor above the duff layer, including freshly fallen leaves, needles, bark, flakes, fruits (e.g., acorns, cones), cone scales, dead matted grass, and a variety of accumulated dead organic matter which is unaltered, or only slightly decomposed. This layer typically does not include twigs and larger stems. One rough measure to distinguish litter from duff is that you can pick up a piece of litter and tell what it was (a leaf or leaf part, a needle, etc.). Duff is generally not identifiable. There is a gradient, not a clear division between litter and duff.

management Area– The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. Groups of management activities are called “prescriptions" and the land units are called "management areas."

mature tree– A tree that has attained most of its potential height growth.

maintenance levels– Maintenance levels define the level of service provided by, and maintenance required for, a specific road FSH 7709.58

> ***level 1–*** Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to

adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Roads receiving maintenance level 1 may be of any type, class, or construction standard, and may be managed at any other maintenance level while they are open for traffic. While being maintained at level 1, they are closed to vehicular traffic, but may be open and suitable for non-motorized uses.

level 2– Assigned to roads open for use by high clearance vehicles. Passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or specialized uses. Log haul may occur at this level.

level 3– Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. Roads in this maintenance level are typically low speed, single lane with turnouts and spot surfacing. Some roads may be fully surface with either native or processed material.

level 4– Assigned to roads that provide a moderate degree of user comfort and convenience at moderate traffic speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved and/or dust abated.

level 5– Assigned to roads that provide a high degree of user comfort and convenience. These roads are normally double lane, paved facilities. Some may be aggregate surfaced and dust abated.

mechanical treatment– Any activity (e.g., silvicultural thinning, biomass removal) performed by human-controlled tools (e.g., chainsaw, feller-buncher) that results in the removal or alteration of wood fiber. Does not include the use of fire.

Mexican spotted owl habitat– Three levels of habitat management are described in the Recovery Plan: protected areas, restricted (recovery) areas; and other forest and woodland types.

mid-scale– is a unit of 100 to 1,000 acres and is composed of assemblages of fine scale units which have similar biophysical conditions.

monitoring– a systematic process of collecting and storing data related to natural systems at specific locations and times. Determining a system's status at various points in time yields information on trends, which is crucial in detecting changes in systems.

mosaic– The spatial arrangement of habitat where there is stand heterogeneity, measured at many spatial scales from the patch, the stand, and the vegetative community.

native species– a species which is an indigenous (originating where it is found) member of a biotic community. The term implies that humans were not involved in the dispersal or colonization of the species.

nest/roost recovery habitat– areas managed to replace nest/roost habitat lost to disturbance or senescence and to provide new nest/roost habitat for a recovering owl population.

national forest system road– A classified forest road under the jurisdiction of the Forest Service.

NEXUS– a crown fire hazard analysis software that links separate models of surface and crown fire behavior to compute indices of relative crown fire potential.

non-market values– The benefits and values associated with National Forests that do not have a monetary price including clean water and air, biodiversity, forest products, and other goods and services. Also referred to as "ecosystem services."

nutrient cycling (soil) – The circulation of chemicals necessary for life, from the environment (mostly from soil and water) through organisms and back to the environment.

old growth– the last stage in forest succession. Important structural features of old growth in frequent-fire forests are large trees, old trees, age variability, snags, large dead and downed fuels, and between-patch structural variability. Old-growth habitat is the sum of the physical and biological components of old-growth forest that are essential to maintaining populations of certain old growth dependent species of wildlife.

openings– Spatial breaks between groups or patches of trees containing grass, forb, shrub, and/or tree seedlings but are largely devoid of big trees.

passive crown fire– a crown fire in which individual or small groups of trees torch out, but solid flaming in the canopy cannot be maintained except for short periods. Passive crown fire encompasses a wide range of crown fire behavior from the occasional torching of an isolated tree to a nearly active crown fire. Also called torching and candling. See also **intermittent crown fire**.

patch– a small part of a stand or forest (see also "group"); an area of vegetation, which is relatively homogeneous internally and differs from surrounding elements.

pile burning– activity fuels, once piled by machine or by hand, are burned in place.

planned ignition– the intentional initiation of a wildland fire by hand-held, mechanical, or aerial device where the distance and timing between ignition lines or points and the sequence of igniting them is determined by environmental conditions (weather, fuel, topography), firing technique, and other factors which influence fire behavior and fire effects (see prescribed fire).

post and pole– any considerable length of round timber below sawlog size ready for use without further conversion or processing (SAF, 1983).

post fledging area (PFA)– area around the nest used by the adults and young from time of fledging the nest to the time when fledglings are no longer dependent upon the adults for food. It also includes a foraging area that comprises the balance of the goshawk's home range.

pre-commercial thinning– is the removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees.

prescribed fire– is a wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition (see planned ignition).

properly functioning condition (PFC)– A methodology for assessing the physical functioning of riparian and wetland areas. The term PFC is used to describe both the assessment process, and a defined, on-the-ground condition of a riparian-wetland area.

protected habitat (Mexican spotted owl)– protected habitat consists of protected activity centers (PACs) and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas. The primary objective for protected habitat is the protection of the best available habitat for Mexican spotted owls while retaining management flexibility to abate high fire risk and to improve habitat conditions for the owl and its prey.

proposed action– in terms of the National Environmental Policy Act, the project, activity, or action that a Federal agency intends to implement or undertake (Coconino NF Forest Plan Glossary).

quadratic mean diameter– the expression of average stand diameter conventionally used in forestry is not the arithmetic mean of diameters, but the quadratic mean, quadratic mean diameter = where d_i is the diameter at breast height of an individual tree, and *n* is the total number of trees. Quadratic mean diameter is commonly symbolized as QMD. In stands with large diameters and a wide range of diameters present or with strongly skewed diameter distributions, the differences between arithmetic mean and quadratic mean diameters can be substantial. Use of the quadratic mean of diameters is a very old practice in forestry, which goes back to 19th century Germany and possibly earlier. It has been standard practice in the United States from the earliest days of North American forestry.

http://www.cnr.uidaho.edu/for274new/pdfs/s6.pdf (5/30/2012)

recovery unit– a specific geographic area, identified mainly from physiographic provinces, used to evaluate the status of Mexican spotted owls and within which to develop specific management guidelines. The recovery unit specific to this analysis is the Upper Gila Mountain Recovery Unit (RU), also referred to as the UGMRU.

recreational opportunity spectrum (ROS) – a classification system that describes different outdoor recreation settings across the forests using seven standard classes that range from primitive, undeveloped settings to urban, highly developed settings. Attributes typically considered in describing the settings are size, scenic quality, type, and degree of access, remoteness, and level of development, social encounters, and the amount of on-site management. See the recreation and scenery report for additional information.

Reference Condition (also referred to as Historic Reference Condition) – are conditions existing prior to the suppression or exclusion of the primary processes and mechanisms influencing a system along a natural trajectory. The reference can consist of one or several specified locations that contain model ecosystems, a written description, or a combination of both. Information collected on the reference includes both biotic and abiotic components.

regenerate– is the act of renewing tree cover by establishing young trees naturally or artificially.

residence time– is the time required for the flaming front of a fire to pass a stationary point at the surface of the fuel. The length of time the flaming front occupies one point; relates to downward heating and fire effects below the surface.

resiliency– the capacity of a (plant) community or ecosystem to maintain or regain normal function and development following disturbance.

resource protection measures– (design features or mitigation) are implemented to minimize nonpoint source pollution as outlined in the intergovernmental agreement between the Arizona Department of Environmental Quality and the Southwestern Region of the Forest Service.

recovery habitat (Mexican spotted owl)– ponderosa pine-Gambel oak habitat that does not meet the definitions of protected habitat, i.e., there are no known resident Mexican spotted owls, and is not considered a reserved land (e.g., designated wilderness, research natural areas, etc.). The objective in recovery habitat is to manage the landscape to maintain and create replacement owl habitat where appropriate while providing a diversity of stand conditions and stand sizes across the landscape.

riparian area– riparian ecosystems are distinguished by the presence of free water within the common rooting depth of native perennial plants during at least a portion of the growing season. Riparian ecosystems are normally associated with seeps, springs, streams, marshes, ponds, or lakes. The potential vegetation of these areas commonly includes a mixture of water (aquatic) and land (phreatic) ecosystems (Coconino NF Forest Plan Glossary).

road– A motor vehicle travelway over 50 inches wide, unless designated and managed as a trail. A road may be classified, unclassified or temporary.

road decommissioning– Activities that result in the stabilization and restoration of unneeded roads to a more natural state. Activities used to decommission a road include, but are not limited to: reestablishing former drainage patterns, stabilizing slopes, restoring vegetation, blocking the entrance to the road, installing waterbars, removing culverts, reestablishing drainage-ways, removing unstable fills, pulling back road shoulders, scattering slash on the roadbed, completely eliminating the roadbed by restoring natural contours and slopes, or other methods designed to meet the specific conditions associated with the unneeded road. (FSM 7712). One or many of the methods described may be used as deemed necessary. Decommissioning removes the road from the transportation system.

road reconstruction– Activity that results in the improvement or realignment of an existing classified road as defined:

> ***Road Improvement*** – Activity that results in an increase of an existing road's traffic service level, expansion of its capacity, or change in its original design function.
>
> ***Road Realignment*** – Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway (36 CFR 212.1).

sawlog– a log considered suitable in size and quality for producing sawn timber (SAF, 1983).

scenery management system (SMS)– guidance developed by the Forest Service for managing scenery and determining the relative value and importance of scenery in the national forest (also see VMS and the scenery specialist report for additional information).

severity– The quality or state of distress inflicted by a force. The degree of environmental change caused by a disturbance (e.g., fire).

scenic integrity objective (SIO)– Scenic Integrity or "intactness" of national forest lands is the means by which proposed alterations to the land are evaluated. Scenic Integrity is produced from the combined inventory of scenic attractiveness, viewing distance from the observer, and concern level of forest visitors. SIOs are established for the forest and can be applied at the forest, management area or treatment area. SIOs range from Very High, meaning the landscape character is unaltered, to Very Low, meaning the landscape character is highly altered. Intermediate levels include High (landscape character appears unaltered), Moderate (landscape character is slightly altered), and Low (landscape character is moderately altered). Another basic premise of the SMS is landscape character, which gives a geographic area its visual and cultural image. It consists of a combination of physical, biological and cultural attributes that make each landscape identifiable and unique. Landscape character embodies distinct landscape attributes that exist throughout an area.

slash– the residue left on the ground after timber harvest or as a result of storms, fire, girdling, or poisoning. Slash includes unused logs, uprooted stumps, broken or uprooted stems and the heavier branchwood, lighter tops, twigs, leaves, bark, and chips.

snag– standing dead tree from which the leaves or needles have fallen.

soil function– the characteristic physical and biological activity of soils that influences productivity, capability, and resiliency (FSM 2521.05).

soil productivity– the capacity of soil, in its normal environment, to support plant growth.

(soil) tolerance– the point beyond which there is high risk that potential may be permanently altered or impaired through changes in specified physical, chemical, and biological factors brought about by management activities or natural events (FSM 2521.05).

spatial pattern– the spatial arrangement of elements at the fine-, mid-, and landscape-scales that determine the function of a landscape as an ecological system.

special forest products– products or natural resources that are not the traditional timber and fiber products. Another name for special forest products is non-convertible products, because they are products that are not converted into board foot or cubic foot measure. Examples include such products as floral greenery, Christmas trees and boughs, mushrooms, transplants (trees, shrubs or herbaceous plants), cones, medicinal plants, cuttings, herbs, nuts, berries, decorative wood, and pitch.

spring– in this analysis, springs are natural water features that existed prior to Euro-American settlement and were probably functional due to lack of human disturbances.

stand– a contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands– bio-physical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time).

stand density– a measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios (e.g., height/spacing).

stand density index (SDI)– a widely used measure that expresses relative stand density based on some standard condition such as the relationship of number of trees to the stand quadratic mean diameter or the biological maximum density for a specific species (Long, 1985).

stand structure– the horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris (SAF 2008).

state historic preservation office (SHPO)– The state office responsible for consultation and assistance regarding the presence and significance of cultural resources in a project area, efforts needed to find and evaluate them, whether the project will cause harmful effects to the cultural resource, and how to reduce or avoid the harm.

stratum/strata (plural)– A layer of soil with internally consistent characteristics that distinguish it from other layers.

surface fire– A fire spreading through **surface fuels**.

surface fuels– fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants. See also duff, fuel, large woody debris, and litter.

temporary road or trail– a road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or trail and that is not included in a forest transportation atlas (36 CFR 212).

thermal cover– "a stand of coniferous trees tall enough to allow animal movement and bedding with a high degree of crown closure." Thermal cover offers protection from the heat and cold.

threatened and endangered species– Species identified by the Secretary of Interior in accordance with the 1973 Endangered Species Act, as amended. See the wildlife report for additional information.

total maximum daily load (TMDL)– A written analysis that determines the maximum amount of a pollutant that a surface water can assimilate (the "load"), and still attain water quality standards during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background levels and seasonal variation, with an allocation set aside as a margin of safety. See the Soil and Water Resources specialist report for additional information.

traditional cultural property (TCP)– Traditional use areas and places that have been used by cultural groups over generations. Natural springs are also considered TCPs and/or sacred sites by some tribes. Many plants are gathered for ceremonial on or near TCPs.

travel management rule (TMR)– On December 9, 2005, the Forest Service published the TMR. The agency rewrote direction for motor vehicle use on National Forest Service lands under 36 CFR, Parts 212, 251, and 261, and eliminated 36 CFR 295. The rule was written to address at least in part the issue of unmanaged recreation. The rule provides guidance to the Forest Service on how to designate and manage motorized recreation on the Forests. The rule requires each National Forest and Grassland to designate those roads, motorized trails, and areas that are open to motor vehicle use.

trees per acre (TPA)– a count of the total number of trees on an acre.

unauthorized road– see definition for unclassified road

unclassified road– Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail: and those roads that were once under permit or other authorization and were not decommission upon the termination of the authorization (36 CFR 212.1).

understory– The trees and other woody species growing under a more or less continuous cover of branches and foliage formed collectively by the upper portion of adjacent trees and other woody growth. In this analysis, the term understory is also referred to as "herbaceous understory."

uneven-aged forests– are forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

uneven-aged management– The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes (to provide a sustained yield of forest products). Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

vegetation structural stage (VSS)– a generalized description of forest growth and aging stages based on the majority of the trees in the specific diameter distribution of the stand. Six growth and aging stages have been identified. Goshawk management guides utilize six growth and ages stages coupled with three canopy cover classes to describe stand structure. For example, if the majority of the stems of a stand (based on proportion of total stand basal area) were in the 12-18 inch diameter class and the canopy cover was 45%, the stand would be classified as a VSS4B.

Stage	DBH Range (inches)	Description
1	0 - 0.9	Grass-forb-shrub
2	1 - 4.9	Seedling-sapling
3	5 - 11.9	Young forest
4	12 - 17.9	Mid-aged forest
5	18 - 23.9	Mature forest
6	24+	Old forest

Code	Canopy cover (%)	Description
A	0-39	Open
B	40-59	Moderately Closed
C	60+	Closed

visual management system (VMS)– The VMS was used to develop Visual Quality Objectives (VQOs) that are prescribed in the forest plan for all lands within the CNF. The VQO classifications range from Preservation, Retention, Partial Retention, Modification, to Maximum Modification. The VMS process has been updated in the Scenery Management System (SMS). See the scenery report for additional information.

watershed– The area that contributes water to a drainage or stream (Coconino NF Forest Plan, Glossary).

watershed condition– The state of a watershed based upon physical and biological characteristics and processes affecting hydrologic and soil functions (FSM 2521.05).

watershed condition framework– A framework established by the Forest Service that provides a new consistent, comparable, and credible process for improving the health of watersheds on national forests and grasslands. The framework includes a technical guide which provides protocol for assessing watershed condition across all 193 million acres of National Forest System lands (http://www.fs.fed.us/publications/watershed).

water yield– The total net amount of water produced including streamflow and groundwater Recharge (Coconino NF Forest Plan Glossary).

wildland fire– A general term describing any non-structure fire that occurs in the wildland.

wildland urban interface (WUI)– includes those areas of resident human populations at imminent risk from wildfire, and human developments having special significance. These areas may include critical communications sites, municipal watersheds, high voltage transmission lines, observatories, church camps, scout camps, research facilities, and other structures that if destroyed by fire would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved.

APPENDIX A: Old and Large Tree Implementation Plans

The issue of conserving large and old trees has been identified by stakeholders and the public and has been similarly identified and addressed in every single large-scale fire risk reduction or restoration project on the Coconino National Forest in recent years. In response to this issue, two implementation plans have been developed and integrated into the proposed action to conserve old trees and large trees. These plans are also included to meet management direction in the Healthy Forest Restoration Act to protect old growth stands and retain large trees. The plans identify ecological conditions where old pre-settlement and large, post-settlement trees may be removed to move toward or meet desired conditions.

Old Tree Implementation Plan

Old trees (approximately over 150 years old) would be retained, with few exceptions, regardless of their diameter and condition, within the project area. Removal of old trees would be rare. Exceptions would be made for threats to human health and safety and to provide for community protection goals (such as in the Baker Butte Treatment), and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation. Old trees would not be cut for forest health issues or to balance age or size class distributions.

One example of a situation where the removal of an old tree is necessary in order to prevent additional habitat degradation is in the rare case of an old tree growing on the side of an existing curve in a road. Logging equipment may require a wider turning radius. The options are to relocate the road or cut the old tree and widen the curve to accommodate the larger turning radius. Relocating the road would result in a larger area of the forest being permanently disturbed, versus cutting the large tree and widening the curve's radius. This is an example where cutting the old tree would result in less habitat degradation then relocating a road.

The guidance for identifying old trees is specific to Ponderosa pine; however there are many areas of mixed conifer vegetation with different tree species in the project area. Since the majority of the project area is made up of Ponderosa pine and Ponderosa pine is a major component of dry mixed conifer forests, old trees will be determined by the following characteristics described by (Thomson, 1940) as 3 (intermediate-mature) and 4 (mature to over-mature).

- **Age** – approximately 150 years and older.
- **D.B.H**. – Site dependent.
- **Bark** – ranging from reddish brown, shading to black in the top with moderately large plates between the fissures to reddish brown to yellow, with very wide, long and smooth plates.
- **Tops** – ranging from pyramidal or rounded (occasionally pointed) to flat (making no further height growth).

- **Branching** – ranging from upturned in upper third of the crown, horizontal in the middle third and drooping in the lower third of the crown to mostly large, drooping, gnarled or crooked. Branch whorls range from incomplete and indistinct except at the top to completely indistinct and incomplete.

For other species of trees which occur in dry mixed conifer; (white fir, Douglas fir, Southwestern white pine etc.), the assumed age of trees will be based on their size and other characteristics that do apply will be used along with professional judgment to determine if the old tree implementation plan should apply.

Large Tree Implementation Plan

The large tree implementation plan is designed to reflect the Healthy Forest Restoration Act's intent to focus on forest restoration through fire risk reduction rather than large tree removal by clarifying the intent to focus treatments on small and intermediate-diameter tree thinning, to retain large trees whenever possible, and to more specifically design treatments so that large trees would be retained unless they must be cut to meet the desired conditions listed in the categories below. The Forest Plan's desired conditions are consistent with the summarized desired conditions found in the project's purpose and need and the plan provides additional citations that support the desired conditions. It incorporates the old tree implementation plan by reference.

For the purpose of this document, large post-settlement trees, as defined by the socio-political process, are those that are 16 inches dbh or larger. Trees greater than or equal to 18 inches dbh represent VSS 5 and 6. VSS 5 and 6 represent the largest and (sometimes) oldest trees. These size classes best correspond with the successional age classification system that was developed to address the forest dynamics of southwestern ponderosa pine, which is also relevant to dry mixed conifer where it occurs in the project area.

The plan may not include every instance where large post-settlement trees may be cut. There may be additional areas and/or circumstances where large post-settlement trees need to be removed in order to achieve restoration objectives. During implementation (prescription development), if a condition exists that does not the meet the desired conditions included in this strategy, no large trees would be cut until the NEPA decision is reviewed by the Forest Service implementation team. The team would decide whether the action is consistent with the analysis and the decision made.

Exceptions to the large tree implementation plan include ecological conditions where large, post settlement trees may (or should) be removed to move toward or meet desired conditions. Since the Cragin Watershed Protection Project has a purpose and need based on fire risk reduction and watershed protection, many of the exception categories included in the Four Forest Restoration Initiative (such as exceptions to cut large trees in Seeps and Springs, Riparian areas, Wet Meadows, Encroached Grasslands, and Aspen Forest and Woodland) do not apply to this project. Exceptions where large or old trees may be cut include the following for the CWPP:

- Where necessary to meet protection of facilities and structures, public and operational safety goals, and other community protection needs.

- To remove large trees within the ponderosa pine cover type that obstruct the viewsheds from the Baker Butte Lookout Tower.

- Ponderosa Pine/Gambel Oak Forest (Pine-Oak PIPO/QUGA)
- Within Stand Openings
- Heavily-Stocked Stands (with High Basal Area)
  Generated by a Preponderance of Large, Young Trees

Fire Risk Reduction Operational Safety Needs or WUI Protection

The CWPP area includes a number of values at risk including facilities, infrastructure, residencens, and the CC Cragin Reservoir. It may be necessary to remove one or more large trees in various situations to meet the desired conditions identified to reduce specific risks or the project purpose of reducing the risk of high-intensity fire in WUI areas.

Desired Conditions

- Minimize fire hazards where protection of people, structures, and community infrastructure (such as roads, bridges, power corridors, and water supply) in and associated with the wildland-urban interface (WUI) are at risk
- Conditions in the WUI, such as live and dead fuel loading, tree basal area, logs, and snags, are on the lower end of the range given in cover type desired conditions
- In forested vegetation communities, the area occupied by interspace with grass/forb/shrub vegetation is on the upper end of, or above, the range given in the vegetation community desired conditions. Trees within groups may be more widely spaced with less interlocking of the crowns than desirable in adjacent forest lands. Interspaces between tree groups are of sufficient size to discourage isolated group torching from spreading as a crown fire to other groups.

Baker Butte Lookout Tower

The meet a desired condition for a 360 degree view from the Baker Butte fire lookout tower, it is necessary to remove 33 conifer trees and 2 oak trees greater than 24.0 inches dbh that directly obscure the view from the tower. There is an additional 3-4 conifer trees greater than 16.0 dbh that may also be removed. Hardwoods such as oak would be topped rather than flush cut to maintain wildlife habitat value of the remaining tree while removing viewshed impediments.

Ponderosa Pine/Gambel Oak Forest (Pine-Oak PIPO/QUGA)

A number of habitat types exist in the southwestern United States that could be described as pine-oak. Ponderosa pine forests are interspersed with Gambel oak trees in locations throughout the CWPP area in a habitat association referred to as PIPO/QUGA (USDA Forest Service 1997, USDI Fish and Wildlife Service 2012).

In southwestern ponderosa pine forests, Gambel oak has several growth forms distinguished by stem sizes and the density and spacing of stems within clumps. These include shrubby thickets of small stems, clumps of intermediate-sized stems, and large,

mature trees that are influenced by age, disturbance history, and site conditions (Kruse 1992, Rosenstock 1998, Abella and Springer 2008, Abella 2008a). Different growth forms provide important habitat for a large number and variety of wildlife species (Neff et al. 1979, Kruse 1992). These include hiding cover in a landscape with limited woody shrub cover, cavity substrate for birds and bats, roost potential for bats, nest sites for birds, and bark characteristics used by invertebrates. Whether as saplings, shrubby thickets, or larger sized trees, oak adds a high value for wildlife in ponderosa pine forests.

Gambel oak provides high quality wildlife habitat in its various growth forms and is a desirable component of ponderosa pine forests (Neff et al. 1979, Kruse 1992, Bernardos et al. 2004). Gambel oak enhances soils (Klemmedson 1987), wildlife habitat (Kruse 1992, Rosenstock 1998, USDI Fish and Wildlife Service 1995, Bernardos et al. 2004), and understory community composition (Abella and Springer 2008). Large oak trees are particularly valuable since they typically provide more natural cavities and pockets of decay that allow excavation and use by cavity nesters than conifers. In addition to its important ecological role, Gambel oak has high value to humans as it is a popular firewood that possesses superior heat-producing qualities compared to other tree species (Wagstaff 1984).

Although management on public lands with regard to oak has changed to better protect the species, illegal firewood cutting of Gambel oak, and elk and livestock grazing negatively impact oak growth and regeneration (Harper et al. 1985, Clary and Tiedemann 1992). Illegal firewood cutting of Gambel oak continues to result in the removal of rare, large diameter oak trees (Bernardos et al. 2004).

A literature review by Abella and Fulé (2008) found that Gambel oak densities appear to have increased in many areas with fire exclusion, especially in the small and medium diameter stems (under 8 inches dbh). Chambers (2002) found that Gambel oak on the Coconino NF was distributed in an uneven-aged distribution, dominated by smaller size classes (under 5 centimeter dbh) and few large diameter oak trees. Because of Gambel oak's slow growth rate, there may be little opportunity for these small Gambel oak trees to attain large diameters (over 85 centimeters) (Chambers 2002).

Pine competition with oak has been identified as an issue in slowing oak growth, particularly for older oaks (Onkonburi 1999). Onkonburi (1999) also found that for northern Arizona forests, pine thinning increased oak incremental growth more than oak thinning and prescribed fire. Fulé (2005) found that oak diameter growth tended to be greater in areas where pine was thinned relative to burn only treatments and controls. Thinning of competing pine trees may promote large oaks with vigorous crowns and enhanced acorn production (Abella 2008b), and may increase oak seedling establishment (Ffolliott and Gottfried 1991).

Desired Conditions

All Gambel Oak

- Small oak trees develop into larger size classes.
- Fire treatments retain small and shrubby oak in numbers and distribution.
- All growth forms of Gambel oak are present and larger, older oak trees are enhanced and maintained.

- Large, post-settlement trees are not restricting oak development.
- Frequent, low intensity surface fire occurs in ponderosa pine-Gambel oak forests.
- Brushy thicket, pole, and dispersed clump growth forms of Gambel oak are present and maintained by allowing natural self-thinning, thinning dense clumps, and/or burning.
- Gambel oak growth forms are protected from damage during treatments including thinning and post-thinning slash burning.

In Mexican Spotted Owl Recovery Habitat

- Within Mexican spotted owl habitat and designated critical habitat, the recovery plan for the Mexican spotted owl improves key habitat components and primary biological factors, which includes Gambel oak (USDI Fish and Wildlife Service 2012).
- Within 30 feet of oak 10- inch diameter at the root collar or larger, post-settlement mixed conifer trees up to 18 inches dbh (that do not have interlocking crowns with oak) are not restricting oak development.

Outside Mexican spotted owl Recovery Habitat

- Large post-settlement trees' drip lines or roots do not overlap with those of Gambel oak trees over 8 inch diameter at the root collar.

Within-stand Openings

Within-stand openings are small openings in Ponderosa pine dominated vegetation types (generally 0.05 to 1.0 acres) that were occupied by grasses and wildflowers before settlement (Pearson 1942, White 1985, Covington and Sackett 1992, Sánchez Meador et al. 2009). These within stand openings are also known as interspaces. Creating within stand openings is very important to change forest structure to facilitate low intensity wildfire that has canopy openings between groups of trees with closed canopies and helps move conditions toward Forest Plan desired conditions (USDA Forest Service 2018, pp. 62, 69, 224). For the purposes of this strategy, within-stand openings are equivalent to interspaces. The within-stand opening management approach described below is distinct from, and should not be considered as guidance relating to regeneration openings.

For mixed conifer, denser conditions are desired with interspaces ranging from 10 to 50 percent of the area. In areas with mixed conifer habitat canopy openings would be smaller and tree groups would be at finer scales with aggregates and individual large trees separated by small openings.

Pre-settlement openings can be identified by the lack of stumps, stump holes, and other evidence of pre-settlement tree occupancy (Covington et al. 1997). These openings are most pronounced on sites with heavy textured (e.g., silt-clay loam) soils (Covington and Moore 1994). Current openings include fine-scaled canopy gaps. It is not necessary to have desired within-stand openings and groups located in the same location that they were in before settlement (the site fidelity assumption). Trees might be retained in areas that were openings before settlement, and openings might be established in areas which had previously supported pre-settlement trees.

Within-stand openings appear to have been self-perpetuating before overgrazing and fire exclusion (Pearson 1942, Sánchez Meador et al. 2009). Fully occupied by the roots of grasses and wildflowers as well as those of neighboring groups of trees, these openings had low water and nutrient availability because of intense root competition (Kaye et al. 1998). Heavy surface fuel loads insured that tree seedlings were killed by frequent surface fires, reinforcing the competitive exclusion of tree seedlings (Fulé et al. 1997).

These natural openings appear to have been very important for some species of butterflies, birds, and mammals (Waltz and Covington 2004) in Ponderosa pine forests. Often the largest post-settlement trees, typically a single tree, became established in these natural within-stand openings as soon as herbaceous vegetation was removed by historic overgrazing (Sánchez Meador et al. 2009). Similar patterns have been found in mixed conifer forests where tree spatial patterns were random or aggregated prior to European settlement and that the large majority of trees were isolated or in groups of 2-4 trees (Rodman 2016). Contemporary within- stand openings or areas dominated by smaller post-settlement trees should be the starting point for restoring more natural within-stand heterogeneity in Ponderosa pine and mixed conifer vegetation types.

Desired Conditions

- The pattern of openings within stands that provide natural spatial heterogeneity for biological diversity are conserved.
- Openings break up fuel continuity to reduce the probability of torching and crowning and restore natural heterogeneity within stands.
- Openings promote snowpack accumulation and retention which benefits groundwater recharge and watershed processes at the fine (1 to 10 acres) scale.
- The presence of such trees does not prevent the reestablishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other objectives.
- Groups of trees typically range in size from 0.1 acre to 1 acre. Canopy gaps and interspaces between tree groups or individuals are based on site productivity and soil type and range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition.
    - Mixed conifer forests types will be treated to result in a more finely grouped pattern with many stand-alone trees
- Suitable openings for successful natural regeneration in this project would range in size from 3/10 to 8/10 of an acre. Openings would be created by focusing on removal of VSS 3 and lower VSS 4, given the excess of such trees across the project area.

Heavily-Stocked Stands (with High Basal Area) Generated by a Preponderance of Large, Young Trees

In some areas, the increase in post-settlement trees has been so rapid that current stand structure is characterized by high density and high basal area in large, young ponderosa pine trees. These stands or groups of stands exhibit continuous canopy which promotes unnaturally severe fire effects under severe fire weather conditions. At the fine scale, the management approach would apply on a case-by-case basis. The cutting of large trees may be necessary to meet site-specific ecological objectives as listed below. For example,

the cutting of large trees may be necessary in order to reduce the potential for crown fire to spread into communities or important habitats that include Mexican spotted owl and/or goshawk nest stands. This approach would apply when other options would not alleviate severe fire effects.

In stands where pre-settlement evidences, forest structure, community protection, or other project desired conditions indicate much lower tree density and basal area would be desirable, large post-settlement pines may need to be removed to achieve post-treatment conditions consistent with trajectory toward desired conditions. Where evidence indicates higher tree density and basal area would have occurred pre-settlement, only a few large pines may need to be removed. Many of these areas would support crown fire and, thus, require structural modification to reduce crown fire potential and restore understory vegetation that supports surface fire.

Desired Conditions

- Groups are restored by retaining the largest trees on the landscape to reestablish old growth structure in the shortest timeframe possible.
- Decreased shading and interception from the canopy, decreased needle litter and duff, and surface fire restore and maintain a mosaic of natural vegetative communities.
- Decreased shading and interception from the canopy fuels allow the growth of continuous herbaceous surface fuels to carry surface fire.
- Reduced horizontal and vertical canopy fuels reduce the potential for crown fire.
- Fire is the principle regulator of forest structure over time.
- Regeneration openings that contribute to the ecological objective of natural heterogeneity of historical forest structure and age class diversity are not encroached upon by trees.

Stands with a preponderance of large young trees (SPLYT) that meet the following criteria and that are located outside of Mexican Spotted Owl (MSO) Protected Activity Centers, MSO Recovery Habitat, and wildland urban interfaces (WUI), should be treated at the lowest range of intensity to meet desired conditions. For ponderosa pine SPLYT, criteria are that: a) the Quadratic Mean Diameter (QMD) of the top 20% of trees is >15" diameter at breast height (DBH), and b) there is >50 square feet/acre of basal area (BA) in trees >16" DBH. All stands would be field-verified prior to mechanical thinning. Stands (or portions thereof) meeting SPLYT criteria, including those not captured by the data filter, would be treated at the lowest range of intensity within the identified silvicultural prescription. For example, a stand identified by the decision matrix to receive an uneven-aged treatment leaving 10 to 25% interspace, would be treated to 10% interspace and to the upper end of its natural range of variation for trees per acre (TPA) and BA in order to maintain large tree dominance and conditions favorable to canopy-dependent species. Stands (or portions thereof) that are identified by the SPLYT criteria data filter but, upon field verification, are determined not to meet the SPLYT criteria, will be treated within the range of intensities applied to other non-SPLYT stands.

APPENDIX B: Project Design Features, Best Management Practices and Project Monitoring

The design features listed below are the best compilation at this time of resource protection measures to mitigate impacts of implementing the project. They come from the Forest Plan or are modified from the Forest Plan guidelines or come from Forest Manual or Handbook direction as well as law and regulation. These design features may be modified, changed or new measure added in response to public comments and the environmental analysis process.

Table 98. Project Design Features

SILVICULTURE	
Vegetation Protection during Thinning and Timber Harvest	
S1	Identify staging areas for heavy equipment to protect existing vegetation surrounding project sites from damage from logging activities
S2	Minimize creation of green slash between January and June, and monitor the green slash left on site so that if a serious bark beetle (*ips spp.*) infestation develops it can be treated.
Slash Treatment	
S3	In thin and pile areas, pile slash in openings, outside drip lines of retained trees whenever possible.

PROCESSING SITES	
Authorization and Permitting	
P1	Processing sites would be authorized under the terms of the timber contract or through a special use authorization depending on who would be the operator. Fees may be associated with special use authorizations.
P2	Through the Arizona Department of Environmental Quality (ADEQ), the operator of a processing site would obtain coverage under a Multi-Sector General Permit (MSGP) for storm water discharges associated with non-mining industrial facilities such as timber products http://www.azdeq.gov/node/525 and http://www.azdeq.gov/permits-needed-timber-products-sector . Coverage under this permit would entail preparation and implementation of a storm water pollution prevention plan (SWPPP) as well as periodic inspections of the facility consistent with requirements of the permit.
P3	Petroleum storage in aboveground storage containers with a total aggregate capacity of 1,320 gallons or more, would be subject to the Spill Prevention, Countermeasures, and Contingency (SPCC) Rule and a SPCC plan is required. A permit for installation of an aboveground storage tank is also required through the AZ State Fire Marshall's Office, https://www.dfbls.az.gov/ofm/AGST.aspx .
	Design and Construction
P4	Support operations and facilities on processing sites that would be allowed include: office trailers, sanitation facilities and fuel products storage containers or temporary structures. Fencing would be allowed to provide security for equipment and products. Camping or living trailers would not be allowed in the processing sites. Operators would provide their own water and water storage facilities and trash pickup. Connections to nearby powerlines and phones lines would be permitted (Sites 211 Revised and 9033H). Operations on site would comply with fire restrictions and forest closures as applicable. Processing sites located in the interior of the project area would operate when the roads are open and passable and would be closed during the winter months, typically mid-December to April. Sites located near State Highway 87 may be operated year round (Sites 211 Revised, 9033H).
P5	The design, construction and operation of processing sites shall utilize practicable procedures for control of surface water runoff from facilities.

PROCESSING SITES	
P6	Aggregate surfacing of the processing site location would be required to minimize soil rutting, control surface water runoff and allow for operations during wet weather periods
P7	Processing site equipment and vehicles shall be operated and maintained to minimize petroleum and lubricating products from entering soil or surface/ground waters.
	Reclamation and Rehabilitation
P8	The contractor or permittee operating the processing site shall maintain the authorized facility and site in good condition and in accordance with approved contract or operating plans and specifications. When the contractor or permittee completes the authorized activity, they must rehabilitate by removing all facilities and structures, removing all wastes with disposal at an approved facility, restoring the pre-disturbance site gradient, preparing the site for reseeding by scarifying the site, and application of a native seed mix native as specified and approved by the Forest Service

SOIL AND WATERSHED PROTECTION	
In order to avoid negative impacts to soils and water resources, best management practices (BMPs) would be implemented for prescribed fire and mechanical vegetation treatment measures. These resource protection measures are derived mainly from the Soil and Watershed Conservation Practices Handbook (FSH 2509.22) and the National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide (USDA Forest Service, 2012). Resource protection measures are implemented to protect soils and minimize nonpoint source pollution as outlined in the intergovernmental agreement between the Arizona Department of Environmental Quality and the Southwest Region (Region 3) of the Forest Service (ADEQ, 2008). BMPs would be incorporated in prescribed fire burn plans and timber harvesting or stewardship contracts. Where applicable, design features that are included for other resources are noted.	
Prescribed Burning	
SW1	Incorporate prescription elements into the prescribed fire plan including such factors as weather, slope, aspect, soils, fuel type and amount, and fuel moisture in order to minimize high soil burn severity.
SW2, WL	Consider the spatial distribution and contiguous size of the planned burn area in a watershed during prescription development to reduce the effects of peak flow change on channels.
SW3, WL	At a minimum, all perennial water bodies including but not limited to streams and springs, wetlands, and areas with riparian ecosystems would be designated as Aquatic Management Zones (AMZs), also called filter strips. Those stream channels that support seasonal flow in response to snowmelt and/or seasonal fluctuations in the water table would also be evaluated for potential designation as AMZs. AMZ widths would be adjusted based on the steepness of up gradient hillslopes.
SW4,WL	AMZ width is the distance measured perpendicularly from the outer edges of the stream course (i.e., channel bank) or wetland. For stream courses or wetlands with up gradient hillslopes of 35% or less, the AMZ width shall be 25'plus the width of the stream course (i.e., 25' from either streambank). For those with up gradient hillslopes greater than 35%, AMZ width shall be 50' plus the width of the stream course (i.e., 50' from either streambank).
SW5,WL	Equipment/vehicle staging areas, and fuel used for ignition devices would be located outside of AMZs. Ignition of fuels would not be initiated within AMZs. Prescribed fire can occur within AMZs while meeting desired objectives for vegetation, soils, snags, down logs, etc. Hand piling and burning of slash within AMZs would be avoided to the extent practicable.
SW6, SCN,WL	Control lines for prescribed burns would be sited and constructed in a manner that minimizes erosion and prevents runoff from directly entering water bodies by consideration of placement relative to the water body or bodies and lay-of-the-land and through construction and maintenance of suitable drainage features such as water bars. To minimize the need to create new lines, features such as existing roads and old roadbeds would be used to the extent possible and sensitive areas including wetlands and riparian areas would be avoided. Where applicable, natural fire breaks such as outcrops would be used in lieu of ground-disturbing containment lines. In general, spacing of water bars would be such that water bars are located at eye level when viewed starting at the bottom of a slope and traversing upward.

SOIL AND WATERSHED PROTECTION	
SW7, SCN,WL	Fire containment lines would be rehabilitated by rolling back the soil berm formed during line construction and constructing drainage features as necessary to prevent concentration of runoff. Disguise containment lines to line of sight or first 300 feet, whichever is greater, from where they intersect trails or roads using native materials such as rocks and slash.
SW8, SCN	Staging areas would be kept as small as possible while allowing for safe and efficient operation.
Thinning and Timber Harvest	
SW9, SP	At a minimum, all perennial water bodies including but not limited to springs and streams, wetlands, and areas with riparian ecosystems shall be designated as Aquatic Management Zones (AMZs. Those stream channels that support extended flow in response to snowmelt and/or seasonal fluctuations in the water table shall also be evaluated for potential designation as AMZs. AMZ widths shall be adjusted based on the steepness of up gradient hillslopes with the following general guidelines listed below.
SW10, SP	AMZ width is the distance measured perpendicularly from the outer edges of the stream course (i.e., channel bank) or wetland. For stream courses or wetlands with up gradient hillslopes of 35% or less, the AMZ width shall be 25' plus the width of the stream course (i.e., 25' from either streambank). For those with up gradient hill slopes greater than 35%, AMZ width shall be 50' plus the width of the stream course (i.e., 50' from either streambank).
SW11	All fueling/servicing of vehicles shall be conducted in a designated staging area outside of AMZs. Temporary fuel storage tanks shall be permitted and installed in accordance with the Office of the State Fire Marshall requirements.
SW12,W L	Prior to conducting harvesting activities, all skid trails, cable yarding corridors, temporary roads, and landings shall be designated on a map and visibly marked by means of flagging or other suitable measures for approval by the timber sale administrator. This requirement is included in contract provision BT6.422 (landings and skid trails) and BT6.63 (temporary roads).
SW13,W L	Skid trail design shall not include long, straight downhill segments which would concentrate runoff. Skid trails shall be located out of AMZs except at approved crossings. Skidding up or down drainage courses shall not be permissible.
SW14	Insofar as safety permits, trees shall be felled to angle in the direction of skidding.
SW15	The following activities shall be prohibited in AMZs: skid trails, new temporary roads (except at designated crossings), landings, and machine piling of slash. This requirement is included in timber sale contract provision BT6.5 (stream course protection).
SW16	Crossing of AMZs must be at designated locations as approved by the timber sale administrator. Temporary road or skid trail crossings of stream courses shall be oriented perpendicular to the stream course.
SW17,W L	Equipment would not be operated when ground conditions are such that excessive damage would result as visually monitored through such indicators as soil rutting. This requirement is included in timber sale contract provision B9.3 (Breach).
SW18	Machine piling of logging slash would be done in such a manner as to minimize the construction of new clearings for slash piles through use of natural openings, temporary roads, and landings. Slash would not be piled adjacent to old trees (as defined in the large tree retention policy) or next to trees > 24 inches dbh.
SW19,W L	Drainage of roads shall be controlled by a variety of methods including but not limited to insloping of the road bed toward an interior drainage ditch with periodic cross drains, outsloping of the road bed, crowning of the road bed, and construction of rolling dips and turn-outs. Drainage from landings and skid trails shall be controlled to prevent concentration of runoff.
SW20,W L	Skid trails shall be restored after use by a combination of any or all of the following practices in order to prevent the concentration of runoff in skid trails and to protect exposed soil: reshaping the surface to promote dispersed drainage (i.e., create convex vs. concave cross-section), installation of drainage features such as water bars to shed water, and spreading slash across skid trails to protect areas where mineral soil is exposed. Where skid trails intersect existing roads or trails, native materials such as logs, slash, and/or boulders shall be placed along skid trail to line-of-sight or first 300', whichever is greater. This requirement is described in a standard

SOIL AND WATERSHED PROTECTION	
	contract provision BT6.6 (erosion prevention and control), BT6.67 (erosion control structure maintenance) and within the road package
SW21	Skidding shall be limited to slopes less than 40%.
SW22	Where visual observation indicates that the above methods of erosion protection are inadequate, a certified weed-free mix of native or naturalized grasses suitable for the area would be broadcast evenly over the inadequately protected surface at the rate 5 pounds per acre after surface scarification. This requirement is included in timber sale contract provision BT6.01.
SW23,WL	Unless waived in writing, following the completion of skidding and yarding operations in the project footprint, all landings, skid trails, and temporary roads constructed by the contractor shall be scarified by the contractor to a depth of not less than four inches and must effectively prepare the ground for seeding. If deemed necessary by district sale administration staff, the contactor shall seed with native, weed-free seed areas of exposed soil on landings, skid trails, firebreaks and temporary roads where other erosion control measures will not result in satisfactory control of soil movement. The need for seeding would be determined by the District timber sale administrator in conjunction with the District hydrologist and is included in timber sale contract provisions (WO) CT6.601# (Erosion Control Seeding) and CT6.602 (Temporary Road and Landing Scarification).

TRANSPORTATION SYSTEM, ROAD USE AND MAINTENANCE, ROCK PIT USE	
	Where applicable, design features that are included for other resources are noted.
RD1	Applicable Coconino National Forest Management Plan direction, Best Management Practices, Forest Service Manual and Handbook direction, as well as standard mitigation measures would be implemented.
RD2	A new temporary road is a primitive road created during vegetation treatment activities for the specific purpose of transporting woody material from the project area. The road is constructed where there is no evidence of a road prism being present and/or does not exist in the FS transportation system. During use the new temporary road shall be stabilized by use of such measures as, but not limited to, outsloping and installing drainage dips. After the new temporary road has served its purpose, the road will be rehabilitated which may include lopping and scattering of slash, ripping and seeding, installing adequate drainage structures and effectively blocking the road to normal vehicular traffic where feasible. This requirement is included in the standard timber contract provision BT6.63 (temporary roads). An existing temporary road is a road used for harvest activities that is recorded in the FS transportation system as decommissioned. After use of such road, it is the contractor's responsibility to return the road to the condition it was immediately prior to operations.
RD3	New temporary roads and landings would be restored after use by a combination of any or all of the following practices in order restore original topography, protect soils, and prevent concentrated runoff: roll berms created during temporary road and/or landing construction back across the disturbed surface to restore original surface topography to the extent practicable, install drainage features such as water bars where needed to prevent runoff from concentrating, and spread slash on areas with exposed mineral soil. Where new temporary roads intersect existing roads or trails, native materials such as logs, slash, and/or boulders would be placed along temporary road to line-of-sight or first 300', whichever is greater.
RD4, NW	New temporary roads would be seeded with certified weed free native or naturalized grasses suitable for the area. Where feasible, slash would be spread across the road to disguise the roadbed and provide for surface roughness.
RD5, SCN	Where new permanent gates are necessary, use non-reflective materials such as self-weathering steel, dimensional timbers, etc. that are Forest Service in character.
RD6,SU	Track-out gravel pads used to remove mud and dirt from tires are required wherever contract logging trucks enter the SR87 highway from a FS native surfaced or aggregate surfaced road.
RD7, SU	A traffic control and signage plan will be required for logging and prescribed burning activities conducted by the FS or contractors over throughout the project area and including entering and exiting the forest from SR87.
RD8	Removal of common variety mineral materials under terms of a timber sale or other Forest Service contract (see 36 CFR 228.63). In carrying out timber sales that involve road construction

	and maintenance, the Forest Service may specify that mineral materials be mined, manufactured, and/or processed for incorporation into the improvement. Where the mineral material is located on National Forest lands and is designated in the contract calling for its use, no permit is required as long as an operating plan as described in 36 CFR 228.56 is specified in the contract provisions and approved by the Forest Service. Title to any excavated material in excess of that needed to fulfill contract requirements revests in the United States without reimbursement to the contract holder or agents or representatives of the contract holder (36CFR 228.58, 228.59, or 228.62

HERITAGE	
Where applicable, design features that are included for other resources are noted.	
H1	The project administrator is responsible for coordinating with the District or Forest Archaeologist in advance of project activity implementation in order to comply with the conditions of the cultural resources clearance. Enough lead time would be provided to conduct pre-implementation survey or site marking work if needed.
H2	Archaeological sites will be marked for avoidance in the field prior to implementation of activities. This requirement is included in timber sale contract provision BT6.24 (protection measures needed for plants, animals, cultural resources, and cave resources). Fire-sensitive sites identified by the archeologist will be lined or otherwise avoided and monitored as needed during and following prescribed burning operations.
H3	All National Register of Historic Places (NRHP) eligible or sites that have not been evaluated will be protected from ground disturbing activities.
H4	Temporary roads will be surveyed prior to their construction following the plan submitted to and approved by the State Historic Preservation Office (SHPO).
H5, REC, SCN	Historic trails, roads and trail markers in the project area will be protected during project implementation in accordance with timber sale contract provision BT6.221, and BT6.22 (protection of improvements not owned by the forest service and those owned by the forest service respectively).
H6	Previously undocumented archaeological sites if discovered during project activities will be reported to the District or Forest Archaeologist within two working days. No activities near the discoveries will take place until such time as the District or Forest Archaeologist can visit the location and determine needed site protection zones. Should sites be damaged by project activities, it must be reported immediately to the District or Forest Archaeologist and all work near the previously recorded site, if not previously recorded must cease, in accordance with timber sale contract provision BT6.24 (protection measures needed for plants, animals, cultural resources and cave resources). Work cannot continue until a damage assessment report is prepared. Damage may include ground disturbance, burning of combustible artifacts or features, heavy scorching or killing of historic tree features, or other physical impacts to the sites.

WILDLIFE	
Where applicable, design features that are included for other resources are noted.	
Mexican Spotted Owl	
W1	Mexican spotted owl (MSO) surveys would be coordinated with the Fish and Wildlife Service the year of implementation or one year prior to determine occupancy of owls in the project implementation area. Surveys include the project area plus ½ mile beyond the perimeter of the project boundary. If a new owl(s) are located, the District biologist will work with USFWS to designate a protected activity center in accordance with the Recovery Plan guidelines.
W2	The CWPP project footprint lies within the boundary for the Four Forest Restoration Initiative (4FRI) Rim Country project as well as other forest thinning and burning projects. District staff will work with USFWS and any other entities as necessary (e.g., other stakeholders) to ensure that all proposed treatments are coordinated to ensure that there are not multiple entries into sensitive habitats (such as MSO PACs or occupied habitat for federally listed or candidate fish species) that are split between different project boundaries. In doing so, habitat and noise disturbance to these areas would be minimized.

WILDLIFE	
W3	Information regarding implementation would be provided to USFWS at annual coordination meetings, in the form of an annual report, or other requested format. This would include time of year project activities were implemented, whether project activities were implemented as analyzed in the site specific Biological Opinion (including conservation measures and terms and conditions), relevant MSO survey information, and any other pertinent information about the project's effects on individual owls, to the extent possible.
W4	Minimize mechanical treatments, hand thinning, hauling, and road maintenance within occupied PACs and within 0.25 mile of PACs during the breeding season (March 1 to August 31) that could result in disturbance to nesting owls. If the District determines through protocol surveys that spotted owls are not nesting the year of a proposed activity or locates a nest and is able to buffer the breeding owls from noise throughout the breeding season, then this restriction would not apply. Coordination with USFWS regarding determinations of nesting status and buffers is required for these activities to occur in a PAC or within 0.25 mile of a PAC. None of these activities are proposed in nest cores. Exceptions to this measure would occur for hauling and three of the five priority areas. Hauling along FRs 95, 123, 139, 141, and 147 would occur during the breeding season as vegetation and topography features would minimize noise disturbance. Mechanical treatments and hand thinning in PACs would still comply with the measure, but treatments within the 0.25 mile buffer of the individual PACs in three of the five priority areas (General Springs, Kinder Springs, and McCarty Ridge) would occur for up to 2 consecutive breeding seasons to reduce the time needed to complete them.
W5	Pile burning would occur in PACs during the fall/winter to minimize impacts from smoke on nesting owls. Initial entry and maintenance burning within PACs could occur during the breeding season but would require coordination with the FWS and District biologist.
W6	Prescribed fire would be allowed to enter nest cores only if it is expected to burn with low fire severity and intensity. Fire management tactics including burning when relative humidity is higher and backing fire into drainages would be used to reduce fire effects and to maintain key habitat elements (e.g. hardwoods, large downed logs, snags, and large trees).
W7	In MSO recovery habitat, manage for large oaks by removing conifers up to 18 inches dbh that do not meet the "old tree" definition within 30 feet of oak 10 inches diameter at root collar or larger. Trees larger than 18 inches may be removed to manage for large oaks in conformance with the old and large tree implementation plan.
W8	Coordinate burning spatially and temporally to limit smoke impacts to nesting owls (March 1 to August 31). Minimize prescribed burning in PACs or within 0.25 mile of PACs during the breeding season (March 1 to August 31) that could result in disturbance to nesting owls from smoke or noise. If the District determines through protocol surveys that spotted owls are not nesting the year of a proposed activity or locates a nest and is able to buffer the breeding owls from disturbance during implementation of the burn(s), then this restriction would not apply. Coordination with USFWS regarding determinations of nesting status and buffers is required for prescribed fire to occur in a PAC or within 0.25 mile of a PAC during the breeding season.
W9	To minimize the collisions with owls, if hauling will occur in the 2 hours prior to sunrise or after sunset, the speed limit for log trucks in the action area would be 15 mph. If an owl or raptor is hit, the USFWS will be notified immediately so that the specimen could be collected.
W10	Development of prescriptions for mechanical treatments in all owl habitats would be required to involve USFWS and District biologists.
Federally Listed & Sensitive Fish Species	
W11, SW	Minimize impacts to federally listed and sensitive fish species and aquatic habitats through implementation of watershed design features and BMPs. See also soil and watershed protection BMPs.
Other Forest Plan Guidelines for Wildlife	
W12	Minimize mechanical treatments, hand thinning, hauling, and road maintenance that could result in disturbance to nesting goshawks within occupied PFAs during the breeding season. If the District determines through surveys that goshawks are not nesting the year of a proposed activity or locates a nest and is able to buffer the breeding birds from noise throughout the breeding season, then this restriction would not apply. Coordination with the District biologist regarding determinations of nesting status and buffers is required for these activities to occur in a PFA. If a

WILDLIFE	
	new pair(s) of northern goshawks are found during implementation of the project, the District biologist will designate post-fledging family areas following Forest Plan guidelines.
W13	Prescribed burn plans in northern goshawk PFAs would be designed and implemented to minimize smoke impacts to nesting birds and minimize loss of nest trees.
W14	No mechanical treatments would occur within 0.25 mile of the peregrine eyrie near the headwaters of Dude Creek if occupied during the breeding season (March 1 – August 15).
W15	Burn plans within 0.5 mile a peregrine falcon eyrie would be coordinated with the District wildlife biologist to ensure nesting falcons would not be adversely impacted by smoke.
W16	Minimize impacts to large snags and logs where possible through site preparation, implementation planning, and ignition techniques to retain: In ponderosa pine and ponderosa pine – Gambel oak habitats, an average of 1 – 2 snags per acre ≥18 inches dbh and ≥3 logs with >12 inches mid-point diameter and ≥ 8 feet in length In dry mixed conifer habitats, an average of 3 snags per acre ≥18 inches dbh and an average of 3 logs with >12 inches mid-point diameter and ≥ 8 feet in length In wet mixed conifer habitats, an average to 1 – 5 snags per acre >18 inches dbh and large logs depending on seral stage.
W17	Emphasize retention of snags exhibiting loose bark to provide habitat for roosting bats.
W18	Where possible, retain the largest and tallest snags and downed logs along edges of openings and within groups/clumps of trees to provide habitat and roost sites for wildlife species such as small mammals, cavity-nesting birds, and tree-dwelling bats.
W19	To increase small mammal occupancy in areas where logs are deficient and to provide nesting habitat and cover for turkeys, birds, small mammals, reptiles, and invertebrates, retain slash piles for several years, rather than burning them immediately. This should be coordinated with the District biologist, be consistent with scenic integrity objectives and balanced with potential threats from bark beetles and fire/fuels concerns.
W20	To minimize potential impacts to other breeding raptor species, project-related activities with the potential to disturb active nests should be restricted within a minimum of 300 yards. Coordination with the District biologist is required to determine the appropriate buffer size.

NOXIOUS AND INVASIVE WEEDS	
The Best Management Practices as outlined in Appendix B of the "Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds" (USDA Forest Service, 2005) would be followed to incorporate weed prevention and control into the project. The following design features would be incorporated into project implementation and monitoring.	
NW1	Avoid known populations of noxious or invasive weed during project activities.
NW2	Survey temporary roads and landings before work begins. Avoid existing noxious or invasive weeds during soil disturbing activities.
NW3	Prevent the spread of potential and existing noxious or invasive weeds by vehicles used in management activities by incorporating weed prevention and control into project layout, design, and implementation.
NW4	Fully incorporate the equipment cleaning provisions (BT6.35 equipment cleaning) of the timber sale and/or stewardships contracts into the implementation contract(s) to prevent the introduction or spread of noxious or invasive weeds.
NW5	Clean all equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds before entry into a project area. Clean vehicles, machinery and tools before moving from infested areas into uninfected areas.
NW6	When in areas where known noxious weeds exist, designate turnaround sites for log trucks and other large equipment that are weed free.

NOXIOUS AND INVASIVE WEEDS	
NW7	Manage prescribed fires as an aid to control of existing weed infestations and to prevent the spread of existing weeds through coordination with the District Weeds Coordinator.
NW8	Place slash piles on previously used locations such as old piling sites, old log deck sites, or other disturbed sites to avoid severe disturbance to additional locations where possible.
NW9	Monitor slash pile sites after burning and if found, control noxious or invasive weeds.
NW10	Avoid acquiring water from weed-infested areas to use for dust abatement.
NW11	Minimize period from end of project activities to site rehabilitation, revegetation, and contract closure.
NW12	Inspect material sources and ensure that they are weed-free before use and transport. Treat weed-infested sources for eradication and strip, stockpile and treat contaminated material before using pit materials. Inspect and document areas where materials are used annually for at least 3 years after project completion to ensure that any weeds transported to the site are promptly detected and controlled.

MOGOLLON RIM BOTANICAL AREA	
MRBA1	The botanical area is managed to maintain existing conditions and natural processes for public enjoyment, demonstration, and study. Natural events are not rehabilitated.
MRBA2	Off-road driving is prohibited.
MRBA3	Exclude timber harvest and fire wood cutting in the Mogollon Rim Botanical Area to help conserve the white fir/maple vegetation community represented the botanical area.
MRBA4	Use prescribed fire with planned ignitions as a management tool provided its use is compatible with the management of the specific area.

SENSITIVE PLANTS	
SP1	Determine locations of Region 3 sensitive plants within the treatment areas through survey, herbarium searches, or reviews of existing data to allow for mitigation of management effects.
SP2	Prohibit slash pile or fire line construction within populations of Region 3 sensitive plants.
SP3	Construct slash piles at least 10 to 20 feet away from known populations of Region 3 sensitive plants to the extent practicable.
SP4	Avoid known populations of Region 3 sensitive plants when constructing temporary roads or reconstruction, log landings, use of tracked vehicles.
SP5	Retained tree groups may include Region 3 sensitive plant groups where practical to allow for retention of existing plants.
SP6	Review existing data on locations of Bebb's willow and/or survey springs or channels before ground disturbance activities in those areas that could destroy Bebb's willow plants. Mitigate the loss of existing plants to the extent possible by avoidance, fencing, etc. The surveyed area may be localized but should include the area of disturbance.
SP7	Protect documented locations of Bebb's willows during prescribed burning if there is risk of loss. This could be done by constructing firelines, no ignitions near the plants or other techniques as determined by fire personnel.
SP8	Review watershed BMPs for project area and incorporate mitigations for Arizona sneezeweed into BMPs. Arizona sneezeweed may occur in sensitive areas needing protection for watershed

SENSITIVE PLANTS	
	values such as channels, wet areas and ephemeral ponds. Impacts to Arizona sneezeweed can be mitigated through implementation of watershed design features and BMPs in these areas.
SP9	Prescribed fires are conducted under conditions that facilitate low to moderate fire severity that promote native plant communities, hinder weed species germination, aid with controlling existing weed infestations, and prevent the spread of existing weeds.

RECREATION	
Where applicable, design features for scenery that apply to recreation sites are noted.	
Public Awareness	
REC1	Inform forest visitors about activities within the project area and make them aware of potential impacts when visiting this part of the forest. Provide information about implementation activities on the Forest website.
REC2	Issue news release(s) as appropriate when forest restoration activities are scheduled to occur and how it may affect forest visitation.
REC3	Consider use of a hotline or link on our web pages that would indicate closures or hazards that may be encountered. Ensure front liners are well informed about activities occurring on the districts and forests.
REC4	If it is necessary to close forest roads or areas of the forest during burning or harvesting operations, notices and signs would be posted at key locations adjacent to and within the project area to inform the public of these closures, in conjunction with issuing news releases as stated above. This may include major FS roads accessing the area, kiosks at trailheads, bulletin boards, electronic sign boards, etc.
REC5	Utilize dust abatement methods during haul of logs on unpaved roads near private land residences during the season
Forest System Trails	
REC6	Coordination with the District Recreation Planner, District Trails Specialist and local trail stewards will occur during prescription or burn plan development, layout, marking logging and burning where any treatment will occur on, adjacent or near National and system trails. This is to ensure that trails and trail infrastructure are considered and protected and effects to scenic qualities are minimized to the extent practicable.
REC7	Harvesting activities would avoid National and forest system trails, if possible. If it is determined necessary that a trail must be used as a skid trail crossing, then the trail would be restored to USFS standards (pre-project condition) post-treatment.
REC8, SCN	National and forest system trails will not be used as skid trails or for temporary roads, except where motorized use is already authorized (trails located on open system and administrative roads).
REC9, SCN, H	It is acceptable to make perpendicular trail crossings. Trail crossing locations, including those on the Arizona National Scenic Trail and General Crook National Recreation Trail would be designated and flagged with input from the District Trails Specialist, Recreation Planner or Archaeologist. Crossing of the National and forest system trails will be done sparingly and only if no other alternative exists. Trail crossings would be restored to pre-project condition after use.
REC10 SCN	Forest restoration treatments within close proximity (i.e. 100'-200') of National or forest system trails would consider "feathering" the treatment so the visual impacts are more transitional than abrupt and as to not significantly change the character or experience of the trail.
REC11, SCN	Minimize using National and system trails as boundaries especially for visually different treatments.
REC12, SCN, H	Large, upright trail cairns and markers used on the Arizona National Scenic Trail or General Crook National Recreation Trail and other system trails must be protected. Locate cairns ahead of time. Logging operations will not damage the cairns or markers.
REC13, SCN, H	If National or system trails are determined to be necessary to be used as fire control lines, involve the District Recreation Planner, Trails Specialist or Heritage Specialist in preparation and post treatment of those lines.

REC14	Place warning signs on all trail access points and along trails where treatment activities are occurring. It is also appropriate to place warning signs at developed recreation sites to inform visitors.
REC15 SCN	If trails are temporarily closed due to harvesting, the trail tread will be cleared of all slash prior to reopening the trail.
REC16 SCN	Character trees that have unique shape or form along the Arizona Trail should be retained where feasible within the applicable prescription.
REC17	Coordinate with the District Recreation Planner or trails specialist to ensure well marked and publicized detour routes for the Arizona Trail, General Crook Trail and system trails during operational closures within the project.
Special Use Events	
REC18	Coordinated efforts would be made with sponsors of recreational special-use events (i.e. running or mountain biking races) to minimize the impacts of such proceedings within the project area during CWPP project implementation activities. Appropriate signage will be used to inform the public of logging or prescribed burning activities.
High Use Weekends and Holidays	
REC19	Efforts would be taken to limit forest treatment activities within the project area during high-use weekends and holidays (i.e. Memorial Day, 4th of July, Labor Day, etc.); especially in locations where recreation based activities (i.e. trails, trailheads, etc.) occur.
Developed Recreation Sites	
REC20	Any vegetation treatments or prescribed burning in developed recreation sites would generally occur in fall, winter, or spring (low use recreational periods). All treatments in recreation sites would be designed to protect and enhance existing vegetative structure, while maintaining the character of the site. Work with the District Recreation Specialist to determine boundaries or no treatment zones around constructed features that need to be protected in the campgrounds. Treatments around the perimeter of the campgrounds are encouraged.
Temporary Closures	
REC21	Implement road closures, one-way traffic, and area closure restrictions as deemed necessary by forest officials for health and safety concerns during any operation. Notices and signs will be posted at key locations adjacent to and within the project area to inform forest visitors of the restrictions.

SCENERY	
Where applicable, scenery measures were combined with Recreation measures and are not duplicated here. Design features that apply to recreation and heritage resources scenery are noted.	
Scenery Concern Levels	
SCN1	Concern Level 1 is where visitors have a primary concern for scenery. Concern Level 1 Travel ways include the following: FR300, FR300E, AZ87, FR751, FR751A, and FR147A. Concern Level 1 Recreation Use areas include the following: General George Crook Trail FS130, Arizona Trail FS87A, Fred Haught Trail FS141, Houston Brothers Trail, FS 171, Rock Crossing Trail FS18A, Rock Crossing Trail FS18B/C, U-Bar Trail FS28, Barbershop Trail, FS91, Foot Trail FS139, Baker Butte Lookout, Moqui Lookout, Moqui Group Camp and Amphitheater, Blue Ridge Campground, C.C. Cragin Reservoir and boat launch, East Clear Creek, Kehl Spring Campground, Long Valley Group Camp, Rock Crossing Campground, Potato Lake, McFarland Spring, Hay Meadow Trailhead, Jumbo Trailhead, Arizona Trail Trailhead at FR138 and General Springs Trailhead. Concern Level 1 Waterways include portions of Bear Canyon and East Clear Creek.
SCN2	Concern Level 2 is where visitors have a moderate concern for scenery. Concern Level 2 Travel ways that have been defined include the following roads: FR141, FR95, FR751B, FR751D, FR751E, FR9033H, FR218, FR218A, FR139, FR300B, and FR139A.

SCENERY	
	Concern Level 2 Recreation Use areas include group event use sites at Aspen Spring at 139,139G, Oak Grove at FR 218, 218A, Long Valley Draw and the Central Arizona Motorcycle Trial Area. Concern Level 2 Waterways include portions of Bear Canyon, and East Bear Canyon.
Edges of Individual Units	
SCN3	Shape and/or feather the edges of treatment areas to avoid abrupt changes between treated and untreated areas. This criteria would also be applied to the processing sites to minimize impacts to scenery when viewed from a distance.
Unit Marking	
SCN4	Directional mark trees within 300 feet of Concern Level 1 and 2 travel ways, trails, and recreation sites. Where multiple travel ways intersect determine the priority of marking prior to unit layout.
Road, Skid Trail and Landing Construction	
SCN5	New temporary roads, skid trails and log landings shall be located out of view of Concern Level 1 and 2 use areas to the extent possible. Screen log landings using existing vegetation and slash piles from view to the extent possible. If impacts are unavoidable prior to unit layout, coordinate with Recreation Planner or Landscape Architect to minimize impacts to areas of high scenic integrity.
SCN6	Highest priorities for slash treatment, temporary road closures, road decommissioning and landing rehabilitation will be placed on foreground (up to 300 feet) of developed recreation sites, private home, and concern level 1 roads (paved roads and passenger car level roads) and trails, especially those designated as national scenic or recreation trails.
Stump Heights and Slash Treatments	
SCN7	Stump heights shall be cut low with a 6” height maximum in the immediate foreground (300 feet) of CL1 and CL2 travel ways and in the foreground of recreation sites, private lands and trails.
SCN8	Unless used for erosion control or maintenance of soil productivity, slash on log landings must be burned or removed within 5 years.
SCN9, SW	Skid trails, slash piles and soil exposure shall be minimized to the extent possible from the seen areas of CL 1 and CL 2 travel ways and use areas.
SCN10	Slash must be treated or removed in the seen area immediate foreground CL1 and CL2 travel ways and use areas within 5 years.
SCN11, REC, H	Locations of landings and slash piles in seen areas CL1 and CL2 travel ways and use areas will be placed to minimize scenery effects and visual contrasts. The timber sale planner will coordinate with Scenery, Recreation and Archaeology specialists on locations of landings and piles.
Fire Control Lines	
SCN12	Restore control lines to a near undisturbed condition in the foregrounds (within 300 feet) of CL1 and CL2 travel ways, private lands and developed recreation sites.
	Processing Sites
SCN13	All constructed features including but not limited to fencing, office trailers, sanitation facilities, fuel storage containers or temporary structures shall be designed to blend with surrounding environment. Color of proposed above ground features shall be non-reflective and treated to be forest service brown or for a rusty appearance, or as approved by FS landscape architect or other FS official.

PUBLIC HEALTH AND SAFETY	
The following measures are designed to: minimize impacts to campers and hunters during prescribed burns that coincide with hunting seasons; provide public information and notification about prescribed fire implementation; prevent injury or damage to private citizens, agency personnel, and or private property; and to prevent electrical power outages caused by management activities.	
HS1	Temporary gates may be necessary on some roads for public safety.

HS2	Notify the public by placing signs in conspicuous locations at least one week prior to and during prescribed burning. This would include maps of the boundaries of the scheduled burns.
HS3	Notify smoke-sensitive individuals and other private landowners in the area through the media (signs, newsletters, personal communication etc.) prior to prescribed burns.
HS4	Hazard trees felled along roads may be left for coarse woody debris where feasible.

AIR QUALITY	
The following measures are designed to minimize impacts to the Verde Valley, local residents, the Discovery Channel Telescope, and to forest visitors caused by heavy smoke conditions from prescribed burning.	
AQ1	All burning would be coordinated daily with the Arizona Department of Environmental Quality (ADEQ). Burning would not take place on any portion of the project without prior approval from ADEQ. Coordination with ADEQ would take place through the Coconino National Forest Zone Dispatch Center and the Prescribed Burning Boss.
AQ2	Control the duration of heavy smoke conditions. The following guidelines would be initiated when heavy smoke conditions are occurring.
AQ3	Minimize burning when numerous consecutive days are predicted to have poor ventilation.
AQ4	Burning would be conducted early in the day or at night to allow heavy materials time to be consumed, and give smoke most of the day to disperse.
AQ5	Smoke from prescribed burning activities of adjacent districts and Forests would be considered in scheduling prescribe burn ignitions in the analysis area.
AQ6	Minimize burning on Saturday and/or Sunday unless ventilation is predicted to be good or better.
AQ7	Minimize smoke impacts to the Verde River Airshed and the highways of FH-3 and SR87. Burn with winds that will carry smoke away from the Verde River Airshed or reduce acreage burned unless safety of urban interface or Highways are compromised.
AQ8	Take advantage of spring burning where possible to minimize impacts to local air quality.

CAVE AND KARST FEATURES	
CK1	Design site-specific no mechanical treatment (logging) protection buffers around cave entrances and karst sinkhole feature footprints, based on the characteristics and importance of the cave or karst features. Generally a 300 foot buffer would be used for all significant caves or potentially significant caves and for karst/pseudokarst sinkholes that contain openings, sinking or emerging streams. 100 and 50 foot buffers are applied on small sinkhole features with small openings or karst features that have no openings and are less susceptible to erosion or sedimentation. Protection buffers should be designed or reviewed by a geologist familiar with karst systems.
CK2	Existing roads may be used for mechanical harvest and hauling within buffers but no skid trails use should occur within buffers. Utilize erosion control measures (straw wattles, silt fences, etc.) to minimize road-related sedimentation into caves or sinkholes.
CK3	Aquatic Management Zone buffer strips will be used to minimize erosion and sedimentation within stream courses that lead into or emerge from caves, sinkholes and karst springs. The AMZ buffer should extend 1000 feet upstream or downstream of the karst feature or to where the channel ends if less than 1000 feet. The buffer should be 100 foot wide or 50 feet from the center of the channel.
CK4	Prescribed fire can occur within cave or karst feature buffers while meeting desired objectives for vegetation, soils, snags, down logs, etc. Management ignitions and fire control lines should not occur within karst features, the feature footprint or near cave openings.
CK5	Hand thinning to facilitate timber stand improvement prescriptions can occur 50 feet from cave openings or the edge of the sinkhole (karst feature footprint) and outside of any stream buffer associated with a karst feature. Thinning slash must be piled 50 feet or more from cave openings or the edge of the sinkhole/pit (karst feature footprint). Directional felling should be used to fell trees away from the karst feature.

LANDS AND SPECIAL USES	
SU1	Notify the appropriate permit holder and office whenever land management activities such as prescribed burning or logging, are going to be implemented in areas having authorized infrastructure, facilities or data sites. Coordinate planned activities including burn plans and contracts well in advance with the permit holder and office. Share planned activities at annual coordination meetings.
SU2	Ensure non-federal land boundaries are known and marked in advance of any activities or treatments near those lands.
SU3	Evaluate potential haul routes that may be needed through non-federal land and ensure easements are in place or obtained prior to use.
Utility Lines and Corridors, Underground Cables	
SU4	Coordinate management activities such as prescribed burning and mechanical thinning with the local utility contact. Provide notification of activities during planning/layout and prior to implementation.
SU5	Place project-generated slash outside of permitted utility line and pipeline rights-of-way; do not interfere with utility corridor management.
SU6	Vegetation treatments adjacent to power line corridors will be designed to reduce linear edges and create a more irregular natural appearance outside of the right-of-ways.
SU7	Plan and design to have a 100 feet or other required buffer where trees have to be fully suspended to protect underground cables and pipelines.
SU8	Coordinate and plan to have a pre-work safety meeting with utility contacts and contractors.
Cragin Project Pipeline and Powerline	
SU9	The C.C. Cragin pipeline is a concrete and rebar reinforced pipe that was not designed to support the weight of heavy machinery. The buried depth of the pipe at most road-crossing locations does not provide enough weight disbursement to support heavy machinery crossing the pipeline. Mitigation measures in the form of steel plate or earthen berms and mounding for weight distribution over pipeline is required for any pipeline crossing intended to be utilized by heavy equipment.
SU10	The power lines that traverse the forest provide power to the water delivery facilities and may create overhead obstruction for logging equipment. Pipeline crossing mitigation plans and evaluation of power line height for timber harvest machinery must be submitted to SRP for review and approval prior to implementation or any activities (timber harvest, prescribed burning and equipment crossings.
SNOTEL and Snow Course Protection	
SU11	Implement a 100 foot buffer zone around a snow courses, data sensors, snow pillows or other meteorological facilities. No road construction or timber harvest is to occur within the buffer.
SU12	Conduct management activities such as prescribed burning, or hazard tree removal within the buffer zone in a manner that will protect site infrastructure from damage and will not diminish the value of the site, facility or the approved access to the site.
SU13	Notify the appropriate NRCS State Snow Survey Data Collection or Water Supply Specialist Office whenever land management activities are going to be implemented in areas having authorized snow courses or data sites.
State Highway 87	
SU14	Conduct management activities such as prescribed burning, hazard tree removal and mechanical thinning in a manner that will protect site infrastructure within the right-of-way from damage.
SU15	Coordinate planned mechanical thinning and prescribed burning activities with the Northcentral District (Flagstaff) of the Arizona Department of Transportation to ensure no interference with the safe operation of the roadway including requiring an operator to acquire an encroachment permit for activities with the right-or-way or for temporary access points to Highway 87.
SU16	Remove thinning slash from the ROW. If slash is chipped it must be removed completely or if left on site and agreed and approved on by the FS, the maximum chip depth is two inches. The maximum amount of time logs and biomass can be left in the ROW is 30 days.

SU17	The thinning prescription in ROW areas identified by ADOT as safety concerns for ice and visibility, will be at the lower end of the target basal area and trees per acre identified for the treatment type.
SU18	Contractors or the FS will need to obtain sign permits and encroachment permits from ADOT in advance of when logging trucks are entering the highway.
SU19	Contractors cutting trees or conduction other operations in the ROW of the highway (such as chipping) will need to have an approved safety plan for their operations. For greatest safety to the travelling public, the plan should include provisions for closing one lane of the highway and using pilot cars to lead traffic through in the open lane.

RANGE RESOURCES	
Infrastructure	
RG1	Protect range infrastructure from prescribed fire (e.g. by lining fence stays).
RG2	Upon completion of implementation, cattle guards would be cleaned to pre-implementation condition.
Timber Harvest and Prescribed Burning Implementation	
RG3	Coordinate implementation activities with range specialists when implementation would impact an active grazing allotment.
RG4	Vehicles passing through grazing pastures would close gates upon entering and exiting the area to ensure livestock remain in the correct pasture.

Project Monitoring

Mexican Spotted Owl

The revised Mexican Spotted Owl Recovery Plan (USDI Fish and Wildlife Service, 2012) provides guidance for vegetation and prescribed burning treatments and emphasizes the need for monitoring and feedback loops to allow management to be adaptive. Well-designed monitoring would provide valuable information on the effects of these activities on the owls and their habitat. A monitoring plan that would contribute to determining the effects of thinning and burning on Mexican spotted owls and their habitat would be implemented and follow methodologies similar to those developed for other projects that involved treatments in occupied owl habitat such as the Flagstaff Watershed Protection Project. The monitoring plan would include the details for sample selection, treatment specifics, measurement protocols including timing, and planned analyses. The monitoring plan will be reviewed as part of the consultation process for treatments planned to occur within PACs.

APPENDIX C: Forest Plan Compliance

The 2018 Coconino National Forest Land and Resource Management Plan (Forest Plan) provides standards, guidelines, desired conditions, and management approaches for different vegetation types (Ponderosa Pine and Mixed Conifer, Infrequent Fire ERUs), Wildland Urban Interface, and Fire Management. Relevant desired conditions, objectives, guidelines, and management approaches for all relevant resources are listed below.

Alternative 2 - Proposed Action was designed to move toward desired conditions and comply with Forest Plan standards and guidelines to the greatest extent feasible while still providing for treatments that would meet the purpose and need of the project. Compliance with Forest Plan direction is documented in the table below.

Table 99. Documentation of Compliance with Forest Plan Desired Conditions, Standards, and Guidelines

Plan Decision Code	Forest Plan Management Direction	Compliance Statement
Applicable Desired Conditions, Standards, and Guidelines for Wildland Urban Interface		
FW-WUI-DC-1	Firefighters are able to safely and efficiently suppress wildfires in the WUI.	Alternative 2 is expected to reduce the risk of crown fire in and adjacent to WUI areas and thus move toward this desired condition. Within the project area, 17,000 acres of WUI sites and values at risk, including private property, the Cragin Project dam infrastructure and facilities, powerlines, DOPLAR radar site, campgrounds and lookout towers. The three municipal water supply watersheds are also considered as WUI in this project and amount to about 45,485 acres. Proposed treatments are expected to reduce fuel loadings throughout the project area and reduce the amount of acres susceptible to active and passive crown fire to support frequent, low-intensity wildfire for at least the next two decades. These treatments will help move toward desired conditions for WUI.
FW-WUI-DC-2	Human life and property are protected. There is reduced fire hazard, intensity, and severity to human health, safety, infrastructure, communication sites, water supply, astronomical sites, and characteristic ecosystem function.	
FW-WUI-DC-3	In forested ecosystems, WUI conditions result in fires that burn primarily on the forest floor and rarely spread as crown fire. Ladder fuels are nearly absent and crown base heights may also be higher than non-WUI areas to reduce the likelihood of fire reaching the tree canopy.	
FW-WUI-DC-4	The WUI may have a higher frequency of disturbance from prescribed burning, wildfires managed for resource objectives, and/or vegetative treatments than the natural disturbance regime.	
FW-WUI-DC-5	Conditions in the WUI, such as live and dead fuel loading, tree basal area, logs, and snags, are on the lower end of the range given in vegetation community desired conditions.	
FW-WUI-DC-6	In forested vegetation communities, the area occupied by interspace with grass/forb/shrub vegetation is on the upper end of, or above, the range given in the vegetation community desired conditions. Trees within groups may be more widely spaced with less interlocking	

Plan Decision Code	Forest Plan Management Direction	Compliance Statement
	of the crowns than desirable in adjacent forest lands. Interspaces between tree groups are of sufficient size to discourage isolated group torching from spreading as a crown fire to other groups.	
FW-WUI-DC-7	Forests in the WUI are dominated by early seral, fire-adapted species growing in a more open condition than the general forest.	
FW-WUI-DC-8	When WUI intersects ERUs with a mixed- or high-severity fire regime, such as Interior Chaparral, Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, Mixed Conifer with Infrequent Fire, Spruce-Fir, and some portions of Mixed Conifer with Frequent Fire, characteristic ecosystem function is modified to promote low-severity surface fires.	
FW-WUI-DC-9	Dead and down fuel load is between 1 and 10 tons per acre, depending on ERU, with lower amounts in frequent fire ERUs, and higher amounts in infrequent fire ERUs such as Mixed Conifer with Infrequent Fire, Spruce-Fir, and portions of Mixed Conifer with Frequent Fire. This light fuel load provides improved fire protection to the WUI, yet still meets desired conditions. This light fuel load applies even in ERUs with higher reference fuel loads, such as Mixed Conifer with Infrequent Fire or Spruce-Fir.	
FW-WUI-DC-10	Fuel loading or tree densities at the higher end of the range may occur in areas where it provides for important fine-scale habitat structure or cover, as long as it meets the overall intent of protecting WUI values at risk.	
FW-WUI-G-1	While still remaining within the range of desired conditions, forest structure in the WUI should have lower tree density and lower levels of snags, logs, and coarse woody debris than non-WUI areas and be arranged spatially to reduce fire hazard and to increase suppression success.	Proposed treatments would reduce fire risk and post-fire effects in WUI, while still remaining within the range of desired conditions. Design features are included to ensure treatments maintain or facilitate development of snags, downed logs, and other forest characteristics identified for wildlife management
Applicable Desired Conditions, Standards, and Guidelines for Fire Management		
FW-Fire-DC-1	Public and firefighter safety is the highest priority in managing fire.	The CWPP is being analyzed under the Healthy Forest Restoration Act and is specifically designed to reduce the risk of

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FW-Fire-DC-2	Wildland fires burn within the historic fire regime of the vegetation communities affected. High-severity fires occur where this is part of the historical fire regime and do not burn at the landscape scale.	high-intensity wildfire to protect nearby WUI, and reduce the potential for post-fire effects to downstream communities. Reducing the risk of high-intensity wildfire even on a small portion of the project area will move the project area toward desired conditions for public safety, protection of private property, and protection of forest resources. The proposed action is expected to improve fire management capabilities over the long-term by reducing the intensity and risk associated with fire throughout the project area.
FW-Fire-DC-3	Wildland fires do not result in the loss of life, property, or ecosystem function.	
FW-Fire-DC-4	People understand that wildland fire is a necessary natural disturbance process integral to the sustainability of the ecosystems in which fire is the primary disturbance.	
FW-Fire-G-1	WUI areas should be a high priority for fuels reduction and maintenance to reduce the fire hazard.	The CWPP was identified and prioritized for planning and implementation because the large majority of the project area is considered WUI, and a high-intensity wildfire could directly and indirectly affect both WUI areas within and adjacent to the project area, in addition to drinking water supplies and infrastructure for the Town of Payson and surrounding communities. Proposed action mechanical thinning and prescribed fire treatments in addition to the design features incorporated as part of the proposed action will reduce the risk of high-intensity wildfire in the project area while also being consistent with maintaining or moving toward desired conditions for other resources, such as wildlife, scenic integrity, water and soil resources, cultural resources, and others.
FW-Fire-G-2	Fire management activities should be designed to be consistent with maintaining or moving toward desired conditions for other resources.	
Applicable Desired Conditions, Standards and Guidelines for All Ecosystems		
FW-Eco-DC-1	Within their type and capability, ecosystems are functioning properly, provide habitat for native species, and are resilient to natural disturbances (e.g., flooding, fire, and periodic drought) and climate change. Ecosystem processes and contributions (e.g., nutrient cycling, water infiltration, and wildlife habitat) are sustained as vegetation on the forest adapts to a changing climate.	Alternative 2 is expected to move habitat conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and maintain or improve proper ecosystem function and wildlife habitat. This alternative is expected to move toward the desired conditions identified here by addressing ecosystem function and resiliency to help preserve habitats for rare species. Reducing uncharacteristic disturbances prevents loss or damage of rare species while reducing the threat of noxious or invasive weed invasions.
FW-Eco-DC 2	The composition, structure, function, and arrangement of vegetation conditions reduce the threat of uncharacteristic disturbances.	The purpose of Alternative 2 is to modify the composition, structure, function and arrangement of vegetation conditions within the project area to reduce the threat of uncharacteristic wildfire. The Fire and Fuels analysis shows that the proposed treatments

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		are expected to reduce the risk and severity of uncharacteristic crown fire.
FW-Eco-DC 3	Uncharacteristic fires are infrequent as is the associated flooding and sedimentation into downstream communities, perennial streams and their tributaries, headwaters, wildernesses, and other areas and resources.	Post-fire flooding is a secondary fire effect that can result after uncharacteristic fire. The results of post-fire flooding include soil erosion and loss of habitat and plants. Uncharacteristic fire and post-fire flooding can lead to high levels of disturbance which are prone to invasion by noxious or invasive weeds. This project will reduce the risk of these disturbances in the project area. The Purpose of Alternative 2 is to reduce the threat of uncharacteristic wildfire so as to reduce the risk to WUI and post-fire flooding. The proposed action includes mechanical thinning and prescribed fire treatments to modify the structure, function, and arrangement of vegetation to meet this goal. Thus, the CWPP Proposed Action is expected to move toward these desired condition to reduce the threat of uncharacteristic wildfire and to reduce the potential for post-fire flooding and sedimentation affecting downstream values and resources.
Applicable Desired Conditions, Standards, and Guidelines for All Terrestrial ERUs		
FW-TerrERU-All-DC-1	Each ERU contains a mosaic of vegetation conditions, densities, and structures. This mosaic occurs at a variety of scales across landscapes and watersheds, and reflects the natural disturbance regimes affecting the area.	Alternative 2 is expected to result in moving conditions toward more heterogeneous forest structure and density across the landscape.
FW-TerrERU-All-DC-2	Within their type and capability, terrestrial ERUs are functioning properly and are resilient to the frequency, extent, intensity, and severity of disturbances, such as fire in fire-adapted systems, and adapt to climate variability. Natural and human disturbances provide desired overall plant density, species composition (mix of species), structure, coarse woody debris, and nutrient cycling. Desired disturbance regimes, including fire, are restored where practical.	The purpose and need for CWPP helps move toward these desired conditions by decreasing the risk of uncharacteristic fire and improving he resiliency of vegetation conditions within the project area to various disturbances, including the effects of climate change. Alternative 2 is expected to result in forest conditions that are more resilient to multiple disturbances such as wildfire, pests and disease, and drought, and move disturbance regimes toward those known from historical conditions.
FW-TerrERU-All-DC-3	Vegetation and stream ecosystems are connected based on natural patterns that are consistent with landforms and topography and provide for upland and aquatic species movements and genetic exchange.	Alternative 2 is expected to move conditions toward patterns that are within the natural range of variability with respect to forest structure and density. This is expected to reduce risks to nearby stream ecosystems and prevent major disturbances from effecting aquatic species movements and genetic exchange.

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FW-TerrERU-All-DC-4	Vegetation conditions allow for inclusions and variability within the landscape as well as for transition zones or ecotones between riparian areas, forests, woodlands, shrublands, and grasslands. Transition zones shift in time and space due to factors affecting site conditions (such as fire or climate). Stringers persist where they naturally occur. For example, pine stringers are noncontiguous narrow communities of pine (often large old trees) that extend into lower elevation vegetation.	Alternative 2 is expected continue to support vegetation conditions that allow for inclusions and variability over the project area. The proposed treatments will facilitate low-intensity fire on the landscape to maintain heterogeneity within vegetation types and among vegetation types on the landscape.
FW-TerrERU-All-DC-5	Vegetation provides ecologically sustainable amounts of products, such as wood fiber or forage.	Alternative 2 would provide wood products through contracts to remove cut trees. Forage would be provided through increased grass and forb production after cutting and prescribed burning have been implemented.
FW-TerrERU-All-S-1	When openings are created with the intent of regeneration, efforts shall be made to ensure that lands can be adequately restocked within 5 years of final harvest.	Alternative 2 is compliant – Openings created for the intention of initiating regeneration of new tree age classes using individual and group selection harvest methods are planned to be restocked by natural regeneration. Based on observations from other projects in similar forest types, natural regeneration is expected to initiate within five years of the regeneration harvest. Monitoring of regeneration openings are planned and other regeneration activities would be proposed if a need arises.
FW-TerrERU-All-G-1	Management activities such as vegetation treatments or other restoration actions should be designed to maintain or move toward desired conditions, to minimize impacts to other uses and resources, and to maintain biodiversity created by inclusions, landscape variability, and transition zones.	Alternative 2 is compliant. The prescribed cutting and burning treatments proposed are designed to maintain or move toward the desired conditions defined in the forest plan and other guiding documents such as the 2012 MSO Recovery Plan as described by the proposed actions and the effects analysis.
Applicable Desired Conditions, Standards and Guidelines for Ponderosa Pine ERU		
FW-TerrERU-PP-DC-1	*Landscape Scale (1,000 to 10,000+ acres)* Ponderosa Pine has a mosaic of trees with varying age classes and understory vegetation, which provide habitat for a variety of species, including Mexican spotted owls and northern goshawks, and ground fuels conducive to low-severity fires.	Alternative 2 is compliant as forest structure is manipulated through prescribed cutting and fire to trend ponderosa pine forests to meet desired conditions for wildlife habitat and reduced risk of high severity fire. Proposed treatments would help the project area move toward desired conditions by decreasing the percentage of the project area at risk of crown fire, reducing basal area and trees per acre closer to historical ranges, and reducing fuels to support frequent, low-severity fire. Treatments would reduce homogenous forest conditions including crown cover, and even-aged stands by moving

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		conditions toward a mosaic of trees with varying age classes and understory vegetation. While treatments may not result in immediate attainment of desired conditions, implementation of the proposed action would move project area conditions toward desired conditions over the next 20 years.
FW-TerrERU-PP-DC-2	The composition, structure, and function of vegetation conditions are resilient to the frequency, extent, intensity, and severity of disturbances and climate variability. The landscape is a functioning ecosystem that contains its components, processes, and conditions that result from natural levels of disturbances (such as insects, diseases, fire, dwarf mistletoe, lightning, drought, and wind), including snags, downed logs, and old trees. Dwarf-mistletoe occurs in less than 15 percent of host trees in uneven-aged forest structures and less than 25 percent in even-aged forest structures. Infections may be present in stands, particularly those that include Douglas-fir or ponderosa pine. Infection size, degree of severity, and amount of mortality varies among infected stands. Grasses, forbs, shrubs, and needle cast (fine fuels), and small trees maintain the natural fire regime. Vegetative ground cover provides protection from accelerated soil erosion, promotes water infiltration, and contributes to soil nutrient cycling, plant and animal diversity, and to ecosystem function. The amount of shrub cover depends on the TEUI unit. Across the Ponderosa Pine Bunchgrass and Ponderosa Pine/Gambel Oak subtypes, perennial grasses and forbs dominate the understory, though shrubs are present throughout. In areas where Ponderosa Pine Evergreen Oak subtype occurs and perennial grasses dominate the understory, shrubs average less than 30 percent canopy cover and do not inhibit ponderosa pine regeneration. In areas where Ponderosa Pine Evergreen Oak subtype occurs and evergreen shrubs dominate the understory, shrubs average greater than 30 percent canopy cover. At the landscape scale, overall plant composition is similar to site potential (greater than 66 percent), but can vary considerably at the fine- and mid- scales	Alternative 2 is compliant as the effects analysis support that the prescribed cutting and burning treatments will trend forest composition, structure, and functions toward the Forest Plan's desired conditions.

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	owing to a diversity of seral conditions. The seral state proportions contained in appendix E apply at the landscape scale, where low overall departure from reference proportions is a positive indicator of ecosystem condition.	
FW-TerrERU-PP-DC-3	Frequent, low-severity fires (Fire Regime I) are characteristic in the vast majority of this ERU, including throughout northern goshawk home ranges. Spatial heterogeneity and discontinuous crowns (interspaces between groups and single trees) prevents crown fire spread. However, in the Ponderosa Pine Evergreen Oak subtype, where evergreen shrubs dominate the understory, low- and mixed-severity fires are characteristic and burn on the forest floor as well as in the overstory, and crown fires occur in small patches. Natural and human disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.	Alternative 2 supports this desired condition through tree thinning, and low-severity prescribed burns.
FW-TerrERU-PP-DC-4	At the landscape scale, Ponderosa Pine is composed of trees in structural stages that range from young to old and are dominated by ponderosa pine trees. Forest appearance is variable, but generally uneven-aged and open; occasional areas of even-aged structure are present. Forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. Openness typically ranges from 10 percent in more productive sites to 70 percent in the less productive sites.	Alternative 2 is compliant as forest structure is manipulated through prescribed cutting and fire to trend ponderosa pine forests to meet desired conditions. Uneven-aged structure, one year post treatment is represented on 67 to 75 percent of the total forested acres depending on forest type. The proposed action trends towards a balanced range of tree sizes (see the analysis on pages 47 and 48 of the silviculture specialist report regarding size class distribution as described by vegetation structural stages). In terms of openness, within twenty years most acres are within the desired range for tree canopy cover and openness, particularly within both the mixed conifer and ponderosa pine cover types. Within the pine-oak cover type, the majority of the area is within the desired canopy cover. However, about 39 percent of the area has high canopy, close to the current condition.
FW-TerrERU-PP-DC-5	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 (greater than 3-inch diameter), all well-distributed throughout the landscape. Snags, down logs and coarse woody debris are representative of the species within the	Alternative 2 is compliant as treatments would result in healthier residuals trees. However, declining trees will still be part of the composition, particularly in areas that will not be treated mechanically. Coarse woody debris would be maintained at the desired level of 3-10 tons per acre (see EA – Desired Conditions for Vegetation Condition Class and Fire and Fuels report). Snags would only be cut for

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	vegetation community. Ponderosa pine snags are typically 18 inches or greater at diameter at breast height (dbh.) and average 1 to 2 snags per acre. There are varying sizes of snags greater than 18 inches dbh. In the Gambel oak subtype, large oak snags (greater than 10 inches) are a well-distributed component. Downed logs (greater than 12-inch diameter at mid-point, greater than 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 and is sufficient to maintain or improve long-term soil productivity and provide cover and food for a variety of species.	operational or safety reasons, therefore the impact to snag numbers should be minimal.
FW-TerrERU-PP-DC-6	Old-growth structure occurs throughout the landscape consistent with vegetative characteristics of a frequent, low-severity fire regime. Old growth is a component of uneven-aged forests, generally composed of groups of similarly aged trees and single trees interspersed with open grass–forb–shrub interspaces, but occasionally, it occurs in larger even-aged patches where local microsites facilitate less frequent fire regimes. Within-group variability may be low, but variation among groups is typically high, and proportions of patches with different developmental stages may vary, depending on site-specific conditions. Old-growth components include old trees, dead trees (snags), and dead and downed wood (coarse woody debris including large size classes). Snags and large dead and downed fuels are irregularly distributed across the landscape and may not exist in some patches. The location of old-growth components shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).	Alternative 2 includes a project design feature promoting the conservation of old and large trees. Even though the effects analysis shows there is a reduction of large trees immediately post-treatment, this is effect is expected to be mitigated through the application of the large and old tree retention strategy. Even with an initial reduction of large trees, within 20 years large trees would surpass the existing condition in terms of trees per acre.
FW-TerrERU-PP-DC-7	In the Ponderosa Pine Gambel Oak and Ponderosa Pine Evergreen Oak subtypes, all sizes, structures (that is, the shrub or tree forms depending on the capability of the site), and ages of oak trees are present in natural patterns of abundance and density. These subtypes are reproducing and maintaining their presence on suitable sites across the landscape. Old oak trees occur as dominant individuals or in small	Alternative 2 is compliant with this desired condition. It includes design features to retain Gambel oak and large snags to the extent practicable as they are key habitat component for Mexican spotted owls and other wildlife species in the analysis area. The proposed treatments are designed to encourage oak persistence within the forest ecosystems by reducing competing vegetation, stimulating sprouting through prescribed fire, and

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	groups. Where they naturally occur, large to moderate-sized oak snags are well-distributed across the landscape, as are moderate to large live oak trees with dead limbs, hollow boles, and cavities. These provide shelter and habitat for rare plants and a variety of wildlife species, including owls and bats	allowing more light infiltration through to the forest floor.
FW-TerrERU-PP-DC-8	*Mid-Scale (10 to 999 acres)* At the mid-scale, Ponderosa Pine 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. At the mid-scale, openness typically ranges from 30 percent in more productive sites to 60 percent in the less productive sites. Openness in outlying sites may be as low as 10 percent in some situations such as in high-elevation, mesic sites or where needed to meet wildlife habitat requirements. Openness in outlying sites may be as high as 90 percent in situations such as low-elevation sites on south-facing slopes, where ponderosa pine transitions into grasslands, or where site-specific information indicates the site was historically more open. Tree density within forested areas generally ranges from 22 to 89 square feet basal area per acre. Forest conditions may exceed these densities in some areas, such as on steep slopes and in canyons. In addition, the density of larger trees and canopy cover may be higher where needed to manage for Mexican spotted owls. Ground cover consists primarily of perennial grasses and forbs capable of carrying surface fire, with basal vegetation values ranging between about 5 and 20 percent, depending on the terrestrial ecological unit inventory (TEUI) unit.	Alternative 2 is compliant as the effects analysis discussed in the silvicultural specialist report on pages 52 and 53 support that the prescribed cutting and burning treatments will trend forest composition, structure, and functions toward the Forest Plan's desired conditions.
FW-TerrERU-PP-DC-9	The mosaic of tree groups generally comprises an uneven-aged forest with all age classes present, including old growth. Groups of seedlings and saplings are maintained at sufficient levels to provide a reliable source of replacement as trees grow and progress into succeeding size and age classes. Infrequently, patches of even-aged forest structure is present.	Alternative 2 is compliant as forest structure is manipulated through prescribed cutting and fire to trend ponderosa pine forests to meet desired conditions. Uneven-aged structure, one year post treatment is represented on 67 to 75 percent of the total forested acres depending on forest type. The proposed action trends towards a balanced range of tree sizes (see the analysis on pages 47 and 48 of silviculture

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	Disturbances sustain the overall age and structural distribution.	specialist report regarding size class distribution as described by vegetation structural stages). In terms of openness, within twenty years most acres are within the desired range for tree canopy cover and openness, particularly within both the mixed conifer and ponderosa pine cover types. Within the pine-oak cover type, the majority of the area is within the desired canopy cover. However, about 39 percent of the area has high canopy, close to the current condition.
FW-TerrERU-PP-DC-10	Diversity of understory species (such as grasses, forbs, and shrubs) is within the capability of the site and provides for water infiltration and soil stability. The understory has a variety of heights of cool and warm season vegetation and produces seed heads and all age classes of vegetation food and cover for wildlife and forage for livestock. A mosaic of dense cover, high amounts of litter, and bare ground provide habitat for a variety of species.	Alternative 2 better meets the desired condition than No Action. With increased light and moisture hitting the forest floor, understory species are expected to increase in richness, densities and diversity. Sensitive species such as Bebb's willow and Arizona sneezeweed could occupy the openings in the more open stand conditions.
FW-TerrERU-PP-DC-11	Fires burn primarily on the forest floor and do not spread between tree groups as crown fire. Single tree torching and small group torching, however, are not uncommon, resulting in a mosaic across the landscape. Crown fires may occur in small patches in the Ponderosa Pine Evergreen Oak subtype where evergreen shrubs predominate in the understory.	Alternative 2 is designed to increase the frequency of low severity fire and decrease the risk of crown fire through creating openings and interspaces, thinning trees, and removing surface fuels through the use of prescribed fire.
FW-TerrERU-PP-DC-12	Conditions in northern goshawk post-fledging family areas are similar to general Ponderosa Pine ERU conditions, except these post-fledging areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups. Conditions in northern goshawk foraging areas are similar to general Ponderosa Pine ERU conditions. Forest conditions in northern goshawk nest areas are multi-aged, but are dominated by large trees with relatively denser canopies than other areas in the Ponderosa Pine ERU.	Alternative 2 proposes prescribed cutting and burning treatments that retain basal areas 10 to 20 percent higher than adjacent forested areas, and associated canopy cover (see proposed action for goshawk PFAs). They are also designed to maintain or trend towards nest areas that are multi-aged and dominated by large trees. The proposed action alternative following treatments, increases the difference for basal area to 45 percent higher basal areas within mid-aged to old tree groups than within the surrounding ponderosa pine ERU immediately and after 20 years due to the focus on thinning and removing of small diameter trees.
FW-TerrERU-PP-DC-13	*Fine Scale (less than 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.	Alternative 2 is compliant as the effects analysis discussed in the analysis suports that the prescribed cutting and burning treatments will trend forest composition, structure, and functions toward the Forest Plan's desired conditions.

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	Interspaces surrounding tree groups are variably shaped and composed of a grass/forb/shrub mix. Some natural openings contain individual and randomly distributed patches of trees and a diversity of grasses and forbs, which provide habitat for species, including invertebrates, small mammals, migratory birds, and turkey. 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 they may range from a few to many trees in extent and be larger in areas managed for bald eagles and Mexican spotted owls or where site-specific information indicates the group was larger historically. Old-growth groups contain trees having similar age characteristics and conditions. Such groups may include fairly similar tree ages and sizes or combinations of ages and sizes, limited amounts of dead and downed material, and dead trees and spike tops (snags), but they are readily distinguished from adjacent groups having different characteristics. Groups at the mid-aged to old stages consist of 2 to approximately 40 trees per group.	
FW-TerrERU-PP-DC-14	Witches brooms (dense mass of branches and stems growing from a single point) may form on trees infected by dwarf mistletoe, providing valuable habitat components for wildlife species.	Treatments proposed under Alternative 2 for mitigating dwarf mistletoe impacts are not intended to completely eliminate this naturally occurring disturbance agent. Rather, they are typically aimed at reducing infection levels across the stand and increasing host vigor. Doing so would increase stand resilience, reduce susceptibility to insect infestations, increase resistance to droughts and adverse climate change, and allow for development of a diversity of age classes across the landscape.
FW-TerrERU-PP-DC-15	Large oak trees and pine-oak groups in the Ponderosa Pine Gambel Oak and Evergreen Oak subtypes provide cooler, moister microsites and higher overstory diversity than found in the Ponderosa Pine Bunchgrass subtype. Acorns provide food for wildlife species.	Alternative 2 is compliant with this desired condition. It does not include cutting of oak trees. The proposed treatments are designed to encourage oak persistence within the forest ecosystems by reducing competing vegetation, stimulating sprouting through prescribed fire, and allowing more light infiltration through to the forest floor.
FW-TerrERU-PP-G-1	To protect old-growth forest components, existing old-growth forest attributes should be protected from uncharacteristic natural disturbances. Methods of protecting existing old-growth forest components on the landscape may include	Alternative 2 is expected to reduce the effects of uncharacteristic disturbance such as high-intensity wildfire. Key old growth forest attributes such as large trees, large snags, and downed logs are expected to move toward desired conditions under this alternative as a

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	prescribed cutting, prescribed fire, and wildfires managed for resource objectives.	result of treatments including prescribed cutting, prescribed fire, and wildfires managed for resource objectives. The proposed thinning and burning treatments are expected to reduce the mortality from wildfire to old-growth forest components. In addition the project old and large tree retention policy further improves protection of old growth forest components throughout the project area.
FW-TerrERU-PP-G-2	To perpetuate old-growth forest components, the development of old-growth conditions should be encouraged in areas where old growth is lacking. Uneven-aged vegetation treatments should be designed such that replacement structural stages and age classes are proportionally present to assure continuous representation of old-growth characteristics across the landscape over time.	Alternative 2 includes prescribed uneven-aged treatments to increase the presence of VSS6 mature forest over time. Proposed treatments are also expected to support the development of replacement structural stages and age classes by improving recruitment of new age classes and supporting the transition of trees from smaller size classes to larger size classes throughout the project area over the next several decades. Alternative 2 also includes old and large tree retention plans specifically designed to retain as many pre-settlement trees as possible while also helping to facilitate the project purpose and need of reducing the risk of high-intensity wildfire, protecting the watershed, and facilitating forest conditions that are resilient to disturbance.
FW-TerrERU-PP-G-3	In promoting an uneven-aged forest condition that maintains or contributes to the restoration of old-growth conditions characteristic of the forest type, preference for retention should be given to presettlement trees, often the largest, oldest, and tallest trees onsite.	Alternative 2 includes old and large tree retention plans specifically designed to retain as many pre-settlement trees as possible while also helping to facilitate the project purpose and need of reducing the risk of high-intensity wildfire, protecting the watershed, and facilitating forest conditions that are resilient to disturbance.
FW-TerrERU-PP-G-4	To promote old-growth attributes consistent with desired conditions, manage for large Gambel oak trees and snags to be sustained over time.	Alternative 2 is compliant with this guideline through project design features retaining and encouraging oak reproduction and vigor.
FW-TerrERU-PP-G-5	To provide necessary habitat components, the largest and tallest snags representative of the stand and downed logs should be emphasized along edges of openings and within groups/clumps of trees to provide habitat and roost sites for wildlife species such as small mammals, cavity-nesting birds, and tree-dwelling bats.	Alternative 2 is compliant with this guideline through the incorporation of project design features for managing snags and downed logs. Alternative 2 includes design features to retain large snags to the extent practicable as they are key habitat component for Mexican spotted owls and other wildlife species in the analysis area.
FW-TerrERU-PP-G-6	Large accumulations of green material (such as slash, wind thrown trees) should be managed to reduce the risk of uncharacteristic bark beetle outbreaks.	Alternative 2 is compliant with this guideline through the incorporation of project design features for managing the timing of the creation of slash.

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FW-TerrERU-PP-G-7	To increase small mammal occupancy in areas where logs are deficient and to provide nesting habitat and cover for turkeys, birds, small mammals, reptiles, and invertebrates, slash piles should be retained across the landscape for several years, rather than immediately being burned. This should be consistent with scenic integrity objectives and balanced with potential threats from bark beetles and fire/fuels concerns.	Alternative 2 is compliant with this guideline through the incorporation of project design features for managing slash and coarse woody debris such as retaining slash piles for wildlife where feasible, given other concerns such as fuel loads and scenery.
Applicable Desired Conditions, Standards and Guidelines for Mixed Conifer ERU		
FW-TerrERU-MC-All-DC-1	All Mixed Conifer ERUs Mixed Conifer ERUs have a mosaic of trees with varying age classes and understory vegetation, which provide habitat for wildlife species, including Mexican spotted owls and northern goshawks; ground cover for functional soil and watersheds; and fuel for fire to occur according to historic ranges of frequency and severity.	Alternative 2 is compliant as forest structure is manipulated through prescribed cutting and fire to trend ponderosa pine forests to meet desired conditions for wildlife habitat and reduced risk of high severity fire.
FW-TerrERU-MC-All-DC-2	Native herbaceous and shrub species occur in natural patterns of abundance and density with varying seral stages ranging from young to old and are regenerating successfully. The amount of shrub cover depends on the TEUI unit. At the landscape scale, overall plant composition is similar to site potential (greater than 66 percent), but can vary considerably at fine- and mid- scales owing to a diversity of seral conditions. The seral state proportions contained in appendix E apply at the landscape scale, where low overall departure from reference proportions is a positive indicator of ecosystem condition.	Alternative 2 better meets the desired condition than No Action. With increased light and moisture hitting the forest floor, understory species are expected to increase in richness, densities and diversity.
FW-TerrERU-MC-All-DC-3	A variety of different sizes and ages of Gambel oak trees are present in natural patterns of abundance and density. Gambel oak is reproducing and maintaining its presence on suitable sites. Large to moderate-sized oak snags are scattered across the landscape, as are moderate to large live oak trees with dead limbs, hollow boles, and cavities, providing shelter and habitat for rare plants and a variety of wildlife species, including owls and bats.	Alternative 2 is compliant with this desired condition. It does not include cutting of oak trees. The proposed treatments are designed to encourage oak persistence within the forest ecosystems by reducing competing vegetation, stimulating sprouting through prescribed fire, and allowing more light infiltration through to the forest floor.
FW-TerrERU-MC-All-DC-4	Dwarf mistletoe occurs at natural levels. Infections may be present in stands, particularly those that include Douglas-fir, spruce, or ponderosa pine. Infection	Treatments proposed with Alternative 2 for mitigating dwarf mistletoe impacts are not intended to completely eliminate this naturally occurring disturbance agent. Rather, they are

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	size, degree of severity, and amount of mortality varies among infected stands. Witches brooms may form on trees infected by dwarf mistletoe and may be scattered throughout the infections, providing structural diversity in the stand and improved foraging and nesting habitat for wildlife species such as small mammals (tree squirrels) and raptors such as northern goshawks and Mexican spotted owls.	typically aimed at reducing infection levels across the stand and increasing host vigor. Doing so would increase stand resilience, reduce susceptibility to insect infestations, increase resistance to droughts and adverse climate change, and allow for development of a diversity of age classes across the landscape.
FW-TerrERU-MC-All-G-1	To increase small mammal occupancy in areas where coarse woody debris is deficient and to provide nesting habitat and cover for turkeys, birds, small mammals, reptiles, and invertebrates, slash piles should be retained across the landscape for several years, rather than immediately being burned. The number and distribution of retained slash piles should be consistent with scenic integrity objectives (SIO) and balanced with potential threats from bark beetles and fire/fuels concerns. If slash is scattered, it should be at a height that still allows big game movement.	Alternative 2 is compliant with this guideline through the incorporation of project design features for managing slash and coarse woody debris, such as retaining slash piles for wildlife where feasible, given other concerns such as fuel loads and scenery.
FW-TerrERU-MC-All-G-2	To retain structural diversity, existing and developing old-growth forest structures should be protected from uncharacteristic disturbances. Methods of protecting existing old growth may include thinning, prescribed fire, and the use of wildfires managed for resource objectives in adjacent areas, especially those areas that are situated upwind or are topographically lower.	Alternative 2 is compliant with this guideline as determined by the language as proposed for the activity treatments.
FW-TerrERU-MC-All-G-3	To promote structural diversity, the development of old-growth structural components should be encouraged in areas where lacking. Vegetation treatments should be designed such that replacement structural stages and age classes are proportionally present to assure continuous representation of old-growth characteristics across the landscape over time.	Alternative 2 is compliant with this guideline. The proposed action using group selection harvest methods will diversify forest structure while retaining old growth structural components.
Applicable Desired Conditions, Standards and Guidelines for Mixed Conifer with Frequent Fire ERU		
FW-TerrERU-MC-MCFF-DC-6	*Mid-Scale (10 to 999 acres)* At the mid-scale, Mixed Conifer with Frequent Fire 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 forested sites	Alternative 2 is compliant as the effects analysis supports that the prescribed cutting and burning treatments will trend forest composition, structure, and functions toward the Forest Plan's desired conditions.

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	contain more trees per group and more groups per area. Openness typically ranges 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 feet basal area per acre. Forest conditions may exceed these densities in some areas, such as on steep slopes and in canyons. In addition, the density of larger trees and canopy cover may be higher where needed to manage for Mexican spotted owls.	
FW-TerrERU-MC-MCFF-DC-7	The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages, including old growth. Groups of seedlings and saplings are maintained at sufficient levels to provide a reliable source of replacement as trees grow and progress into succeeding size and age classes. Occasionally, small patches (generally less than 50 acres) of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution.	Alternative 2 is compliant as forest structure is manipulated through prescribed cutting and fire to trend ponderosa pine forests to meet desired conditions. Uneven-aged structure, one year post treatment is represented on 67 to 75 percent of the total forested acres depending on forest type. The proposed action trends towards a balanced range of tree sizes.
FW-TerrERU-MC-MCFF-DC-8	Ground cover consists primarily of perennial grasses and forbs capable of carrying surface fire, with basal vegetation values ranging between about 5 and 20 percent, depending on the TEUI unit. Fires burn primarily on the forest floor and do not spread between tree groups as crown fire, but may result in torching of single trees or tree groups.	Alternative 2 better meets the desired condition than No Action. With increased light and moisture hitting the forest floor, understory species are expected to increase in richness, densities and diversity.
FW-TerrERU-MC-MCFF-DC-9	Basal area per acre for mid-aged to old tree groups in northern goshawk post-fledging areas is 10 to 20 percent higher than northern goshawk foraging areas and the general forest. Northern goshawk nest areas have forest conditions that are multi-aged, but are dominated by large trees with relatively denser canopies than other areas in Mixed Conifer with Frequent Fire, consistent with current technical guides for northern goshawk in the southwestern United States (Reynolds, et al., 1992).	Alternative 2 proposes prescribed cutting and burning treatments that retain basal areas in PFAs 10 to 20 percent higher than adjacent forested areas. They are also designed to maintain or trend towards nest areas that are multi-aged and dominated by large trees and relatively denser canopies than other areas in Mixed Conifer with Frequent Fire.
Applicable Desired Conditions, Standards and Guidelines for Mixed Conifer with Infrequent Fire ERU		
FQ-TerrERU-MC-MCIF-DC-3	Old-growth structure generally occurs over large areas as stands or patches where old-growth components are concentrated. Old-growth components include old trees, dead trees (snags),	Alternative 2 is expected to reduce the risk of high intensity wildfire, which would cause old growth mortality, and remove snags and downed wood that meet the specifications identified in these desired conditions. The

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	downed wood (coarse woody debris), and structural diversity. The location of old-growth components shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality). Snags 18 inches or greater at dbh average 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 (greater than 8 inches dbh) averages 20 per acre and provides wildlife habitat and future downed logs. Coarse woody debris, including downed logs, varies by seral stage, with averages ranging from 5 to 20 tons per acre for early seral stages; 20 to 40 tons per acre for mid-seral stages; and 35 tons per acre or greater for late-seral stages. Coarse woody debris and logs provide for long-term soil productivity	prescribed cutting and burning proposed in this alternative is expected to result in short-term reductions in old growth components, snags and downed logs, but would improve the survival and recruitment of old growth components, large trees, and the downed logs over the next several decades. AS a result Alternative 2 will help move toward these desired conditions for the patches of mixed conifer, infrequent fire forests that occur within the project area.
FQ-TerrERU-MC-MCIF-DC-7	Fire severity is mixed or high, with a fire return interval of 35 to 200 or more years (Fire Regimes III, IV, and V). Fire and other disturbances maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling. During moister conditions, fires exhibit smoldering low-intensity surface behavior with single tree and isolated group torching. Under drier conditions, fires exhibit passive to active crown fire behavior with conifer tree mortality up to 100 percent across mid-scale patches. High-severity fires generally do not exceed 1,000-acre patches of mortality. Other smaller disturbances occur more frequently.	Alternative 2 is expected to result in low, severity fires where there is isolated single tree and group torching. This is based on observations of previous, recent fires such as the Bear and Highline fires where fire occurred in small patches of mixed conifer infrequent fire forests and displayed this type of behavior. Alternative 2 would result in a landscape where patches of this vegetation type could exhibit passive to active crown fire behavior with conifer mortality up to 100 percent across mid-scale patches during drier conditions. As a result this alternative would move toward and maintain desired conditions for the mixed conifer with infrequent fire vegetation type.
FW-TerrERU-MC-MCIF-DC-8	Forest conditions in northern goshawk PFAs are similar to general forest conditions except PFAs typically contain 10 percent or greater tree density (basal area) than northern goshawk foraging areas and the general forest. Nest areas in Mixed Conifer with Infrequent Fire have forest conditions that are multi-aged but are dominated by large trees with relatively denser canopies than other areas.	Alternative 2 has vegetation treatments that are designed to maintain or increase basal areas in PFAs 10 or greater than adjacent forested areas. They are also designed to maintain or trend towards nest areas that are multi-aged and dominated by large trees and relatively denser canopies than other areas in Mixed Conifer with Infrequent Fire.
Applicable Desired Conditions, Standards and Guidelines for Aspen and Maple		

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FW-TerrERU-AspMpl-DC-1	Where they naturally occur, all age classes of aspen and maple are present in groups or patches and are regenerating and vigorous, providing habitat for a variety of species. Natural and human disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling. The size and number of patches depend on the scale and type of disturbance as well as microsite conditions such as elevation, soil type, aspect, and site productivity. A diverse understory consisting of native graminoids, forbs, and/or shrubs is present and has a variety of seral stages and age classes.	Quaking aspen and maple were addressed at the "sub-ERU" level in the Forest Plan because these important species generally occur as inclusions within other forest types including ponderosa pine and mixed conifer. This desired condition is included in the Botany Report to focus on the maple component in the project, particularly in the Mogollon Rim Botanical Area. Alternative 2 includes prescribed fire treatments in the Botanical Area and in other parts of the project area with aspen and maple overstory, which is expected to maintain tree density, structure, species composition, woody debris, and nutrient cycling consistent with this desired condition.
FW-TerrERU-AspMpl-G-1	Where needed, aspen and maple should be protected from excessive herbivory using methods such as fencing that protect regeneration and recruitment. Fences should be removed when no longer needed to allow wildlife and human access.	Aspen and maple regeneration are not included as part of the management actions of this project. However, vegetation treatments proposed under Alternative 2 that result in reduced density in the conifer stands may lead to regeneration and recruitment in some areas. As a result this project will help move toward the intent of this guideline.
Applicable Desired Conditions, Standards, and Guidelines for Wildlife, Fish, and Plants		
FW-WFP-DC-1	Properly functioning ecosystems and ecologically responsible forest activities support sustainable populations of native plant and animal species distributed throughout their potential natural range. Properly functioning ecosystems reflect the diversity, quantity, quality, and site potential of natural habitats on the forest. Habitat is available at the appropriate spatial, temporal, compositional, and structural levels for a wide variety of species.	Alternative 2 is expected to move habitat conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and move towards properly function ecosystems and sustainable wildlife populations. Treatments would also move conditions towards properly function ecosystems and sustainable populations of fish and macroinvertebrates.
FW-WFP-DC-2	Habitat conditions contribute to the survival and recovery of listed species, allow for repatriation of extirpated species, contribute to the delisting of species under the Endangered Species Act, preclude the need for listing new species, improve conditions for Southwestern Region sensitive species, and keep common native species common. Habitat conditions provide the resiliency and redundancy necessary to maintain species diversity and metapopulations.	Alternative 2 is expected to move habitat conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and maintain or improve habitat conditions and contribute to the survival and recovery of listed wildlife species and preclude the listing of other species.

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FW-WFP-DC-3	Terrestrial ERUs and riparian areas provide the necessary physical and biological habitat components for carrying out growth, reproduction, survival, dispersal, and other key life cycle needs of associated native species.	Alternative 2 is expected to move vegetation conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and maintain or improve the physical and biological habitat components for native wildlife species.
FW-WFP-DC-4	Stream ecosystem conditions within perennial and intermittent riparian streamcourses support habitat for self-sustaining populations of native aquatic and riparian species. Woody and herbaceous overstory and understory (where the natural potential exists) and overhanging banks provide fish habitat, regulate stream temperatures, and maintain soil moisture in the aquatic management zone. Stream substrates provide clean gravels for fish spawning, woody debris for hiding cover, and sites for germination and establishment of riparian vegetation. Abiotic structure such as silt, sand, gravel, cobble, boulders, and bedrock provide habitat for a variety of aquatic and terrestrial species.	Alternative 2 is expected to move habitat conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire in areas adjacent to streamcourses and maintain or improve riparian habitats to continue to support self-sustaining populations of fish and macroinvertebrates.
FW-WFP-DC-5	The composition, structure and function of ERUs and associated physical elements (e.g., canyons, cliffs, caves, karst, talus slopes, rock piles, specific soil types, springs, wet areas, and other special features) provide functioning habitat and refugia to support populations of federally listed, Southwestern Region sensitive species, narrowly endemic species, and species with restricted distributions.	Alternative 2 is expected to move vegetation conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and maintain or improve the function of ERUs and associated physical elements that support wildlife populations. The CWPP Proposed Action is expected to improve the long term survival and recovery of R3 sensitive species that depend upon the physical elements described here by facilitating the return of the key ecosystem process of low-severity fire in the project area
FW-WFP-DC-6	Interconnected terrestrial, riparian, and aquatic habitats promote wildlife, fish, and plant species movements and genetic exchange, allow for movement of wide ranging species, and promote natural predator-prey relationships, particularly for strongly interactive species (e.g., mountain lions). Species are able to access adjoining habitat, disperse, migrate, meet their life history requirements, and adjust their movements in response to climate change. Ephemeral and intermittent streamcourses function as habitat and movement corridors for species.	Alternative 2 is expected to move vegetation conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and maintain the function of streamcourses as habitat and meet life history requirements of wildlife populations.

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FW-WFP-DC-7	Forest attributes such as multistory structure; large, old trees; large trees with sloughing, exfoliating bark; snags; large downed logs; and other indicators of mature stands are present in all forest and woodland ERUs, providing habitat for the associated species.	Alternative 2 includes treatments that are designed to maintain or enhance forested habitats with multistories, large and old trees, snags, large logs that are indicators of mature stands and are key habitat components for many wildlife species including Mexican spotted owls.
FW-WFP-S-1	Direction for species listed as threatened, endangered, proposed, or candidate takes precedence over direction for species not listed by the U.S. Fish and Wildlife Service.	Alternative 2 complies with this standard. Alternative 2 was specifically designed so that treatments were based on recommendations for Threatened species such as the Mexican spotted owl where their habitat was located in the project area.
FW-WFP-S-2	Timing restrictions will be applied to projects and activities that have the potential to negatively affect federally listed species, bald eagles, and golden eagles to minimize or avoid impacts to survival or successful reproduction.	Alternative 2 includes timing restrictions to minimize effects to federally listed species from most project activities and survival or successfully reproduction. In coordination with Fish and Wildlife Service and based on inter-disciplinary team review of site-specific information, the CWPP Proposed Action does include some exceptions allowing hauling and some limited mechanical thinning outside of, but within a ¼ mile distance of Mexican spotted owl PACs. These activities may result in short-term, minor adverse effects, and are expected to result in long-term benefits from reducing the risk of crown fire in MSO PAC habitat. This alternative meets the language in the standard (because timing restrictions were applied), and follows the Forest Plan guidance included as a management approach specific to this standard, which explains, "The application of timing restrictions, like those referenced in FW-WFP-S-2 and FW-WFP-G-8, will be based on site-specific information and may vary depending on variables such as species, weather, timing of activity relative to species life cycle, or duration, frequency, and type of activities that are occurring in the species' habitat. Other variables to be considered could include the duration, extent, and intensity of the proposed activity, or the type of activity itself, such as emergency or safety-related actions versus non-emergency activities. The best available information and science is utilized to develop timing restrictions to reduce impacts to disturbance-sensitive species."

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FW-WFP-G-1	Habitat management objectives and species protection measures from approved recovery plans should be applied to activities occurring within federally listed species habitat to promote recovery of the species.	Alternative 2 includes design features to minimize impacts to federally listed wildlife species and key habitat components to promote recovery of the species.
FW-WFP-G-2	To improve the status of species and prevent Federal listing, management activities should comply with species conservation agreements, assessments, strategies, or national guidelines.	Alternative 2 includes design features that comply with species conservation agreements, assessments, strategies or national guidelines to improve the status of wildlife species or prevent federal listing.
FW-WFP-G-3	Projects and management activities should be designed or managed to maintain or improve habitat for native species and to prevent or reduce the likelihood of introduction or spread of disease.	Alternative 2 has vegetation treatments that are designed to maintain or improve habitat for the native wildlife species in the analysis area.
FW-WFP-G-8	Timing restrictions should be applied to projects and activities that have the potential to negatively affect Southwestern Region sensitive species and pronghorn. The intent is to minimize or avoid impacts to survival or successful reproduction.	Alternative 2 includes timing restrictions to minimize effects to Southwestern Region sensitive wildlife species from project activities and avoid impacts to survival or successfully reproduction.
FW-WFP-G-10	Projects and management activities should be designed and implemented to maintain refugia and primary life cycle needs of Southwestern Region sensitive species and to protect and provide for narrowly endemic species and species with restricted distributions where they are likely to occur.	Alternative 2 includes design features and BMPs to avoid impacts to refugia for sensitive species within the project area, or to improve their habitat over the long-term (next 10-20 years) and is designed to maintain refugia and primary life cycle needs for wildlife species in the analysis area.
FW-WFP-G-11	Project-related activities with the potential to disturb active raptor nests should be restricted within a minimum of 300 yards of these nest sites to promote survival or successful reproduction.	Alternative 2 includes design features to minimize potential disturbance to active raptor nests to promote survival or successful reproduction.
FW-WFP-G-14	To provide habitat while young northern goshawks are maturing, northern goshawk post-fledgling family areas (PFAs) of approximately 420 acres in size should be designated surrounding nest areas. A minimum of six nest areas (known or replacement) should be located per territory and each nest area should generally be 25-30 acres in size. Northern goshawk nest and replacement nest areas should include known nests and generally be located in drainages, at the base of slopes, and on northerly (northwest to northeast) aspects. Nest areas and surrounding PFAs should be delineated to include the best available northern	Alternative 2 includes a design features that requires the designation of PFA for each new pair of goshawks found during implementation.

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	goshawk habitat and generally comprise about 600 acres.	
FW-ConstWat-G-2	Earthen stock ponds determined to be important for threatened, endangered, and Southwestern Region sensitive species, should be managed to maintain water and habitat needed for species survival and reproduction, consistent with existing water rights.	Alternative 2 is expected to move habitat conditions in the analysis area towards desired conditions. Vegetation treatments would reduce the risk of uncharacteristic, stand-replacing fire and minimizing potential impacts to earthen stock ponds that provide habitat for federally listed or Southwestern Region sensitive wildlife species in the analysis area.
Applicable Desired Conditions, Standards, and Guidelines for Invasive Species		
FW-Invas-DC 1	Invasive species are absent or exist at levels where they do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species.	The CWPP proposed action may result in localized increases in invasive species populations during project activities and within 1-5 years afterwards, but as a result of design features incorporated into the proposed action, they are expected to be detected and treated so that their populations' do not spread to levels that disrupt ecological composition, structure, and function within or adjacent to the project area.
FW-Invas-DC 2	Infestations of invasive species are detected at an early stage.	Design features to survey treated areas to detect invasive species and then treat them are included in the CWPP proposed action to conform to this desired condition.
FW-Invas-G 1	Measures should be incorporated into authorized activities, project planning, and implementation to prevent, control, contain, and eradicate priority infestations or populations of invasive species to ensure the integrity of native species populations and their habitats is maintained.	These guidelines provide direction for managing noxious or invasive weeds on the project area. These requirements are incorporated in the Proposed Action primarily through design features related to invasive species.
FW-Invas-G 2	Integrated pest management approaches and other treatments to control invasive species should be used to improve watershed condition and maintain ecosystem function while minimizing project impacts on native species	
FW-Invas-G3	Weed-free plant material should be selected for all seeding and mulching projects to restore natural species composition and ecosystem function to the disturbed area. Plant or seed materials should be used that are appropriate to the site, capable of becoming established, and are not invasive.	
Applicable Desired conditions, Standards and Guidelines for Soils		

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FW-Soil-DC-1	Soils function properly to distribute water and cycle nutrients to a variety of vegetation including lichens, mosses, grasses, forbs, shrubs, and trees.	These desired conditions indirectly address the botanical resources in this analysis by providing the proper substrates needed for rare plants. This project reduces the risks to proper soil function by addressing the landscape scale disturbances of uncharacteristic fire and post-fire flooding. Alternative 2 would help move toward this desired condition over the long-term by reducing the risk to soil function from uncharacteristic wildfire, which would impair soil function. Also over the long-term CWPP is expected to facilitate more frequent low severity wildfire over the project area, which would improve understory growth and nutrient cycling. The Proposed Action is consistent with forest plan because we are moving toward the desired conditions for healthy soil and not in conflict with them. There is some disturbance to soil but this is mitigated by soil design features and BMPs and also by mitigation of activities such as road construction. There may be short term departure from these desired conditions from the disturbance associated with management activities but the long term effects of management activities will generally result in movement toward these desired conditions in the project area. Part of these desired condition are to assure adequate vegetation cover to assure healthy soil and soil stability. Healthy native vegetation cover may also help discourage noxious or invasive weed invasions by providing competition.
FW-Soil-DC-2	Soil productivity and functions are sustained and functioning properly within the capability of the site, so the soil has the ability to resist erosion, infiltrate water and recycle nutrients. Coarse woody debris, including downed logs, provides for long-term soil productivity. Soil productivity and functions contribute to the resiliency and adaptability of terrestrial and riparian ecosystems to climate change.	
FW-Soil-DC-3	Vegetative ground cover is maintained at levels that contribute to suitable hydrologic function, soil stability, and nutrient cycling. Soils are protected by adequate vegetative ground cover on the soil surface to prevent erosion from exceeding natural rates of soil formation (soil tolerance), within their inherent capability. Soils are permeable and capable of infiltrating water to reduce instances of overland flows during precipitation events. The composition of grass and forb species and presence of plant litter and grass, forb, shrub, and tree basal area surface cover reduce occurrences of compaction and erosion.	
FW-Soil-DC-5	Localized short-term accelerated soil erosion occurs following high-severity fires (Fire Regimes IV and V), but it does not occur to the extent that it risks long-term impairment to connected waters downstream or causes loss of soil productivity over major portions of the 5th or 6th code watershed.	
FW-Soil-G-1	The forest should implement and monitor BMPs for all activities with the potential to impair water quality in accordance with the intergovernmental agreement between ADEQ and the Forest Service Southwestern Regional Office to control and manage nonpoint source pollution.	The CWPP proposed action includes Best Management Practices for prescribed fire and mechanical thinning activities as part of the design features that are incorporated into the proposed action. The design features are included in the Environmental Assessment and their effects are discussed in this analysis.
FW-Soil-G-2	Projects should be designed to avoid disturbance that would result in long-term impacts to soil function and productivity. Where disturbance cannot be avoided, project-specific soil and water conservation practices should be developed.	The CWPP proposed action includes a number of design features (including BMPs) to avoid disturbance that would cause long-term impacts to soil function and productivity, such as the identification of AMZs and restrictions on activities in these areas. The proposed activities were also designed to avoid the use of heavy machinery for mechanical thinning

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		on steep slopes and in other sensitive areas to comply with this guideline.
FW-Soil-G-3	Project-specific design features should be used when projects occur on slopes with a grade of about 40 percent or greater, on soils with moderate or severe erosion hazard, or on soils that are sensitive to degradation when disturbed, such as calcareous soils, to minimize or avoid soil impacts.	The CWPP proposed action does not include any mechanical thinning or use of heavy machinery on slopes of 40 percent or greater. Prescribed burning activities may occur on slopes of 40 percent or greater, but would be planned for low-severity, surface fire so that ground cover vegetation on steep slopes remain and does not result in threat of accelerated erosion after prescribed fire treatments.
Applicable Desired Conditions, Standards, and Guidelines for Watersheds and Water		
FW-Water-DC-1	Watersheds are functioning properly and are resilient to natural and human disturbances.	Alternative 2 is expected to reduce the risk of crown fire and reduce fire severity of areas burned during wildfire disturbance. AS a result, this alternative would make the landscape, including wetlands, more resilient to natural disturbance such as wildfire.
FW-Water-DC-3	Vegetation and soil conditions in watersheds support important ecosystem services such as clean water, base flow, riparian communities, and long-term soil productivity. These conditions also help moderate climate variability and change. Soil and vegetation function to facilitate precipitation infiltration and groundwater recharge.	Alternative 2 is expected to reduce the risk of crown fire and reduce fire severity of areas burned during wildfire disturbance, which will help maintain ecosystem services such as clean water, base flow, riparian communities, and long-term soil productivity. The treatments proposed under Atlernative 2 are expected to have minor short-term effects to soils and clean water.
FW-Water-DC-5	Water quantity (base flows) of intermittent and perennial streams are sustained to mimic seasonal flow regimes. Peak flows and flood potential occur within the historic range of variability for that stream system. For baseflows, this means that during low-flow periods (fall and winter, generally), water flow is sustained within its natural capability.	Alternative 2 is expected to reduce the risk of crown fire and reduce fire severity of areas burned during wildfire disturbance, which will reduce the risk of post-fire flood potential. Prescribed thinning and burning may result in minor enhancements in base flows, but not flooding, over the next several decades, which would benefit native species.
FW-Water-DC-6	Water quality, water quantity and the timing of water flows support ecological functions, habitat for aquatic and riparian species, and water sources for municipalities. Water quality, water quantity, and the timing of flows are sustained at levels that retain the biological, physical, and chemical integrity of associated systems and benefit survival, growth, reproduction, and migration of native species.	

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FW-Water-DC-7	Water quality meets or exceeds Arizona water quality standards and supports identified designated beneficial uses.	The proposed treatments would not result in water quality changes that would affect water quality standards; however, the proposed treatments will reduce the risk of a large-scale high-severity wildfire that could result in exceedences of Arizona water quality standards.
FW-Water-G-1	Watersheds should have enough vegetative ground cover to recover rapidly from natural and human disturbances and to maintain long-term soil productivity.	The CWPP project may result in short-term (1-3 years) reductions in vegetative ground cover as a result of disturbance from mechanical treatments and prescribed fire, but is expected to improve vegetative ground cover over the long-term (> 3 years), which would improve resilience to disturbance and maintain long-term soil productivity.
FW-Water-G-2	Watershed restoration and maintenance, and vegetation treatments should focus on priority 6th code watersheds to ensure that ecosystem processes, resilient vegetation conditions, and natural disturbance regimes are functioning properly.	The CWPP project is specifically designed to focus on 6th code watersheds that are a priority due to their contribution to the C.C. Cragin Reservoir, which is a municipal drinking water source. The proposed treatments are expected to improve ecosystem function and structure and improve resiliency of the project area to disturbance events.4
FW-Water-G-3	Best management practices for management activities should be identified, implemented, and monitored to maintain water quality, quantity, and timing of flows, and to prevent or reduce accelerated erosion.	Best management practices are incorporated into the CWPP proposed action for implementation to avoid or minimize effects to water quality and reduce the potential for accelerated erosion.
Applicable Desired Conditions, Standards, and Guidelines for Riparian Areas		
FW-Rip-All-DC-1	Within their type and capability, riparian ecosystems and corridors promote the natural role of water, natural hydrogeomorphic processes, sediment movement and capture, woody debris recruitment and retention, and root masses, and maintain water tables. This includes perennial and intermittent riparian streamcourses. The associated water table supports riparian vegetation.	The CWPP project may result in short-term (1-3 years) reductions in vegetative ground cover as a result of disturbance from mechanical treatments and prescribed fire, which can correlate to ownstream effects on water quality. However, this alternative is expected to improve udnerstory ground cover and reduce crown cover over the long-term (> 3 years), which would improve resilience to disturbance and maintain long-term downstream riparian streamcourses and water quality.
FW-Rip-All-DC-4	Riparian areas are managed consistent with designated beneficial uses associated with existing claimed or certified water rights. Water quality is maintained or improved so it fully supports State water quality standards or designated beneficial uses identified by ADEQ.	
FW-Rip-All-DC-5	Where the potential exists, vegetation, root masses, and woody debris stabilize and protect banks, edges, and shorelines of riparian areas from disturbances. Plant	

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	distribution and occurrence are resilient to natural disturbances.	
FW-Rip-All-G-1	Management activities such as vegetation treatments or other restoration actions should be designed to maintain or move toward desired conditions for soil, riparian vegetation, and water quality.	The CWPP proposed action is designed to move toward desired conditions for soil, riparian vegetation, and water quality in the long-term (> 1-3 years post treatment) by restoring the function of low-intensity ground fire within the project area and improving these resources' resiliency to disturbance events.
FW-Rip-All-G-2	Riparian areas should be managed to promote natural movement of water and sediment, to maintain ecological functions, and to maintain habitat and corridors for species.	The CWPP proposed action is expected to reduce the potential unnatural movement of sediment into riparian areas from a large-scale surface fire. This would help promote the natural movement of water and maintain habitat and corridors for species in the project area. The Proposed Action includes resource protection measures that maintain ecological functions of riparian areas and maintain habitat for fish and macroinvertebrates in the analysis area.
FW-Rip-All-G-3	An aquatic management zone should be identified and maintained in riparian areas to protect water quality and to avoid detrimental changes in water temperature or chemical composition, blockages of streamcourses, or sediment deposits that would seriously and adversely affect water conditions, habitats for aquatic species, or connected downstream cave, karst, and lava tube resources. Soil and vegetation disturbance from management activities should be managed to meet these intents, but is not necessarily excluded in this zone. The general starting points for widths of aquatic management zones are shown in table 1 (p. 34 of the Coconino National Forest Plan).	Aquatic management zones are included in the proposed action as a required design features / BMP to protect key habitat components for aquatic habitats and fish including riparian vegetation and water quality and conditions.
Applicable Desired Conditions, Standards, and Guidelines for Wetlands		
FW-Rip-Wtlnds-DC-1	Wetlands provide functional soil and water resources on most acres, consistent with their flood regime and flood potential, and provide diverse habitats for native species. Wetlands are in or trending toward proper functioning condition.	This guidance may benefit the Bolander's quillwort (*Isoetes bolanderi*), a rare plant that was included as "other" rare species in the Forest Plan. It has been collected on several occasions in Dude Lake, an ephemeral wetland within the project area. This desired condition addresses the proper functioning of these small but important habitats across the forest. No management actions are proposed for wetlands in the CWPP. Management actions in
FW-Rip-Wtlnds-DC-2	Consistent with the natural hydrologic cycle, wetland vegetation has a variety of age classes ranging from young to old and a composition of native species that reflects the individual wetland types.	

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	Plant composition can vary considerably at the fine- and mid-scales depending on site potential (as determined by TEUI or other appropriate ecological classification system) and geomorphology, elevation, climate, topography, soils, and smaller scale disturbances. Wetlands include vegetation that indicates maintenance of riparian soil moisture characteristics.	the uplands such as tree removal and prescribed burning may benefit wetlands in the project area by allowing for more consistent water supplies in these areas through the reduction of tree density and reduction of heavy litter through prescribed burning. These actions would allow areas such as Dude Lake to trend toward proper functioning condition and would be consistent with forest plan. Thus the CWPP would help move toward these desired conditions.
Applicable Desired Conditions, Standards, and Guidelines for Springs		
FW-Rip-Spr-DC-1	Springs have functional soil, water, and vegetative resources consistent with natural waterflow patterns, recharge rates, and geochemistry appropriate for the site.	The desired conditions for springs focus on improving or maintaining the function and ecological condition of these small but important areas that occur sporadically across the forest. Springs provide important habitat for species such as Bebb's willow by providing quality habitat with consistently moist soils.
FW-Rip-Spr-DC-2	Spring vegetation has young, mid, and late seral stages and a composition of native aquatic and riparian species consistent with spring type, slope, aspect, natural disturbances, and natural solar energy budget (amount of radiation during different times of the year).	
FW-Rip-Spr-DC-3	Spring riparian zones are capable of filtering sediment, capturing and/or transporting bedload, improving or maintaining water quality, providing groundwater recharge and supporting perched water-bearing zones within their natural potential, consistent with the spring type.	No management actions are proposed for springs in the Cragin Project but management actions in the uplands such as tree removal and prescribed burning may benefit springs in the project area by allowing for more consistent water supplies in these areas through the reduction of tree density and reduction of heavy litter through prescribed burning. These actions will indirectly improve the condition of springs in the project area and will move toward these desired conditions. The CWPP may benefit Bebb's willow in the project area over the long-term by improving proper functioning of springs that support the species, by both removing the risk of crown fire that would impact spring function and by modifying vegetation to improve understory growth in areas surrounding springs to support spring recharge and composition of native aquatic and riparian species.
FW-Rip-Spr-DC-5	The physical and biological components of springs provide habitat for narrowly endemic species and those with restricted distributions.	
FW-Rip-Spr-G-1	Spring recharge areas, where known, should be managed to maintain or improve spring discharge.	Alternative 2 includes design features including SW3, SW9, which involves the designation of Aquatic Management Zones and protection of karst features (CK1 through CK5) to protect and maintain spring recharge and discharge areas during treatments. The proposed treatments are expected to create slam opening in the forest canopy and reduce the number of trees, which is expected to improve spring recharge over the long-term.

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FW-Rip-Spr-G-3	Projects and activities should be designed and implemented to maintain or improve soil and riparian function; maintain or improve native vegetation; and/or prevent the introduction or spread of disease, invasive, or undesirable species. Design features could include road, recreation, and/or livestock management.	Alternative 2 includes a number of design features to avoid and/or minimize effects to native vegetation and to prevent the introduction or spread of disease, invasive, or undesirable species.
Applicable Desired Conditions, Standards, and Guidelines for Riparian Forest Types		
FW-Rip-RipType-DC-1	Riparian forests are functioning or in good condition and contribute to healthy watersheds while providing for multiple uses. Periodic flooding and scouring are the primary natural disturbances and promote a diverse plant structure consisting of herbaceous, shrub, and tree species of all ages and size classes necessary for the recruitment and succession of riparian-dependent species. Age and size classes include seedling, sapling, mature, and overmature vegetation. Fire is infrequent and of low burn severity when it occurs.	Alternative 2 does not include prescribed treatments in riparian vegetation, but these areas may be affected by indirect effects. Short-term indirect effects are expected to be very minor and would not have a measurable effects on riparian vegetation. The CWPP proposed action is designed to move toward desired conditions for soil, riparian vegetation, and water quality in the long-term (> 1-3 years post treatment) by restoring the function of low-intensity ground fire within the project area and improving these resources' resiliency to disturbance events.
FW-Rip-RipType-DC-2	Riparian forests and their channels and adjacent flood plains are capable of filtering sediments, ash, and contaminants; building and stabilizing banks; reducing the effects of flooding; storing and releasing water; cycling nutrients, and recharging aquifers to support basic functioning and resilience. Riparian forests provide habitat and help maintain temperatures necessary for maintaining populations of native aquatic and riparian-dependent species and for their dispersal. At the landscape scale, overall plant composition similarity to site potential averages greater than 66 percent. Plant composition and spatial arrangement can vary considerably at the fine- and mid-scales because of diverse seral conditions, depending on site potential (as determined by TEUI or other appropriate ecological classification system) and climate, elevation, geomorphology, topography, soils, and smaller scale disturbances.	
FW-Rip-RipType-DC-3	Protective litter and plant cover is similar to site potential (greater than 66 percent) which allows higher stream terraces and floodplains to recycle nutrients, and resist	

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	erosion and compaction. The amounts of litter and cover can vary considerably at the fine- and mid-scales, depending on site potential (as determined by TEUI or other appropriate ecological classification system).	
FW-Rip-RipType-DC-4	Root masses and herbaceous vegetation stabilize banks, filter sediment, and maintain or improve water quality.	
FW-Rip-RipType-DC-5	Dead (snags) and live trees, and down woody material provide prey base habitat, aquatic nutrient cycling, and soil retention.	
Applicable Desired Conditions, Standards, and Guidelines for Stream Ecosystems		
FW-Rip-Strm-G-2	An aquatic management zone for non-riparian, intermittent streamcourses should be identified and maintained to reduce sedimentation, maintain functioning of the channel within its floodplain, and maintain downstream water quality and riparian habitat and function. This management zone would also avoid detrimental changes in water temperature or chemical composition, blockages of streamcourses, or sediment deposits that would seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources. Soil and vegetation disturbance from management activities should be managed to meet these intents but is not necessarily excluded in this zone. The general starting points for widths of aquatic management zones are shown on p. 36 of the Coconino National Forest Plan	Alternative 2 includes designation of aquatic management zones to protect key habitat components for aquatic habitats and fish including riparian vegetation and water quality and conditions.
Applicable Desired Conditions, Standards, and Guidelines for Geologic Features		
FW-BioPhys-Geo-DC 1	Geological features are generally undisturbed by human activities. The cultural, archaeological, geological, hydrological, paleontological, biological, and aesthetic resources associated with caves, karst, talus slopes, and cliffs are maintained.	The cultural resource inventory plan for the CWPP project specifies focused survey of canyon rock faces, karst features and caves in order to identify associated rock shelters, camp sites, rock art or other historic or prehistoric use around such features. Cultural resources found associated with these features will be protected from direct disturbance or burning if

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FW-BioPhys-Geo-DC 6	Cliffs provide specialized habitats for a variety of species including nesting and feeding habitats for birds of prey and roosting habitat for bats. They provide escape, bedding, and lambing cover for bighorn sheep. They provide habitat for rare plants such as cliff fleabane and Senator Mine alumroot.	found to be fire sensitive. The CWPP project is in compliance with the 2018 Forest Plan concerning Desired Conditions for Geological Features. Cliff fleabane, a Region 3 sensitive species is dependent on cliffs for habitat and occurs in the project area. The desired condition provides for undisturbed habitat for cliff dependent species as well as protecting the cliffs. Alternative 2 is not expected to result in effects to cliff habitat and would thus help meet this desired condition.
FW-BioPhys-Geo-S-1	Designated or nominated significant caves shall be managed to perpetuate those features, characteristics, values, or opportunities for which they were designated.	There are no significant caves that have been nominated in the CWPP area, but there are several known caves that are potentially significant and will be nominated in the future. The cave/karst inventory concentrated on mapping surficial karst features and so the extent of underground passages is largely unknown, therefore there may be potentially many more significant caves in the area. The cave/karst inventory located these resources so that they can be protected from disturbance or damage from logging, prescribed burning and other associated activities (existing roads, temporary roads and processing sites). Protection buffers for each feature were developed considering the type of feature, size and the critical resource values it has.
FW-BioPhys-Geo-G1	Projects should be designed and uses should be managed to maintain the integrity and function of caves, karst, cliffs, and talus slopes. Where alteration of these resources cannot be avoided, they should be mitigated to mimic pre-disturbance conditions and function.	A project geologist and a crew of qualified Geo-Corps interns planned and implemented the karst survey for the CWPP and developed protection buffers to protect cave and karst resources from ground disturbance and water or air quality impacts. A GIS database was developed that can be used in project implementation. Design features were developed to protect caves and karst features (CK1-5) See also Geo-G2 below.
FW-BioPhys-Geo-G2	Projects and activities should be designed to prevent siltation into sinkholes and cave entrances, collapse of cave passageways, and alteration of the chemical, physical, and biological conditions of the cave resource. A radius of 300 feet should be used for restrictions on activities that can alter the cave's resources, functions, and associated features unless site-specific adjustments are made, based on topography, drainage, soil type, and the expected impact of the proposed activity.	The protection buffers for the caves and karst features are a no mechanical equipment thinning buffer. The vegetation surrounding the cave entrance will not be altered within 50 feet or more of the cave entrance or sinkhole feature. (CK1, CK5). Many of the protection buffers are 100, 150 or 300 feet in width depending on the size of the karst feature and whether it is open to the subsurface. The protection buffers and AMZs will limit activities around a karst feature so that there will be no cave collapse, and minimal changes to air flow, temperature, humidity and sedimentation into or out from a cave (CK1,

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		CK3). The protection buffers will protect cave and karst features from pollution from petroleum products used in logging (CK1, CK2, and CK3). Potentially hazardous karst conditions such as active sinkhole subsidence and open sinkholes was identified as part of the cave and karst survey. Sinkholes, disappearing streams, springs, caves, and areas vulnerable to contamination from anthropogenic or natural events were identified and protection buffers were designated to prevent collapse, water pollution or sedimentation into subsurface cave passages. Erosion control measures will be implemented to minimize road-related sedimentation into caves or sinkholes (CK2). The cave entrance or underground openings will not be altered by project activities. Smoke impacts from prescribed burning will occur but since the burning will be low to moderate severity, the smoke impacts will be short term over several days and will mimic wildfires within the natural range of variability and where fire is the primary natural disturbance.
FW-BioPhys-Geo-G-6	Caves and abandoned mines that are used by bats should be managed to prevent disturbance to species and spread of disease such as white-nose syndrome (*Pseudogymnoascus destructans*).	Bat use of caves and sinkholes with openings is not well known in this area as very few surveys have been conducted. The designated protection buffers around caves and karst features will protect bat species that utilize the features. The project does not involve any cave entry or survey so there should be no potential for introduction or spread of white-nose syndrome from cave exploration with this project.
FW-BioPhys-Geo-G-7	Caves containing endemic species should be managed to emphasize protection of those species.	Little is presently known about any rare, endemic, listed or sensitive species that inhabit caves and karst features. The designated protection buffers around caves and karst features will protect the environment and habitat for the species that utilize the features (CK1-5).
FW-BioPhys-Geo-G-8	Aquatic management zones or best management practices should be applied to perennial, intermittent, or ephemeral streamcourses to maintain the chemical, physical, and biological conditions of connected or downstream caves, karst, and lava tubes.	Buffer widths around the karst features range from 300 feet to 50 feet. AMZs were also designated for caves and sinkholes where water enters the subsurface or emerges from the feature. Erosion control methods may be used on roads to prevent sediment or aggregate from entering an open cave or swallet. See project design features CW1-5.
Applicable Desired Conditions, Standards, and Guidelines for Established and Proposed Research Natural Areas and Designated Botanical and Geologic Areas		

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SA-RNABotGeo-DC 5	The unique characteristics of botanical and geological areas are protected and maintained. The inherent physical and biological processes of botanical areas and geological areas are sustained, and not negatively impacted from human activities or permitted uses. Natural processes continue to shape and define the unique features, characteristics, and formations of these areas.	The Mogollon Rim Botanical Area that is within the project area and was established to represent an example of the unique white fir/Rocky Mountain maple forest type. It is well established that low- to moderate intensity wildfire is a key natural process that maintained the unique characteristics of this forest type. The CWPP is expected to restore low-to moderate intensity wildfire within the project area, and thus help sustain this key process.
SA-RNABotGeo-DC 6	Botanical areas and geological areas provide opportunities for study, monitoring, and interpretation.	The CWPP may result in days or weeks long temporary closures during nearby mechanical treatments or prescribed fire, but would not prevent or decrease opportunities to study, monitor, or interpret the Mogollon Rim Botanical Area. There are currently no ongoing studies within the Botanical Area that would be affected by proposed action.
SA-RNABotGeo-G 1	To support the area's purpose, human activities, permitted uses, and types and levels of access should be managed to protect the uniqueness and/or ecological condition of these special areas, and the values for which they were designated, established, or proposed.	The CWPP is not expected to change the level of access to the Mogollon Rim Botanical Area during the project or in the foreseeable future. As a result the project meets the intent of this guideline.
SA-RNABotGeo-G 3	Fire should be managed using minimal impact suppression tactics or other appropriate suppression tactics to protect the resources for which research natural areas, botanical areas, and geological areas were designated, established, or proposed.	The CWPP proposed action includes low-to moderate intensity fire so that suppression tactics that could affect the Mogollon Rim Botanical Area are minimal or avoided in the case of a wildfire. The project is considered consistent with the intent of this guideline.
Applicable Desired Conditions, Standard, and Guidelines for National Trails		
SA-NatlTrails-DC-1	Scenic integrity and broad views of the surrounding landscapes are retained on national scenic trails and national recreation trails.	A number of design features are included in the proposed action to maintain the scenic integrity of the project area when viewed from national scenic and recreation trails such as SCN3, SCN4, SCN5, SCN6, SCN11, SCN12, and SCN13. While there may be noticeable visual effects from treatments, especially during or within the 1-3 years after treatments, there would be no landscape scale scenic effects that would degrade scenic integrity.
SA-NatlTrails-DC-2	The integrity of cultural and natural resources, scenery, or recreational experiences is maintained along designated national trails on the Coconino NF.	A number of design features are included in the proposed action to maintain the integrity of natural resources, scenery, and recreational experiences along the Arizona Trail and General Crook Trail in the project area. Measures including REC6, REC7, REC8, REC9. REC10, REC11, REC 12, REC 13,

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		REC 14, REC 15, REC 16, and REC 17 include direction to implement treatments so that they avoid or limit effects to trails and maintain opportunities for visitors.
SA-NatlTrails-DC-3	In remote areas on national scenic trails, the sights and sounds of roads, motorized trails, utility corridors, and other facilities and infrastructure are rarely encountered.	The CWPP project may result in short-term noise or changes in scenic integrity; however, these would not change the recreational settings in remote areas on national scenic trails in the long-term. Treatments would improve forest resilience to most of the project area to disturbance over the long term, which would help maintain natural conditions appropriate for this setting.
SA-NatlTrails-DC-7	The ANST provides opportunities to experience a variety of vegetation, terrain, and scenery. Visitors can enjoy a simple day hike to multi-week hikes along the 8 trail passages (over 165 miles) that cross the forest. Wild and remote, backcountry segments of the route provide opportunities for solitude, immersion in natural landscapes, and primitive outdoor recreation. Front-country and more easily accessible trail segments connect to communities that lend their own character and history to each section of the trail.	Implementation of the CWPP project may result in temporary closures or detours, but would not affect the long-term opportunities, accessibility, or experience afforded by the Arizona National Scenic Trail.
SA-NatlTrails-DC-8	The ANST is well maintained, signed, and passable. Alternate routes are made available in the case of temporary closures resulting from natural events, such as fire or flood, or land management activities.	Alternative routes will be made available in conformance with REC17 where temporary closures limit access to one or more portions of the Arizona National Scenic Trail.
SA-NatlTrails-DC-9	The historic route, features, and associated values along the General George Crook Recreation Trail are preserved.	Since General Crook Trail is also a historic site, the route will be surveyed and marked for avoidance of any features and associated values. In addition, REC6, REC7, REC9, and REC13 are included in the proposed action to preserve features identified for General Crook and other trails in the area.
SA-NatlTrails-S-1	Protect General George Crook National Recreation Trail chevrons and route markers and historic milepost markers.	Effects to historic chevrons, route markers, and historic milepost markers will be avoided during implementation of the CWPP in compliance with the 2018 Forest Plan, Standard for National Trails.
SA-NatlTrails-G-2	Management activities should be designed and implemented to maintain long-term scenic values within and adjacent to national scenic trail corridors.	The CWPP project may result in short-term scenic effects associated with the mechanical and prescribed fire treatments, but would help move toward desired conditions for the Crook National Recreation Trail in the long-term (2-20 years after treatment) by reducing the risk of uncharacteristic wildfire along the trail in compliance with Guidelines for National

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		Trails. Resource protection measure REC10 is included in the proposed action to maintain long-term scenic values within and adjacent to National or forest system trails.
SA-NatlTrails-G-3	To retain the character for which a national scenic trail was designated, management activities should not result in recreation setting changes from less to more developed, particularly within the foreground.	The CWPP project would not result in any changes to the recreation setting along the General Crook Trail in compliance with Guidelines for National Trails. Activities such as temporary roads and processing sites, which would be used in conjunction with treatments would affect some areas, but would ultimately be restored to a natural setting and would not be within the foreground of any part of a national scenic trail.
SA-NatlTrails-G-5	New road or motorized trail construction across or adjacent to a national scenic trail should be avoided to protect the non-motorized setting and recreational experiences.	The CWPP does include temporary roads, which include new road constriction. Resource protection measures REC8 and REC9 include strict limits and process for avoiding and minimizing road and trail construction associated with mechanical treatments. Any new temporary roads or skid trails would be temporary and would not result in a long-term shift from a non-motorized setting to a motorized setting. None of the proposed temporary roads affect the non-motorized setting of the General Crook Trail in compliance with Guidelines for National Trails.
SA-NatlTrails-G-8	Using the ANST for landings or as a temporary road for any purpose should not be allowed. The purpose of this guideline is to provide for a natural-appearing setting and to avoid visual, aural, and resource impacts.	Resource protection measures REC6, REC7, and REC8 ensure the CWPP will meet this guideline to avoid temporary roads and landings on the ANST.
SA-NatlTrails-G-10	If forest health projects result in short-term impacts to the scenic integrity of the ANST, design features or mitigation measures should be included to minimize visual impacts within and adjacent to the trail corridor (within visible foreground at a minimum).	The CWPP follows this guidelines by including REC8, REC9, and REC10 to minimize visual impacts within and adjacent to the trail corridor.
SA-NatlTrails-G-11	The General George Crook National Recreation Trail should be managed to preserve evidence of historic roadway and landscape character, including related historic trees, markers, gravesites, and water holes within a 200-foot corridor.	The CWPP follows this guidelines by including REC8, REC9, REC10, REC11, REC12, and REC13 to preserve evidence of historic character including historic trees, markers, gravesites, and water holes along the General Crook National Recreation Trail.
Applicable Desired Conditions, Standards, and Guidelines for Special Uses		

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FW-SpecUse-DC-1	Authorized activities are consistent with Recreation Opportunity Spectrum Settings. Motor vehicle use for authorized activities occurs on roads and trails displayed on the motor vehicle use map or on roads specifically authorized.	Authorized project activities would include use of heavy machinery, tree thinning, and prescribed fire that may affect the sights and sounds of the environmental experienced by Forest visitors in the project area in the short-term, but would help move toward ROS designations in the long-term by establishing more resilient forest conditions.
FW-SpecUse-DC-10	The footprints for recreation residences and commercial facilities are stable with some exceptions to accommodate improvements that address health, safety, and environmental issues.	The proposed action include processing areas, which could be considered commercial facilities. These facilities have footprints identified in the EA process that are limited and these areas will be used to address forest health needs identified in this project purpose and need.
FW-SpecUse-S2	Require permit holders to rehabilitate unplanned, user-created trails and other impacted areas created by their activities that were not authorized under their special use permit.	Any permitted activities will be managed by a permit administrator who will ensure any unplanned trails are rehabilitated to pre-permit conditions. For mechanical thinning the timber contract or agreement will include terms that will require conditions are returned to pre-contract (or agreement) conditions at the conclusion of the contract/agreement. If processing areas are permitted via special use permit a bond or other mechanism will be required to ensure rehabilitation is completed to standard.
FW-SpecUse-G-1	Lands and recreation special uses should be designed to maintain or move toward desired conditions for other uses and resources.	The only special uses that would be approved from this decision would be a permit to authorize processing areas. These permits would be managed to help meet the project purpose and need, which is designed to help move towards desired conditions for fire and fuels resources, wildlife, and watershed resources.
FW-SpecUse-G-2	To reduce social conflicts, all special use activities should occur during times, in ways, and in locations that are consistent with the needs of national forest users while addressing disturbance and safety concerns for area residents.	The proposed action includes 12 resource protection measures included as part of the proposed action specifically to facilitate management efforts to minimize conflict in ways that meet needs of national forest users while allowing for project implementation to reduce the risk of crown fire and post-fire flooding.
FW-SpecUse-G-3	Lands and recreation special use permits should not be issued for activities proposed to occur within 200 feet of perennial streams, springs, or waters that contribute to or support sensitive resources such as federally listed or Southwestern Region sensitive species. The intent is to protect riparian resources. Exceptions	The only special uses that would be approved from this decision would be a permit to authorize processing areas. None of the proposed processing areas are within 200 feet of perennial streams or in sensitive wildlife habitat, or riparian, or other sensitive areas.

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	may be made for hardened or slickrock sites, water-dependent activities, or safety.	
Applicable Desired Conditions, Standards, and Guidelines for All Recreation		
FW-Rec-All-DC-2	The diverse landscapes of the Coconino NF offer a variety of settings for a broad range of recreational opportunities in all seasons and access to natural, wild places.	The proposed project would include improving forest resilience, which would facilitate the forest's ability to offer a variety of settings for a broad range of recreational opportunities and access.
FW-Rec-All-DC-4	Coconino NF provides a broad spectrum of developed and dispersed recreation settings. Some recreation settings are undeveloped and offer opportunities for primitive character, challenging access, and solitude while other settings offer opportunities for more developed infrastructure, easier access, higher levels of social interaction, and increased user comforts. Social encounters in an area, road or trail are generally consistent with ROS settings.	The CWPP would not affect levels of dispersed recreation, but during project implementation there could be temporary area closures or displacement of users from implementation efforts, which could result in greater challenges for access or greater social encounters than suggested by the ROS. These effects would be short term and this project would not affect the long-term consistency of meeting ROS settings.
FW-Rec-All-DC-6	Recreation opportunities are balanced with the capacity of forest resources to support them. There are minimal user and resource conflicts. As development and population in the region continue to grow and new forms of recreation emerge, recreation settings on the Coconino NF are stable, retaining their natural character. Short-term increases in recreation during holidays and weekends do not result in long-term adverse effects to other forest resources.	The CWPP would not affect levels of dispersed recreation, but during project implementation there could be temporary area closures or displacement of users from implementation efforts, which could result in greater challenges for access or greater concentration of use in nearby recreational areas. These effects would be short term and this project would not result in long-term adverse effects to other resources.
FW-Rec-All-DC-7	Developed recreation sites located adjacent to road corridors emphasize safety and minimize user conflict.	The proposed project would not result in any changes to developed recreations sites located in or adjacent to the project area.
FW-Rec-All-DC-10	Opportunities for experiencing solitude and natural soundscapes are consistent with ROS objectives.	The CWPP would not affect levels of dispersed recreation, but during project implementation there could be temporary area closures or displacement of users from implementation efforts, which could result in greater social encounters than suggested by the ROS. These effects would be short term and this project would not affect the long-term opportunities for solitude or natural soundscapes identified for each ROS setting.
FW-Rec-All-G-1	Recreational activities, locations, and/or settings should be designed and managed to maintain or move toward desired conditions for other uses and resources.	Recreational activities, locations, and/or settings may experience short-term effects during project implementation that impede meeting recreational desired conditions. Over the long-term CWPP is expected to improve

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		forest health and resilience and decrease the potential effects of a crown fire, thus improving the ability to move toward desired conditions for recreational uses and other resources.
FW-Rec-All-G-2	Recreational activities, locations, and/or settings should be managed to have minimal user conflicts, to be in balance with the capacity of other resources to support them, to promote public health and safety, and/or to prevent wildlife access to food, trash, and human waste.	The CWPP would not affect recreation locations and settings directly, but during project implementation there could be temporary area closures or displacement of users from implementation efforts, which could result in short-term user-conflict or capacity issues. These effects would be short term and this project would not affect the long-term recreational user conflict or capacity.
FW-Rec-All-G-8	Signs should be provided so people can easily find trails and facilities.	The Forest currently provides signage for recreation trails and facilities. The proposed action may affect access to recreation trails or facilities or may result in temporarily closures or detours. Temporary signage will be used to keep forest visitors informed of any access impediments or detours to facilitate continued ability of forest visitors to find trails and facilities.
Applicable Desired Conditions, Standards, and Guidelines for Developed Recreation		
FW-Rec-Dev-DC-1	Developed recreation opportunities are available for individuals, families and groups, with a multitude of recreation experience types. Campgrounds, rental cabins, and reservoirs provide developed recreation opportunities	The proposed action would help move toward desired conditions by reducing risks associated with loss of recreation opportunities at the CC Cragin reservoir. While project implementation may result in temporary closures or short-term limits on developed recreation opportunities, there would be long-term benefit for maintaining developed recreation opportunities in the future in the project area.
FW-Rec-Dev-DC-4	Developed sites promote visitor safety and enjoyment of the area.	Developed sites will continue to promote visitor safety and enjoyment of the area during and after project implementation.
FW-Rec-Dev-DC-6	Well planned and maintained trails are available to link users in developed sites to a variety of nearby recreation opportunities.	The Cragin proposed action will include treatments that may result in temporarily closures or detours for trails. Resource protection measures including Rec7, Rec8, and Rec9 include direction to avoid impacts to existing trails, including trail connectivity.
FW-Rec-Dev-G-1	Developed recreation sites should be managed to protect human health and safety, and should be located to avoid floodplains, rock fall areas, and other areas of hazardous concern.	The CC Cragin project may result in activities that will require temporarily closures to ensure safe working conditions. In addition, These temporary closures would meet the intent of guidelines to manage developed recreation sites to protect human health. Resource protection measure Rec20 identifies strategies to implement treatments during low recreation

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		periods to minimize safety concerns and encourages vegetation treatment near developed sites to reduce wildfire risk over the long-term.
FW-Rec-Dev-G-2	To promote a natural-appearing landscape, use of native plant species should be emphasized during planning activities (such as design of new sites or improvements to existing sites). Invasive species should be removed or treated on existing sites before they become widespread within recreational sites.	Resource protection measure P8 includes language for revegetation of disturbed areas resulting from treatment activities to use an application of native seed mix. Resource protection measures NW1 throughNW12 are included in the proposed action to minimize the establishment and control the spread of invasive species during project implementation.
FW-Rec-Dev-G-3	Developed recreation sites should be managed to discourage or prohibit broken or cut tree limbs or the removal of all downed woody debris to maintain a natural-appearing landscape, to maintain the integrity of the site, and to control accelerated erosion.	The proposed action includes resource protection measure REC20, which states, "All treatments in recreation sites would be designed to protect and enhance existing vegetative structure, while maintaining the character of the site. Work with the District Recreation Specialist to determine boundaries or no treatment zones around constructed features that need to be protected in the campgrounds."
Applicable Desired Conditions, Standards, and Guidelines for Dispersed Recreation		
FW-Rec-Disp-DC-1	The diverse landscapes of the Coconino NF offer a variety of settings and challenges for a broad range of recreational opportunities in all seasons. There are numerous locations for visitors to escape into natural, wild places. Semiprimitive and primitive settings retain their remote and undeveloped characteristics.	Project activities may temporarily affect semiprimitive and primitive settings during treatments, but these areas would retain their remote and undeveloped characteristics over the long-term.
FW-Rec-Disp-DC-3	Areas used for dispersed recreation across the forest retain their natural character to the extent possible and have minimal evidence of human waste and litter, sanitation issues, and resource damage.	Project activities may temporarily affect dispersed recreation settings during treatments, but these areas would retain their natural character over the long-term.
FW-Rec-Disp-DC-5	The Coconino NF provides abundant and high-quality opportunities for hunting, fishing and other wildlife-based recreation opportunities.	Project activities may temporarily affect opportunities for hunting, fishing or other wildlife-based recreation within the project area during treatments. Forest treatments are expected to result in a long-term increase in forest resilience to disturbance, which would retain hunting, fishing and other wildlife-based recreation opportunities in the project area.
FW-Rec-Disp-S-1	Motorized vehicle use shall occur as identified on a designated system of roads, trails, and areas (including locations designated for motorized big game retrieval), as defined on motor vehicle use maps, except for those uses authorized by law, permits, and orders in	The CWPP authorizes mechanical thinning and prescribed fire activities that will include motor vehicle use off of designated routes and areas, however, it will not change the current motor vehicle routes or areas currently designated for motor vehicle use.

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	connection with resource management and public safety.	
FW-Rec-Disp-G-2	In designated dispersed camping sites and corridors, vegetation should be retained to provide shade and screening around hardened sites to preserve the recreation setting.	The CWPP includes resource protection measures to limit effects to designated dispersed camping sites. SW11 includes requirements that all skid trails, temporary roads, and landings are approved by a timber sale administrator.REC6 also includes coordination with District Recreation Planner during burn plan development, layout, and marking to limit impacts to the recreational setting.
FW-Rec-Disp-G-3	Visitors should be restricted from soil and plant restoration sites to promote re-establishment of vegetation and functioning soil.	RD3 includes techniques including restoring of the original surface topography and spreading of slash as methods to include in the revegetation of disturbed areas, which would reduce the potential for visitors to affect soil and plant restoration sites.
Applicable Desired Conditions, Standards, and Guidelines for Inventoried Roadless Areas		
SA-IRA-DC-1	The inventoried roadless areas identified in the 2001 Roadless Area Conservation Rule maintain their overall roadless character.	About 1.5 acres of the East Clear Creek IRA is contained within the CWPP boundary. Such a small area within the project boundary would not result in changes to overall roadless character.
SA-IRA-S-1	Projects and management activities shall be designed to maintain the overall roadless character of inventoried roadless areas.	About 1.5 acres of the East Clear Creek IRA is contained within the CWPP boundary. Such a small area within the project boundary would not result in changes to overall roadless character.
Applicable Desired Conditions, Standards and Guidelines for Forest Products		
FW-FProd-DC-1	The Coconino NF provides a sustainable supply of forest products consistent with other resource desired conditions and applicable laws and regulations. This supply contributes to the stability and social, economic, and cultural aspects of the communities in central and northern Arizona.	Alternative 2 supports this desired condition by providing forest products as a result of prescribed cutting treatments designed to treat vegetation towards Forest Plan desired conditions.
FW-FProd-DC-2	Silvicultural treatments for forest products reflect natural disturbance regimes and contribute to ecosystem sustainability. Silvicultural timber cutting techniques integrate considerations for socioeconomic values, water quality, soils, wildlife habitat, recreation opportunities, visual quality, and other values, while providing opportunity for a sustainable and appropriately scaled industry.	Alternative 2 supports this desired condition by providing forest products as a result of prescribed cutting treatments designed to treat vegetation towards Forest Plan desired conditions.

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FW-FProd-S-1	No harvest for purposes of timber production shall occur on lands not suited for timber production.	Alternative 2 is compliant with this standard. The forest stands proposed for timber harvest using individual tree and group selection, commercial and pre-commercial thinning meet the criteria of being on land suitable for timber production as described by the Forest Plan and FSH 2409.12, Chap. 20.
FW-FProd-G-1	Timber harvest activities should be designed to be consistent with maintaining or moving toward ecological/social desired conditions.	Alternative 2 is compliant with this standard. The proposed silvicultural treatments are consistent with the desired condition expressed through the CWPP purpose and needs to: Reduce the risk of uncharacteristic wildfire to the Wildland Urban Interface (WUI) and drinking water watersheds in and adjacent to the project area; Reduce the risk of post-fire erosion and/or flooding that could impact reservoir operations and storage which could affect the water supply for the Town of Payson, the community of Mesa del Caballo, the Salt River Project, Native American Indian tribes and other northern Gila County water users; and move the forest on a positive trajectory of restoring forest structure, composition and function and initiate the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem.
FW-FProd-G-2	Harvesting systems should be selected based on their ability to meet desired conditions and not on their ability to provide the greatest dollar return.	Alternative 2 is compliant with this standard. While forest product outputs were considered in the decision process, other factors such as: reducing risk of uncharacteristic fire and its effects to forest resources; re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem; and improving wildlife habitat within the CWPP area were the primary factors used to determine the timber harvesting system.
Applicable Desired Conditions, Standards and Guidelines for Roads and Facilities		
FW-RdsFac-DC-1	The transportation system (roads) provides reasonable motorized access to the public, city, county, State, and other Federal entities for permissible uses such as recreation, fire management, wildlife management, and access to infrastructure or neighboring land. The transportation system expands and contracts commensurate with use and needs, and it balances the desire for access with management activities and	This desired condition addresses the need for a road system that is adequate for the management and recreational activities within the project boundary while addressing the needs of natural resources. For the purposes of this report this includes minimizing or mitigating the effects of management actions on watershed conditions, recreation opportunities, scenery, heritage resources, rare plants, fisheries, and wildlife habitat and movement.

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	ecological impacts. An economical system of sustainable, well maintained, and marked roads provides diverse opportunities to explore the forest while protecting watershed conditions, recreation opportunities, scenery, heritage resources, rare plants, fisheries, and wildlife habitat and movement. However, the transportation system does not necessarily provide for user comfort or all-weather access on all roads.	
FW-RdsFac-DC-3	Temporary increases in roads are appropriate for projects associated with watershed protection and restoration. Temporary roads that support ecosystem restoration activities, fuels management, or other short-term projects are rehabilitated promptly after project completion.	Alternative 2 includes temporary roads to facilitate mechanical treatments in areas where treatments are necessary to restore forest function and improve resiliency to disturbance. All temporary roads will be rehabilitated after project completion.
FW-RdsFac-G-1	Roads should be located, designed, and maintained to move toward or maintain desired conditions for other uses and resources.	These guidelines provide direction for a sustainable road system while addressing the needs of other resources. These guidelines are incorporated into the Proposed Action and included in design features.
FW-RdsFac-G-5	Soil and water BMPs should be implemented to protect water quality while designing, constructing, reconstructing, or relocating new and existing roads, parking areas and pullouts. For example, permanent and temporary road construction and relocation should: Occur outside of streamcourses and aquatic management zones, except where crossing is required. Avoid wetlands, springs, seasonally wet meadows, and montane meadows. Avoid soils that are unstable and highly erodible where connected to streamcourses.	Alternative 2 includes project design features to ensure this Forest Plan guideline is complied with.
FW-RdsFac-G-8	For projects where long-term access is not needed, temporary roads should be used and naturalized in a timely manner. The intention is to have the road footprint, and potential impacts from road use, such as possible introduction of	Alternative 2 is consistent with this guideline as the project proposes the use of temporary roads in association with vegetation management activities.

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	invasive species, modification of scenic integrity objectives, or increased sedimentation into connected waters, on the landscape for as short a time as possible.	
Applicable Desired Conditions, Standards, and Guidelines for the C.C. Cragin Watershed Management Area		
MA-CCCrg-DC-1	There is low risk of substantial damage from uncharacteristic fire and recreation to water supply, infrastructure, water quality, visual quality, and cultural integrity (such as tribes and local communities).	Alternative 2 is compliant with this desired condition. The purpose of the CWPP is to: Reduce the risk of uncharacteristic wildfire to the WUI and municipal water supply watersheds in and adjacent to the project area. Reduce the risk of post-fire erosion and/or flooding that could impact reservoir operations and storage which could affect the water supply for the Town of Payson, the community of Mesa del Caballo, the Salt River Project, Native American Indian tribes and other northern Gila County water users. Move the forest on a positive trajectory of restoring forest structure, composition and function and initiate the re-establishment of a fire-adapted, resilient, diverse and sustainable forest ecosystem. The effects analysis of the fire and fuels specialist and vegetation specialist affirm this finding.
MA-CCCrg-DC-2	The canyons in this MA provide solitude and more primitive non-motorized recreation opportunities than surrounding areas. These areas also provide low-disturbance wildlife habitat.	The CWPP project may result in short-term noise or changes in scenic integrity; however, these would not change the recreational opportunities available over the long-term. Treatments would improve forest resilience to disturbance over the long term, which would help maintain or move toward desired conditions for primitive non-motorized opportunities and low-disturbance wildlife habitat.
MA-CCCrg-G-1	The C.C. Cragin Watersheds MA should be managed to reduce the threat of uncharacteristic wildfires, flooding, and sedimentation, and to maintain water quality and quantity.	Alternative 2 is expected to result in forest conditions that are more resilient to disturbance by decreasing the risk of high-intensity wildfire. Reducing the potential for high-severity wildfire within the project area is expected to reduce risks to water quality and quantity over the next several decades. Water and soil best management practices included as part of the alternative are expected to maintain water quality and quantity downstream of areas proposed for treatment.
Applicable Desired Conditions, Standards, and Guidelines for the Long Valley Management Area		
MA-LngV-DC-1	Long Valley MA provides a mix of well-preserved, semiprimitive opportunities	Treatments would improve forest resilience to disturbance over the long term, which would help meet these desired conditions for well-

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	interspersed with rural or roaded natural settings.	preserved, semiprimitive opportunities in a rural or roaded natural setting.
MA-LngV-DC-2	Long Valley MA provides opportunities for motorized dispersed camping and associated recreation uses.	Treatments would improve forest resilience to disturbance over the long term, which would help meet these desired conditions for motorized dispersed camping opportunities.
MA-LngV-DC-3	The ridges and canyons in Long Valley MA provide solitude and more primitive non-motorized recreation opportunities than surrounding areas. These areas also provide low disturbance wildlife habitat.	Treatments would improve forest resilience to disturbance over the long term, which would help maintain or move toward desired conditions for low disturbance to wildlife habitat, and more primitive and non-motorized recreation opportunities.
Applicable Desired Conditions, Standards, and Guidelines for the East Clear Creek Management Area		
MA-EastClr-DC-1	East Clear Creek MA provides mainly semiprimitive recreational opportunities. The environment is predominantly natural-appearing with little evidence of resource modification and there are opportunities for self-reliance, challenge, and solitude.	The CWPP project may result in short-term noise or changes in scenic integrity; however, these would not change the recreational opportunities available over the long-term. Treatments would improve forest resilience to disturbance over the long term, which would help maintain or move toward desired conditions for an environment that is predominantly natural-appearing with little evidence of resource modification.
MA-EastClr-DC-2	The canyons in this MA provide solitude and more primitive non-motorized recreational opportunities than surrounding areas. These areas also provide low-disturbance for wildlife habitat and non-motorized recreation, except along designated roads.	The CWPP project may result in short-term noise or changes in scenic integrity; however, these would not change the recreational opportunities available over the long-term. Treatments would improve forest resilience to disturbance over the long term, which would help maintain or move toward desired conditions.
Applicable Desired Conditions, Standards, and Guidelines for Heritage Resources		
FW-Hrtg-DC-1	Historic and prehistoric sites, including known American Indian sacred places and traditional cultural properties, are preserved and protected for their cultural importance.	The CWPP project includes design features that will avoid direct impacts to cultural sites. Project activities are expected to move the forest toward desired conditions which will reduce the risk of direct and indirect impacts from extreme wildfire including combustion and damage to fire sensitive sites and post fire erosion. No traditional cultural properties (TCPs) are known for this project area. The CWPP project is in compliance with the 2018 Forest Plan concerning Desired Conditions for Heritage Resources.
FW-Hrtg-DC-2	Site integrity and stability are protected and maintained on sites that are susceptible to imminent risks or threats, or where the values are rare or unique.	
FW-Hrtg-DC-3	Conservation and preservation efforts maintain site significance and integrity. Site eligibility is not impacted by visitors. Priority heritage assets, the Coconino NF's cultural resource "crown jewels," are all stable and their significant values are protected.	

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FW-Hrtg-G-6	Through consultation with those tribes who are descendants of the prehistoric people or with groups that have associations with the area in historic times, historic and prehistoric sites should be managed to prevent or minimize adverse impacts.	Consultation with local tribes was conducted in writing and in person where requested. The tribes expressed interest in protection of cultural resource sites and satisfaction with design features developed to minimize impacts to sites. The CWPP project is in compliance with 2018 Forest Plan concerning Guidelines for Heritage Resources.
Applicable Desired Conditions, Standards, and Guidelines for Trails and Trailheads		
FW-Rec-Trails-DC-1	A system of well-marked and well-maintained sustainable trails provides opportunities for visitors to explore the Coconino NF and surrounding areas. Trails are planned and designed to be harmonious with neighboring lands and trail systems through logical connections, which expand recreational opportunities.	Design features REC6, REC7, REC8, REC9, REC10, REC11, REC 12, REC 13, REC 14, REC 15, REC 16, and REC 17 include direction to implement treatments so that they avoid or limit effects to trails and maintain opportunities for visitors.
FW-Rec-Trails-DC-6	Motorized routes are easily identified on the ground and on the motor vehicle use map.	CWPP implementation may involve temporary closures or detours that can affect route signage. Design features to notify forest visitors of closures or detours with clear signage will help motorized routes remain easily identified.
FW-Rec-Trails-G-3	Unplanned, user-created trails should be managed to prevent future access. Resources damaged by unplanned, user-created trails should be rehabilitated to accelerate recovery and to prevent further resource impacts.	The CWPP includes the construction of temporary roads and use of non-system roads for implementation of project activities. Timber contracts require that any new road construction or other route modifications from contact activities be returned to their previous condition at the end of the contract. In addition, the Mogollon Rim Ranger District has been very effective in using logging slash to block and revegetate non-system and user-created trails and roads.
Applicable Desired Conditions, Standards, and Guidelines for Interpretation and Education		
FW-InterpEd-DC-2	Through a variety of strategically located interpretive facilities and/or efforts, forest visitors learn about, become oriented to, and appreciate forest and cultural resources, history, and management, such as wilderness, geology, botanical communities, biodiversity, and heritage site etiquette.	The purpose of CWPP is not directly related to interpretation or visitor education, however, project activities may affect interpretive facilities or opportunities in the short-term. Treatments would improve forest resilience to disturbance over the long term, which would support access and interpretive facilities and efforts available for visitor education.
FW-InterpEd-G-2	Information on the conditions and opportunities that may be encountered along trails should be posted at trailheads to promote visitor safety and enjoyment.	REC14 is included as a design features so that adequate signage is included during implementation for visitor safety and enjoyment.
Applicable Desired Conditions, Standards, and Guidelines for Designated and Eligible Wild and Scenic Resources		
SA-WSR-DC1	Designated and eligible wild and scenic river segments retain their free-flowing condition and their outstandingly	This project would have no effects to flow conditions on any eligible wild and scenic rivers. By reducing the threat of landscape

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	remarkable values (that is, archaeological, scenic, fishery, wildlife, recreational, and botanical). Eligible classifications remain intact until further study is conducted or designation by Congress.	scale crown fire, the project is expected to reduce risks to outstandingly remarkable values in nearby streams.
SA-WSR-DC2	Activities in designated and eligible rivers and associated corridors are primarily nature based, are consistent with the river's classification, and maintain the outstandingly remarkable values.	This project would affect 96 acres of the East Clear Creek eligible WSR corridor and 92 acres of the Barbershop Canyon eligible WSR corridor. By reducing the threat of landscape scale crown fire, the project is expected to reduce risks to outstandingly remarkable values in nearby streams.
SA-WSR-G1	Recreation and other activities at designated and eligible rivers and associated corridors should be managed to occur at appropriate locations and intensities to protect and enhance the free-flowing condition, and the outstandingly remarkable values, consistent with the classification.	CWPP implementation is not expected to change recreation activities within WSR eligible corridors. Treatments planned in portions of the East Clear Creek and Barbershop Canyon WSR eligible corridor would reduce the threat of landscape scale crown fire, which could directly or indirectly affect these areas. Thus the proposed action would reduce risks to outstandingly remarkable values in these eligible rivers.