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Gila National Forest Revised Forest Plan

Final Environmental Impact Statement

Catron, Grant, Hidalgo, and Sierra Counties, New Mexico

Volume 1: Chapters 1 through 3, Glossary, and References

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Gila National Forest Revised Forest Plan Final Environmental Impact Statement

Catron, Grant, Hidalgo, and Sierra Counties, New Mexico

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Abstract: To comply with the National Forest Management Act and address changes that have occurred over the past 30 years, the Gila National Forest leadership and staff revised the existing 1986 land and resource management plan. This programmatic environmental impact statement documents analysis of impacts of five alternatives developed for programmatic management of the 3.3 million acres administered by the Gila National Forest. The analysis displays anticipated progress toward desired conditions, as detailed in the plan, as well as the potential environmental and social consequences of implementing each alternative. Alternative 1 is the no-action alternative, which is the 1986 Gila National Forest Land and Resource Management Plan as amended. Alternative 2 is the proposed action that addresses the needs for change identified through the assessment phase of plan revision. Alternative 3 maximizes mechanical restoration of grassland and open-canopy woodlands, while alternative 4 maximizes mechanical restoration of forests. Both alternatives 3 and 4 limit the use of fire as a management tool. Alternative 5 emphasizes fire as a management tool, restricts mechanical treatments, and maximizes wilderness recommendations. The final action alternatives include elements that are responsive to feedback and recommendations received from stakeholders on the draft documents.

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Commonly Used Acronyms

AUM	animal unit month
CFR	Code of Federal Regulations
EIS	environmental impact statement
EPA	Environmental Protection Agency
ERU	ecological response unit
FIA	Forest Inventory and Analysis
FS	Forest Service
FSH	Forest Service Handbook
FSM	Forest Service Manual
GIS	geographical information system
MMBF	million board feet
MMCF	million cubic feet
MTBS	Monitoring Trends In Burn Severity
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NM	New Mexico
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMRPTC	New Mexico Rare Plants Technical Council
PILT	payment in lieu of taxes
P.L.	Public Law
PM	particulate matter
PTSQ	projected timber sale quantity
PWSQ	projected wood sale quantity
RAVG	rapid assessment of vegetation condition after wildfire
SRSCS	Secure Rural Schools and Community Self-determination Act
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDI FWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VDDT	Vegetation Dynamics Development Tool

Chapter 1. Purpose of and Need for Action

Background

In 2012, the U.S. Department of Agriculture adopted a new Forest Service land management planning rule codified in the 36 Code of Federal Regulations (CFR) chapter II part 219 (USDA FS 2012d). The planning rule is intended to guide the development, amendment, and revision of plans that further sustainable resource management and multiple uses on National Forest System lands, in the context of the broader landscape. It fosters a holistic approach that recognizes the interdependence of ecological, social, cultural, and economic systems and relies on best available science and local knowledge to inform plan development or revision. Public engagement, collaboration and transparency are central to the process and the plan itself.

Document Structure

The Forest Service prepared this final environmental impact statement in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This analysis discloses indirect and cumulative environmental impacts that could result from the proposed action and its alternatives. This analysis is presented in four volumes as described below:

Volume 1 contains chapters 1, 2 and portions of 3.

> Chapter 1 – Purpose of and Need for Action
>
> Chapter 2 – Alternatives, Including the Proposed Action
>
> Chapter 3 – Affected Environment and Environmental Consequences
>
> List of Preparers, Contributors, Cooperating Agencies, and Tribes
>
> List of Agencies, Organizations and Persons to Whom Copies of the Final Environmental Impact Statement are Sent
>
> Glossary
>
> Literature Cited

Volume 2 consists of an appendix that provides more detailed information that supports the analysis.

> Appendix A: Response to Comments

Volume 3 consists of appendices that provide more detailed information that supports the analysis.

> Appendix B: Changes between Draft and Final
>
> Appendix C: Documentation of the Public Engagement Process
>
> Appendix D: Coordination with Other Public Planning Efforts
>
> Appendix E: State and Transition Modeling Process
>
> Appendix F: Timber Production Suitability, Estimated Vegetation Practices, and Projected Harvest Levels Methodology

Appendix G: Crosswalk between At-Risk Species Needs and Plan Components

Appendix H: Documentation of the Recommended Wilderness Process

Appendix I: Documentation of the Wild and Scenic Rivers Eligibility Study

Appendix J: Documentation of the Research Natural Area Evaluation Process

Appendix K: Documentation of the Botanical Area Evaluation Process

Appendix L: Crosswalk between the 1986 and Revised Plans

Appendix M: Letters from Government Agencies

Additional documentation may be found in the planning record located at the Gila National Forest Supervisor's Office. Key analysis documents can be found online at the Gila National Forest, Forest Plan Revision webpage.

A Description of the Gila National Forest and Vicinity

Located in southwestern New Mexico, the Gila National Forest (the Gila or the forest) was established in 1905.[1] The approximately 3.3-million-acre administrative unit is one of five national forests in New Mexico and includes the New Mexico portion of the Apache National Forest east of the Arizona-New Mexico state line. All references to the Gila National Forest made in this document include those Apache National Forest lands in New Mexico.[2]

The forest comprises six ranger districts: Quemado, Reserve, Glenwood, Silver City, Wilderness, and Black Range. These ranger districts are located within portions of Catron, Grant, Hidalgo, and Sierra Counties (see figure 1). The forest shares borders with the Apache-Sitgreaves National Forests; Gila Cliff Dwelling National Monument, administered by the National Park Service; land administered by the Bureau of Land Management and the state of New Mexico; and private property owners.

[1] The Gila Forest Preserve was originally established in 1899, before the Forest Service was established.
[2] In 1974, the administration and management of the Apache National Forest was divided at the state-line between the now Apache-Sitgreaves National Forests in Arizona and the Gila National Forest in New Mexico to reduce the complexities and costs of managing under the laws and regulations of two different states.

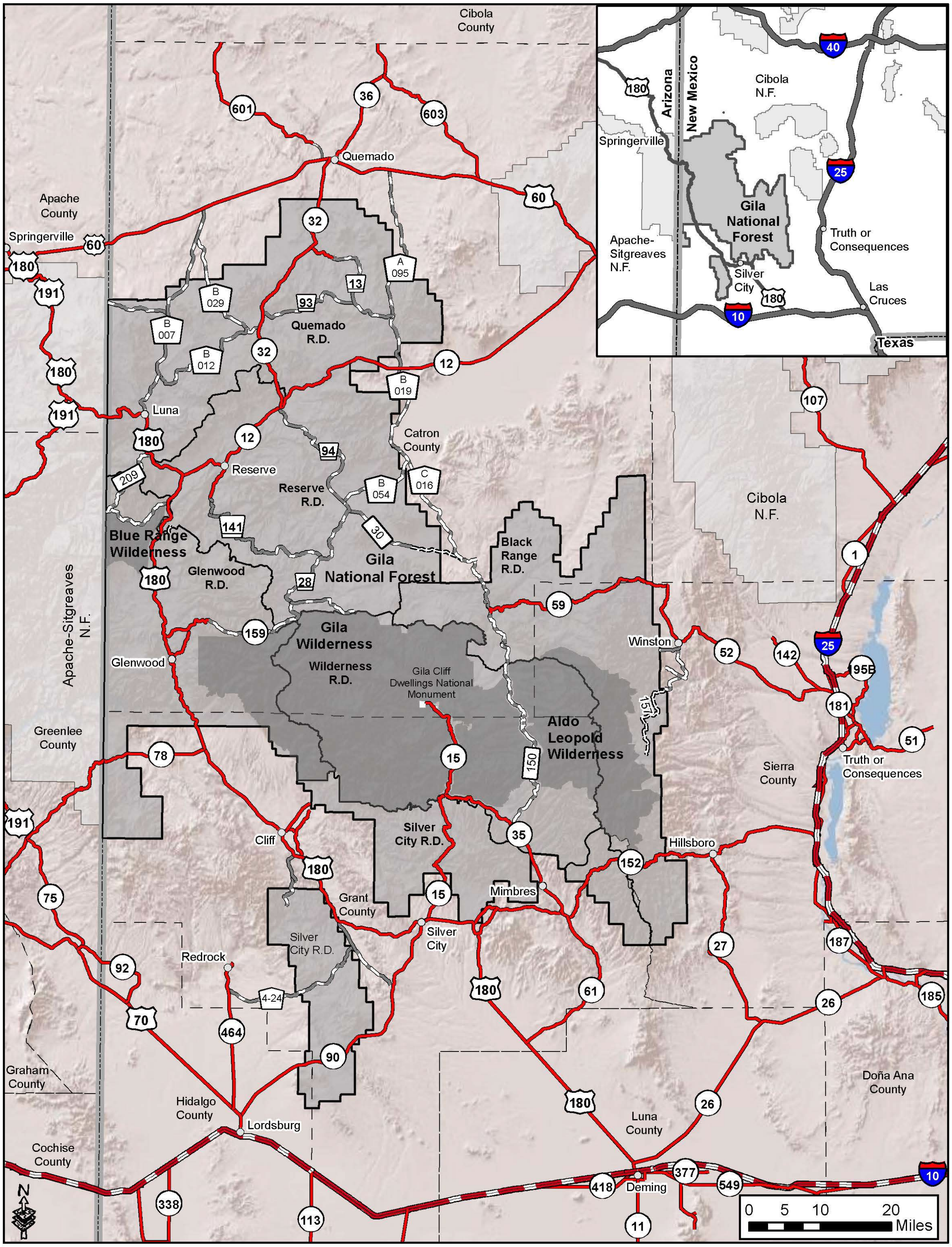


Figure 1. Location of the Gila National Forest showing county boundaries and major highways. The inset shows the location of the Gila National Forest within New Mexico.

The forest has 12 mountain ranges and an elevational range of 4,160 to 10,770 feet. Annual precipitation ranges from approximately 11 inches in the northern end of the forest near Quemado to over 35 inches in the higher elevations of the Black Range and Mogollon Mountains in the central and southern portions of the forest. The forest includes semi-desert grasslands and shrublands, woodlands, ponderosa pine, mixed conifer, and spruce-fir life zones. Major streams include the Gila, San Francisco, Tularosa and Mimbres Rivers.

Purpose of and Need for Change

The 1986 Gila National Forest Land and Resource Management Plan (1986 forest plan), as amended, has been the primary document guiding forest management toward the agency's mission to provide for healthy, resilient ecosystems and watersheds that meet the diverse needs of the American people. The National Forest Management Act of 1976 directs every national forest to revise its forest plan when monitoring and evaluation indicate that revision is necessary, when changes in agency policies, goals or objectives would have a significant effect on forest-level programs, when conditions or demands on the forest have changed significantly, or every 10 to 15 years.

Over 35 years have passed since the regional forester approved the original forest plan in 1986. The last 35 years have yielded new scientific information and understanding; changes in the ecological, social, cultural, and economic environment; and a shift in management emphasis from outputs to outcomes. A complete revision of the original plan is needed to address these changes and meet the legal requirements of the National Forest Management Act and the planning rule.

In preparation for plan revision, Gila National Forest leadership, staff, and a diverse stakeholder group identified what was working, ongoing challenges that could be better addressed, and new challenges that needed to be addressed. This preparatory work is documented in the Gila National Forest's 2017 final assessment report (USDA FS 2017a), which served as the basis for identifying 54 individual needs for change in management direction (Need for Change document) (USDA FS 2017b). The needs for change statements addressing risks to sustainability are summarized in the following subsections: (1) Plan-Wide Changes; (2) Ecological Changes; and (3) Social, Cultural, and Economic Changes.

Plan-Wide Changes

Forest leadership and staff have not consistently prioritized relationships, capitalized on partners who are willing to help, or been able to reach all stakeholders. Stakeholders are individuals or groups of individuals who care about the forest and how it is managed. Successful plan implementation requires good working relationships with all stakeholders. To address these issues there is a need to:

- Develop a desired condition to recognize and improve the forest's role in contributing to local economies through recreation and tourism, timber and forest products, livestock grazing, and other multiple-use-related activities and products, while balancing these uses and values with available resource capacity and emerging opportunities.
- Use collaboration with stakeholders, partnerships, and volunteer opportunities as a management option to strengthen relationships and to promote movement toward desired conditions.
- Strategically leverage and streamline processes for engaging partners and volunteers during project implementation and monitoring.
- Emphasize public education about the Gila National Forest's diverse ecological, social, and economic resources; the multiple-use sustained-yield philosophy; public laws and regulations; shared use ethics; and management strategies.
- Connect people—particularly youth and underserved populations—with public lands and nature.

- Encourage working with neighboring land managers to implement projects at a scale that improves landscape-scale connectivity across mixed ownerships where natural systems span multiple administrative boundaries.

The 1986 forest plan imposes internal management boundaries, often with different management direction, which artificially fragments the landscape within the forest boundary and creates unnecessary complexities. To address this issue there is a need to:

- Reevaluate the number, arrangement, and boundaries related to management areas.

Many advances in scientific understanding, methods, and technology have occurred since 1986. The monitoring plan has not been amended for quite some time, and it is out of date with current science and trends in resources. To address this issue there is a need to:

- Develop a monitoring program that collects relevant data, tracks progress toward desired conditions, distributes information consistently, and allows for a responsive adaptive management program with available resources, and uses updated terminology and methodologies.

Ecological Changes

Past fire suppression, historic overgrazing, and other activities have disrupted many natural processes, such as fire regimes and natural vegetation succession. In the meantime, factors such as climate change and drought, have made upland vegetation more vulnerable to insects, diseases, high intensity wildfire, and non-native species. High intensity wildfire has impacted soils, watersheds, riparian ecosystems, and aquatic habitat. Restoring historic vegetation conditions can increase resistance and resilience, but restoring natural ecological processes such as fire is key to sustainability. Restored, resilient, and connected habitats are also necessary to maintaining biodiversity. Fire is an important tool, but it is not the only tool available to facilitate restoration. Mechanical and manual vegetation treatments, along with managed fire, are expected to occur more often and over larger areas. These types of treatments sometimes produce increases in shade-intolerant, re-sprouting native species such as alligator juniper that alter the composition, structure and pattern of the vegetation community and the way fire interacts with the landscape. While there is not currently an issue with invasive species, in the coming years, such species may compound the challenges to managing for resistant and resilient ecosystems. To address these issues there is a need to:

- Promote ecological restoration and resilience.
- Promote the restoration and maintenance of native herbaceous vegetation, and limit woody species encroachment or infill and non-native invasive plant establishment.
- Increase flexibility for the restoration and maintenance of fire as an ecological process while addressing firefighter and public safety and health concerns.
- Recognize the natural role of fire and its use as a management tool to help reduce fuel accumulations, reduce the risk of future undesirable fires, improve wildlife habitat and range conditions, and improve watershed and overall forest health.
- Address vegetation structure within the wildland-urban interface.
- Restore, maintain, and sustainably manage watershed condition.
- Develop adaptive management approaches for water-dependent resources and multiple uses.
- Inventory, restore, maintain, and sustainably manage riparian areas, including those associated with springs, seeps, and wetlands.
- Manage toward terrestrial, riparian, and aquatic habitat conditions and connectivity that supports the native range of species and their movements across the landscape.

- Support ecological conditions that contribute to the conservation and recovery of federally listed and candidate species, as well as maintain viable populations of species of conservation concern and other native species.
- Update plan direction regarding integrated pest management and provide plan direction on the use of pesticides for restoration.
- Address the presence of non-native species by encouraging the removal of existing populations and limiting the introduction and spread of new populations.

Social, Cultural, and Economic Changes

For many years, the lands of the forest have provided economic, social, and religious value to Native Americans, Hispanics, and Anglo-American communities. The continued use and access to the forest contributes greatly to the continuation of local culture and tradition. Risks to ecological sustainability create risks to the sustainability of social, cultural, and economic systems, and the benefits desired and enjoyed by residents and visitors. At the same time, industries fueled by wood products can help reduce ecological risk and support social, cultural, and economic systems. These industries need to be recognized and supported as such.

The forest provides a diverse range of recreational opportunities and use is increasing. Roads and trails across the forest are necessary for access that facilitates multiple uses and management, but limited funding has led to an increasing amount of deferred infrastructure maintenance. Historic and cultural sites provide valuable information about the past, but these sites are not fully inventoried and are increasingly vulnerable. To address these issues there is a need to:

- Provide management direction for historic and contemporary cultural uses, including both economic and noneconomic uses for tribes and for those communities not considered under tribal relations.
- Consider the value and importance of areas that may be identified as part of an important cultural landscape by tribes.
- Update plan direction for livestock management that incorporates increased flexibility and adaptive management to restore and maintain ecological integrity of rangelands.
- Address the long-term sustainability, changing trends in demands, and intended use of recreation infrastructure, trails, and facilities.
- Update plan direction for road maintenance prioritization and decommissioning of unneeded roads that accounts for budgets or resource needs and constraints, but also involves affected stakeholders.
- Emphasize the importance of scenery and recreation opportunity effects when planning projects.
- Stabilize, preserve, interpret, and protect historic and sensitive cultural properties.
- Encourage the protection of existing public access and the acquisition of new public access opportunities to the forest.
- Develop plan direction related to land adjustments that are not covered by the existing forest plan.
- Include education and communication of policies regarding recreational mining and non-commercial rock and mineral specimen collection activities.

There is also a need to address specific requirements in the National Forest Management Act and 2012 Planning Rule including processes for evaluating management area designations and the suitable timber base.

Alternatives and the Decision-Making Framework

Proposed changes to the 1986 forest plan include incorporating desired conditions and updating objectives, standards, guidelines, suitability, management areas, and monitoring requirements based on the identified needs and significant issues raised during the public engagement process. The public engagement process is fully documented in appendix C. Alternative 2 (proposed action) and action alternatives 3, 4, and 5, represent different ways to address the needs for change and significant issues. This analysis evaluates how well each alternative supports movement toward desired conditions.

Comments received during the 90-day comment period on the draft revised plan and environmental impact statement were analyzed and many informed revisions to the draft proposed action and alternatives. The comment analysis and the planning team's response to those comments are in appendix A. Changes made between draft and final are documented in appendix B.

The forest supervisor will review the alternatives, and the environmental consequences of each before making a reasoned choice among alternatives. The choice will be based on the agency's mission and multiple-use sustained-yield mandate, the needs for change, issues raised by the public, and the requirements of law, regulation, and policy. It may be that reasoned choice is not packaged in a single alternative. In that event, the forest supervisor is free to use parts of other alternatives to modify the selected alternative. For example, alternative 5 could be chosen except for the amount of recommended wilderness that is packaged with that alternative. The forest supervisor could choose alternative 5 and decide to carry forward the recommended wilderness associated with alternative 2.

The decision will be documented in the final revised forest plan and draft record of decision that identifies the selected alternative. The final plan and draft decision will be subject to an objection process guided by direction in 36 CFR Subpart B (219.50 to 219.62). A final record of decision and accompanying final plan will reflect the outcomes of the objection process. The plan is strategic in nature and does not specifically authorize any projects or activities. Project-level public engagement, proposals, alternatives, and environmental analyses will be how the forest plan decision is implemented.

Public Involvement

Our stakeholders have valuable ideas, knowledge, opinions, and needs that can inform and improve how we manage the forest. To cultivate meaningful dialogue and collaboration, forest leadership and staff offered a variety of opportunities throughout the revision process. This has involved more than a hundred meetings, activities, and opportunities to provide input and feedback, which are detailed in appendix C. Our contact list includes more than 20,000 individuals, groups, and representatives of groups that have participated in at least one of those opportunities since 2015.

Tribal consultation and collaboration have been ongoing since 2015. Gila National Forest leadership and tribal liaison maintain a governmental relationship with 13 federally recognized tribes including the Pueblos of Acoma, Laguna, Zuni, and Ysleta Del Sur, the Navajo Nation, the Hopi Tribe, the San Carlos Apache Tribe, the Fort Sill Apache Tribe, the Mescalero Apache Tribe, and the White Mountain Apache Tribe, and collaborates with other non-federally recognized tribal entities that live nearby. These interactions have included mail, email, phone, and face-to-face consultation according to tribal preferences and have led to a growing understanding of their vision of co-stewardship in the care of the forest. Forest leadership and appropriate staff also participated in two regional tribal roundtables held by the Southwest Regional Forester. These discussions brought together all the national forests in New Mexico to discuss, learn, and collaborate with tribes around forest plan revision.

In June 2017, we sent letters to tribal, federal, state, county, and municipal governmental entities describing and soliciting coordination and cooperating agency opportunities. The purpose of coordination is to foster greater recognition and discussion of issues that have cross-boundary effects, to look for common objectives and solutions, and to find opportunities to integrate management across landscapes. As part of coordination, we requested management plans, reviewed the land use policies within those plans and identified opportunities for us to contribute to shared goals and objectives (see appendix D). Cooperating agency status is established with a formal written agreement. Cooperating agencies provide technical assistance or other resources to the development of the plan. Three agencies responded to the June 2017 letter and entered cooperating agency status: New Mexico Department of Agriculture, New Mexico Department of Game and Fish, and San Francisco Soil and Water Conservation District.

Issue Identification

The local governments, agencies, organizations, and the public submitted comments at each phase of the revision effort. This led to better understanding of different interests, positions and perspectives, areas of alignment or potential alignment, areas of disagreement, and different ways to approach tradeoffs. Areas of alignment were able to be incorporated into the plan and every alternative. Areas of disagreement on how the plan ought to address something that could lead to different environmental effects were identified as issues.

Issues serve to highlight effects or unintended consequences that may occur from the proposed action or alternatives, providing opportunities during the analysis to reduce adverse effects and compare tradeoffs for the decision maker and public to understand (Forest Service Handbook (FSH) 1909.15 section 12.4). The following items represent issues that the forest supervisor recognized as significant during the iterative development and refinement of the plan and its alternatives. Items 1 through 9 came from input and feedback received from the beginning of plan revision through the preliminary draft plan and were the basis of the draft range of alternatives. Item 10 came from comments received on the draft range of alternatives and were incorporated into the final range of alternatives. Not all topics that were commented on or discussed rose to the level of a significant issue. Many of these still informed the plan or this analysis, but do not have a cause-effect relationship between an alternative and a significant effect of the analysis or are already decided by other law, regulation, or policy direction. More detail on the range of alternatives can be found in the next chapter.

1. **Methods for Restoring Vegetation**: Overall, comments supported the need to move vegetation toward desired conditions that are healthier and more resilient to anticipated future changes. However, opinions differed on the means to achieve it. Some preferred an emphasis on mechanical methods like logging and thinning, while others desired an approach relying on natural processes such as wildland fire.

2. **Vegetation Types to Focus Restoration Efforts**: When stakeholders were asked about conditions and trends they had observed in the forest, people overwhelmingly said “there’s more woody vegetation than before.” Woody species infill in woodlands and forests, and encroachment in grasslands and meadows are prevalent on the forest. Several woodland, forest and grassland types are departed from desired conditions and people expressed dissatisfaction with the current rate of restoration. Funding, workforce, and industry capacity may constrain the forest’s ability to achieve desired conditions at a satisfactory rate in every vegetation type.

3. **Riparian Management**: Riparian areas are affected by the presence of water and composed of distinctively different vegetation and higher productivity, compared to adjacent areas where water is more limited. As a result, riparian areas are a focal point for humans, wildlife, and livestock activities. Riparian areas are adapted to disturbance and defined by change. However, riparian areas are susceptible to degradation and loss. People have varying perspectives on riparian area management and the flexibility around that management.

4. **Livestock Grazing**: Commenters have varying opinions on the amount of flexibility for livestock management. Some wanted to increase flexibility of livestock management with fewer strict standards and more guidelines in the plan, while others wanted to decrease flexibility of livestock management with more strict standards and less guidelines in the plan.

5. **Vacant Allotments**: When the draft plan was released, there were 10 vacant allotments out of the 138 active grazing allotments. Commenters provided a wide variety of opinions about what to do with the vacant allotments. Some commenters would like to see permits issued for all the vacant allotments so that all the allotments are fully stocked and there are no vacant allotments in the future. Others would like to see these vacant allotments used to increase management flexibility and allow current permit holders use during times of need like drought years, before or after fire, or to avoid livestock-wildlife conflicts. Still others would like to see the vacant allotments kept vacant and unused or even removed from grazing for wildlife and watershed purposes.

6. **Lands**: Since the Gila National Forest was established, numerous land transactions have added and subtracted portions of the land area, through land exchanges, purchases, donations, and sales. Peak Facilitation, a contracted facilitation company, conducted a web survey in February 2017 to gather stakeholder thoughts on how land adjustments should be conducted in the future. The results of the survey showed differing opinions. Some commenters thought that the forest should acquire desirable lands for public access and resource management when available, and when possible, dispose of isolated, unmanageable lands or lands that support community development. Others expressed that more effort should be directed toward land exchanges so that no net loss of private property value in a county would occur.

7. **Group Size Limits and Length-of-Stay Limits**: To protect the wilderness characteristic of opportunities for solitude or primitive and unconfined recreation, the 1986 forest plan and draft revised plan contained group size limits in wilderness. Some commenters felt that the revised group size and length-of-stay limits were too restrictive, and that backcountry behavior is a more important variable than group size in determining a group's social and ecological impact.

   Length-of-stay limits are tools to manage recreation and its impacts on natural and cultural resources. They are commonly and consistently established through forest orders. The draft environmental impact statement erroneously identified length-of-stay options in wilderness as an alternative or alternative element considered but not analyzed in detail. The 1986 forest plan did not prescribe length-of-stay limits for forest orders. The draft revised plan established limits forestwide and for wilderness areas based on a logic flaw.

   The draft plan contained a forestwide length-of-stay limit (draft Sustainable Recreation standard 3), as well as length-of-stay limits in the Recommended Wilderness (draft standard 10) and Designated Wilderness (draft standard 6). The limits established for wilderness were the same as those established forestwide, except they applied to each individual wilderness. As worded, the wilderness standards suggest it would be allowable for a person or group to stay in the Aldo Leopold Wilderness for 14 days, and immediately restart the clock in the Gila or Blue Range Wilderness the next day. But this would not be consistent with the forestwide limit, which is 14 days. Plan direction for management areas such as recommended or designated areas are supposed to be less permissive or more restrictive than direction for the general forest. That's the point. Between draft and final, these wilderness standards were removed for this reason. Therefore, the real issue was the forestwide length-of-stay limit. Nevertheless, some commenters thought the limits included in the draft plan should be lengthened or modified to be more permissive, especially for through-hikers on the Continental Divide Trail. Other expressed a preference for no length-of-stay limits because behavior is a more important variable than length-of-stay in determining the social and ecological impacts of recreation.

8. **Amount of Recommended Wilderness**: Each national forest undertaking forest plan revision is required to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System. The four-step process concludes with a determination about whether to recommend any of the evaluated lands to Congress for wilderness designation. Commenters provided divided opinions as to whether to recommend more wilderness. Some people desired no additional wilderness. Others wanted a significant amount of new recommended wilderness. Still others wanted some new recommended wilderness while still taking into consideration other forest uses and restoration needs.

9. **Amount of Other Designated Areas**: There are other types of designations open for consideration during plan revision to maintain unique special characters or purposes across the landscape. A proposal to establish botanical areas was submitted to forest leadership and planning staff and garnered support from some stakeholders. Others would prefer no additional designated areas.

10. **The Use of Herbicide:** The draft plan contained plan components and other content related to the use of herbicide to treat non-native invasive plants and native, re-sprouting alligator juniper and evergreen oaks in areas where there is often a response after mechanical treatment that leads us away from desired conditions for vegetation and fuel composition, structure, pattern, and fire behavior. The draft environmental impact statement included an herbicide use proposal, separate from the plan, which generated a robust public response. That proposal is removed from the final environmental impact statement, but the issue of herbicide use on the forest led to refinement of the alternatives. Some commenters wanted the draft plan direction and other content related to herbicide replaced with an unconditional ban on herbicide use. Others wanted the plan to ban herbicide use on native species but could accept its use on non-native invasive species. Still others supported the draft plan’s direction and approach to herbicide as a tool to manage both native and non-native species.

Chapter 2. Description of the Alternatives

Introduction

This chapter describes each action alternative considered for the revision of the 1986 plan, as well as the no-action alternative. From the issues identified in chapter 1, a range of alternatives was developed that represent different perspectives on how best to move toward desired conditions. This range of alternatives represents different ways of managing the forest often grouped by theme on a variety of issues. This chapter also presents the alternatives in comparative form, describing the differences between each alternative.

Alternative Development

The preliminary alternatives were developed to address the purpose and need as described in chapter 1; changes in ecological and socioeconomic conditions since the 1986 forest plan was signed; issues identified from comments received up to and through public scoping when the notice of intent to revise the plan was published in the Federal Register (2017); issues identified from comments on the preliminary draft plan (2018); and the constraints of budgets as required by the 2012 Planning Rule (36 CFR 219.7). None of the alternatives represent any single perspective; rather they are each a blend of many different perspectives on the identified issues.

The preliminary draft plan was built on what we had learned from the assessment phase, a series of technical meetings with a diverse group of stakeholders, the constraints of existing law, regulation, policy, and regional guidance. We offered an unofficial comment period on the preliminary draft, which informed both the draft plan and the draft alternatives. Comments received on the draft led to identification of an additional issue that fit within the existing range of alternatives (Issue 10). Rather than create additional alternatives, we revised the existing alternatives to reflect that issue.

Alternatives Considered in Detail

The following discussions of each alternative provide a general sense of how the issues identified in chapter 1 drove alternative development. Greater detail about the differences between alternatives is provided at the end of this section in table 1.

Alternative 1 is the no-action alternative to continue using the 1986 forest plan. However, the desired conditions for vegetation in the revised forest plan serve as the basis of comparison for all alternatives including the no action. Additionally, the timber suitability analysis process replaces the analysis supporting the 1986 plan per the National Forest Management Act. The new wild and scenic river eligibility study also replaces the previous eligibility study and remains the same under all alternatives (FSH 1909.12 chapter 80).

Alternative 2 (proposed action) is to implement the revised forest plan developed iteratively in a collaborative manner to address the need for change. Alternative 2 was designed to represent an “all tools in the toolbox” approach (Issue 1); providing emphasis on restoring vegetation types that evolved with frequent, low or mixed severity fire or are highly vulnerable to climate change, preserving the flexibility to shift focus should changing conditions or opportunity warrant it (Issue 2); prioritizing riparian and aquatic ecosystems, providing necessary constraints and retaining sufficient flexibility to determine appropriate management actions when the site, circumstances, species, and use or activity can be considered (Issue 3); maintaining livestock grazing as a use of the forest, while providing some baseline constraints and preserving the flexibility to address allotment and operation-specific conditions and factors contributing to sustained yield, ecological integrity and biodiversity (Issue 4); create a system of swing allotments or forage reserves by strategically selecting some allotments for which the permits are waived back to the agency with no preferred applicant (Issue 5); fostering a lands and realty program focus on providing visitor access to public land and resource management (Issue 6); establishing group size limits in congressionally designated and recommended wilderness to protect the wilderness characteristics of opportunities for solitude and primitive or unconfined recreation and establishing forestwide length-of-stay limits (Issue 7); recommending outstanding areas for inclusion in the Wilderness Preservation System where reduced management options would not have a substantial effect and existing uses of the area would not be substantially changed (Issue 8); providing an alternative amount of area to the proposal for designating botanical areas so that the decision was not restricted to "all or nothing" and include proposals for areas qualifying for research natural area status (Issue 9); and providing baseline constraints for future proposals to use herbicide as a management tool for non-native invasive or native, re-sprouting species (Issue 10).

Alternative 3 was developed to respond to issues by limiting the use of fire and placing more emphasis on mechanical treatments (Issue 1) in grassland and historically open canopy woodlands to maintain or move toward desired conditions for those vegetation types (Issue 2). Alternative 3 addresses issues 1 and 2 in this way because during the assessment phase, many commenters observed a lack of progress in restoring these ecosystems. Planning staff recognized that to address this issue, more of the limited budget resources would have to be focused in these areas as opposed to forested vegetation types. Issue 1 was treated in this way because many of those commenting on the lack of progress in grasslands and open woodland vegetation types during the assessment also expressed a preference for mechanical treatment over fire. This alternative addresses Issue 3 in the same manner as alternative 2. Issue 4 is addressed by creating additional flexibilities for livestock grazing and Issue 5 by emphasizing timely restocking of vacant allotments to the maximum extent possible. Issue 6 is addressed by fostering a lands and realty program focus that requires no-net loss of private property in a county and addresses Issue 7 by providing no standardized group size limit in wilderness areas and no forestwide length-of-stay limit. Instead, the need for any limitations to be addressed as part of the special use permitting process and forest orders. Issue 8 is addressed by excluding any grassland and historically open canopy woodland areas that qualify for inclusion in the Wilderness Preservation System from a recommendation to Congress where there is an identified restoration need, consistent with how this alternative addresses issues 1 and 2. Alternative 3 approaches Issue 9 by aligning with the no-action alternative, including no botanical areas, but deviates from the no-action alternative by withdrawing proposals for research natural areas that are not already established. Issue 10 is addressed the same way as it is in alternative 2.

Alternative 4 differs from alternative 3 only in the way it addresses issues 2 and 8. Instead of responding to commenters who emphasized the lack of progress in grasslands and open-canopy woodlands, alternative 4 was formulated to respond to commenters who observed the declining contributions that timber harvest has provided to local economies and the lack of restoration progress in the forested or timbered vegetation types. Correspondingly, areas in the forested vegetation types that would otherwise be suitable for timber production or have an identified restoration need are not recommended for wilderness designation (Issue 8).

Alternative 5 addresses Issues 3, 4, and 6 similar to alternative 2. It addresses Issue 3 the same as alternative 2 except for increasing the buffer size for certain riparian management zones during new construction or realignment of roads. It also adds a similar buffer for Mexican spotted owl protected activity centers although this was more of a concern than an issue given that the approved U.S. Fish and Wildlife Service's recovery plan identifies the necessary constraints to promote recovery of that species. It addresses Issue 4 similarly but introduces slightly less flexibility by moving several plan guidelines to standards.

Alternative 5 addresses Issue 1 by emphasizing fire and restricting the use of mechanical treatment methods to the wildland-urban interface with few exceptions. It addresses Issue 2 by focusing on vegetation communities that historically experienced frequent, low to mixed severity fire and leaving highly vulnerable vegetation types with lower frequency, mixed, and stand-replacement type fire without treatment. It addresses Issue 5 by restricting the ability to authorize existing permit holders in good standing temporary use of vacant allotments, until an environmental analysis was complete, and a decision signed. It also removes a management approach discussion about the possibility of creating forage reserves or a system of swing allotments. Issue 7 is addressed the same way as alternative 2 and Issue 8 by maximizing the area recommended to Congress for wilderness designation. Issue 9 is addressed by carrying forward all the proposed research natural areas from alternative 2 whether they qualify for research natural area status or not, and by designating the full amount of National Forest System lands identified in the original proposal as botanical areas. Plan direction for the botanical areas does not differ between alternatives 2 and 5 and is based on the suggestions that accompanied the original proposal. Finally, alternative 5 addresses Issue 10 by prohibiting the use of herbicide on native species, but it allows herbicide use on non-native noxious weeds.

Elements Common to All Alternatives

All five alternatives:

- Comply with applicable laws, regulations, and policies
- Contain desired conditions, objectives, standards, guidelines, timber suitability, and monitoring;
- Provide sustained multiple uses, products, and services in an environmentally acceptable manner;
- Conserve soil and water resources and do not allow significant or permanent impairment of the productivity of the land;
- Provide management direction for riparian areas;
- Maintain air quality that meets or exceed applicable federal, state, and local standards and regulations;
- Provide for and maintain diversity of plant and animal communities to meet overall multiple-use objectives;
- Provide for species' viability by providing appropriate habitat that is well distributed across the planning area;
- Use a common list of species of conservation concern selected based on national direction and regional guidance;
- Recognize and respect the unique status of Native American Tribes and their rights conveyed by trust and treaty with the United States, including consultation requirements;
- Recognize the value of traditional and cultural uses and their relationship to the forest;
- Protect cultural resources;
- Mitigate risks to firefighters and the public during responses to wildland fire, risks to firefighters and the public are mitigated, because protection of human life overrides all other priorities;
- Retain existing congressionally designated areas because the agency does not have the authority to do otherwise; and
- Have 16 stream reaches (approximately 225 miles) that are eligible Wild and Scenic River status based on the 2019 eligibility study.

Elements Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 share these elements:

- Increase guidance on fostering relationships and developing opportunities to leverage partnerships and collaboration, and enhance communication;
- Contain the same desired conditions for vegetation communities;
- Promote ecological restoration, climate adaptation and resilience;
- Sustainably manage watershed condition and integrate best management practices;
- Use a common list of species of conservation concern selected based on national direction and regional guidance;
- Provide direction on integrated pest management and provide plan direction on the use of pesticides for restoration;
- Emphasize collaborative, sustainable recreation programs;
- Update plan direction for the sustainable infrastructure, road maintenance prioritization process and decommissioning of unneeded roads that accounts for budgets and resource needs and constraints, but also involves affected stakeholders;
- Use the scenery management system and recreation opportunity spectrum to consider scenery and recreation opportunities when planning projects;
- Provide direction for fuels reduction treatments and maintenance of vegetation for those areas of resident populations at imminent risk from wildfire, as well as human developments having special significance;
- Include extensive management approaches that describe the ways in which the plan is likely to be implemented; and
- Provide a comprehensive updated monitoring plan.

Alternatives and Alternative Elements Considered but Eliminated from Detailed Study

The National Environmental Policy Act requires federal agencies 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). Public comments received up to this point have provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives are outside the scope of the plan revision process; already decided by higher law, regulation, or policy; or already addressed by the alternatives considered in detail. The following alternatives, or elements of alternatives were considered, but not incorporated into one of the alternatives analyzed in detail or as its own alternative for reasons summarized below.

Alternative E from the 1996 Amendment of Forest Plans in Arizona and New Mexico

There was a suggestion to use alternative E from the Southwestern Region revision of 11 forest plans (including the Gila National Forest) in 1996 for northern goshawk, Mexican spotted owl, and old growth standards and guidelines. Alternative E was originally developed by Applied Ecosystems Inc., and includes standards and guidelines related to forest health, desired forest condition, assessment and planning function, implementation function, monitoring function, Mexican spotted owl, northern goshawk, wildlife cover, and allocated old growth (USDA FS 1996). This suggestion was considered, but not analyzed in detail because some of the broader guidance within this alternative is generally consistent with the action alternatives developed as part of the plan revision process, which is reflected in the proposed desired conditions for vegetation. Specific plan components reiterating the original recovery plan guidance in Alternative E are no longer considered the best available science.

Alternatives Outside the Historic Range of Variation

Some stakeholders commented that the Forest Service can no longer manage to a historic range of variation for vegetation due to the existing degree of departure from historic conditions, climate change, or both. Those offering the existing degree of departure as a reason suggested managing for traditional uses or a future range of variation instead. Those offering climate change as a reason to abandon the historic range of variation suggested managing for resiliency instead, although without many details on how this was to be accomplished.

These suggestions were considered but not analyzed in detail for two reasons.

(1) The responsible official has the discretion to determine that it is not appropriate, practical, possible, or desirable to contribute to restoring conditions to the historic range of variation in specific areas within ecosystems. Some conditions are departed from historical conditions, desired conditions, or both in some ecosystems. The assessment findings and the analysis contained in environmental impact statement do not support a determination that conditions are degraded to the extent that the historic range of variation is no longer appropriate, practical, possible, or desirable across entire ecosystems, or the entire forest.

(2) The idea the natural range of variation and resiliency are independent from one another and incompatible is not supported by best available science. We understand that achieving historical conditions may not be possible in all parts of the forest but, the historic range of variation remains relevant as the current scientific and ecological understanding of what sustains key ecosystem characteristics, conditions that sustain at-risk species, and resilience. The plan provides the strategic framework and flexibility to support the entire Resistance-Resilience-Transition climate adaptation spectrum. The action alternative's desired conditions for vegetation are based on the historic range of variation but are not tied to one version of an ecosystem map, enabling climate-informed application at the project-level (USDA FS 2023a) in alignment with the 2012 planning rule and agency directives at FSH 1909.12 chapter 20 section 23.11a.

There was another suggestion to manage for carbon storage above the historic range of variation. This was considered but not analyzed in detail because scientific research indicates this is not sustainable. Higher levels of carbon storage become a wildfire liability, leading to large emissions pulses and a decline in the capacity of the ecosystem to store carbon over the long term (for example Hurteau et al. 2016).

A Citizens' Climate Change Alternative

A fully developed citizens' climate change alternative was submitted in response to the draft alternatives that addressed climate change by maximizing wilderness acres, continuing to use fire as the primary restoration tool, minimizing grazing impacts, and prioritizing the identification and protection of refugial areas. This alternative was considered but not analyzed in detail because climate change, refugia, recommended wilderness acres, and the use of fire as a restoration tool are all addressed in the action alternatives. All action alternatives provide a science-based adaptation strategy, including refugia as discussed in the supporting management approach Change and Uncertainty. Alternative 5 maximizes recommended wilderness acres. Alternatives 2 and 5 continue to rely on fire as the primary restoration tool. All alternatives include desired conditions for livestock grazing that support maintaining or moving toward desired conditions for natural resources and other uses.

Eliminate Livestock Grazing

Eliminating livestock grazing would not meet the identified needs for change for revising the forest plan because this suggestion ignores the contribution grazing makes to local cultural and socioeconomic desired conditions. Furthermore, a no-grazing alternative would not meet legal direction provided by the Multiple-Use Sustained-Yield Act, the National Forest Management Act, or the agency policy that guides the implementation of these laws. There was also a suggestion to phase out grazing from the wilderness, but livestock grazing is directed by Congress to continue where it occurred prior to wilderness designation under the Wilderness Act of 1964.

Under all alternatives, the rangelands management and livestock grazing program has multiple mechanisms to evaluate, review, and adapt management as needed to effectively conserve resources and respond to changing conditions. Decisions regarding whether grazing should occur at a particular time or in a particular area, animal numbers; the intensity, frequency, and season of use; and other aspects of operation authorized for each grazing allotment are considered as part of allotment-level environmental analysis and decision-making process, permit issuance, allotment management plans and annual operating instructions. For all these reasons, a no-grazing alternative was not considered.

Permanently Exclude Riparian Management Zones from Livestock Grazing

Commenters suggested permanently excluding livestock grazing from all riparian management zones. This suggestion was considered but not analyzed in detail because standards, guidelines and allotment management plans would direct the use of best management practices and adaptive management to move toward the plan’s desired conditions for riparian and aquatic ecosystems. Livestock grazing that impaired riparian areas would not be compliant with the plan.

Under all alternatives, the rangelands management and livestock grazing program has multiple mechanisms to evaluate, review, and adapt management as needed to effectively conserve resources and respond to changing conditions. Decisions regarding whether grazing should occur at a particular time or in a particular area, animal numbers; the intensity, frequency, and season of use; and other aspects of operation authorized for each grazing allotment are considered as part of allotment-level environmental analysis and decision-making process, permit issuance and annual operating instructions.

Exclosures can be one of several adaptive management strategies to help move degraded riparian areas toward proper functioning condition, but exclosures are not necessary in every circumstance, as evidenced by the body of proper functioning condition assessments that have been documented, on the Gila National Forest. This is disclosed in the assessment report (USDA FS 2017a chapter 7, Key Characteristics, Seral State Proportion subheading last paragraph). Also disclosed in the assessment report, there are approximately 10,640 acres of riparian areas that have been and remain excluded from livestock grazing for various reasons (USDA FS 2017a chapter 9, Current and Reference Disturbance Regimes subheading Herbivory). Temporary and permanent exclosures of specific riparian areas would remain a viable option under the plan through the allotment-specific decision-making and regulatory framework described in the previous paragraph.

Minimize Livestock Grazing as part of a Climate Change Adaptation Strategy

Commenters suggested that minimizing livestock grazing as a natural climate solution, and strictly monitoring where grazing is allowed. This suggestion was offered because grazing negatively impacts carbon uptake and storage and conditions in riparian and other refugial areas, generates methane emissions that contribute to climate change, and because grasslands are more resistant to the ecological type conversions expected with climate change. This suggestion was considered, but not analyzed in detail for several reasons, some of which have already been discussed in the two previous subsections but might deserve some reframing here for context.

First, carbon uptake and storage are just some of the many ecosystem services provided by national forests and grasslands. Second, the body of science regarding the effects of livestock grazing on carbon stocks is inconclusive as discussed in the Climate and Carbon section of chapter 3. Third, the impacts of livestock grazing on any given area depend on how livestock grazing is managed. Under all the alternatives analyzed in detail, livestock grazing would be managed toward desired conditions to maintain sustainability of the use and the natural resources grazing depends on. This analysis includes a quantitative analysis of those emissions to disclose the effects of each alternative more clearly and provide context to the cumulative effects analysis. Based on our data and analysis, grasslands are not less vulnerable to ecological type conversions than other vegetation types; there is evidence that southwestern semi-desert grasslands have already been transitioning to desert scrub (Triepke 2017a).

Prioritize the Removal of Feral or Estray Cattle

There were suggestions to create a plan standard prioritizing the removal of what are colloquially called “feral” cattle. This suggestion was considered, but not analyzed in detail because this is a legal compliance issue, not a planning issue. Unauthorized use by feral or estray cattle is not compliant with the law or any of the plan alternatives. Efforts to remove these animals from the forest are ongoing.

Road Density Standard

Commenters suggested including a motorized route density standard of generally less than one mile per square mile to promote habitat connectivity and water quality. This standard was considered, but not analyzed in detail because while road density measures may be useful condition indicators, they make poor management standards. This is because the effects of roads on habitat connectivity also depends, at least, on traffic volume, the species, and sometimes the sex of the species. Road density standards are also ineffective management standards for water quality because the effects of roads on watershed condition and water quality depend on many other factors, including road location and design features, maintenance, the size and topography of the watershed, and vegetative cover over the rest of the watershed. Additionally, road densities and their effects on species, habitats and watersheds were addressed by the 2014 travel management decision (USDA FS 2014a) and its supporting environmental analysis (USDA FS 2014b), which have been incorporated into the project record for plan revision. Under the travel management process, alternatives were developed and analyzed based on issues including the effects on wildlife and water quality. The decision was based on a collaborative process and scientifically based information. While minimizing new roads and decommissioning unneeded roads is desirable, managing toward a specific road density would be arbitrary and would not meet the purpose and need to revise the forest plan.

Suitability Studies

Comments were received requesting that planning staff conduct suitability analyses for mineral and energy development, restoration-focused vegetation management, motorized vehicle use, energy development, road building, and other forest uses or activities. These suitability studies were considered, but not undertaken at the discretion of the forest supervisor because suitability determinations in forest plans are a coarse analysis indicating a general compatibility with desired conditions. Because plans prepared under the 2012 Planning Rule have explicit desired conditions, a determination for whether an activity is suitable in a particular location is best conducted at the project-level.

Prohibit Certain Types of Management Tools

There was a suggestion to prohibit use of prescribed fire as a vegetation management tool with the goal of reducing smoke-related impacts to air quality in surrounding communities. Vegetation management would rely solely on mechanical means; however, this prohibition was not considered in detail because it is inconsistent with promoting natural disturbance regimes, ecological integrity, and sustainability. All alternatives considered in detail include direction to meet state and federal air quality standards and minimize smoke impacts to the public.

Another commenter suggested prohibition on the use of chemical piscicide only physically removing non-native fishes. This suggestion was considered but not analyzed in detail because physical removal is not effective as a stand-alone tool (for example Propst et al. 2014). Physical removal methods can be effective if combined with other removal tools such as piscicide. It is useful as one tool in a suite of tools that includes piscicide. Like pesticides, piscicide use is regulated by the Environmental Protection Agency.

There were also suggestions that herbicides should be prohibited by the plan, even for noxious weed treatment. This suggestion was considered but not analyzed in detail because it will not support maintenance or achievement of desired conditions. For some noxious plant species, the size or density of the population, or the plant's biological characteristics require the use of herbicide for effective treatment. For example, species that can reproduce the root system, or small pieces of the root will rarely be controlled, contained, or eradicated without herbicide. An example would be Canada thistle. Canada thistle has a deep spreading root system, tends to establish and thrive in moist areas like springs and seeps and easily displaces the native plant community. Not only does this plant reproduce by seed, but a half-inch piece of the root system can also sprout a new plant. Digging and hand-pulling stimulate growth. If repeated roughly every one to three weeks during the growing season, mowing can sometimes, eventually be effective, but it is more effective in combination with a fall-applied Aminopyralid treatment. It is not reasonable for the plan to completely remove what in some cases, may be the only viable tool to maintain, move toward or achieve desired conditions for healthy, native plant communities and natural processes.

Finally, there were suggestions to prohibit chaining and mastication as a mechanical management tool. These suggestions were considered, but not analyzed in detail because management cannot foresee all circumstances under which any type of mechanical management tool may be the best or worst option. Treatments are not "one size fits all" and many factors need to be considered during project development or fire incident management. Many undesirable effects can be mitigated with site- and activity-specific best management practices. These comments did bring to light an oversight on our part related to slope restrictions provided in plan standards. This oversight has been corrected in the final plan in All Upland Ecological Response Units standard 4.

All these suggestions were considered but not included in an alternative because eliminating tools from the toolbox unnecessarily reduces the options and the flexibility necessary to adapt to changing conditions.

Length-of-Stay Limit in Wilderness

There was a suggestion that permitted outfitters, operators who are pursuing an educational outcome, or permittees who provide progressive expedition-style trips, should not be subject to any length-of-stay limit for wilderness established by plan direction. Another suggestion was that dispersed campers may be allowed to remain in the forest for longer than 14 days, but not more than 30 days, if they do not remain in any one camp for more than 3 days and do not return to previous campsites on the same trip. Others suggested it was unreasonable to expect all Continental Divide National Scenic Trail thru-hikers to be able to cross the Gila in 14 days and that all but the strongest hikers needed at least 16 days.

First, the draft plan contained a forestwide length-of-stay limit (draft Sustainable Recreation standard 3), as well as length-of-stay limits in the Recommended Wilderness (draft standard 10) and Designated

Wilderness (draft standard 6) sections. The limits established for wilderness were the same as those established forestwide, except they applied to each individual wilderness. As worded, the wilderness standards suggest it would be allowable for a person or group to stay in the Aldo Leopold Wilderness for 14 days, and then restart the clock in the Gila or Blue Range Wilderness the next day. Between draft and final, these wilderness standards were removed because they were confusing, difficult implement and did not meet the original intent of protecting wilderness character or characteristics.

Alternatives 1, 3, and 4 contain no length of stay limit. Alternatives 2 and 5 include a 14-day forestwide length-of-stay limit, and include language that provides for exceptions, on a case-by-case basis, with written authorization. Any restrictions on the public can only be enforced with a current forest order.

The suggestions for more permissive limits were considered but not analyzed in detail because there have been efforts to make the limits more consistent across the Forest Service Southwestern Region. Differing stay limits in recommended and designated wilderness were considered but not analyzed in detail.

Suggested Management Areas

Commenters provided many suggestions regarding alternatives for management areas. Management areas are delineated areas with a common set of plan components that differ from forestwide plan components and are established to meet specific management needs. Management areas may be established administratively through plan approval, require a separate administrative process to designate, or may only be designated through an act of Congress.

Wilderness Inventoried Lands

The forest supervisor and planning staff considered but did not analyze an alternative based on the comment to include all inventory areas as recommended wilderness. This suggestion was considered but not analyzed because not all lands in the wilderness inventory have wilderness characteristics. The planning rule requires the responsible official identify which specific areas or portions thereof, from the evaluation of wilderness characteristics to carry forward as recommended wilderness in one or more alternatives to be analyzed for effects. After completion of the inventory and the evaluation, the responsible official established criteria to develop the recommendations for each alternative analyzed in the environmental impact statement.

Ecologically Representative Recommended Wilderness

There was a suggestion to recommend 20 percent of all ecosystems in the Gila National Forest that are “underrepresented” (less than 20 percent) in the Wilderness Preservation System nationally, to protect ecological integrity and diversity. This was considered but not analyzed in detail because this is not the purpose of wilderness established by the Wilderness Act and is inconsistent with the process outlined in agency direction (FSH 1909.12 Chapter 70). The action alternatives protect ecological integrity and diversity for all lands administered by the Gila National Forest through plan components.

Critical Habitat

There was a suggestion to include critical habitat as a management area in the plan, incorporating specific elements in the recovery plan. This suggestion was considered but not analyzed in detail because management within critical habitat is addressed through consultation, considering site-specific conditions, and may change over time. The forest plan incorporates Fish and Wildlife Service approved recovery plans by reference, which ensures the continued implementation of the most current recovery plan without amending the forest plan every time there were changes to a species critical habitat. All alternatives include plan components that provide for the recovery and persistence of species.

Conservation Watershed Network

Some commenters suggested identifying and designating a network of conservation watersheds in which protection from climate change, overgrazing and other environmental stressors, and restoration of pristine water quality and fish habitat would be the highest priority. This suggestion was considered, but not analyzed in detail because: (1) climate change adaptation is important in every watershed; (2) overgrazing would not be consistent with the plan or any alternatives in any watershed, and (3) the agency has a responsibility to manage for high-quality water and habitat in every watershed with the hydrologic and ecologic potential for flowing surface water, riparian, or wetland vegetation and fish. The action alternatives contain plan components for water quality, watersheds and riparian areas, and aquatic ecosystems that provide the necessary guidance to manage for high-quality waters and habitat in all watersheds. Species that are federally recognized under the Endangered Species Act with approved recovery plans may have more specific needs, and the action alternatives incorporate those approved recovery plans by reference (Wildlife, Fish and Plants S4), as previously described in the Critical Habitat subsection above.

Wildlife Corridor Network

There was a suggestion to create a management area for a wildlife corridor network to support species movements and range shifts that are expected to accompany climate change progression. This suggestion was considered, but not analyzed in detail because different species have different needs to facilitate their movement, migration corridors tend to shift over time, and most of the forest has been identified as having high connectivity value (Belote et al. 2016) under current management (see also the Forest Service Climate Risk Viewer Biodiversity and Species at Risk dataset). The Gila National Forest is a relatively unfragmented landscape and plan components provide direction to maintain or enhance habitat connectivity forestwide. The plan also includes management approaches about working with other jurisdictions to promote connectivity across boundaries. This type of collaborative work is site-specific, project-level work. For example, working with the New Mexico Department of Game and Fish and the Department of Transportation to implement the state's Wildlife Corridor Action Plan to address wildlife-vehicle collision problems along Highway 90 and 180 near Silver City (see Wildlife, Fish, and Plants section of the final plan).

Roadless Lands

There was a suggested management area focused on backcountry restoration and recreation designed to protect roadless, non-motorized recreation, habitat, and other social and ecological values associated with the Gila National Forest's complex of roadless lands. This suggested management area was considered, but not analyzed in detail because it is duplicative of existing inventoried roadless areas and designated wilderness. The action alternatives do establish management area direction for both inventoried roadless areas and designated wilderness, though much of their management is already decided by law.

Inventoried Roadless Areas not Recommended for Wilderness Designation

There was a suggestion to create special management areas to maintain ecological conditions, wildlife connectivity, roadless characteristics, and other values of inventoried areas not recommended for wilderness designation. This suggestion was considered, but not analyzed in detail because the plan provides management area direction for inventoried roadless areas that is consistent with law, regulation, policy, and the purposes for which these areas were established.

Alternate Routes for the Continental Divide National Scenic Trail

There were suggestions to create alternate routes for the Continental Divide National Scenic Trail. This suggestion was considered, but not analyzed in detail because it is not within scope of the draft forest plan.

The trail corridor is legislatively determined or modified by Congress. Proposed changes may be submitted as a citizens' proposal directly to Congress.

Citizens' Proposal for Recommended Wilderness

There was a suggestion to analyze a citizens' proposal for recommended wilderness as an alternative. This suggestion was considered, but not analyzed in detail because alternative 5 includes over 745,000 acres that includes and exceeds the 432,166 acres recommended by the citizens' proposal. The boundaries of most areas recommended by the citizens' proposal are within very close alignment to those of alternative 5, with some adjustments made to accommodate alternative criteria identified in the analysis process. The forest supervisor has the discretion to choose the citizens' proposal because it is within the range of alternatives analyzed.

Citizens' Proposal for Wild and Scenic Rivers

There was a suggestion that the wild and scenic eligibility study should find eligible all the river segments included in the citizens' proposal to Congress for designation. A revision of the eligibility study process was considered but not undertaken because interdisciplinary team followed the process outlined in the Forest Service handbook. Regardless of whether the Forest Service identifies a segment as eligible, Congress can designate any river segment as Wild and Scenic.

Comparison of Alternatives

This section provides a summary comparison of the alternatives. This summary focuses on the differences in plan direction, and areas proposed or recommended for congressional or administrative designations such as research natural areas, botanical areas, and recommended wilderness. Plan content not included in this summary is consistent across the alternatives, or only applies to areas proposed or recommended for designations. A summary comparison of the projected outcomes associated with the alternatives is provided at the end of chapter 3.

Table 1. Primary differences between alternative management direction

Bold italicized text is used to highlight specific differences compared to alternative 2.

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Vegetation Management Methods or Tools	Combination of naturally ignited wildfire, prescribed fire and mechanical thinning is allowed	Objectives specifically include a combination of naturally ignited wildfire, prescribed fire, and mechanical thinning	Objectives emphasize mechanical thinning and limited use of prescribed fire	Same as alternative 3	Objectives utilize naturally ignited wildfire and prescribed fire and limited use of mechanical thinning
	Provides slope and soil-based restrictions on mechanical thinning based on outdated information	Provides slope and soil-based restrictions on mechanical thinning updated to reflect current information and allowances for specific exceptions	Removes slope and soil-based restrictions for mechanical thinning. These would be determined at the project level	Same as alternative 3	Same as alternative 2
	No comparable management direction	No guideline	No guideline	No guideline	Includes guideline restricting mechanical thinning to the wildland-urban interface except in strategic locations identified through a science-based analysis that concludes it is necessary to restore landscape-scale adaptive capacity or mitigate the potential for undesirable fire effects
	Aerial application of herbicides may be authorized	Prohibits aerial application of herbicides	Same as alternative 2	Same as alternative 2	Same as alternative 2

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Vegetation Management Methods or Tools (continued)	Establishes specific native plant species that are candidates for herbicide treatment	Herbicide use on native species may be authorized in situations where it supports maintenance or achievement of desired conditions for vegetation communities or the wildland-urban interface	Same as alternative 2	Same as alternative 2	Prohibits the use of herbicides on native species
Priority Vegetation Types	No objectives reflecting priority vegetation types	Objectives reflect relative priorities on forests, historically open-canopy woodlands, and grasslands; objectives target a range a wide range of acres to allow priorities to shift with changing conditions	Objectives place priority on historically open canopy woodlands and grasslands	Objectives place priority on forest types that produce timber products	Same as alternative 2
Spruce-Fir Forest[3]	No objective	Objective to treat at least 250 and no more than 23,779 acres per decade using naturally ignited and prescribed fire	Same as alternative 1	Same as alternative 1	Same as alternative 1
Mixed Conifer with Aspen[3]	No objective; based on congressionally allocated budgets over a 10-year period, 167 acres mechanical thinning and 1,539 acres naturally ignited wildfire	Objective to treat at least 300 and no more than 73,934 acres per decade using any combination of naturally ignited wildfire, prescribed fire and mechanical thinning	No objective	No objective	No objective

[3] The pool of congressionally appropriated dollars for vegetation treatments between 2007 and 2017 was used to develop plan objectives under each alternative. These funds were re-allocated between treatment types based on cost estimates of doing the treatments, and the theme of the alternative. The exercise was intended to demonstrate that the plan is within the fiscal capacity of the forest, which is a requirement of the 2012 Planning Rule. If partnerships and associated funding make additional treatment possible, acres will change.

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Mixed Conifer-Frequent Fire[3]	No objective; based on congressionally allocated budgets over a 10-year period, 518 acres mechanical thinning, 4,795 acres prescribed fire, and 29,515 acres naturally ignited wildfire	Objective to treat at least 6,875 and no more than 282,400 acres per decade using any combination of naturally ignited wildfire, prescribed fire, and mechanical thinning	No objective	Objective to treat ***at least 12,500 acres per decade using mechanical thinning[4] and no more than 2,000 acres per decade of prescribed fire***	Objective to treat ***at least 5,500*** and no more than 282,400 acres per decade ***using a combination of naturally ignited wildfire and prescribed fire***
Ponderosa Pine Forest[3]	No objective; based on congressionally allocated budgets over a 10-year period, 9,445 acres mechanical thinning, 50,508 acres prescribed fire, and 59,274 acres naturally ignited wildfire	Objective to treat at least 6,320 and no more than 600,300 acres per decade using any combination of naturally ignited wildfire, prescribed fire and mechanical thinning	No objective	Objective to treat ***at least 29,230 acres using mechanical thinning[4] and no more than 12,600 acres per decade of prescribed fire***	Objective to treat ***at least 55,000*** and no more than 600,300 acres per decade ***of naturally ignited wildfire and prescribed fire***
Ponderosa Pine-Evergreen Oak[3]	No objective; based on congressionally allocated budgets over a 10-year period, 4,093 acres mechanical thinning, 33,411 acres prescribed fire and 29,360 acres naturally ignited wildfire	Objective to treat at least 1,000 and no more than 540,000 acres per decade using any combination of naturally ignited wildfire, prescribed fire, and mechanical thinning	No objective	Objective to treat ***at least 10,000 acres using mechanical thinning[4] and no more than 2,000 acres per decade of prescribed fire***	Objective to treat ***at least 25,000*** and no more than 540,000 acres per decade ***of naturally ignited wildfire and prescribed fire***

[4] Partner contributions and industry capacity will determine the maximum number of acres that can be mechanically thinned to move toward desired conditions for vegetation communities. The minimum number of acres for mechanical thinning represents what could be accomplished with reasonably foreseeable budgets and existing industry capacity, consistent with the theme of the alternative.

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Pinyon Juniper Grass Woodland[3]	No objective; based on congressionally allocated budgets over a 10-year period, 2,890 acres mechanical thinning, 3,795 acres prescribed fire, and 10,623 acres naturally ignited wildfire	Objective to treat at least 4,000 and no more than 145,800 acres per decade using any combination of naturally ignited wildfire, prescribed fire, and mechanical thinning	Objective to treat ***at least 19,000 acres using mechanical thinning[4] and no more than 500 acres per decade of prescribed fire***	No objective	Objective to treat ***at least 24,000*** and no more than 145,800 acres per decade ***of naturally ignited wildfire and prescribed fire***
Juniper Grass Woodland[3]	No objective; based on congressionally allocated budgets over a 10-year period, 190 acres mechanical thinning, 30 acres prescribed fire, and zero acres naturally ignited wildfire	Objective to treat at least 4,000 and no more than 88,000 acres per decade using any combination of naturally ignited wildfire, prescribed fire, and mechanical thinning	Objective to treat ***at least 13,000 acres using mechanical thinning[4] and no more than 500 acres per decade of prescribed fire***	No objective	Objective to treat ***at least 18,000*** and no more than 88,000 acres per decade ***of naturally ignited wildfire and prescribed fire***
Pinyon Juniper Woodlands[3]	No objective; based on congressionally allocated budgets over a 10-year period, 6,717 acres mechanical thinning, 34,182 acres prescribed fire, and 34,321 acres naturally ignited wildfire	No objective	Same as alternative 2	Same as alternative 2	Same as alternative 2

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Montane/Subalpine Grasslands[3]	No objective; based on congressionally allocated budgets over a 10-year period, 5,359 acres mechanical thinning, 5,220 acres prescribed fire and 11,334 acres naturally ignited wildfire	Objective to treat at least 4,600 and no more than 94,800 acres per decade using any combination of naturally ignited wildfire, prescribed fire, and mechanical thinning	Objective to treat ***at least 11,000 acres using mechanical thinning[4] and no more than 500 acres per decade of prescribed fire***	No objective	Objective to treat ***at least 12,000*** and no more than 94,800 acres per decade ***of naturally ignited wildfire and prescribed fire***
Colorado Plateau/Great Basin Grassland[3]	No objective; based on congressionally allocated budgets over a 10-year period, 1,375 acres mechanical thinning, 470 acres prescribed fire, and 1,259 acres naturally ignited wildfire	Objective to treat at least 2,000 and no more than 59,500 acres per decade using any combination of naturally ignited wildfire, prescribed fire and mechanical thinning	Objective to treat ***at least 8,800 acres using mechanical thinning[4] and no more than 500 acres per decade of prescribed fire***	No objective	Objective to treat ***at least 10,000*** and no more than 59,500 acres per decade ***of naturally ignited wildfire and prescribed fire***
Semi-Desert Grassland[3]	No objective; based on congressionally allocated budgets over a 10-year period, 1,270 acres mechanical thinning, 25 acres prescribed fire and 883 acres naturally ignited wildfire	Objective to treat at least 800 and no more than 88,900 acres per decade using any combination of naturally ignited wildfire, prescribed fire and mechanical thinning	Objective to treat ***at least 6,000 acres using mechanical thinning[4] and no more than 500 acres per decade of prescribed fire***	No objective	Objective to treat ***at least 8,000*** and no more than 88,900 acres per decade ***of naturally ignited wildfire and prescribed fire***

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Wildland-Urban Interface – Hazardous Fuels Management	No objective; based on congressionally allocated budgets over a 10-year period, 5,660 acres mechanical thinning, 10,820 acres prescribed fire	Objective to treat between 16,480 and 249,000[5] acres per decade using a combination of mechanical thinning and prescribed fire	Objective to treat ***at least 4,500 acres per decade by mechanical thinning and no more than 725 acres per decade using prescribed fire***	Same as alternative 3	Same as alternative 2
Riparian Management – Roads and Infrastructure	No plan direction	Guideline establishing a minimum buffer distance from riparian management zones when project activities involve construction or realignment of motorized routes, recreation sites and other infrastructure intended to promote maintenance and achievement of desired conditions	Same as alternative 2	Same as alternative 2	Guideline ***establishing a larger minimum buffer distance for riparian management zones containing year-round water or native trout populations***
Wildlife, Fish and Plants Management – Roads and Infrastructure	Guideline establishes Mexican spotted owl protected activity centers as avoidance areas for new road constructions; provides exceptions for “pressing management reasons”	Standard incorporates all current, approved recovery plans for federally listed species by reference, including the Mexican spotted owl	Same as alternative 2	Same as alternative 2	Guideline establishes Mexican spotted owl protected activity centers as avoidance areas for new construction and realignment of motorized routes and adds an additional half-mile buffer

[5] The upper bound on the range of acres is the total wildland-urban interface acres currently mapped on lands under Forest Service jurisdiction within the Gila National Forest administrative boundary.

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Livestock Grazing Management - Infrastructure	No comparable direction	Standard requiring new or reconstructed infrastructure incorporate design features to prevent wildlife entrapment and allow passage with specific exceptions allowable for health and safety reasons, or when the intent is to exclude wildlife; an elk exclosure intended to prevent overuse of a wet meadow, spring, or young aspen stand is an example of infrastructure that would qualify for exception	***Guideline*** establishing the same requirements for new or reconstructed infrastructure	Same as alternative 3	Same as alternative 2
Livestock Grazing Management – Infrastructure (continued)	No comparable direction	Standard requiring new livestock handling facilities such as corrals, traps, and water developments be constructed outside riparian management zones, significant archeological sites and occupied sites of at-risk plant species. Standard requires buffer distances be determined on a case-by-case basis in coordination with the permittee to address the specific issues and management needs	***Guideline*** establishing the same requirements as alternative 2	Same as alternative 3	Same as alternative 2

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Livestock Grazing Management – Supplement Placement	No comparable direction	Guideline requiring mineral placement to avoid known occupied sites of at-risk plant species, significant archeological sites, cave entrances, poorly drained or saturated soils, unsatisfactory soils, or those with severe erosion hazard or high mass wasting hazards. Requires buffer distances be determined on a case-by-case basis in coordination with the permittee to address the specific issues and management needs	Same as alternative 2	Same as alternative 2	***Standard*** establishes same requirements as the guideline in alternative 2
Livestock Grazing Management – Adaptive Management	No comparable direction	Guideline requires an interdisciplinary evaluation of range readiness with the permittee before restocking after vegetation management activities	Same as alternative 2	Same as alternative 2	***Standard*** establishes same requirements as the guideline in alternative 2

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Livestock Grazing Management – Swing Allotments or Forage Reserves	No comparable direction	Guideline requiring that vacant allotments be considered for their appropriateness and utility as swing allotments or forage reserves that current permit holders could be authorized to use when their allotments are not available because of wildfire, drought, or other disturbance, or to avoid seasonal conflicts with wildlife; management approach describes the intent for strategic selection of a few allotments to serve as swing allotments or forage reserves	***No guideline; management approach is to authorize stocking of vacant allotments to the maximum extent possible***	Same as alternative 3	***Guideline requiring those vacant allotments without a current National Environmental Policy Act decision to remain in vacant status, unstocked, until a new environmental analysis and decision-making process is completed to evaluate any restoration needs or natural resource issues and to determine future management and uses; management approach is not to use vacant allotments as swing allotments or forage reserves***
Lands Program Management – Ownership Adjustments	Goal is for landownership adjustments, rights-of-way acquisition, land-line location, and special uses to promote efficient management	Management approach for land adjustments is to enhance public access and use and support resource management objectives; criteria for identifying desirable lands are provided	***Guideline establishing a preference for land exchanges over acquisitions so that no net loss of private property occurs in a county; management approach is removed***	Same as alternative 3	Same as alternative 2

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Recreation Special Uses – Group Size Limits in Wilderness	Standard for congressionally designated wilderness establishing a group size limit of 25 persons and 35 head of pack and saddle stock for special-use permits	Standard for congressionally designated and administratively recommended wilderness establishing a group size limit of 15 persons and 25 head of pack and saddle stock for special use permits; allows for exceptions to be made if certain criteria are met and for all emergencies involving health and safety	***Does not prescribe a group size limit. Guideline requires that operating plans include appropriate wilderness practices and an education and training component that builds awareness of wilderness values and practices; allows group size limits to be incorporated into a permit as determined necessary with larger group size limits for permit holders with a good track record.***	Same as alternative 3	Same as alternative 2
Recreation – Length-of-Stay Limits	No prescription for a specific length-of-stay limit for forest orders	Standard requiring forest orders to establish a length-of-stay limit of 14 consecutive days forestwide	Same as alternative 1	Same as alternative 1	Same as alternative 2

Topic	Alternative 1 Current (1986) Plan	Alternative 2 Proposed Plan	Alternative 3	Alternative 4	Alternative 5
Amount of Recommended Wilderness	No new areas are recommended to Congress for wilderness designation	110,402 acres are recommended to Congress for wilderness designation[6]	130,012 acres are recommended to Congress for wilderness designation[6]	72,901 acres are recommended to Congress for wilderness designation[7]	725,286 acres are recommended to Congress for wilderness designation[8]
Research Natural Areas	4 areas totaling 1,878 acres are proposed	2 areas totaling 1,500 acres are proposed	No areas are proposed	Same as alternative 3	Same as alternative 2
Botanical Areas	No areas are established	3 areas totaling 68,171 acres are established	Same as alternative 1	Same as alternative 1	3 areas totaling 150,590 acres are established

[6] These acres do NOT include the two congressionally designated wilderness study areas that currently exist within the Gila National Forest.
[7] This includes the 8,800-acre Lower San Francisco Wilderness Study Area.
[8] This includes both the Lower San Francisco and Hell's Hole Wilderness Study Areas.

Chapter 3. Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the affected ecological (physical and biological), cultural, social, and economic environments; existing conditions; and the potential environmental consequences of implementing each plan alternative on those environments. This chapter also presents the scientific and analytical basis for the comparison of the alternatives presented in chapter 2. The National Environmental Policy Act (NEPA) requires analyses to address direct, indirect, and cumulative effects of a proposed action and alternatives. Additional details related to the analysis are available in the appendices and the administrative record.

Direct and Indirect Effects

Forest plans provide a programmatic framework that guides site-specific actions, but do not mandate, authorize, fund, or carry out any project or activity. Because the forest plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects from the plan itself. On the other hand, plans may have long-term environmental implications or consequences, so there can be indirect effects. Those environmental consequences are described in this chapter. Project-level proposals do authorize activities and have both direct and indirect effects. Individual proposed actions are not evaluated in this environmental impact statement, nor are they defined by specific location, design, and extent. Rather, the effects described are broadly related to the types of activities that would be consistent with the plan to compare the relative effects of the alternatives. Effects analyses are applicable for the expected life of the forest plan unless otherwise noted.

Cumulative Effects

"Cumulative effects" are defined in the White House Council of Environmental Quality's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions..." (40 CFR 1508.7). The council interprets this regulation as referring only to the cumulative impact of the direct and indirect effects of the proposed action and its alternatives when added to the aggregate effects of past, present, and reasonably foreseeable future actions across an area that is deemed appropriate for the impacts being analyzed. At the project level, this can include actions taken on lands of multiple jurisdictions if it is relevant to the area deemed appropriate for the impacts being analyzed. Cumulative effects for forest plans are slightly different than for project-level analyses. They always take a multi-jurisdictional look at actions and their associated effects, but the focus is on reasonably foreseeable future actions likely to occur during implementation that could have effects on neighboring lands, as well as actions likely to occur under the plans of other jurisdictions that could affect the forest.

This analysis follows the "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis" issues by the council's chairman on June 24, 2005. The guidance states the expectation that agencies determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects and further notes that the council's regulations do not require agencies to catalogue or exhaustively list and analyze all individual past actions. The analyses that follow do not attempt to quantify the effects of past human actions by adding up all prior planning actions on an action-by-action basis. Instead, the current environmental conditions serve as a proxy for the impacts of past actions because existing conditions reflect the aggregate impact of all prior human actions and natural events that are sometimes difficult to quantify but have affected the environment and might contribute to cumulative effects.

Changed Circumstances

The 2022 Black Fire and record-shattering monsoon season contributed to changed conditions over more than 327, 000 acres of the Gila National Forest, including 90 percent of the Aldo Leopold Wilderness. This environmental impact statement uses the best available information to update descriptions of the affected environment and inform the analysis where relevant.

Climate Change

Plan content is analyzed in terms of its indirect effects how it addresses climate change mitigation or adaptation. In a climate change context, mitigation refers to approaches that reduce or stabilize the levels of greenhouse gases to slow the rate and degree of climate change. Adaptation is a form of risk management. Adaptation strategies are how management responds to threats and opportunities posed by climate change. Climate change impacts are considered cumulative effects. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Analysis Concepts and Definitions

The analysis of plan content related to climate change adaptation relies on the following concepts and definitions:

Resilience is a word that has evolved multiple meanings. The classic definition of the word as used by the restoration science community, the 2012 Planning Rule and final agency directives is: “the ability of an ecosystem (or watershed) and its component parts to absorb, or recover from the effects of disturbances through preservation, restoration or improvement of its essential structures, functions and redundancy of ecological patterns across the landscape” (1909.12 zero code). Resilience is also a term that has been used as part of classification schemes describing climate adaptation actions and when used in this context, has another meaning (St. Laurent et al. 2021). When resilience is used in an adaptation context is it capitalized to differentiate its use from the restoration context. This distinction is important for the precision and clarity that promote transparency and shared understanding.

Resistance-Resilience-Transition (R-R-T) describes the continuum of climate change adaptation strategies that management can direct actions toward (Chazdon et al. 2021 and St. Laurent et al. 2021). The Resistance end of the continuum describes strategies to resist change. Resistance may be active or passive. An example of active Resistance would be non-native species removal to retain native species communities. An example of passive Resistance would be identifying and maintaining refugia (St. Laurent et al. 2021), which are areas that may be buffered from the worst of climate change by topography or other site characteristics where one or more species can persist during unfavorable environmental conditions. Note that “passive” Resistance does not mean taking a hands-off approach, it too requires management action. The difference between active and passive Resistance is the extent of management action (in the sense of Chazdon et al. 2021). Passive Resistance requires action that leverages existing environmental characteristics and conditions.

At the Resilience level, R-R-T describes actions that enhance the capacity of the natural or human system to return to current or future desired conditions. Resilience strategies may have much in common with Resistance strategies in that they generally aim to limit change, but they also acknowledge that some changes may be inevitable or beneficial. The intent of Resilience strategies is to recover past or current structures, functions (Chazdon et al. 2021 and St. Laurent et al. 2021) and capitalize on opportunities. An example of Resilience would be stream restoration (St. Laurent et al. 2021) or vegetation management projects that reconnect pronghorn travel ways that have been disconnected by tree encroachment.

The intent of Transition strategies is to promote establishment of new structures and functions (Chazdon et al. 2021 and St. Laurent et al. 2021) that maintain critical ecosystem services, ecological integrity, and sustainability within climatic trends. The Transition end of the continuum describes management that allows changes without actively trying to shape them (autonomous Transition), takes actions that direct changes toward a desired outcome (directed Transition) or accelerate Transition toward an outcome better aligned with climatic trends (in the sense of St. Laurent et al. 2021). Examples of directed Transition include assisted gene flow, like using plant materials gathered from the warmer, drier parts of a species range in tree planting or seeding efforts. Climate-informed forestry practices, like planting native tree species that are better adapted to future climate on sites that have experienced stand-replacement fire is another example of directed Transition. Examples of accelerated Transition include assisted range expansion, where a species or population is moved to an area expected to function as a refugium under future climate (in the sense of St. Laurent et al. 2021).

As applied to multiple uses, the Resistance-Resilience end of the adaptation spectrum involves incremental adjustments made in response to climate-driven changes aimed at maintaining existing practices, patterns, and systems of use. The Resilience-Transition end of the spectrum represents intentional changes that are so extensive that they fundamentally alter the practices, patterns, and systems of use. Transition adaptation strategies are used proactively, in anticipation of climate impacts (in the sense of Sample et al. 2022).

Assumptions Common to All Analyses

Complex, multi-disciplinary environmental analyses often require assumptions to reduce complexity and uncertainty. Without assumptions, the analysis cannot provide coherent information relevant to the decision to be made. Disclosing assumptions and the reasons for them is important to foster transparency and shared understanding. One assumption that underlies the entire analysis is that all management actions and permitted uses will be designed and carried out in compliance with the approved plan direction. Compliance with the plan is a necessary assumption that keeps the analysis focused and relevant to the decisions to be made, which are the plan’s desired conditions, objectives, standards, and guidelines. Non-compliance of any kind is an implementation issue, not a planning or analysis issue. Additional topic-specific assumptions are disclosed in the individual analyses that follow in the respective analysis methodology subsections.

Upland Vegetation, Fire Ecology and Fuels

Affected Environment

All the alternatives use the Ecological Response Unit (ERU) classification system (Wahlberg et al. 2014). The Forest Service Southwestern Region developed this system and uses it to facilitate landscape-scale analysis and planning. The ERU framework represents all major vegetation types in the region and a stratification of biophysical themes, like LANDFIRE biophysical settings. ERUs are map unit constructs that combine themes of site potential, historic disturbance regimes, and natural succession. Site potential is a term used to describe the characteristic ecological conditions at late development, resulting from interactions among climate, soil, and vegetation. The plan and the assessment report[9] both contain more information about this classification system.

The Gila National Forest contains 13 different upland ERUs that make up approximately 98 percent of the forest. These include five distinctly different forest or timberland types, four woodlands, one shrubland, and three grassland types. These ERUs and the relative diversity of the upland vegetation they represent

[9] https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd544951.pdf#page=34

are displayed in figure 2. Table 2 provides a tabular summary. Riparian vegetation communities are discussed separately in the Riparian and Aquatic Ecosystems section of this document.

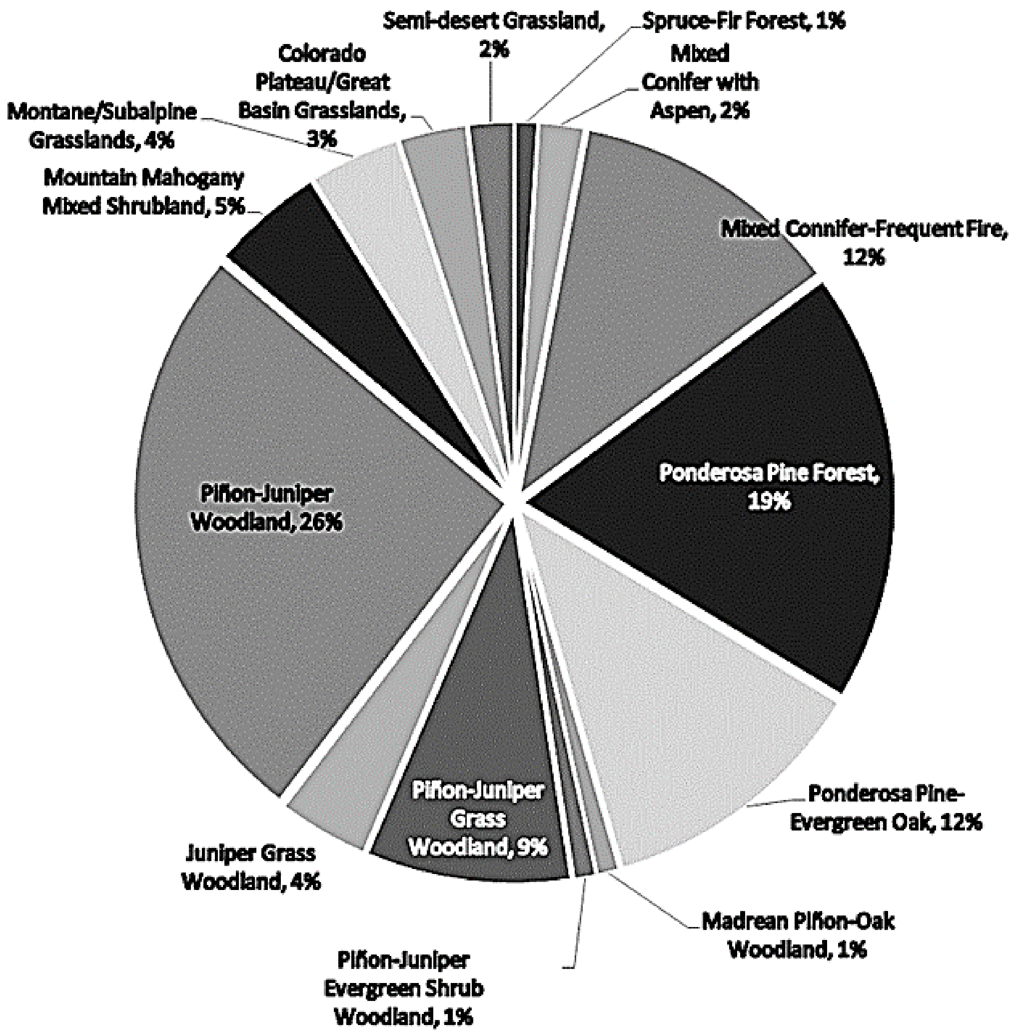


Figure 2. Percentage of upland ERUs in the Gila National Forest

Table 2. Distribution of upland vegetation in the Gila National Forest

Ecological Response Unit (ERU)	System Type	Acres	Percentage of Forest
Spruce-Fir Forest	Forest	23,781	1
Mixed Conifer with Aspen	Forest	74,072	2
Mixed Conifer-Frequent Fire	Forest	395,571	12
Ponderosa Pine Forest	Forest	630,278	19
Ponderosa Pine-Evergreen Oak	Forest	380,156	12
Madrean Piñon-Oak Woodland	Woodland	17,362	1
Piñon Juniper Woodland	Woodland	859,122	27
Piñon Juniper Grass Woodland	Woodland	291,646	9

Ecological Response Unit (ERU)	System Type	Acres	Percentage of Forest
Juniper Grass Woodland	Woodland	114,396	4
Mountain Mahogany Mixed Shrubland	Shrubland	166,489	4
Montane/Subalpine Grasslands	Grassland	113,783	4
Colorado Plateau/Great Basin Grassland	Grassland	89,188	3
Semidesert Grassland	Grassland	55,988	2

The forest is a frequent-fire landscape, but fire does not play the same role in every ERU. Roughly 56 percent of the forest's upland ERUs are characterized by frequent (0 to 35 years), low-severity fire regimes. These are the vegetation types that the terms "fire-adapted" and "fire-dependent" were originally coined to describe. However, the way these terms are often used can foster over-generalization and misunderstanding. Fire plays a variable, and important role in every forest ecosystem.

The variability in fire regime characteristics is specific to location and synchronized with climatic fluctuations (Weins et al. 2012). Examples from a pre-suppression era fire history study conducted in the Gila Wilderness (Abolt 1997) provide an illustration in table 3.

Table 3. Historical fire regime characteristics at select locations in the Gila Wilderness (1706–1904)

Location	Vegetation Type*	Average Number of Years Between Fires	Shortest Fire-Free Period (years)	Longest Fire-Free Period (years)
Snow Park	Mixed Conifer	12	3	41
Upper Langstroth Canyon	Mixed Conifer	8	3	14
Middle Langstroth Canyon	Mixed Conifer	15	9	31
Upper Cub Mesa	Mixed Conifer	7	2	36
Lower Cub Mesa	Ponderosa Pine	6	2	36
Langstroth Mesa	Ponderosa Pine	6	1	26

*As characterized by Abolt (1997), not the ERU classification.

Unfortunately, such reconstructions are not available for most areas in the forest. However, a general sense of the natural role of fire in a particular ecosystem can be gained from aggregating all the available information. Table 4 provides such a summary. Where data are insufficient, or the frequency and severity combination has not been documented, the abbreviation "U" is used in the table. While average values are presented here, the full range of historic variability and its randomness, plays an important ecological role (Agee 1993).

Table 4. Historic ("natural") fire regime characteristics for Gila National Forest vegetation types

Ecological Response Unit	*Average Range of Years Between Fires (Mean Fire Return Interval) by Severity Class			**Average Fire Rotation
.	Low	Mixed	High	.
Spruce-Fir Forest	U†	100–200	200–400	156
Mixed Conifer with Aspen	U	150–400	150–400	120
Mixed Conifer-Frequent Fire	0–35	35–200 or more	U	22
Ponderosa Pine Forest	0–35	U	U	11
Ponderosa Pine-Evergreen Oak	2–200 or more+	2–200 or more	U	13
Madrean Pinyon-Oak Woodland!	U	35–200 or more	35–200 or more	U
Pinyon Juniper Evergreen Shrub	U	35–200 or more	U	206
Pinyon Juniper Woodland	U	35–200 or more	35–200 or more	255
Pinyon Juniper Grass Woodland	0–35	U	U	20
Juniper Grass Woodland	0–35	U	U	13
Mountain Mahogany Mixed Shrubland	U	U	35–200 or more	U
Montane/Subalpine Grasslands	2–22	U	U	12
Colorado Plateau/Great Basin Grassland	0–35	U	U	15
Semi-desert Grassland	3–10	U	U	6

* The average or mean fire return interval is a point frequency estimate describing how often, on average, one would expect fire to occur at the same location on the ground (from Agee 1993).

** The average or mean fire rotation is an area frequency estimate describing how often, on average, one would expect it to take for an area the same size as the study area to experience fire. This does not mean that we would expect every point in the area to experience fire. Some areas could burn more than once and others not at all. It may be most useful when thought of as a rate of burning. This metric is somewhat limited in its practical utility as regional summaries have not included a definition of the "study area" size. From Agee 1993 and Krausmann and Triepke 2015.

†U means the severity and frequency combination has not been documented or is supported by insufficient information.

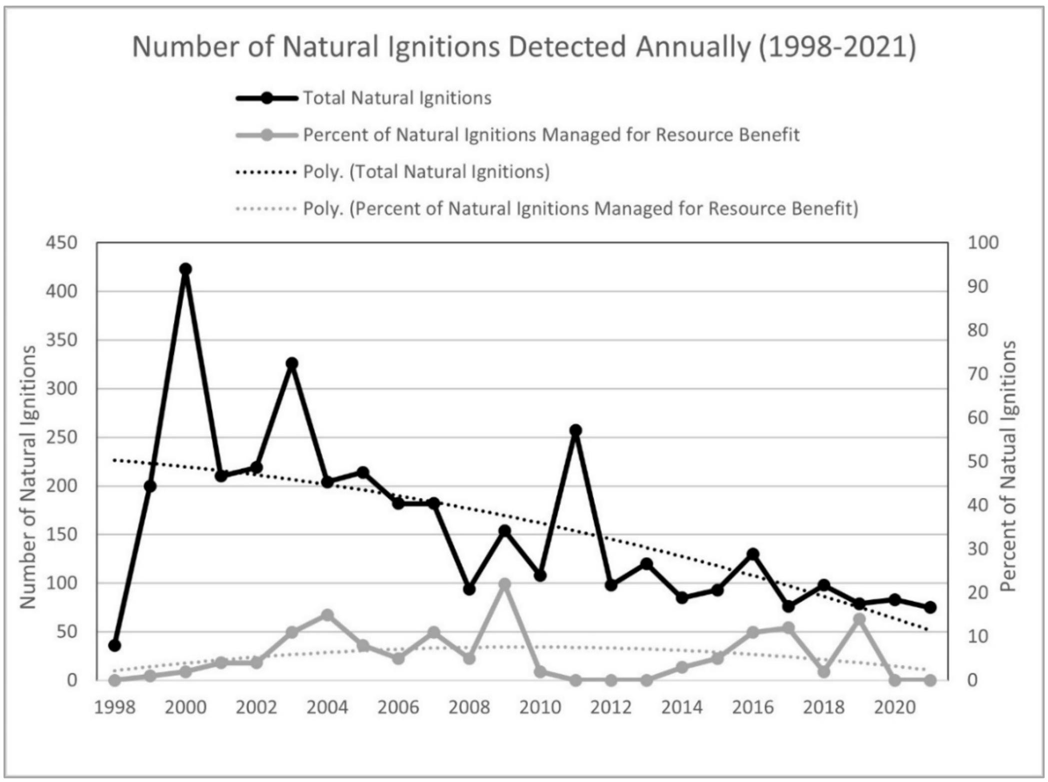
! This information differs from the Madrean-Pinyon Oak Woodland elsewhere in the Southwestern Region due to differences between the physical site characteristics where it occurs in the Gila National Forest as compared to elsewhere. For more information, please see the corresponding ERU description in the revised forest plan.

The historic role of fire changed in the late 1800s, with the arrival of Europeans and the decline in Native American populations. Changes in land management began to alter fire regimes in complex ways. Livestock grazing practices reduced herbaceous vegetation (fine fuels) and contributed to an increase in woody vegetation, because of reduced competition for water and nutrients (Rummel 1951; Madany and West 1983; Savage and Swetnam 1990; Dahms and Geils 1997; Boucher and Moody 1998; Smith 2006; among others). At the turn of the 19th century, the policy of fire suppression further contributed to an increase in woody vegetation and fuel loading. With substantially reduced understory and no fire, conifer seedlings survived at unprecedented rates, invaded openings, and encroached into grasslands and previously open-canopy woodlands. Many large, old trees were harvested for lumber and fuelwood, also reducing structural diversity.

Over time, livestock and timber management practices improved, and while the Forest Service still actively suppresses some fires, the policy of total fire suppression ended. In the mid to late 1970s, the Gila National Forest became one of the first to begin restoring fire to the landscape (Boucher and Moody 1998). Progress has been made; however, the road to fully restoring the resilience and adaptive capacity of the forest remains a long one.

While there is scientific literature that suggests fire sizes were much larger prior to European settlement, many in the science community and the news media continue to highlight the contemporary trend in fire size (Westerling et al. 2006; among others) and severity (Dillon et al. 2011, Parks et al. 2023b). Many predict the likelihood and occurrence of large, stand-replacing fires will continue to increase over the near term with current and future climatic trends, until fuel becomes limiting. Many of the data suggest these trends are only beginning to play out in the Gila National Forest, suggesting the way Gila National Forest leadership and staff have managed the return of fire to the landscape buffered the forest for a time.

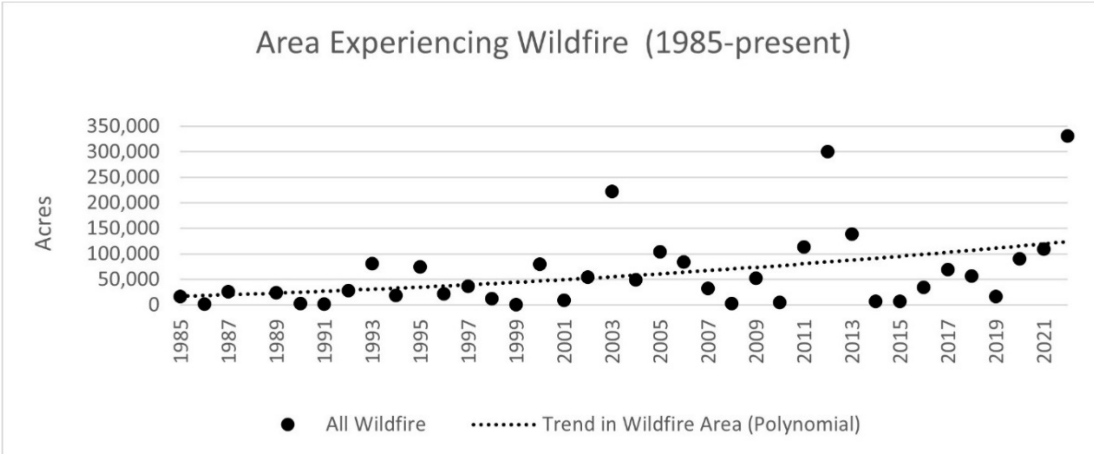
The forest has actually seen a decline in the number of natural ignitions detected annually (figure 3) and the percentage of these fires occurring under conditions that support management for resource benefit has remained relatively stable (figure 5). No fires were managed for resource benefit in 2020 due to the COVID-19 pandemic. The pandemic also influenced 2021, which was an exceptional fire year across the nation, and limited resources were available to manage naturally ignited wildfire as anything other than full suppression.



*Information summarized from Silver City Interagency Dispatch Center annual fire logs. Period of record is determined by the available data. Prior to 1998, recordkeeping practices were not as good.

Figure 3. Trends in number of natural ignitions and percent managed for resource benefit

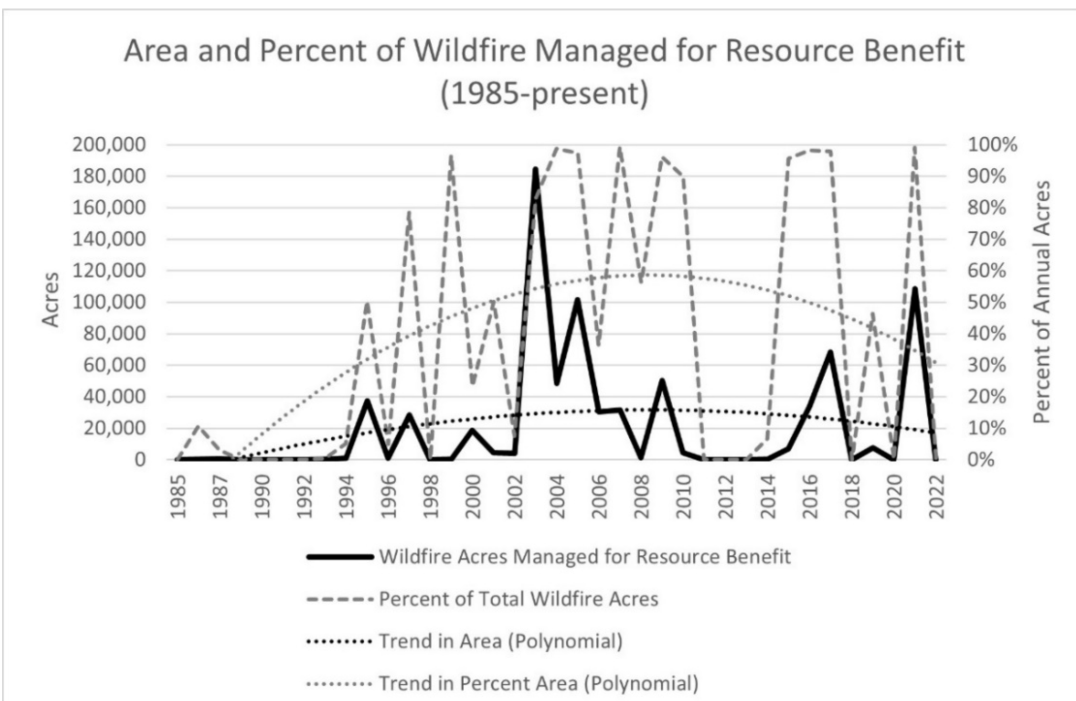
There is an upward trend in the total area experiencing wildfire (figure 4), as would be expected after the end of the total suppression policy and the evolution of how fire is managed on the landscape. To better protect wildland firefighters, fewer risks are being taken. This is especially true in the rugged, unforgiving, and remote terrain like much of the Gila National Forest. Risks are only accepted when the probability of success is high, providing for safety first. Drawing larger fire perimeters to work within puts more distance between firefighters and the risk, leading to more acres burned.



*Information from Gila National Forest Fire History database. Period of record was chosen for consistency with the Monitoring Trends in Burn Severity (MTBS) dataset's period of record. Although the Gila National Forest's Fire History data includes information for a longer time period, records are not as reliable prior to 1985.

Figure 4. Trends in total Gila National Forest area experiencing wildfire

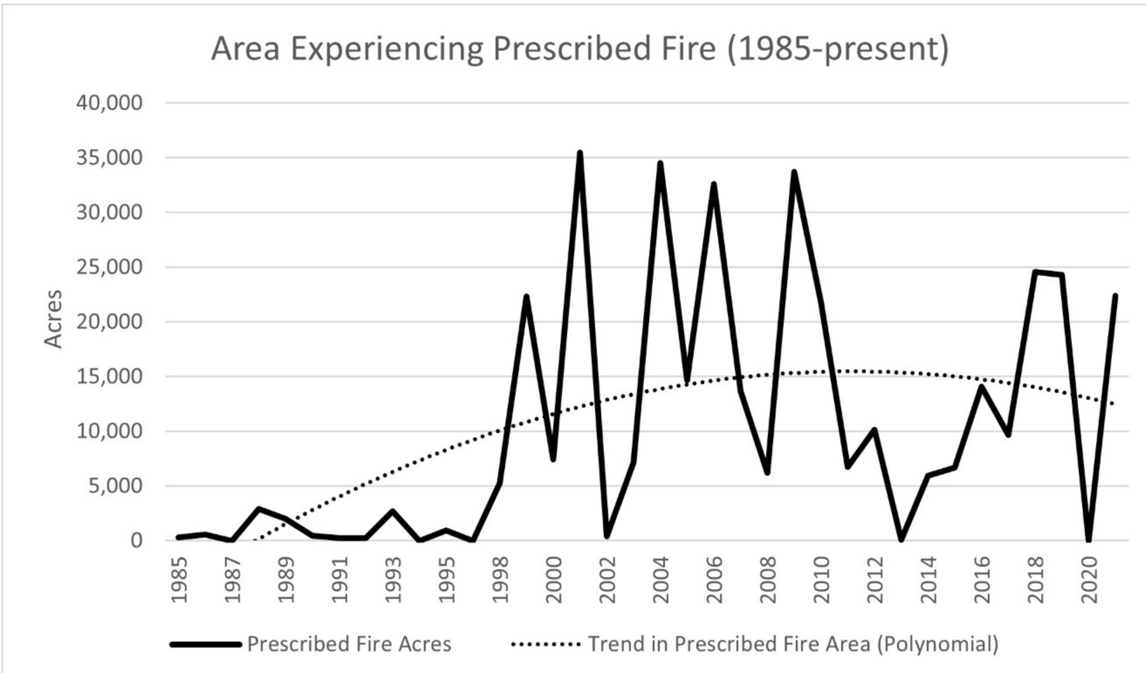
While the number of wildfire acres managed for resource benefit has experienced a small decline since 2010, but the percentage has declined more abruptly (figure 5). This is tied to an upward trend in fire size; larger fires require more resources to manage, which reduces the number of fires that can be managed. There has been an increase in the number of acres being managed under a suppression objective because of unfavorable fuel and weather conditions, or limited resources to manage those fires because firefighters are engaged elsewhere.



*Information from Gila National Forest Fire History database. Period of record was chosen for consistency with the MTBS dataset's period of record. Although the Gila National Forest's fire history data has information for a longer period, records are not as reliable prior to 1985.

Figure 5. Trends in area treated with wildfire

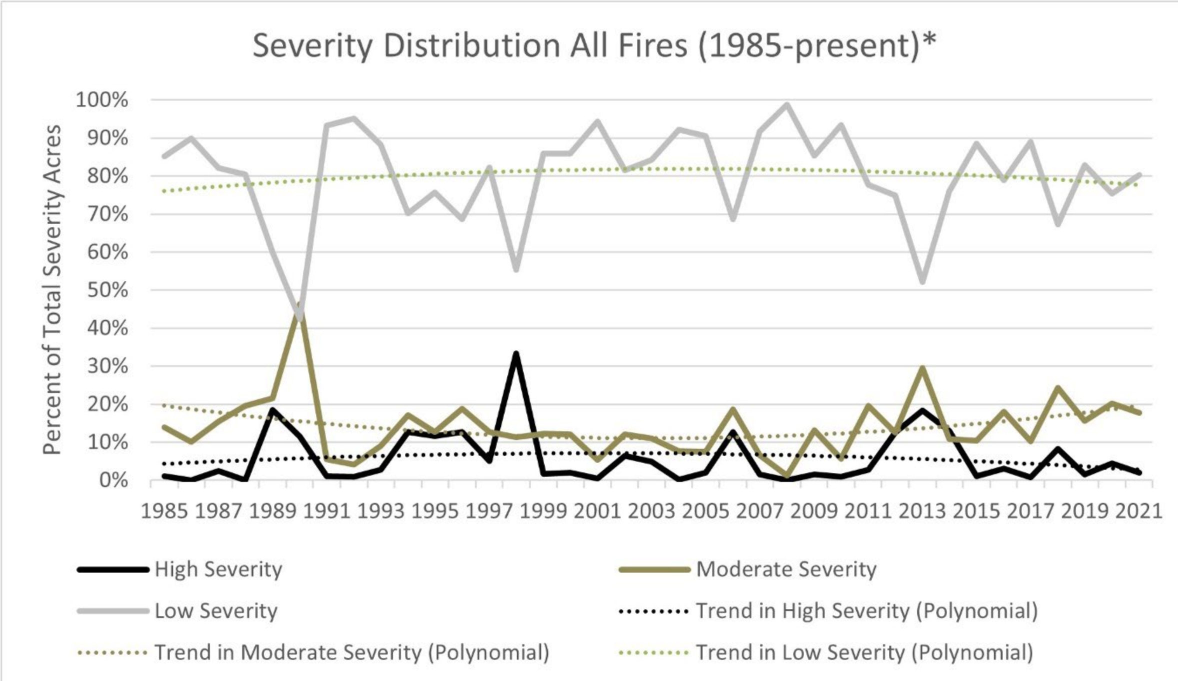
There has also been a slight declining trend in the number of acres treated with prescribed fire after 2010 due to active wildfire seasons, shorter windows of time when fuel and weather conditions are favorable, and availability of staff to implement prescribed fires. In recent years, fire personnel have spent more time responding to wildfire elsewhere in the region, the nation, and the world and have less time to implement prescribed fire on their own forests. No prescribed fire occurred in 2020 due to the COVID-19 pandemic. Leadership determined it was best not to introduce smoke into the air and compound the difficulties of sick individuals and individuals at higher risk for serious COVID-19 infections.



*Information from Gila National Forest Fire History database. Period of record was chosen for consistency with the MTBS dataset's period of record. Although the Gila National Forest's Fire History data has information for a longer time period, records are not as reliable prior to 1985.

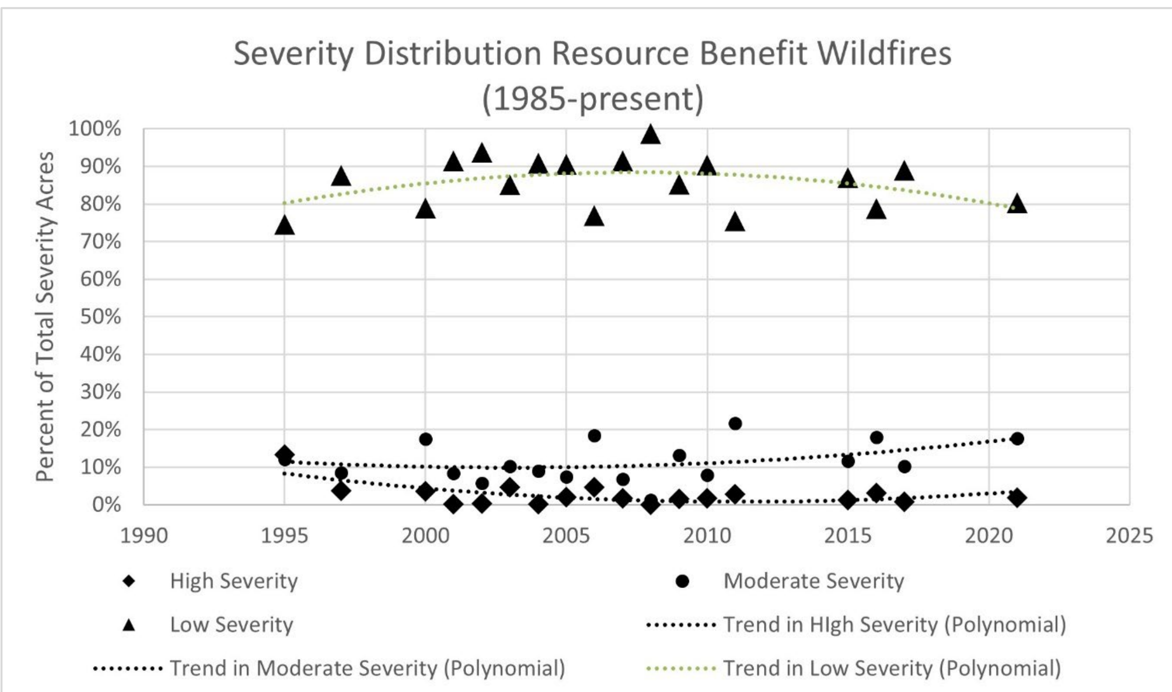
Figure 6. Trends in area treated with prescribed fire

There has been very little change in the severity distribution of wildfires or prescribed fires(figure 7, figure 8, and figure 9). Severity trends summarized by ERU also provide little evidence that severities are changing, with predominantly low departure ratings (USDA FS 2017a). All the ERUs in high departure for fire severity are the result of lack of fire rather than an actual departure in observed severity.



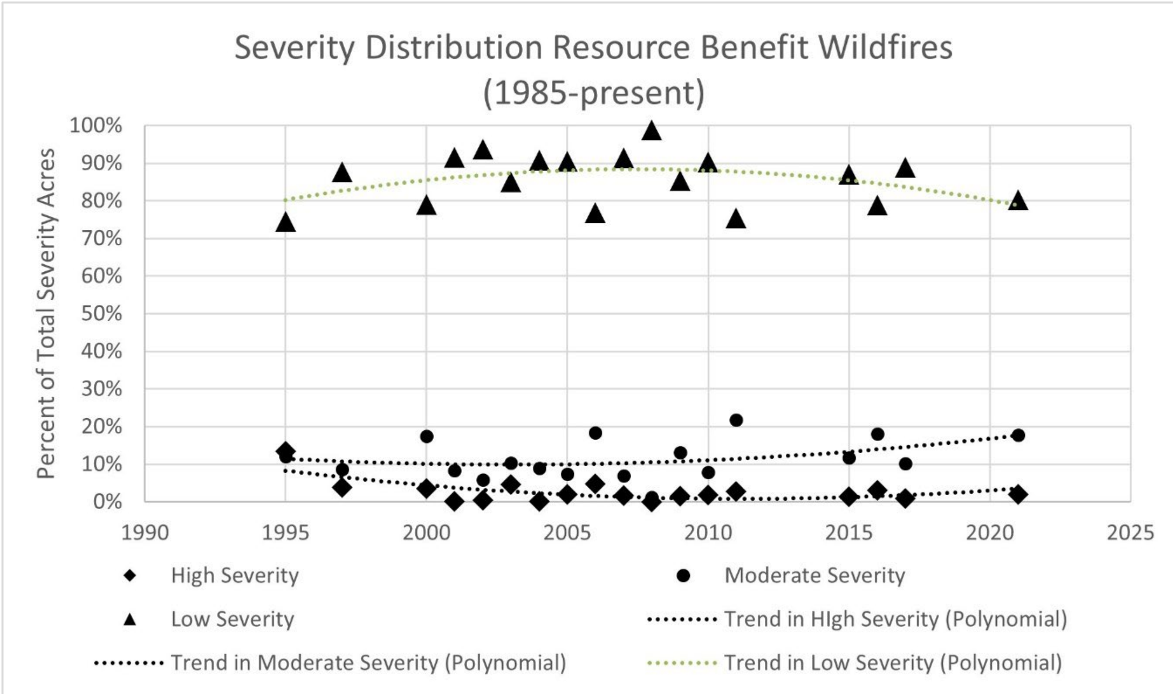
*Information from full period of record of the (MTBS dataset. MTBS data are only available on individual fires greater than 1,000 acres in size. MTBS data were not available for all 2018 fires when this analysis was generated.

Figure 7. Overall trend in fire severity



*Information from full period of record of the MTBS dataset. MTBS data are only available on individual fires greater than 1,000 acres in size. MTBS data were not available for all 2018 fires or any since when this analysis was generated.

Figure 8. Trends in resource benefit wildfire severity



*Information from full period of record of the MTBS dataset. MTBS data are only available on individual fires greater than 1,000 acres in size. Relatively few prescribed fires have been greater than 1,000 acres. MTBS data were not available for all 2018 prescribed fires or any since when this analysis was generated.

Figure 9. Trends in prescribed fire severity

The severity data above describe big picture trends playing out forestwide. Finer-scale patterns emerge at the scale of specific vegetation communities. For example, recent study of fire severity trends in dry conifer forests dominated by ponderosa pine, using the Gila Wilderness as a case study, bears testament to the way Gila National Forest staff has managed fire in the wilderness. The study found that while the southwestern U.S. in general has experienced 5.9 times more stand-replacement fire in dry conifer forests than in the historical reference period, the Gila Wilderness has only seen an increase of 1.8 times (Parks et al. 2023b). More description specific to each of the forest's vegetation communities is provided in the Environmental Consequences subsection dedicated to individual ERUs.

Large extents of stand-replacement type fire remain a threat as illustrated by Parks and others (2018b), who have published spatial predictions of high-severity fire for areas currently under tree cover in the western United States. The following figures are taken from their work and display the probability of high-severity fire in the Gila National Forest—*if* a fire were to occur. Figure 10 displays the predictions under average fire season weather conditions. Figure 11 displays the predictions under extreme conditions (95th percentile). This work does not include predictions for non-treed areas, regardless of how it is mapped in the ERU classification system, which means it is not valid in areas that were previously treed but are currently in grass or shrub states because of stand-replacement fire. It is only valid in grasslands where woody encroachment is present. It is also based entirely on standing fuels as a comparable dataset for surface fuels is not currently available (Parks et al. 2018a). Figure 10 and figure 11 are followed by a tabular display of the predictions by ERU (table 5).

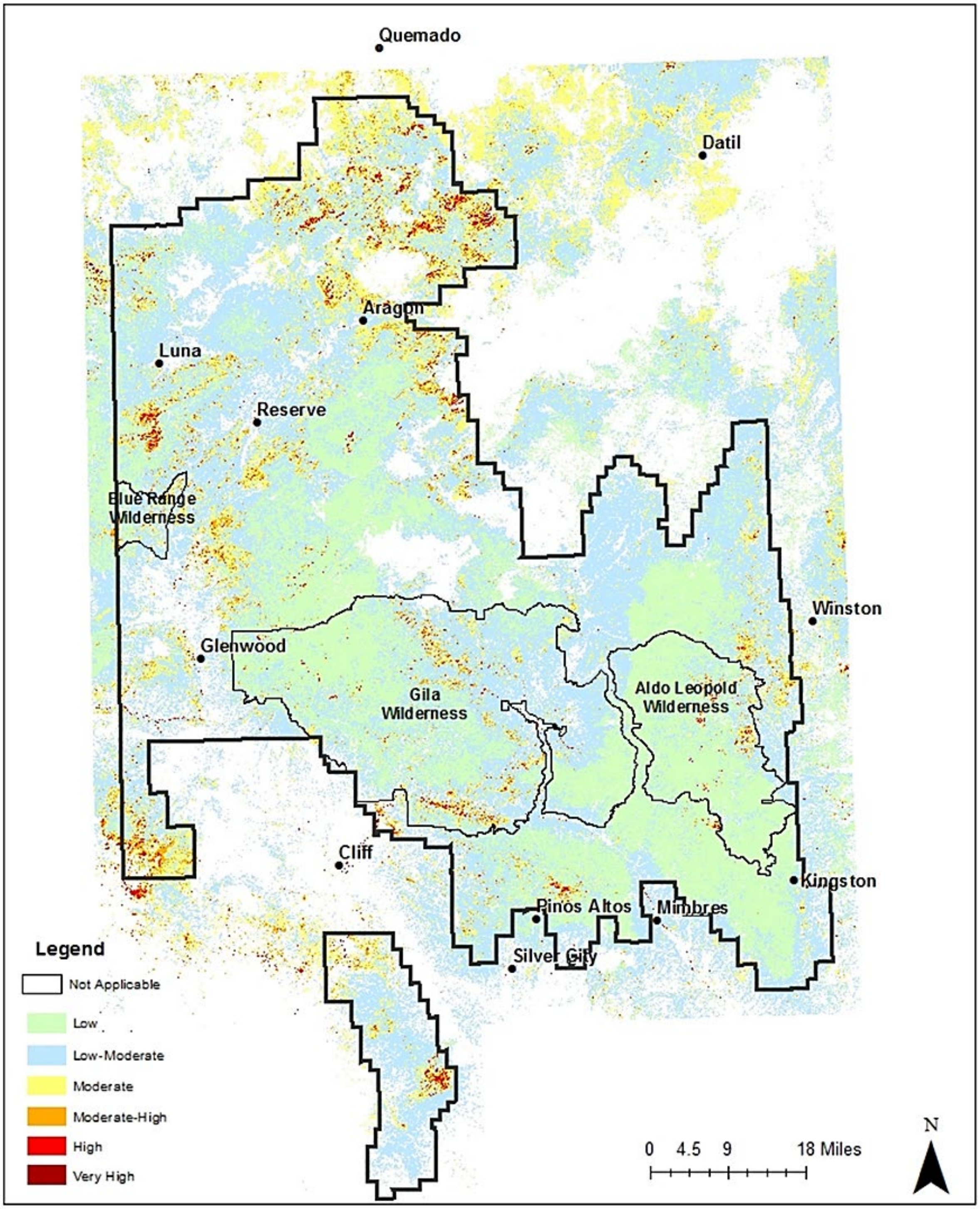


Figure 10. Predicted probability of stand-replacement fire (2018), if a fire occurs under average fire season weather

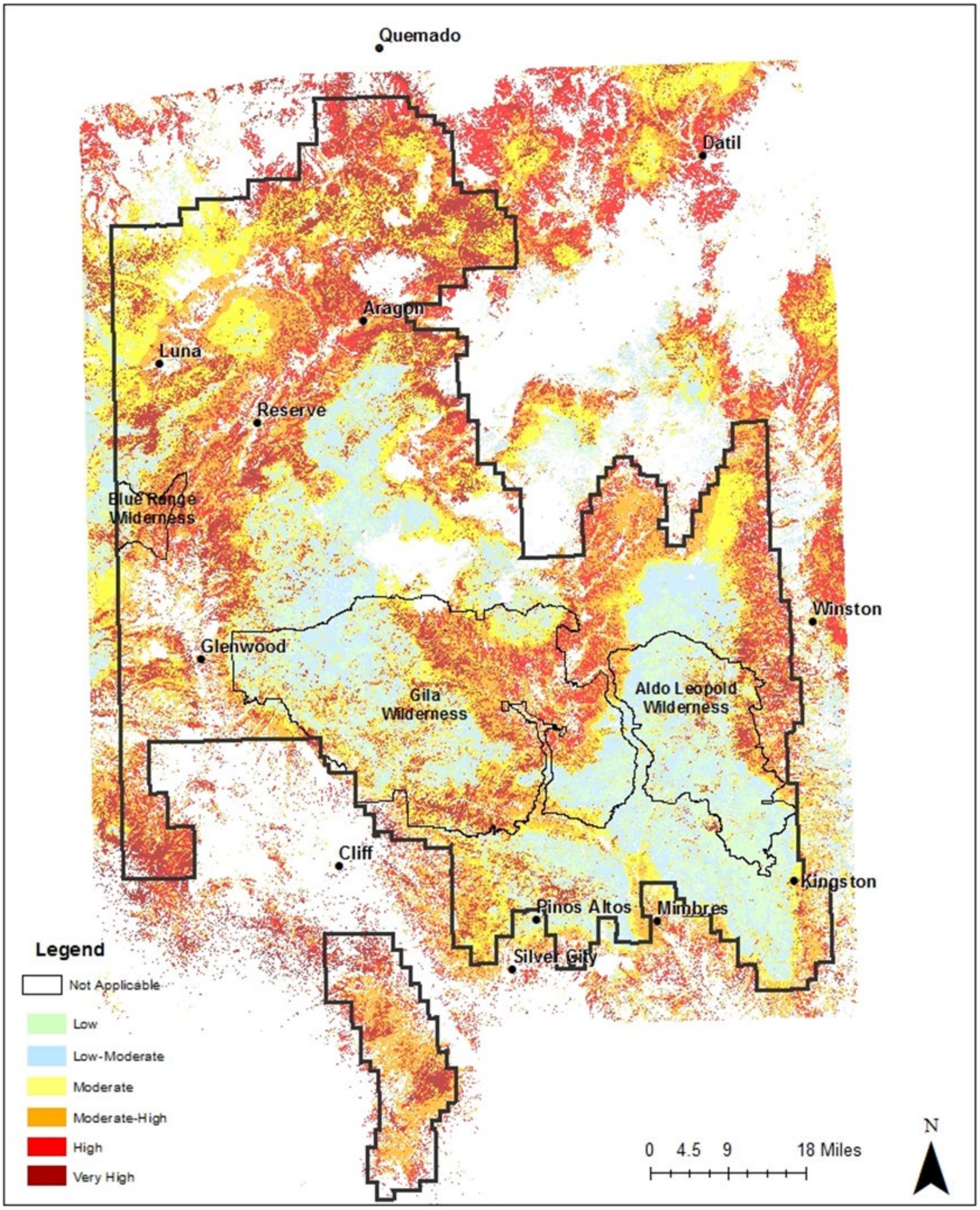


Figure 11. Predicted probability of stand-replacement fire (2018), if a fire occurs under extreme fire season weather

Table 5. Ecological Response Unit area with moderate or greater probabilities of high-severity fire under average and extreme fire season weather

Ecological Response Unit Name	Area with Predicted Moderate or Greater Probability of High-Severity Fire (percent of ERU)	
	Average Fire Season Weather	Extreme Fire Season Weather
Spruce-Fir Forest	3	16
Mixed Conifer with Aspen	6	25
Mixed Conifer-Frequent Fire	20	52
Ponderosa Pine Forest	19	66
Ponderosa Pine-Evergreen Oak	13	61
Madrean Pinyon-Oak Woodland	23	79
Pinyon Juniper-Evergreen Shrub (now lumped with Pinyon Juniper Woodland)	28	77
Pinyon Juniper Woodland	14	70
Pinyon Juniper Grass Woodland	25	75
Juniper Grass Woodland	13	58
Mountain Mahogany Mixed Shrubland	7	55
Montane/ Subalpine Grassland	3	28
Colorado Plateau-Great Basin Grassland	5	40
Semi-Desert Grassland	2	35

Parks and others found that the strongest drivers of high-severity fire in the Arizona-New Mexico mountains are live fuel (approximately 75 percent) and fire weather[10] (approximately 15 percent). Climate and topography[11] are also drivers, explaining 9.7 and 0.2 percent (Parks et al. 2018b). This appears contradictory, given that many fire science studies have found topography to be a substantial driver. However, as Parks and others discuss, this is because topography has been looked at as a proxy for live fuels in the past, rather than as two separate variables. Regardless, these predictions suggest during average fire weather, live fuel densities in the Gila National Forest do not pose a widespread fire management challenge. Under extreme conditions, it is a much different story.

While it might be expected that the infrequent, high-severity fire ecosystems in the forest would have a larger percentage of their area at moderate or greater risk, this is not consistently observed. Spruce-Fir Forest and Mixed Conifer with Aspen are less likely to experience stand-replacement fire than other ERUs, under both the average and extreme predictions. This may be because much of the area they occupy has recently experienced stand-replacement fire and the predictions are not valid because of lack of trees.

Fire-facilitated type conversions concern many Gila National Forest staff and stakeholders, particularly considering current and future predicted climatic trends. While it does not predict interacting mechanisms of conversion, the Climate Change Vulnerability Assessment (Triepke 2015) provides both spatial (figure

[10] The most influential fire weather variables include daily burning index, maximum daily temperature, annual heat moisture and annual climatic moisture deficit.
[11] The most influential climate variables are the average climatic moisture deficit and evapotranspiration (1981 to 2010). The most influential topographic variable is the topographic position index, which is a relative measure of valley bottom versus ridge top.

12) and tabular summary (table 6) of the relative likelihood of type conversion in the Gila National Forest and the surrounding landscape.

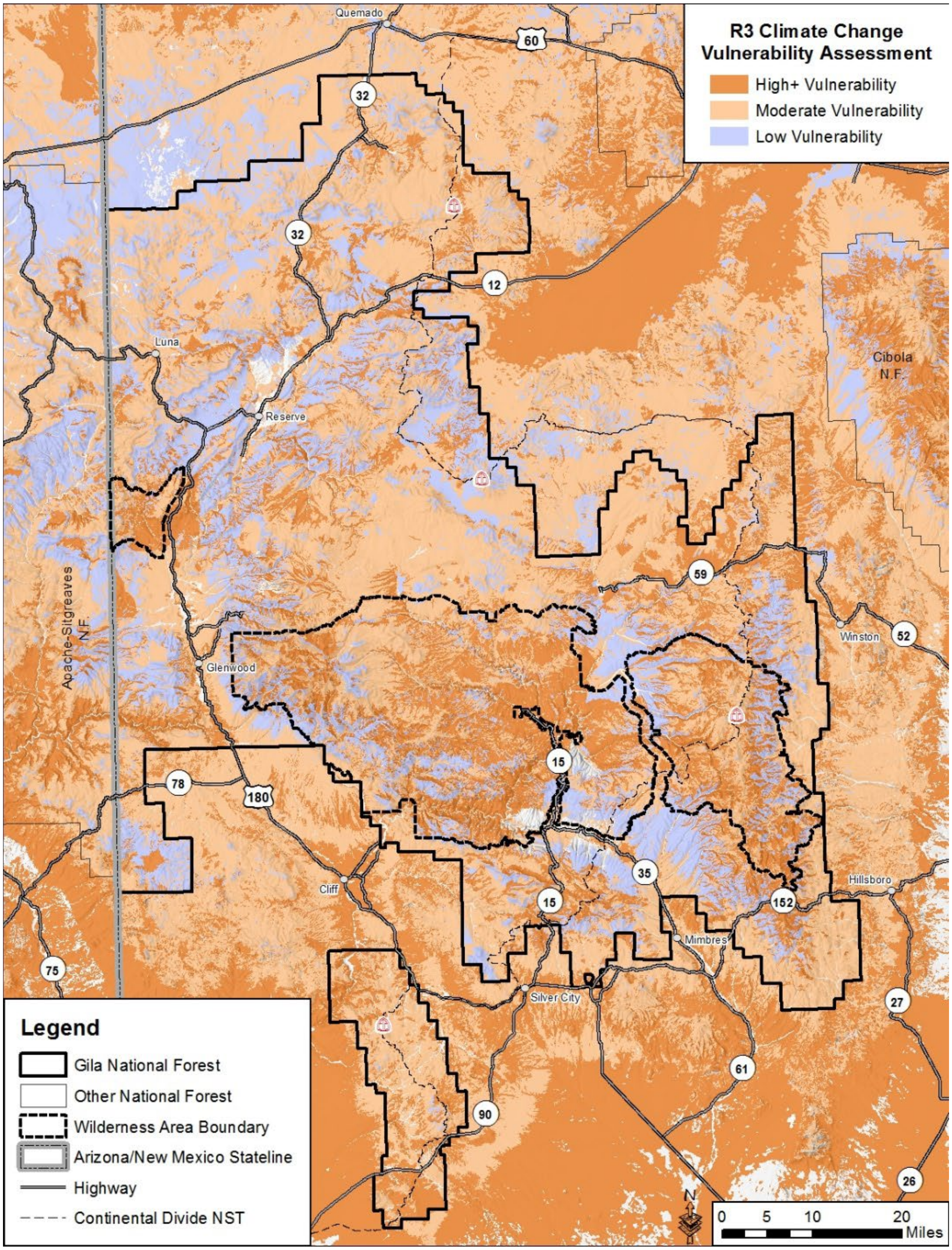


Figure 12. Spatial patterns of vegetation vulnerability to climate change

This work also provides quantitative evaluation of uncertainty based on how many of the climate models agreed. Table 6 summarizes both vulnerability and uncertainty at the forest scale. Ranges indicate there is greater variability depending on where in the forest an ERU is located.

Table 6. Vulnerability and uncertainty ratings for Gila National Forest ecological response units

Ecological Response Unit Name	Vulnerability	Uncertainty
Spruce-Fir Forest	Very High	Low
Mixed Conifer with Aspen	Moderate to Very High	Low to Moderate
Mixed Conifer-Frequent Fire	Moderate to High	Moderate
Ponderosa Pine Forest	Moderate to High	Moderate
Ponderosa Pine-Evergreen Oak	Moderate	Moderate
Madrean Pinyon-Oak Woodland	Low to Moderate	Moderate
Pinyon Juniper-Evergreen Shrub (now lumped with Pinyon Juniper Woodland)	Not Analyzed	Not Analyzed
Pinyon Juniper Woodland	Low to Moderate	Moderate
Pinyon Juniper Grass Woodland	Low to Moderate	Moderate
Juniper Grass Woodland	Moderate to High	Moderate
Mountain Mahogany Mixed Shrubland	Low to Moderate	Moderate
Montane/ Subalpine Grassland	Moderate	Moderate to High
Colorado Plateau-Great Basin Grassland	Moderate	Moderate
Semi-Desert Grassland	Low to Moderate	Moderate

While climate change impacts to the forest's ecosystems may ultimately be beyond the control of management, actions taken within the life of the next forest plan could influence their trajectory. In turn, this will influence the types, amounts, and quality of ecosystem services that the Gila National Forest is able to sustain in the future.

Wildland-Urban Interface

The wildland-urban interface is the area or zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels. Generally, the wildland-urban interface is a buffer around communities, private lands, or other infrastructure. The buffer size may vary based on topography, fuels, and values at risk. Although they are physically delineated places, it may be helpful to think of the wildland-urban interface not as a place, but rather as a set of conditions that can exist in and around nearly every community and surrounding many other types of infrastructure. These conditions are defined by the amount, type, and distribution of vegetation; the flammability of the structures (such as homes, businesses, outbuilding, decks, fences) in the area and their proximity to fire-prone vegetation and other combustible structures; and weather patterns and general climatic conditions, topography, hydrology, road construction and more.

According to Radeloff and others (2018), one in three houses and one one-tenth of all land with housing in the United States are in the wildland-urban interface. Population growth is expected to continue the expansion of wildland-urban interface. While the degree of risk may vary from one place to another, given the right conditions, wildfire can affect people and their homes in almost any location. Even structures not immediately adjacent to wildlands are at risk of damage from fire because embers can be transported by wind and ignite vulnerable homes a mile or more ahead of the flame front. As more people live or work in the wildland-urban interface, fire management becomes more complex and the costs to reduce fire risk, manage wildfires, and protect human life and property go up. Six percent of homes found in Catron, Grant, and Sierra Counties are in the wildland-urban interface (USDA FS 2017a). There are approximately 237,024 acres of wildland-urban interface within the Gila National Forest. Table 7 displays the distribution of these acres across the forest's vegetation types.

Table 7. Wildland-urban interface distribution across vegetation types on the Gila National Forest

Ecological Response Unit Name	Wildland-Urban Interface Acres	Percentage of ERU
Spruce-Fir Forest	786	3
Mixed Conifer with Aspen	2,810	5
Mixed Conifer-Frequent Fire	14,606	4
Ponderosa Pine Forest	57,077	9
Ponderosa Pine-Evergreen Oak	29,191	8
Madrean Pinyon-Oak Woodland	299	2
Pinyon Juniper-Evergreen Shrub (now lumped with Pinyon Juniper Woodland)	91	Included in Pinyon Juniper Woodland
Pinyon Juniper Woodland	66,117	8
Pinyon Juniper Grass Woodland	28,364	10
Juniper Grass Woodland	7,737	7
Mountain Mahogany Mixed Shrubland	5,477	3
Montane/ Subalpine Grassland	8,839	8
Colorado Plateau-Great Basin Grassland	8,985	10
Semi-Desert Grassland	6,461	12
Total	**237,024**	

In recent years, the Gila National Forest has planned and implemented many projects that specifically decrease the potential for undesirable fire effects in these areas. While fire plays an important and variable role in all the forest's ecosystems, even ecologically characteristic fuel conditions and fire behavior may not be desirable in wildland-urban interface settings. Based on the work of Parks and others previously displayed and discussed, approximately 20 percent of the wildland-urban interface currently has a moderate or greater probability of high-severity fire under average fire weather conditions. However, under extreme fire weather conditions, this percentage increases to approximately 71 percent.

In January 2022, the Forest Service launched a 10-year strategy to address the wildfire crisis in the places where it poses the most immediate threat to communities and the infrastructure that supports communities (USDA FS 2022a). During development of the strategy, the agency identified high-risk landscapes, or firesheds, throughout the National Forest System, which were then prioritized at regional and state levels. The Gila National Forest has two regional priority wildfire crises landscapes, one in Catron County and one in Grant County near Silver City. These landscapes will be focal areas for restoration and adaption work in the coming years to meet the objectives of the national strategy.

Environmental Consequences

The following discussion of environmental consequences addresses the effects of the alternatives on upland vegetation communities, fire ecology and fuels, both within and outside of the wildland-urban interface. It does not discuss the effects of vegetation, wildland fire, or fuels management activities likely to occur during implementation of the plan on other natural resources or resource uses. Those discussions are housed under their respective topic headings.

Analysis Methodology

State-and-Transition Modeling

This analysis relies heavily on state-and-transition modeling to project vegetation changes over time under each plan alternative. States, or seral states, are point in time characterizations of vegetation community development from un-vegetated post-disturbance to the final, potential vegetation community adapted to the site conditions such as a grassland dominated by a diversity of perennial grass species, or a mature, old-growth forest. Transitions are the pathways of change between states, and can include human activities, fire, insects and disease pathogens, weather, growth, competition, and herbivory. This type of modeling has a long history of use by the Forest Service, Natural Resource Conservation Service, and many others outside the Department of Agriculture for comparing differences between broad, landscape-level management scenarios.

The state-and-transition models used in this analysis were developed specifically for the Forest Service Southwestern Region. They began as LANDFIRE models, which were subsequently refined by The Nature Conservancy, the Integrated Landscape Assessment Project, and the Forest Service Southwestern Regional Office based on published scientific literature, regional datasets, Forest Inventory and Analysis (FIA) data, Forest Vegetation Simulator (FVS) modeling, and the expert opinion or professional judgment of regional office staff. The models that emerged from this refinement process are referred to as the "regional base models." Documentation for the regional base models is available from the Southwestern Regional Office.

In some cases, forest staff were allowed to tailor the regional base models to describe the current management of the forest more accurately. In other cases, staff were required to develop inputs for which the region determined were best described by local expert opinion. For the draft environmental analysis, these inputs as they were in the assessment models were thoroughly reviewed, which resulted in some substantial changes. These model inputs and their development are discussed in detail in Appendix B: State and Transition Modeling Process.

The software program used to run the models is the Vegetation Dynamics Development Tool (VDDT) by ESSA Technologies Limited (ESSA Technologies Ltd. 2007). VDDT is a non-spatial user interface that is relatively easy to use and is supported by the Southwestern Regional Office for forest planning. It is a non-equilibrium model, meaning that it characterizes ecosystems as constantly changing—within the user-defined limits. VDDT is in the public domain and available for download on the developer's website.[12]

There are many assumptions, limitations, and sources of error associated with state-and-transition modeling generally, and this analysis, specifically. Some limitations or sources of error are associated with datasets, or the amount and quality of scientific literature used to structure the model or develop inputs as described by Shlisky and Vandendriesche (2012). There are several assumptions underpinning this analysis that merit discussion.

State-and-transition modeling rests on the assumption that the future will look like the past. In other words, there is assumption that all the outcomes, and the likelihood of each are known. While there is arguably potential for disagreement about whether this assumption is valid under a stable climatic regime, there is even more room for debate about its validity, given the fact that our current climatic regime is demonstratively unstable. A stable climate is an assumption specific to the regional base models. Although

[12] https://essa.com/explore-essa/tools/vddt/

there are some methodologies in the literature to incorporate projections of future climate into state and transition models, the Southwestern Region has not yet incorporated them into the forest planning models.

A third assumption is associated with the lack of herbivory-driven transitions. While there is ample scientific literature discussing the interacting ecological effects between herbivory, species composition, woody encroachment and fire regimes, the regional base models provide no transition pathways for herbivory in or out of a given state, even though the software is capable of it. This builds in the assumption that herbivory does not affect the trajectory of ecosystems. The decision not to account for herbivory in the models was presumably related to the fact that FVS is not capable of reflecting changes in the herbaceous community, and other difficulties associated with quantifying dynamics. These difficulties include the fact that the agency does not manage herbivory by wildlife, and that herbivory by livestock is driven by allotment-scale analysis and management. Therefore, the only management activities the modeling can reflect are wildland fire management and silvicultural activities, with changes occurring only in terms of woody vegetation.

The non-spatial nature of these models is a substantial limitation. Where vegetation communities, their component states, wildland fires and mechanical vegetation treatments are located on the ground and in relationship to each other has a large influence on outcomes. Another substantial limitation is that the regional base models are highly biased toward mechanical vegetation treatments as demonstrated by the general inability to hold reference conditions under reference disturbance regimes (pers comm. Shahani 2017).

Seral State Diversity

This characteristic describes the diversity of a given ERU in each seral state. It reflects the structural variability in dominant vegetative lifeform (sparsely vegetated, herbaceous, shrub or tree), woody species canopy cover and size class, number of stories or age classes (forested ERUs only) and compositional status (grasslands only). Structural variability is the result of ecological processes and patterns over time. It reflects of the status of ecological processes, ecosystem function, integrity and resilience, and habitat abundance and quality. All these things reflect the sustainability of land use practices. The diversity of each ERU in each state is integral to the definition of each ERU.

In the assessment phase of plan revision, the current amount of each state class was compared to what is known about pre-European diversity of state classes, or the reference condition. This analysis compares current and modeled future state class diversity to desired conditions. For some ERUs, the reference conditions are the desired conditions. Given current management issues, including threatened and endangered species and old growth considerations, this is not the case for all ERUs. Some, like Ponderosa Pine Forest, include a relatively small percentage of the landscape with higher tree densities to support habitat requirements for the Mexican spotted owl. Reference and desired conditions for seral state diversity are maintained in the Regional Seral State Proportion Supplement (USDA FS 2016b).

Current seral state diversity is an input into the state-and-transition model generated by forest staff. More information on how current seral state diversity was assigned can be found in Appendix B: State and Transition Modeling Process.[13] Future seral state diversity is a model output. Both current and future projected seral state diversity is compared to desired diversity and displayed in terms of percent departure from desired conditions. Alternatives are compared to one another based on whether they are trending

[13] The 2022 Black Fire resulted in changed conditions for seral state proportion. The new existing condition was analyzed to determine if changes were extensive enough to warrant re-doing the modeling. The methodology for the assessment of changed circumstances is described in the last analysis methodology subsection. The results are discussed under the headings of each affected ERU.

conditions toward or away from desired conditions. If departure is 33 percent or less, the ERU is within desired conditions.

This characteristic is used as the basis for grouping alternatives in the effects discussions. Alternatives that result in similar outcomes for seral state diversity are discussed together and compared in terms of their effects on other characteristics.

Old-Growth Attributes

Old growth is an important part of landscape ecology and biodiversity conservation. Because of the complex and dynamic nature of forests, efforts to conserve old growth in landscapes must consider all developmental stages (Spies 2004). The presence of old trees is just one component of old-growth structure (Binkley et al. 2008), but old-growth forests have old trees. Old-growth components include old trees, snags, coarse woody debris, and structural variability (USDA FS 2018a). Old trees are not necessarily large trees. Inferences about age may be made from size, but they are not directly correlated. The correlation between age and size depends on tree species and site conditions (Kaufmann et al. 1992). Therefore, large trees are not an essential structural feature of old-growth forests or woodlands.

Old Trees

Areas with dominant story ages of at least 100 years are considered areas of old trees for the purposes of this analysis. This age was chosen because it typically takes 100 to 200 years for stands composed of slow-growing trees in frequent-fire landscapes to develop the full suite of old-growth characteristics (Binkley et al. 2007). This characteristic is only analyzed for forest and woodland ERUs.

Southwestern Regional Office staff used a regional summary of 2010 FIA data to develop a probability sample of forested conditions, including the dominant story age associated with each seral state in each ERU. This analysis assumes the dominant story age produced by the regional probability sample is valid for the Gila National Forest and remains valid through the modeled seral state transitions for each of the alternatives. This allows an estimation of trends in the area occupied by old trees in each ERU but does not reflect actual conditions.

To illustrate, the FIA data show four state classes in which the dominant story age is at least 100 years. The modeling results are used to determine whether the alternative creates more or less of these state classes. To be clear, the trend is only “more or less,” not toward or away from desired conditions. A trend toward or away from desired conditions cannot be clearly articulated at this time because of differences in the way the FIA data and model are structured compared to how the regional desired conditions for vegetation are summarized. The FIA data summary includes dominant story age for individual state classes in the model. The regional desired conditions group state classes based on the body of science to support the description of historical and desired conditions (Regional Seral State Proportion Supplement (USDA FS 2016b). These groupings are the basis for calculating departure from desired conditions. In some instances, those groupings include state classes that the FIA data shows dominant story ages less than 100 years old and those over 100 years old.

Coarse Woody Debris and Snag Density

Ecologically, a dead tree is as important as a live one (Stevens 1997; Marcot 2002; among others), because a dead tree provides carbon storage, fuel, and important habitat features. These characteristics are analyzed using coefficients developed by regional office staff. These coefficients provide estimations, and do not necessarily reflect actual amounts that exist in the Gila National Forest. They are relationships developed between FIA plot data from national forests in Arizona and New Mexico for each ERU and seral state. Comparisons are made between desired and projected future average, per acre amounts for the ERU over the modeled time steps to determine trend. These characteristics are only analyzed for forest and woodland ERUs.

Fire Frequency and Severity

Fire frequency and severity provide a sense of how fire is functioning both as a restoration tool and as a natural ecological process. Model inputs for prescribed fire and wildfire, relative to historic frequency and severity, provide the basis to determine whether a particular alternative is moving toward or away from desired conditions (see Appendix B: State and Transition Modeling Process). Additional inferences can be drawn about the probability for future undesirable wildfire behavior and effects, not predicted by this modeling effort. These are drawn from the status of seral state diversity, coarse woody debris, and snags. This allows for a coarse evaluation of risk.

Ecological Status

Ecological status is a measure of the species composition of a vegetation community relative to the potential vegetation community. For this analysis, we assumed that trends in ecological status will follow trends in seral state diversity. If seral state diversity is moving toward desired conditions, then so will ecological status. However, a greater degree of uncertainty is associated with the analysis of this characteristic, in part due to the model assumption of a stable climatic regime. It is also extremely difficult to predict how it will respond to management activities (Laughlin et al. 2017). Consequently, monitoring, and adaptive management for species composition is particularly important under any management scenario.

Patch Size

A “patch” is a contiguous area within an ERU with similar overstory and canopy cover conditions. This characteristic is only analyzed for the forested ERUs and Pinyon Juniper Woodland due to the volume of data to support reference conditions (USDA FS 2017a). Trends in patch size are inferred from current departure and trends in seral state diversity.

Patch size is a spatially dependent characteristic, so a greater degree of uncertainty is associated with its analysis due to the non-spatial nature of the model. A few additional considerations add uncertainty to the analysis. Depending on the ecosystem, patch size can reflect landscape configuration as much as it is indicative of pattern, process, and function. It is also difficult to predict fire-related changes in patch size because it is not a precise tool like mechanical treatments.

Invasive and Noxious Plant Species

Invasive plants, especially those designated as noxious by the New Mexico Department of Agriculture, can substantially alter plant community composition, landscape structure, and ecosystem functions. In the Gila National Forest, noxious plant species are not known to exist at detrimental levels. For this qualitative analysis, invasive and noxious species are addressed in terms of risk of establishment and spread. Inferences are drawn based on the extent of mechanical treatments and fire associated with each alternative and their associated effects on the probability for future undesirable wildfire behavior and effects, but not predicted by this modeling effort. Ground disturbance increases the risk of establishment and spread proportional to the intensity and frequency of that disturbance, given proximity to a seed source.

Insects and Disease

Changes in insect and disease levels are also difficult to predict. With insufficient information to quantify historical or desired conditions, and no data on which to vary the model inputs among alternatives, these model inputs are held constant, necessitating qualitative analysis. Closed-canopy conditions are the most susceptible to epidemic levels of infestation or infection. In these conditions, trees are already stressed by competition for limited nutrients and water. Inferences can be drawn related to the risk posed by insects and disease based on the net change in the amount of area under closed-canopy conditions.

However, insects and disease levels are also dependent on the spatial configuration of tree densities, drought, and in some cases, winter temperature patterns, none of which can be predicted by the model. This creates a higher level of uncertainty associated with this risk evaluation, as compared to those characteristics supported by quantitative analysis.

Fire Regime Condition Class

Fire regime condition class (FRCC) was a characteristic analyzed in the assessment that was dropped from this analysis. FRCC is an index developed from the analysis of several other of the ecosystem characteristics that are analyzed, such as seral state diversity, fire frequency and severity. Although FRCC is commonly used in fire management analyses, it is redundant here. When used alone, FRCC has the potential to obscure what is going on in terms of the role fire is playing in a particular ecosystem, which can lead to less effective management. Using an example from the assessment, Ponderosa Pine Forest has an FRCC of III at the forest scale, indicating a high departure from the historical fire regime. However, this is driven by a high departure in vegetation structure (seral state diversity), not fire frequency or severity. Both fire frequency and severity departure from historical are low at the forest scale. More frequent fire isn't going to change the FRCC unless it changes vegetation structure, which means more severity is needed for fire to function as a restoration tool. Alternately, mechanical treatments could be used to alter forest structure. The need for a different management approach is not apparent when looking only at FRCC.

Area Designations

Area designations can influence how the forest manages for ecosystem characteristics. Designations that substantially change the allowable types of activities, equipment, or modes of access and travel have the potential to influence the extent and distribution of effects, and at times, the outcomes of management activities. Area designations with this potential include designated wilderness, recommended wilderness, designated and proposed research natural areas, inventoried roadless areas, and other administrative designations. Those effects depend on the designation, amount of area involved, vegetation types and conditions that exist within that area, and the terrain. Terrain can limit the types of activities, equipment and modes of access and travel just as effectively as a designation. The effects of proposals or recommendations for new area designations contained within each alternative are discussed qualitatively relative to these management factors and evaluated based on whether they are consistent with opportunities to move toward desired conditions for vegetation communities, fire ecology, and fuels, or whether they detract from those opportunities. Existing designated wilderness and inventoried roadless areas are not discussed. As these are designated through legislation, they do not contribute to differences in effects among alternatives. Special botanical areas proposed under alternatives 2 and 5 are not analyzed, because direction for their management does not substantially change the types of activities, disturbances, or associated effects. Rather, that direction may have effects on species because it provides avoidance or mitigation measures for rare and endemic plant species in specific areas. The effects to species are analyzed in the Wildlife, Fish, and Plants section of this environmental analysis.

Climate Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Changed Circumstances

A worst-case scenario test was conducted on the ERU most impacted by the 2022 Black Fire to determine if the changed circumstances warranted revisiting the needs for change in plan direction, alternatives, or modeling analysis. This test assumed that if the changed circumstances did not create a substantial change in the initial model input (seral state diversity departure from desired conditions) for the most impacted ERU, under the worst possible scenario, there was nothing to warrant revisiting the needs for change, alternatives, or modeling. This test used the Rapid Assessment of Vegetation Condition after Wildfire (RAVG) data as the Monitoring Trends in Burn Severity data were not yet available for the Black Fire. The most impacted ERU was Mixed Conifer-Frequent Fire. It had the highest percentage of its total acres within the Black Fire perimeter and experienced the most high and moderate fire severity. The worst-case scenario test assumed the fire occurred under extreme conditions. Relying on the regional severity analysis underpinning the state-and-transition model (Weisz et al. 2009), it was assumed that all moderate and high-severity fire occurred in closed-canopy, multi-storied states dominated by medium to very large trees. Under extreme conditions, 100 percent of the area experiencing moderate and high-severity fire moves to a non-forested condition, with less than 10 percent tree cover. A new departure value was calculated and compared to the departure value calculated for the assessment and draft environmental impact statement.

The departure value generated by this test indicated the changed circumstances did not warrant revisiting the needs for change, alternatives, or modeling. The change was in the decimal range, and the initial departure value for Mixed Conifer-Frequent Fire that would be entered into the model remained at 55 percent. The subsections for each individual ERU that follow, disclose the percentage of total ERU acres within the Black Fire and the acres of high and moderate severity indicated by the RAVG data.

Effects Common to All Vegetation Types and Alternatives

Traditional uses such as the harvest of timber, forest, and botanical products, livestock grazing, and recreation would continue under all alternatives. Each alternative contains a mixture of standards and guidelines supporting movement toward, achievement, and maintenance of desired conditions for vegetation communities, the wildland-urban interface, and wildfire and fuels management.

Fire can restore or maintain landscape diversity and vegetation structure, composition, pattern, and processes, or it can do the opposite. Fire can contribute to nutrient availability or result in a loss of nutrients and soil productivity. Fire can increase or reduce coarse woody debris and snag density. Fire can accelerate erosion and sediment delivery to streams and heighten the risk of downstream effects to human life and property, or it can reduce the risk of future undesirable fire effects, or both. Large extents of stand-replacement fire can result in seed dispersal distances that delay or prevent tree regeneration. The potential for any of these effects depends on many variables, including, but not limited to fuel and weather conditions, topography, and incident-specific management decisions that influence severity, patch size, and distribution on the landscape. Because fire is not a precise tool, the full range of these effects would be possible under each alternative. However, the degree to which the effects are likely to be mostly beneficial or detrimental vary by alternative. This is because of different objectives for vegetation treatments within the plan and each of its alternatives.

Detrimental effects are most often the result of large, continuous patches of high-severity fire. Regardless, where negative effects occur, Burned Area Emergency Response (BAER) assessments would continue to be conducted in accordance with agency policy under all alternatives, and recommendations would be designed to mitigate unacceptable risks to critical values: human life and safety, hydrologic function, soil productivity, water quality, federally listed species habitat and significant cultural heritage resources. Both beneficial and detrimental effects to upland vegetation communities are possible, depending on the BAER treatment. The primary landscape-level BAER treatment is aerial seeding. Seeding and mulching in combination are typically reserved for areas that pose an unacceptable risk to human life and safety because of flooding, debris flows, and other types of mass movement.

Beneficial effects of BAER landscape treatments include reducing the length of time the area is vulnerable to noxious weed establishment and spread, and retention of more nutrient and water-holding capacity on site by reducing the volume of soil loss. Soil loss can irreversibly alter the physical, chemical, and biological properties of the soil, and in turn, alter the kind and amount of vegetation a site can support. The effects of noxious weed invasion can include displacement of the native vegetation community, a decrease in native species diversity and range, and ecological processes such as fire regimes (Brooks et al. 2004) and nutrient cycling. All these effects compromise the integrity of ecosystems, their resiliency, and their sustainability. Many noxious weed seeds are dispersed by wind and a nearby seed source is not always needed for recently burned areas to experience invasion. Conversely, seeding and mulching treatments can introduce noxious weed species. This potential is primarily associated with the use of agricultural straw, as the noxious weed-free certification process is based on a field inspection and does not include the laboratory analysis required to certify weed-free seed.

Regardless of method, thinning treatments reduce uncharacteristic or undesirable tree densities and increase resiliency, both in terms of ecological values and human values associated with the wildland-urban interface. In forested systems, reducing uncharacteristic tree densities generally promotes higher herbaceous community cover, productivity, and diversity; reduces the risk of undesirable fire behavior and effects; and promotes the ability of the landscape to support beneficial fire. Thinning dense stands can benefit old-growth development over time as the health and vigor of residual trees improve and tree regeneration in the understory creates multiple age groups and structural complexity. The risk of epidemic insect and disease levels is also reduced. While natural levels of insects and disease are an important disturbance process that promotes variability in vegetation structure, composition, pattern, and process, epidemic levels reduce landscape and species diversity. Less diverse landscapes and species assemblages are less resilient and sustainable. Similarly, repeated occurrences of low- and mixed-severity fire can aid in the development of late successional states by reducing seedling and sapling densities, provided there are fire-free periods that allow for uneven-aged dynamics to occur. The combination of prescribed fire and mechanical treatments has repeatedly demonstrated beneficial effects to understory plant communities and nutrient availability over the short term.

Woodland systems respond differently to thinning treatments. Whether treatments change the long-term trajectory toward or away from desired conditions is highly site-specific. The body of science supporting management of these systems indicates most treatments do not have a significant effect on understory communities. Significant increases and decreases in herbaceous cover have been documented after thinning treatments, with a significant increase being the most prevalent. More research is needed to understand the effectiveness of mechanical thinning treatments on the frequency, extent, and intensity of fire in these systems and the degree to which post-treatment livestock grazing practices may influence the outcomes (Jones 2019).

Whether in forested or woodland vegetation types, reducing tree densities can also potentially lead to positive or negative changes in site moisture characteristics. Changes in site moisture characteristics have implications for drought stress and mortality. In the short term, thinning can mitigate water stress (Clark et al. 2016; Bradford and Bell 2017). However, with enhanced growth rates, water demand in the residual trees and understory vegetation increases, as do evaporative losses, which may increase vulnerability to drought over the long term (Brauman et al. 2007, Clark et al. 2016, Moreno et al. 2016). The success of any given thinning intensity to reduce moisture stress would likely differ, based on local site, soil, and stand conditions (Meyer et al. 2007 in North et al. 2009). Compaction caused by mechanical equipment used in thinning treatments can decrease water-holding capacity on clayey soils and increase it on sandy soils. Best management practices, such as temporarily stopping activities when soils are wet, would help reduce compaction on clayey soils (see Soil and Watershed Resources later in this environmental impact statement).

Areas that cannot be treated, or cannot be treated frequently enough, are likely to continue experiencing encroachment and infill by woody species for the foreseeable future; increases in competition for limited water, nutrients, light, and physical space; reduction in the abundance, vigor, and diversity of the understory; and accumulation of ladder fuels and coarse woody debris.

Ladder fuels facilitate crown-fire, which is difficult and dangerous to manage over larger extents and under extreme weather conditions. While certain levels of coarse woody debris and snags support nutrient cycling and long-term productivity, too much tends to increase fire duration, behavior, and resistance to control. Coarse woody debris also increases the potential for reburn (Brown et al. 2003). Reducing it increases the likelihood that fire effects will result in movement toward desired conditions and present less of a threat to human values, including life. Both fire and mechanical treatments can reduce coarse woody debris, but given wildfire is not subject to utilization standards like many thinning contracts are, fire can also create coarse woody debris. Prescribed and naturally ignited fire can also increase snag density, where mechanical treatments are unlikely to do so. Snags eventually become coarse woody debris.

All alternatives have objectives for vegetation communities and the wildland-urban interface that involve some combination of mechanical treatments, prescribed fire, and naturally ignited wildfire occurring under conditions that support movement toward desired conditions. Under all alternatives, vegetation, fire, and fuels would continue to be managed in accordance with applicable laws and regulations. Naturally ignited wildfires would continue to be managed under fuel and weather conditions that facilitate movement toward desired conditions for all resources, within the operational capacity of the agency. When those conditions are not present, suppression remains an incident objective to limit the extent of undesirable fire effects. The action alternatives provide wildland-urban interface direction to create conditions that support low-intensity ground fires, reduce wildfire risk to human values, and provide the opportunity for firefighters to suppress wildfire safely and efficiently. Although alternative 1 does not contain plan components that specifically address the wildland-urban interface, management would be like that of the other alternatives because the National Interagency Wildland Fire Policy and Forest Service policy provide similar guidance.

Differences in the environmental consequences of the alternatives are primarily tied to vegetation types, treatment methods, and number of acres proposed for treatment in plan objectives. Differences in the amount of land area proposed for new area designations also contribute to differences among alternatives, as it influences the types of treatment methods that may be used.

While herbicide is not included in any of the treatment objectives, its use would be allowable under all alternatives as part of an integrated weed management approach. Even though the action alternatives contain standards and guidelines controlling its use and alternative 1 does not, the ecological effects of the alternatives are the same because constraints would be determined at the project level to comply with laws and regulations. Herbicide use is a highly regulated management activity that requires multiple levels of permitting and reporting to other federal and state agencies. The plan's standards and guidelines are useful as baseline constraints and serve transparency and communication with those who are concerned about the use of chemicals and may or may not have familiarity with the law or regulatory procedures. The need for more restrictive or additional constraints would be determined at the project level when herbicide application is proposed.

Permitted livestock grazing is also a land use that would continue to occur under all alternatives. The effects of herbivory are well documented in the scientific literature, and the degree to which the outcomes are mostly beneficial or detrimental depend on how grazing is managed. Under all alternatives, livestock grazing would be managed in accordance all applicable laws, regulations, and policies, but there are elements within the action alternatives that would better support adaptive management.

Herbivory by wildlife and permitted livestock would continue to influence species composition and nutrient cycling under all alternatives. Grazing can stimulate new growth, but overgrazing reduces vigor and productivity. Overgrazing would not be compliant with plan direction under any alternative. At any level, grazing reduces the amount of material available to create litter, which is important to soil stability and keeping nutrient levels sufficient for plant growth. Compaction caused by wildlife or permitted livestock can decrease water-holding capacity in clayey soils and increase it in sandy soils. Decreases in water-holding capacity reduces plant vigor and productivity (see also Soil and Watershed Resources).

Fire-grazing interactions can drive species diversity and dominance. In post-fire environments, cattle are drawn to the protein-enhanced regrowth of grasses (Allred et al. 2011). However, rest from grazing following fire is not always ecologically necessary (Allred et al. 2011, Powell et al. 2018, Vermeire et al. 2018), in terms of moving toward integrated desired conditions for ecosystems and livestock grazing as a use of the forest's rangelands. In the Southwest, the need for a growing season's rest depends on precipitation patterns (Drewa and Havstad 2001). Drewa and Havstad (2001) suggest that if precipitation was normal or above normal the year prior to the fire, rest from grazing is not necessary. However, if the year prior to the fire was a drought year and a growing season's rest from grazing was not provided, perennial grass plant frequency was reduced because plants died of the combined stress (Drewa and Havstad 2001). Cattle can also act as sources for noxious weed dispersal, as can wildlife, people, roads, trails, wind, and water. Fire-grazing interactions can increase the susceptibility of an area to invasive and noxious weed invasion (Keeley et al. 2003). The plan and its alternatives provide the flexibility for the appropriate decisions to be made at the allotment level as part of permit administration when allotment and site-specific circumstances are known.

With overgrazing, the herbaceous community is unable to compete against woody encroachment, resist invasive species establishment and spread, and support natural fire regimes. Again, overgrazing would not be compatible with plan direction under any alternative. Under all alternatives, livestock grazing would be managed to move toward desired conditions for natural resources and other uses. Differences between alternatives arise from how vacant allotments are managed.

Recreation is another traditional use of the forest that would continue under all alternatives. Most impacts not associated with the use of the motorized transportation system, which is discussed in subsequent paragraphs, are minor and localized (USDA FS 2017a). Human-caused wildfires and invasive and noxious species introduction are the most substantial potential effects. These effects can be reduced, but not eliminated, through collaborative conservation education programs The action alternatives include desired conditions for these types of programs, but forest prevention staff have and will continue to engage in these programs. The negative effects of fire previously discussed are more likely to result from human-caused wildfires. Increased visitation could lead to an increase in these types of fires, but factors outside of plan direction have more influence on visitation (see Sustainable Recreation section of this environmental analysis).

Roads and trails have and would continue to provide access for all these traditional uses and management activities under all alternatives. Their ability to be used for fire management purposes facilitates restoring beneficial fire to the landscape and suppression of undesirable fire, which supports movement toward desired conditions for vegetation. They also serve as vectors for the introduction of non-native invasive and noxious species, the effects of which have been discussed previously. Roads also provide opportunities for human-caused wildfires and may or may not influence patterns of fire severity (McHugh and Finney 2003; Narayanaraj and Wimberly 2013). When they do influence severity, the effect of roads may be either lower or higher severity (Narayanaraj and Wimberly 2013).

Roads and trails require the removal of vegetative cover within the road or trail prism and reduction or removal of vegetation in rights-of-way alongside the road, but these effects are relatively localized. However, roads can have disproportionate effects on soil and hydrologic processes that may alter the distribution of plant-available water and nutrients on a site. This can influence fine-scale patterns of nutrient cycling, species composition, abundance, and vigor (see also Soil and Watershed Resources section of this environmental impact statement). While there are some differences between the alternatives in terms of how the transportation system is managed, and differences between related to the effects on other natural resources, the effects to vegetation communities and fire management do not lead to substantial differences between alternatives.

All alternatives would support the full Resistance-Resilience-Transition adaptation spectrum, whether it is intentionally part of the alternative or not. The differences between alternatives in their support of climate adaptation are related to vegetation treatment objectives as discussed in the subsections that follow.

Effects Common to All Vegetation Types and Alternative 1

In terms of vegetation treatments, alternative 1 represents the continuation of current management. This means the relative emphasis placed on each ERU and treatment method remain the same. While treatments occur in most vegetation types, Ponderosa Pine Forest receives the emphasis.

The continuation of current management also means that prescribed fire continues to target the state classes it has in the past, and that the likelihood of using any wildfire to move toward desired conditions is the same as it has been. Typically, the state classes targeted with prescribed fire are already open canopy. In forested ERUs, this has also included closed-canopy, single-storied state classes as the generally low levels of ladder fuels present little risk in terms of the occurrence of mixed- or high-severity under typical prescribed fire weather conditions. Prescribed fire reduces coarse woody debris and maximizes the beneficial effects of mechanical treatments as previously described, but it isn't fully functioning as a restoration tool in the sense that it is not being used to change canopy cover conditions. Naturally ignited wildfire is also an important tool when fuel and weather conditions are favorable, but the total number of acres treated by mechanical thinning, and prescribed and natural fire are not enough to substantially change the ecological trajectory or mitigate the risk of large, continuous extents of high-severity fire.

Alternative 1 directs management to maintain a substantial number of acres where pinyon and juniper trees were cleared before 1986 to improve forage for livestock. We now understand that the effects of these types of treatments are highly site- and circumstance-specific and may not include improved forage (Jones 2019). Tree removal in grasslands and thinning some woodland settings can be a component of ecological restoration. In other woodland settings, it is an attempt at ecological type conversion. It could also be a Transition adaptation, if it were informed by vulnerability to climate change, but climate change wasn't part of the conversation in 1986. By locking in this type of management to specific locations, alternative 1 does not provide direction consistent with the desired conditions for vegetation communities or the necessary adaptation support that the action alternatives do.

Alternative 1 directs management to address noxious plants using integrated pest management practices but provides no further guidance. Integrated pest management includes physical removal, herbicide, and biological agents like beetles to control, contain, or eradicate invasive and noxious species. While sound, this direction is not supported by objectives or other plan components and does not address the risk as well as the action alternatives. Alternative 1 also directs management toward the use of herbicide on native species such ponderosa pine, pinyon pines, juniper, rabbitbrush and snakeweed where they are encroaching grassland sites. Herbicide has its place in the toolbox and might be the least impactful option on ecosystem health in some cases, but this direction does not appropriately support project-level selection of the best tool or tools to maintain or achieve desired conditions. For example, neither pine species is an appropriate target for herbicide use as they do not re-sprout and if there are too many of them in a project area, mechanical thinning, fire, or a combination of both would be better options.

Alternative 1 also defines geographic areas based on ranger districts, often with different management direction. This artificially fragments the landscape and creates unhelpful complexities in project design and analysis. Projects are more likely to contribute to ecological sustainability if they consider ecologically relevant scales rather than administrative scales.

Effects Common to All Vegetation Types and Alternative 2

Alternative 2 would continue to distribute treatments across most ERUs but increase the emphasis on Mixed Conifer-Frequent Fire as compared to alternative 1. This ERU has received little treatment in the past and there may be opportunity to benefit both this ERU, and Mixed Conifer with Aspen where they occur adjacent to each other on the landscape. Alternative 2 would increase the use of prescribed and naturally ignited wildfire, leading to more acres experiencing fire and more acres treated. Alternative 2 would also allow for more mixed-severity prescribed fire on the landscape and expand state classes targeted to include closed-canopy state classes, both single and multi-storied. Research has suggested that for fire to function effectively as a restoration tool in ponderosa pine-dominated ecosystems, more mixed-severity fire is needed (Huffman et al. 2017, Huffman et al. 2018). Acres treated are based on only what the forest can accomplish with congressionally allocated dollars, under "normal" budget years. The objectives for this alternative are flexible, allowing for priority vegetation types to change based on environmental conditions and monitoring data. It also allows for more acres to be treated if Congress or partnership contributions add additional resources.

While prescribed fire functions more as restoration tool, as opposed to alternative 1, naturally ignited fire remains the dominant change agent, and the full spectrum of fire effects described previously are likely. The difference between alternatives 1 and 2 is the sense of urgency associated with alternative 2's objectives, which were designed to respond to the window of opportunity to address the wildfire crisis and adapt to future climate. Alternative 2's objectives would drive management to make the most out of favorable fuel and weather conditions and use natural ignitions more aggressively to move toward desired conditions. This is risk management. Alternative 2 would accept risk when fuel and weather conditions are favorable instead of deferring that risk to large wildfire events when fuel and weather conditions are decidedly less favorable.

Alternative 2 would retain some vacant allotments in that status, on a case-by-case basis, to provide an alternative source of forage for current permit holders during drought years, before or after fire, and under other circumstances that might render a portion or all a permitted allotment unusable. This provides another measure of flexibility to plan and implement mechanical and prescribed fire treatments, recourse to address the resource conflicts that can arise during drought and accelerates the rate at which management can move vegetation communities toward desired conditions.

Prescribed fires can be more effective at reducing tree densities under a wider range of fire weather conditions if fine fuels are available to produce flame lengths capable of causing tree mortality. Provided time to recover from mechanical treatments, prescribed fire, or both, the herbaceous community response to increased nutrient, light, and water availability is often more vigorous and lasting. During drought, herbaceous production declines and plants become more vulnerable to multiple stressors. Especially in severe drought, the ability to rest an allotment from livestock grazing reduces plant stress. Within climatic limits, the system of swing allotments that would be established under alternative 2 would help maintain the productivity of the land over the long term.

Effects Common to All Vegetation Types and Alternatives 3 and 4

Alternatives 3 and 4 are like alternative 1 in terms of wildfire management, but both would limit the use of prescribed fire in favor of more mechanical treatments. This means fewer acres are treated overall as mechanical treatments are far more expensive than prescribed fire. Alternative 3 would only treat historically open woodlands and encroached grasslands. Other ERUs would be treated only in the wildland-urban interface, proportional to the extent they occur. Alternative 4 is like alternative 3, except forested ERUs would be the focus outside of the wildland-urban interface.

Acres treated are based on only what the forest can accomplish with congressionally allocated dollars under "normal" budget years, and the focus of both alternatives would be on providing products to people.

This limits the number of acres that can be treated, both within and outside of the wildland-urban interface. This limitation is not solely because mechanical treatments are more expensive than prescribed fire, but because to provide products to people, the location of treatment areas must be economically viable. Limiting factors like road infrastructure and hauling distances are stronger considerations with mechanical treatments than with prescribed fire.

Both alternatives would allow for more acres of mechanical treatment should partners contribute, but the acres of prescribed fire are capped. As a result of limiting prescribed fire, the understory plant community would have less response to mechanical treatments, and shrubs are likely to be favored over herbaceous species (Goodwin et al. 2018). While both alternatives 3 and 4 would provide progress toward seral state diversity in one or more vegetation types, there are differences between them in terms of how well they mitigate the risk of large continuous extents of high-severity wildfire. These differences are discussed subsequently and relative to each ERU.

These alternatives would also prioritize stocking vacant allotments to the maximum extent possible, which limits flexibility, leaves no recourse to address drought, and slows the rate at which management can move vegetation communities toward desired conditions.

Effects Common to All Vegetation Types and Alternative 5

Alternative 5 is like alternative 2 in the way prescribed fire and wildfire would be used, but the rate of treatment would be increased because alternative 5 would restrict mechanical treatments to the wildland-urban interface. Exceptions would be made in areas where a compelling, scientific site-specific analysis that suggests such treatment would facilitate more beneficial fire on the landscape. Objectives focus on historically frequent-fire ecosystems and providing products to people is a secondary consideration. Like the alternative 2, more acres could be treated with prescribed fire, should partnerships enable that to happen. Also, more mechanical treatments could occur should site-specific analysis meet the terms described previously, provided partnership dollars were available to fund them. Given more fire on the landscape and near exclusion of mechanical treatments, high-severity fire and its associated detrimental effects are more likely, at least over the life of the plan. The risk would be greater than under alternative 2 because fire would almost exclusively be the tool and management would be managing fire on the landscape under less favorable conditions in order treat more acres and accomplish plan objectives. However, as more acres are treated and open-canopy conditions increase in prevalence, this risk would decline over time as opposed to the other alternatives.

Alternative 5 would also retain vacant allotments in that status, and unstocked, until site-specific environmental analysis is completed to evaluate issues, restoration needs, and future management and uses. The plan component providing this direction was intended to demonstrate we were listening and responsive to a stakeholder suggestion that, as provided to us, was not compliant with the law or policy direction. Forest Service staff tried to come up with wording that would address the stakeholder concern and still follow legal and policy requirements. The result is a plan component that would not have substantially different effects from current management and alternative 1. The only difference is the requirement that vacant allotments would remain unstocked until the responsible official, usually a district ranger, determines the existing National Environmental Policy Act decision and environmental analysis are adequate, or that conditions have changed, and a new analysis and decision-making process is needed.

The requirement that vacant allotments remain unstocked until the environmental analysis is reviewed and determined adequate or that a new analysis is needed could provide some of the beneficial effects described for alternative 2 over the short term, depending on the environmental conditions. It would not provide the lasting benefits of a strategically selected system of swing allotments.

Effects Common to All Vegetation Types and Alternatives 2, 3, 4, and 5

Alternatives 2, 3, 4, and 5 would direct the use of integrated pest management practices but include fiscally achievable minimum objectives for detection and treatment. This approach would reduce the risk of establishment and spread and prevents or minimizes potential alterations to native plant community composition, landscape structure, and ecosystem functions. While detection and treatment are occurring under alternative 1, without an objective there is more potential for the work to be de-prioritized when hard choices must be made about allocating staff and funds.

While plan direction would allow for early detection and rapid response, success would ultimately depend on whether project-level environmental analysis is completed in time to implement effective treatments. Treatments are more likely to be successful on smaller populations, and therefore, they are time sensitive. Maintaining plant communities dominated by native species would maintain existing ecological structures and functions, aligning with the Resistance end of the climate adaptation spectrum.

In contrast to alternative 1, these alternatives would not direct management to maintain historical pinyon juniper treatments for the forage resource. Instead, vegetation treatments would be geared toward desired conditions for vegetation communities, which include the herbaceous component. This better supports the vulnerability informed application of the desired conditions for vegetation and the climate adaptation spectrum.

These alternatives also include several standards and guidelines for reducing the risk of invasive or noxious species introduction and minimizing ground disturbance whenever possible. Wind disperses the seeds of many invasive or noxious plant species and they can already be in the seedbank, ready for ground disturbance to give them the competitive advantage. Objectives for the inventory and treatment of noxious weeds would support the Resistance-Resilience end of the adaptation spectrum more strongly than alternative 1.

While alternative 1 does not prohibit forest staff from participating in collaborative education programs, it does not encourage it. All action alternatives include desired conditions and management approaches for participating in collaborative, community education programs that could help raise awareness and shared understanding of ecological and fire management issues, cultivate the younger generation's interest in public land management, build and maintain strong relationships, and expand the skill sets and resources contributing to management of the Gila National Forest. Management directed toward achieving these social outcomes would increase the ability to get work done on the ground that would generate movement toward desired conditions for vegetation, within and outside the wildland-urban interface.

None of the action alternatives includes geographic areas like alternative 1. This would increase the ability of projects to consider the ecological relationships between vegetation communities within the project area, and across the forest. It would also enable climate-informed adaptation and projects that are responsive to emerging opportunities related to spatial variability and connectivity.

Spruce-Fir Forest

Spruce-Fir Forest is generally characterized as an infrequent, high-severity disturbance ERU. It occurs on the coldest, wettest, and highest-elevation sites in the forest, along a variety of slope gradients including gentle to very steep mountain slopes. Although it occupies just 1 percent of the forest, it has substantial ecological value in terms of biodiversity (see Wildlife and Botanical Species). Ninety-one percent of the ERU is in existing designated wilderness. Potential treatment methods in wilderness are limited to naturally ignited wildfire. Prescribed fire is not allowed for ecological benefit, only for fire management purposes. Between 2012 and 2013, substantial area in mid to late seral states moved to early seral states because of wildfire. Its current seral state departure from desired conditions is estimated at 46 percent. The 2010 FIA data summary predicts 25 percent of this ERU would currently have a dominant story age of at least 100 years. Ecological status is in high departure from the reference due to the extent of stand-replacement fire. Patch size is currently smaller than desired, with a moderate departure rating. Coarse woody debris is currently higher and snag densities are lower than desired conditions, which are an average of 30 tons per acre and 8 per acre, respectively. Current amounts of coarse woody debris are estimated at an average of 44 tons per acre and average of 2.5 per acre, respectively.

Based on RAVG data, 3 percent of the Spruce-Fir Forest exists within the perimeter of the 2022 Black Fire, totaling approximately 630 acres. Approximately 530 of these acres experienced low-severity fire or were not burned. Roughly 96 acres experienced moderate severity and 3 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, nor the modeling analysis.

No treatments have occurred in this ERU and would not occur under alternative 1. Prescribed fire was not modeled, given the primary intent of prescribed fire for fire management purposes would be to reduce coarse woody debris, not overstory canopy cover. Excessive amounts of coarse woody debris are a concern as it could increase the duration and intensity of fire in areas where vegetation is recovering. It is also an access concern for fire management as it limits safe options for firefighters on the ground. As a secondary effect, reducing coarse woody debris may reduce the risk of losing regenerating conifer to re-burn, thus promoting the development of structural variability into the future. The model is not capable of showing this, given the methodology used to analyze coarse woody debris is dependent on changes in seral states. No treatment objectives are proposed as part of any of the remaining alternatives. Model results are presented in figure 13, followed by a tabular trend summary for all ecosystem characteristics and analysis indicators (table 8). Results are discussed under the subsequent effects headings.

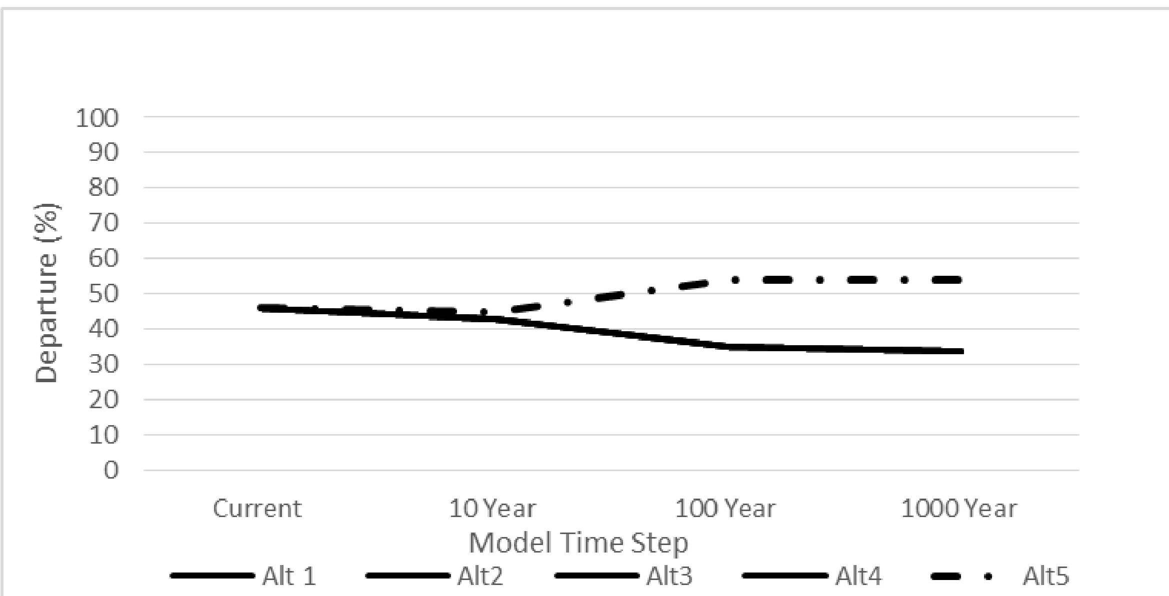


Figure 13. Spruce-Fir Forest seral state diversity departure from desired conditions

Table 8. Spruce-Fir Forest summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	+*	+*	+*	+*	-
Area dominated by old trees	increase	increase	increase	increase	decrease
Coarse woody debris density	-	-	-	-	o
Snag density	+	+	+	+	o
Fire frequency	o*	o*	o*	o*	o*
Fire severity	o*	o*	o*	o*	o*
Ecological status	+	+	+	+	-
Patch size	+	+	+	+	-
Risk of epidemic levels of insects and disease	increase	increase	increase	increase	decrease
Risk of invasive and noxious plant infestation	no change	no change	no change	no change	no change
Climate adaptation spectrum	R-T	R-T	R-T	R-T	T

Effects of Alternatives 1, 2, 3, and 4

Maintenance of an intact fire regime would drive the projected trends under these alternatives. Fire frequency and severity are likely not in departure from historical or desired conditions (Margolis et al. 2011, Schoennagle et al. 2004) although recent fire events are certainly in departure from contemporary human experience. Even though fire frequency remains within historical limits, a warmer, drier climate and the trend in coarse woody debris increase the potential for reburn in areas where tree regeneration is occurring. Further, in a warmer, drier climate, longer fire-free periods are expected to be necessary for successful regeneration (Enright et al. 2015).

Movement toward desired conditions would inherently carry with it a higher risk of epidemic levels of insect and disease as tree densities recover from stand-replacement fire. The risk of invasive and noxious species remains unchanged. This is because the fire regime is intact and most of this ERU is in designated wilderness and inventoried roadless areas, which limits opportunities for introduction.

Overall, these alternatives would generate progress toward the plan's desired conditions and support the Resilience-Transition end of the adaptation spectrum. Alternatives 1, 3, and 4 accept that Transition to new ecological structures and functions would happen on its own. Alternative 2 may improve the system's capacity to recover past structure and function, or maintain existing, over the short term by using prescribed fire, while accepting that reorganization of the system is inevitable. Whether for fire management purposes within designated wilderness areas or adaptation purposes outside of designated wilderness, prescribed fire would likely involve aerial ignitions in early spring with the intended outcome being small patches of coarse woody debris reduction. This carries with it a certain amount of risk. Fire can smolder for long periods of time under these conditions. If fire remains active when spring winds kick up and fuel moisture declines, more extensive and intense fire is possible. Given this vegetation community's very high vulnerability to climate change, Transition is likely to represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Effects of Alternative 5

This alternative would allow for approximately nine times more wildfire as compared to alternative 1 and twice that of alternative 2, while remaining within what is known about the historical fire regime. This is what is driving the trend away from desired conditions for seral state diversity, ecological status, and patch size; a decrease in the area expected to be dominated by old trees; and a reduced risk for epidemic levels of insect and disease outbreaks. These trends may also signal an ecological transition to a grassland or shrubland type of system, suggesting alternative 5 most strongly supports the Transition end of the adaptation spectrum.

Mixed Conifer with Aspen

Mixed Conifer with Aspen is generally characterized as an infrequent, high-severity disturbance ecosystem. It occurs between the Spruce-Fir Forest ERU at its upper elevational limit and the Mixed Conifer-Frequent Fire ERU at its lower elevational limit, along a variety of slope gradients including gentle to very steep mountain slopes. Although it occupies just 2 percent of the forest, it has substantial ecological value in terms of biodiversity (see Wildlife and Botanical Species). Most of this ERU is in existing designated wilderness, inventoried roadless areas, or on steep slopes, more erodible soils, or both. There is a greater opportunity to use a wider range of treatment methods on more acres than in Spruce-Fir Forest. Like Spruce-Fir Forest, Mixed Conifer with Aspen has experienced substantial wildfire activity over that last decade. Its current seral state departure from desired conditions is estimated at 40 percent. The 2010 FIA data summary predicts 46 percent of this ERU would currently have a dominant story age of at least 100 years. Ecological status is in high departure and patch sizes are smaller with a moderate departure, also due to wildfire activity. Coarse woody debris and snag densities are currently higher than desired conditions, which average 31 tons per acre and 4 per acre, respectively. Current amounts of coarse woody debris are estimated at 70 tons per acre, with snag density averaging 6 per acre.

Based on RAVG data, approximately 10 percent of the Mixed Conifer with Aspen exists within the perimeter of the 2022 Black Fire, totaling about 5,333 acres. Approximately 3,983 of the total acres experienced low-severity fire or were not burned. Roughly 1,066 acres experienced moderate severity and 284 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, or the modeling analysis.

Mechanical and prescribed fire treatment acres used in the models are presented in table 9. Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 14 displays model results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 9. Acres treated per decade modeled for Mixed Conifer with Aspen under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	336	353	53	353	195
Prescribed Fire	0	200	0	20	0

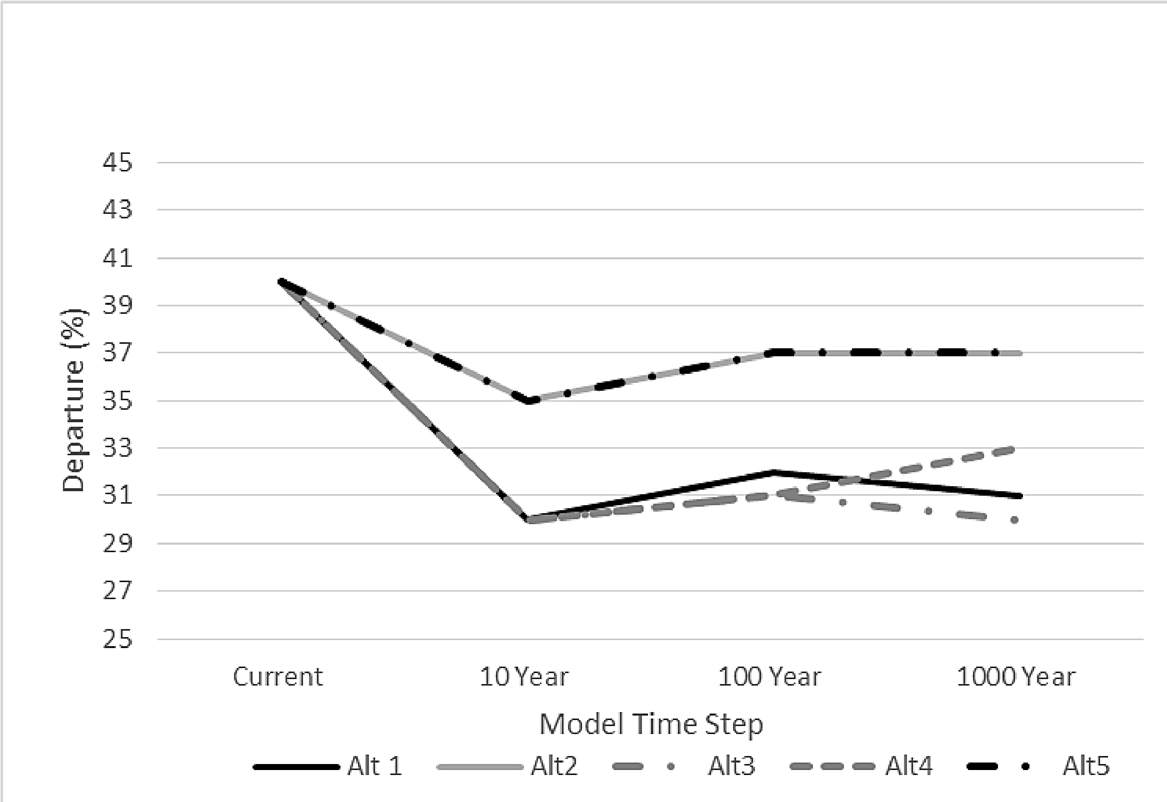


Figure 14. Mixed Conifer with Aspen seral state diversity departure from desired conditions

Table 10. Mixed Conifer with Aspen summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	+*	+	+*	+*	+
Area dominated by old trees	decrease	decrease	no change	decrease	decrease
Coarse woody debris density	o	+	o	o	+
Snag density	o	-	o	o	-
Fire frequency	o*	o*	o*	o*	o*
Fire severity	o*	o*	o*	o*	o*
Ecological status	+	+	+	+	+
Patch size	+	+	+	+	+
Risk of epidemic levels of insects and disease	increase	decrease	increase	increase	decrease
Risk of invasive and noxious plant infestation	no change	increase	decrease	increase	increase
Climate adaptation spectrum	R-T	R-T	R-T	R-T	R-T

Effect of Alternatives 1, 3, and 4

Despite the differences in treatment methods and acres treated, there is little difference in the projected outcomes for the characteristics analyzed. Most of this is explained by the intact fire regime. Fire frequency and severity are likely within desired conditions (Margolis et al. 2011) and would remain so under all these alternatives. The primary difference in projected outcomes is related to one old-growth attribute. The amount of area expected to be dominated by old trees would fluctuate under alternative 3, but at the 1,000-year time step the estimate would be the same as existing conditions. Alternatives 1 and 4 would create a small decrease in the area expected to be occupied by old trees due to estimated silvicultural practices (see Appendix E. State and Transition Modeling Process, Transition Pathways Prescribed Cutting Methods).

The risk of epidemic levels of insects and disease is projected to increase under alternatives 1, 3, and 4, as movement toward desired conditions for seral state diversity include increases in closed-canopy conditions. The risk of invasive and noxious species establishment and spread is likely to become elevated in burned or mechanically treated areas, increasing with severity or intensity, extent, and proximity to roads and trails. Alternative 1 is the baseline defining existing risk. Alternative 3 does not include treatments in this ERU so the risk is reduced. Alternative 4 includes more treatments, so the risk is higher.

These three alternatives perform the best in terms of movement toward desired conditions and support the Resilience-Transition end of the adaptation spectrum. They seek to improve the system's capacity to recover past structure and function, or maintain existing, over the short term while accepting reorganization of the system is inevitable. Given moderate to very high vulnerability to climate change, Transition is likely to represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Effects of Alternatives 2 and 5

Both alternatives would maintain an intact fire regime and trend toward desired conditions for more characteristics than alternatives 1, 3, and 4. However, seral state diversity, would not move within desired conditions at any modeled time step, in contrast to the other alternatives. More fire on the landscape would be expected to reduce coarse woody debris, while reducing the area expected to be occupied by old trees and recruiting snags at higher rates. Under alternative 5 this is entirely due to the area experiencing fire, whereas in alternative 2 it is the combination of mechanical treatments and fire.

The risk of epidemic levels of insects and disease would decline slightly, rather than increasing, based on reductions in closed-canopy conditions as opposed to the other alternatives. However, the risk of invasive or noxious plant establishment and spread would be higher with both alternatives, and highest for alternative 5, based on the number of acres experiencing wildfire. Overall, both alternatives would promote progress toward desired conditions and the Resilience-Transition end of the adaptation spectrum.

Mixed Conifer-Frequent Fire

As indicated by the name of this ERU, Mixed Conifer-Frequent Fire is characterized as a frequent, low-severity disturbance ecosystem. It is transitional between the warmer, drier Ponderosa Pine Forest or Ponderosa Pine-Evergreen Oak ERUs and cooler, wetter Mixed Conifer with Aspen. In the Gila National Forest, it typically occurs on steep slopes (40 percent or greater), although it is occasionally found on gentler terrain. This ERU represents 12 percent of the forest and is more common than it is in the surrounding landscape. This provides the forest a greater opportunity to contribute to the integrity and sustainability of this ecosystem.

Its current seral state departure from desired conditions is estimated at 55 percent, due to more closed-canopy conditions and state classes that have become dominated by higher densities of seedling, sapling, and small-sized trees in the understory. The 2010 FIA data summary predicts 55 percent of this ERU would currently have a dominant story age of at least 100 years. Ecological status is in moderate departure. Patch size is within desired conditions. Coarse woody debris is substantially higher than desired conditions (7.5 average tons per acre) at an estimated average of 61 tons per acre. Snag densities are estimated to be within desired conditions, with an average of three per acre.

There are a few important things to consider with respect to seral state departure. Fire frequency has a low departure from desired conditions and severity has been higher, with a moderate departure (USDA FS 2017a). The data used to establish reference and desired conditions for this ERU are largely from northern Arizona (Reynolds et al. 2013). Most of studies from which the data were derived discuss the rock type the soils developed on but provide little or no discussion about topographic site characteristics. Data obtained from a recent study, which included many of the same sites used to develop the reference and desired conditions as well as eight new sites (Rodman et al. 2017a), reveals 82 percent of the reference sites occur on slopes less than 20 percent (Rodman et al. 2017b). The remaining sites ranged between 20 and 40 percent slope, with only one at 40 percent (Rodman et al. 2017b). This study found that, historically, the number of trees per acre increased with slope (Rodman et al. 2017). Increasing slope has long been associated with increasing tree (and fuel) density, with slope and other topographic factors often being used as a surrogate for live fuel density (in the sense of Parks et al. 2018a). With 73 percent of this ERU, as it is currently mapped, being located on slopes greater than 40 percent, there is some uncertainty about the magnitude of departure. Furthermore, greater slopes have greater surface area per acre as standard land survey practices measure only the horizontal distance between two points, not true ground distance. Unless a correction is applied, this leads to overestimation of tree density on sloped land. Of course, there are other variables that influence historical and current tree densities, with soil, precipitation, and the direction the slope faces (aspect) being prime among them. Furthermore, there is some evidence from a geomorphic fire history reconstruction in northern Arizona that mixed and high severity fire does play a role in ponderosa pine and dry mixed conifer settings on steep slopes (Jenkins et al. 2011).

The uncertainty associated with magnitude of departure from desired seral state diversity has implications for uncertainty associated with the departure in fire severity, as steep slopes and higher tree densities influence fire severity. However, the direction of fire spread is also a major factor in determining severity patterns. The direction of fire spread is beyond the ability to consider for this analysis.

Based on RAVG data, approximately 24 percent of the Mixed Conifer-Frequent Fire exists within the perimeter of the 2022 Black Fire, totaling about 88,007 acres. Of the total acres, 66,190 experienced low-severity fire or were not burned. There are no data available for 204 acres, which is usually because of smoke or clouds obscuring the ground from satellite observations. Roughly 16,416 acres experienced moderate severity and 5,196 acres experienced high severity, making this vegetation type the most impacted by the Black Fire.[14] However, the area experiencing change due to high and moderate severities represents just under 6 percent of the total ERU acres on the forest. The recalculated departure from seral state diversity desired conditions remains at 55 percent. Revisiting the need to change the plan, the alternatives, or the modeling analysis is not warranted.

Mechanical and prescribed fire treatment acres used in the models are presented in table 11. Wildfire acres are not included, as this is better presented as a likelihood or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 15 displays model

[14] Additional acres associated with area currently mapped as Gambel Oak Shrubland but determined by the interdisciplinary team to represent early seral states in Mixed Conifer-Frequent Fire or Mixed Conifer with Aspen also experienced high and moderate fire severity. These acres were already assigned to the non-forest, early seral state class in the model. Therefore, they do not contribute to a change in seral state diversity. More information on how Gambel Oak Shrubland was addressed in the modeling can be found in appendix E in the initial conditions subsection.

results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 11. Acres treated per decade modeled for Mixed Conifer-Frequent Fire under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	626	7,152	277	12,777	1,028
Prescribed Fire	4,743	10,000	0	2,000	5,500

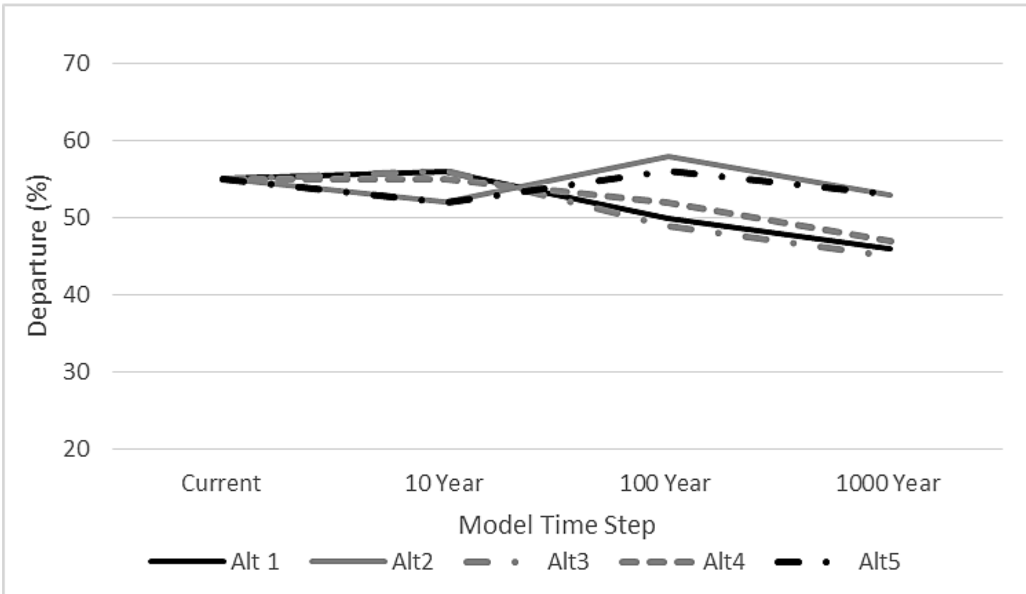


Figure 15. Mixed Conifer-Frequent Fire seral state diversity departure from desired condition

Table 12. Mixed Conifer-Frequent Fire summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	+	+	+	+	+
Area dominated by old trees	decrease	decrease	decrease	decrease	decrease
Coarse woody debris density	+	+	+	+	+
Snag density	-	-	-	-	-
Fire frequency	o*	o*	-	-	o*
Fire severity	o	o	o	o	o
Ecological status	+	+	+	+	+
Patch size	o*	o*	o*	o*	o*
Risk of epidemic levels of insects and disease	decrease	decrease	no change	decrease	decrease
Risk of invasive and noxious plant infestation	no change	increase	decrease	increase	increase
Climate adaptation spectrum	R-T	T	R-T	R-T	T

Effects of Alternatives 1, 3, and 4

Despite very different approaches, there are similar projected outcomes for these alternatives. All would maintain or move toward desired conditions for seral state diversity, ecological status, patch size, and coarse woody debris. Snag densities would increase under these alternatives, moving away from desired conditions, and the area expected to be dominated by old trees would decline. This suggests that naturally ignited wildfire is driving trends because alternative 3 uses neither prescribed fire nor prescribed cutting and yet projected outcomes are substantially the same. Alternatives 1 and 4 do not use enough prescribed fire or prescribed cutting to change the trajectory of this system.

The risk of epidemic levels of insect and disease infestation would remain unchanged under alternatives 1 and 3 but would decrease slightly under alternative 4 due to the reduction in closed-canopy conditions. The risk of invasive and noxious species establishment and spread is likely to remain at current levels under alternative 1 but may increase under alternative 4 due to more treatment-related ground disturbance and decrease under alternative 3, which does not target this ERU for treatment.

These three alternatives would support the Resilience-Transition end of the adaptation spectrum. They aim to improve the system’s capacity to recover past structure and function, or maintain existing, over the short term while accepting reorganization of the system is inevitable. Given moderate to very high vulnerability to climate change, Transition would likely represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Effects of Alternatives 2 and 5

At first glance, the similarities in projected outcomes between alternatives 2 and 5 and the other alternatives also suggest there is not enough fire or prescribed cutting to drive the trajectory of this ecosystem. However, while these alternatives would generate progress toward desired conditions for seral state diversity, it is less than the other alternatives. This difference is due to an increase in open-canopy, single-storied state classes that are not part of the desired condition. Further, the area expected to be dominated by old trees declines substantially, with less than 10 percent remaining at the 100-year time step. These open-canopy, single-storied state classes are indicative of a greater prevalence of even-aged dynamics than are believed to be characteristic of the reference period. Even-aged stands are generally not as resilient as uneven-aged stands, but the open-canopy conditions decrease the risk of epidemic levels of insect and disease. More disturbance on the landscape also elevates the risk of invasion and establishment of non-native plant species.

Based on this information, these alternatives would support the Transition end of the adaptation spectrum more strongly than the other alternatives. Given moderate to very high vulnerability to climate change, Transition would likely represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Ponderosa Pine Forest

Ponderosa Pine Forest includes two sub-types: Ponderosa Pine-Bunchgrass and Ponderosa Pine-Gambel Oak. In the Gila National Forest, this ERU includes relatively small areas where Arizona or Apache pine is the dominant pine species. This generally occurs on soils formed on rhyolite and tuff within the Gila and Aldo Leopold Wildernesses. This ERU represents about 19 percent of the forest and is more common than in the surrounding landscape. This provides a greater opportunity for management to contribute to its integrity and sustainability.

Its current seral state departure from desired conditions is estimated at 79 percent, due to more closed-canopy conditions, lower densities of larger trees, and higher densities of seedling, sapling, and small-sized trees. The 2010 FIA data summary predicts 68 percent of this ERU would currently have a dominant story age of at least 100 years. Ecological status is in moderate departure. Current mean patch size is 71 acres versus the desired 0.02- to 1-acre mean patch size. Coarse woody debris is currently higher than desired conditions (average 9 tons per acre), with an estimated average of 42 tons per acre. Current and desired snag densities average 0.8 per acre. Fire frequency has a low departure from historic and desired conditions, as does fire severity.

Based on RAVG data, approximately 9 percent of the Ponderosa Pine Forest exists within the perimeter of the 2022 Black Fire, totaling about 55,990 acres. Of the total acres, 48,299 experienced low-severity fire or were not burned. There are no data available for 703 acres, which is usually because of smoke or clouds obscuring the ground from satellite observations. Roughly 6,423 acres experienced moderate severity and 566 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, or the modeling analysis.

Mechanical and prescribed fire treatment acres used in the models are presented in table 13. Wildfire acres are not included, as this is better presented as a likelihood or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 16 displays model results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 13. Acres treated per decade modeled for Ponderosa Pine Forest under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	10,437	7,404	1,084	30,314	3,969
Prescribed Fire	51,656	5,508	0	12,600	55,000

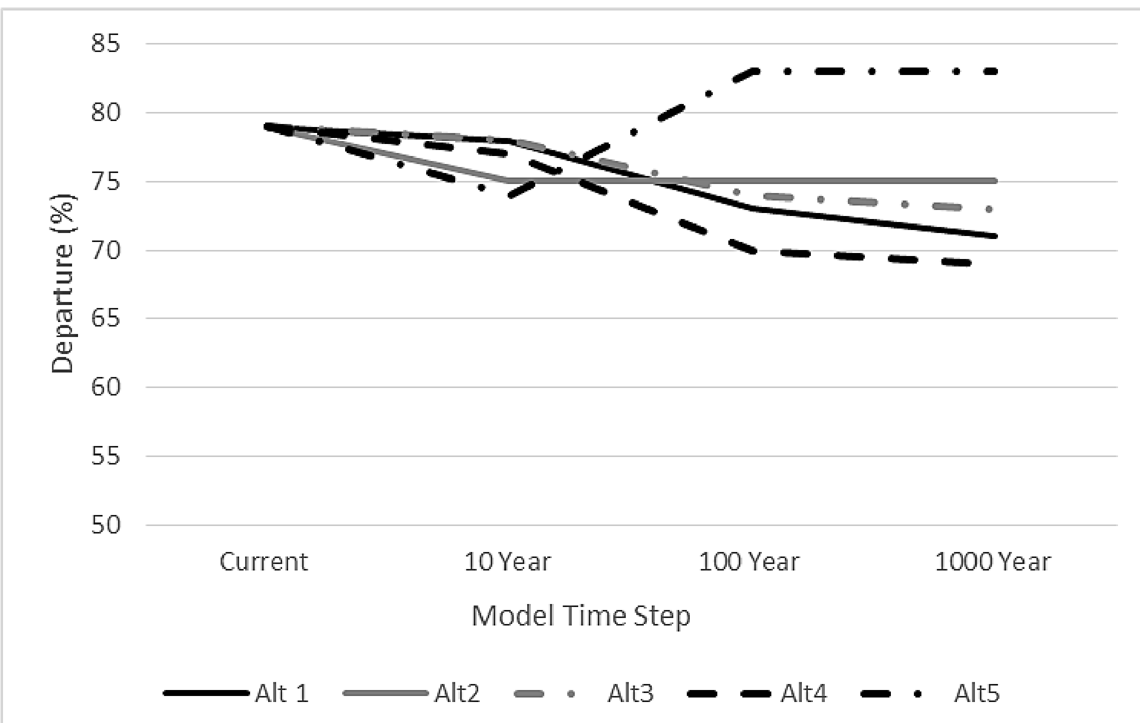


Figure 16. Ponderosa Pine Forest seral state diversity departure from desired conditions

Table 14. Ponderosa Pine Forest summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	+	+	+	+	-
Area dominated by old trees	decrease	decrease	decrease	decrease	decrease
Coarse woody debris density	+	+	-	-	+
Snag density	-	-	-	-	-
Fire frequency	-	o*	-	-	o*
Fire severity	o*	-	o*	o*	-
Ecological status	+	+	+	+	+
Patch size	+	+	+	+	+
Risk of epidemic levels of insects and disease	decrease	decrease	decrease	decrease	decrease
Risk of invasive and noxious plant infestation	no change	increase	decrease	increase	increase
Climate adaptation spectrum	R-T	R-T	R-T	R-T	R-T

Effects of Alternatives 1, 2, 3, and 4

Despite the differences in what these alternatives contain in terms of plan objectives, they are relatively similar in the projected outcomes for state diversity, ecological status, and patch size. All would produce a slight trend toward desired conditions up to the end of the first decade. However, in subsequent decades, the progress made under alternative 2 would stop, and the level of departure would be maintained. However, there is some uncertainty around these results and alternative 2 related to the limitations of the model, geospatial data processing and current patch size departure.

Following the regional protocol, areas in grass/forb/shrub states are placed in an early seral state. The desired condition is for no more than 2 percent of the ERU to be in this state. Under alternative 2, there would be substantial area going to grass/forb/shrub, which is the reason progress toward desired conditions stops after the first decade. Current mean patch sizes are 71 acres, as opposed to the desired 0.0- to 1-acre patches (USDA FS 2017a). Given no spatial context in the model and current high departure in patch size, it is possible that the areas being assigned to the early seral state are equally likely to represent openings within mid- to late-seral states, and therefore, greater progress toward desired conditions for seral state diversity, ecological status, and patch size.

Increases in coarse woody debris and snag densities are expected with alternatives 3 and 4 because they limit the use of prescribed fire. Whereas coarse woody debris would decline, moving toward desired conditions with alternatives 1 and 2. However, snag densities would continue to increase. The area dominated by old trees is predicted to decline under these alternatives. Alternative 3 would retain the most area expected to be dominated by old trees because there would be no prescribed cutting. Alternative 4 would retain the least area expected to be dominated by old trees because of the number of acres treated and estimated silvicultural practices.

In terms of fire frequency, only alternative 2 would maintain this characteristic within desired conditions, which would reduce the risk of undesirable wildfire behavior and effects and increase resilience. The reason fire frequency is currently within desired conditions is because of partnership investments in prescribed fire. Even considering the current use of wildfire, without partnership investments, movement away from desired conditions is likely under alternative 1.

In terms of fire severity, alternative 1 maintains this characteristic within desired conditions over the short term but does less to mitigate the risk of undesirable wildfire behavior and effects as compared to alternative 2. Alternative 2 would target more difficult, expansive acres with mixed-severity fire, creating movement away from desired conditions to use fire as a restoration tool. Alternatives 3 and 4 would maintain fire severity within desired conditions, but the risk of undesirable wildfire would increase with fewer acres treated overall.

The risk of epidemic levels of insects and disease would be best reduced by alternatives 2 and 4. It is likely alternative 3 would reduce the risk of invasive and noxious weed establishment, provided there is no unforeseen wildfire, as it would create the least ground disturbance. Alternatives 2 and 4 would increase this risk given more ground disturbance, and may be highest for alternative 4, as treatment areas usually need to be near roads.

All these alternatives generate movement toward desired conditions and support the Resilience-Transition end of the adaptation spectrum. Overall, alternative 2 likely performs the best in terms of movement toward desired conditions and most strongly supports the Resilience-Transition end of the adaptation spectrum. Given this ERU's moderate to high vulnerability to climate change, Transition is likely to represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Effects of Alternative 5

Like alternative 2, interpretating the model results for alternative 5 requires considering current patch size, the non-spatial nature of the model, and the regional protocol. While the model projections show conditions strongly moving away from desired seral state diversity, it is equally rational to conclude that it represents the strongest movement toward desired conditions for seral state diversity, ecological status, and patch size. Considering the two equally likely interpretations of the model results adds difficulty and additional uncertainty to inferences drawn about trends in other ecosystem characteristics and indicators.

Alternative 5 is projected to reduce the area dominated by old trees more than any of the other alternatives. It would perform the best at reducing coarse woody debris and moving toward desired conditions. Like the other alternatives, snag density would increase, moving away from desired conditions, but to a lesser degree than the other alternatives. This amount of fire on the landscape would still be within historic frequencies, and therefore, desired conditions but severity is not for the same reasons as alternative 2.

Overall, this alternative would likely provide the strongest trajectory toward desired conditions and support for the Resilience-Transition end of the adaptation spectrum. But again, longer fire-free periods are likely necessary for successful regeneration in a warmer, drier climate (Enright et al. 2015) so it may provide stronger support for Transition. Transition is likely to represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends given this ERU's moderate to high vulnerability to climate change.

Ponderosa Pine-Evergreen Oak

The Madrean influenced Ponderosa Pine-Evergreen Oak is like Ponderosa Pine Forest but is generally a bit warmer and drier. It remains dominated by ponderosa pine, but with slightly more even-aged dynamics and one or more well-represented evergreen oak species such as Emory oak, silverleaf oak, gray oak, turbinella oak, or Arizona white oak. Other woodland species are present, including juniper and pinyon. Ponderosa Pine-Evergreen Oak has two subclasses, one with a more continuous layer of perennial grasses, forbs, and a few shrubs, and one with an understory dominated by native evergreen shrubs. In the Gila National Forest, this ERU includes relatively small areas where Arizona or Apache pine is dominant. This typically occurs on soils formed from rhyolite and tuff. Ponderosa Pine-Evergreen Oak is relatively common, representing 12 percent of the forest and providing a greater opportunity for forest management to contribute to ecological integrity and sustainability.

Its current seral state departure from desired conditions is estimated at 43 percent, due to more closed-canopy conditions; lower densities of larger trees; and higher densities of seedling, sapling, and small-sized trees. However, the 2010 FIA summary data predict 60 percent of this ERU's area has a dominant story age of at least 100 years. Ecological status and patch size are within desired conditions. Coarse woody debris is estimated to be higher than desired conditions, with an average of 34 tons per acre as opposed to an average of 4 tons per acre. Snag densities are also higher than desired, with 2 per acre rather than 1 per acre. However, fire frequency has a low departure from historic, as does fire severity. Fire severity is a little higher than it was historically, which may indicate the presence of a stronger oak component.

Based on RAVG data, approximately 11 percent of the Ponderosa Pine-Evergreen Oak exists within the perimeter of the 2022 Black Fire, totaling about 40,520 acres. Of the total, 34,604 acres experienced low-severity fire or were not burned. No data are available for 118 acres, which is usually because of smoke or clouds obscuring the ground from satellite observations. Roughly 5,499 acres experienced moderate severity and 350 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, or the modeling analysis.

Mechanical and prescribed fire treatment acres used in the models are presented in table 15. Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 17 displays model results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 15. Acres treated per decade modeled for Ponderosa Pine-Evergreen Oak forest under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	5,876	1,554	554	30,314	3,969
Prescribed Fire	37,187	33,411	0	2,000	55,000

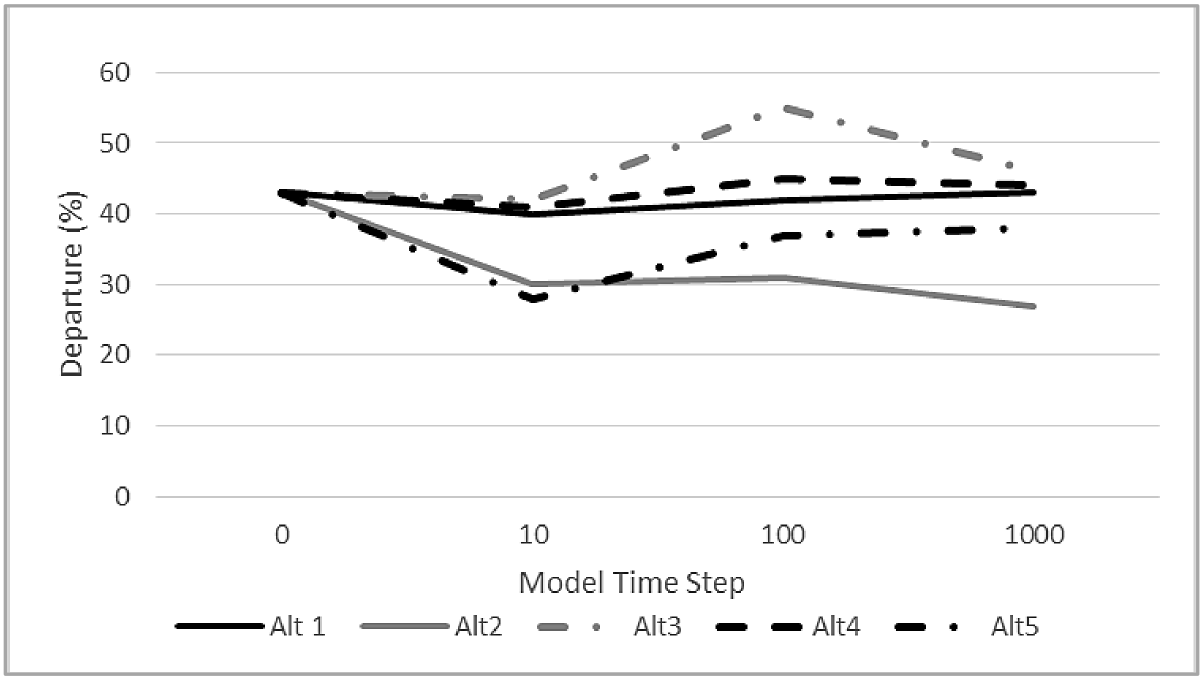


Figure 17. Ponderosa Pine-Evergreen Oak seral state diversity departure from desired condition

Table 16. Ponderosa Pine-Evergreen Oak summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	o	+*	o	o	+*
Area dominated by old trees	no change	decrease	no change	no change	decrease
Coarse woody debris density	-	+	-	-	+
Snag density	-	-	-	-	+
Fire frequency	-	o*	-	-	o*
Fire severity	o*	-	o*	o*	-
Ecological status	o	+	o	o	-
Patch size	o	+	o	o	+
Risk of epidemic levels of insects and disease	no change	decrease	no change	no change	decrease
Risk of invasive and noxious plant infestation	no change	increase	decrease	increase	increase
Climate adaptation spectrum	R-T	R-T	R-T	R-T	T

Effects of Alternatives 1, 3, and 4

Despite very different approaches, these three alternatives would result in similar outcomes in terms of seral state diversity, with only a few percentage points separating them at the 1,000-year time step. All three would essentially maintain existing conditions for seral state diversity, area expected to be dominated by old trees, patch size, and ecological status. Like Ponderosa Pine Forest, fire frequency is expected to decline, moving away from desired conditions under all these alternatives. Alternative 1 has the potential to maintain low departure, but not without partnership investments or increased use of wildfire. All these alternatives would maintain existing severity, but risk more high-severity wildfire due to accumulating coarse woody debris and snags. The existing diversity of this ERU in closed-canopy conditions remains relatively constant and is not projected to be the deciding factor in any fire severity changes. This also means that the existing risk of epidemic levels of insects and disease would remain constant over time. The risk of invasive and noxious plant establishment and spread because of management activities would be least with alternative 3 and greatest with alternatives 1 and 4, due to the level of disturbance.

These alternatives would essentially maintain current conditions and support the Resilience-Transition end of the adaptation spectrum. Given a moderate vulnerability to climate change, Transition would likely represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Effects of Alternative 2

Alternative 2 would maintain desired conditions or create a trend for all characteristics except fire severity and snag density. By virtue of allowing more mixed-severity prescribed fire, this characteristic would move away from desired conditions and likely recruit snags at a higher rate than alternative 1, 3, or 4. The area predicted to be dominated by old trees would decline. More disturbance on the landscape would increase the susceptibility to invasive and noxious species establishment and spread.

Overall, this alternative would be most effective at moving toward desired conditions. While it also supports the Resilience-Transition end of the adaptation spectrum, it may lend stronger support for Transition as longer fire-free periods may be necessary for pine regeneration (Enright et al. 2015). More fire on the landscape, combined with regeneration failure could promote conversion to an evergreen oak-shrubland.

Effects of Alternative 5

Alternative 5 is projected to perform similarly to alternative 2. However, there would be twice as much area moving to open-canopy conditions by the end of the first decade. Overall, this alternative supports movement toward desired conditions and more strongly supports Transition to an evergreen oak-shrubland than alternative 2.

Madrean Pinyon-Oak Woodland

The Madrean Pinyon-Oak Woodland is transitional between Ponderosa Pine-Evergreen Oak and the Semi-Desert Grassland, and intergrades with other woodland types. The central tendency of this ERU is dominated by open to closed canopy of evergreen oaks, alligator juniper, Mexican pinyon, border pinyon, Chihuahua pine, and other pines with a grassy understory. While the Madrean influence can be observed in the floristics of this ERU as it is mapped in the Gila National Forest, it is not strongly expressed. Two-needle pinyon is dominant, with Mexican and border pinyon being subordinate, and only occasionally codominant. Chihuahua pine is uncommon but does occur.

The most substantial difference between this ERU in the Gila National Forest and elsewhere, is the limited potential for a grassy understory. It occurs on shallow, weakly developed soils on rhyolite and tuff and has a substantial bedrock outcrop component. Soil temperature and moisture regimes support more of an evergreen shrub-dominated understory, rather than a grassy understory. This has implications for natural fire regimes, in terms of both frequency and severity.

Relatively little Madrean Pinyon-Oak Woodland is mapped in the forest, representing approximately 1 percent of the forest's area. However, with current seral state diversity within desired conditions, the opportunity for the forest to function as refugia for some of this ERU's associated species does exist. At present, there is a 22 percent departure from desired conditions for seral state diversity. The 2010 FIA data summary predicts 13 percent of this ERU would currently have a dominant story age of at least 100 years. Ecological status is in moderate departure. Snag densities are estimated to be within desired conditions with an average one snag per acre. Coarse woody debris, however, is estimated to be an average of 16 tons per acre, as opposed to the average 3 tons per acre desired. The 2022 Black Fire did not impact the Madrean Pinyon-Oak Woodland.

This ERU has no objectives, and so little of it is in the wildland-urban interface that no prescribed fire or mechanical treatments were modeled. Wildfire is the factor driving differences between modeled outcomes. Figure 18 displays those results followed by a tabular summary of trends, which are discussed subsequently.

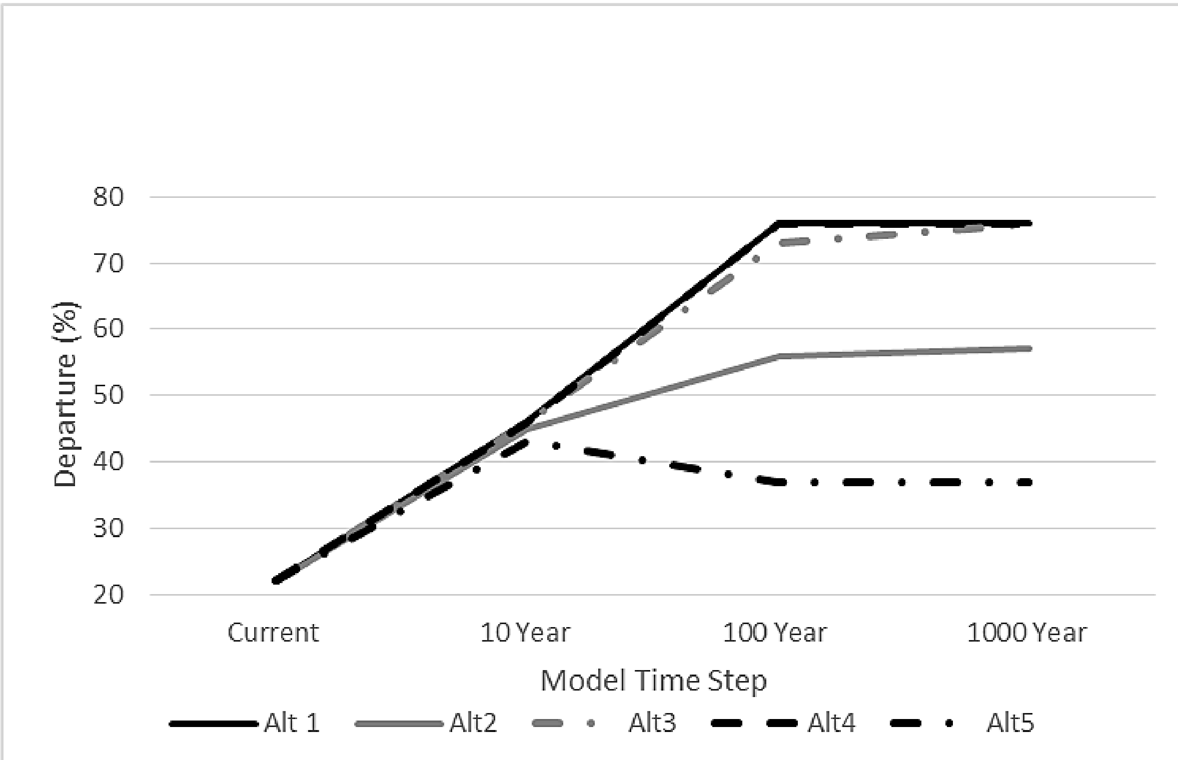


Figure 18. Madrean Pinyon-Oak Woodland seral state diversity departure from desired conditions

Table 17. Madrean Pinyon-Oak Woodland summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	-	-	-	-	-
Area dominated by old trees	increase	increase	increase	increase	increase
Coarse woody debris density	-	-	-	-	-
Snag density	-	o*	-	-	o*
Fire frequency	-	-	-	-	-
Fire severity	-	-	-	-	-
Ecological status	-	-	-	-	-
Patch size	-	-	-	-	-
Risk of epidemic levels of insects and disease	increase	increase	increase	increase	increase
Risk of invasive and noxious plant infestation	decrease	increase	decrease	decrease	increase
Climate adaptation spectrum	T	T	T	T	T

Effects of All Alternatives

Despite different approaches to wildfire management and use, all alternatives would move the Madrean Pinyon-Oak Woodland away from most desired conditions. The area expected to be dominated by old trees would increase substantially under all alternatives. Alternatives 2 and 5 would trend away from desired conditions more slowly over time but the trend remains due to an increase in early seral open-canopy conditions and late seral closed-canopy conditions, and a decline in closed-canopy mid-development conditions. Under alternatives 1, 3, and 4 regeneration infilling late seral open-canopy states and a general lack of disturbance moving area to early seral states would be responsible for the trend.

Overall, the trend would be toward more closed-canopy conditions, resulting in an increase in the risk of epidemic levels of insect and disease of similar magnitude. The risk of invasive and noxious plant establishment and spread would decrease under alternatives that are more risk averse to using wildfire and increase under those that approach wildfire with less risk aversion.

All alternatives would support the Transition end of the adaptation spectrum as inferred by trends away from desired conditions. However, this ERU has a low to moderate vulnerability to climate change. There may be opportunities to support the full Resistance-Resilience-Transition spectrum in areas of low vulnerability. However, natural growth is represented in the model by regionally representative data that is not representative of the Gila National Forest where growth is limited by the soil type on which it occurs; the models may never reflect the dynamics accurately enough to demonstrate a trend toward desired conditions. Further, mechanical vegetation treatments within woodland types demonstrate mixed results (Jones 2019) and may not substantially influence the trajectory of this system.

Pinyon Juniper Woodland

This ERU represents persistent woodlands, where infrequent to very infrequent and high-severity disturbances are the norm. Development takes place in distinct stages, and typically represents even-aged dynamics. Closed-canopy conditions are not uncommon, nor undesirable. Understories are frequently sparse; however, Gila National Forest-specific data suggest that this ERU has some area on productive soils where this was not the case historically and remains that way today. This may be an indicator that these areas are misclassified in the ERU mapping and were historically open-canopy, frequent-fire ecosystems, rather than closed-canopy, infrequent-fire systems. In other places, open-canopy conditions exist where rock outcrop, shallow soils, and low soil productivity limit both woody and herbaceous vegetation densities, which still supports infrequent, high-severity disturbance regimes.

As mapped, Pinyon Juniper Woodland represents 26 percent of the forest and is the most common ERU. The forest has a substantial opportunity to contribute to ecological integrity and sustainability. It is currently just outside desired conditions for seral state diversity with a 36 percent departure. The relatively low level of departure is due to more acres under open-canopy conditions than desired, which has some relationship to the mapping issues discussed in the previous paragraph.

The 2010 FIA data summary predicts 43 percent of this ERU has a dominant story age of at least 100 years. Ecological status is in moderate departure. Patch size is in moderate departure with mean patch size being smaller than desired. Coarse woody debris is estimated to average 18 tons per acre, as opposed to the desired average of 4 tons per acre. Snags are estimated to average two per acre, as opposed to the desired average of one.

Based on RAVG data, approximately 10 percent of the Pinyon Juniper Woodland exists within the perimeter of the 2022 Black Fire, totaling about 81,197 acres. Of the total acres, 68,554 experienced low-severity fire or were not burned. There are no data available for 301 acres, which is usually because of smoke or clouds obscuring the ground from satellite observations. Roughly 12,078 acres experienced moderate severity and 264 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, or the modeling analysis.

This ERU has no ecological objectives given that its low level of departure in seral state diversity is due to more open-canopy conditions, and it is an infrequent disturbance ecosystem. However, under the 1986 forest plan, much of the woodland work has been done in what is mapped as Pinyon Juniper Woodland. Mechanical and prescribed fire treatment acres used in the models are presented in table 18. Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 19 displays model results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 18. Acres treated per decade modeled for Pinyon Juniper Woodland under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	8,557	1,255	1,255	1,255	1,255
Prescribed Fire	37,042	0	0	0	0

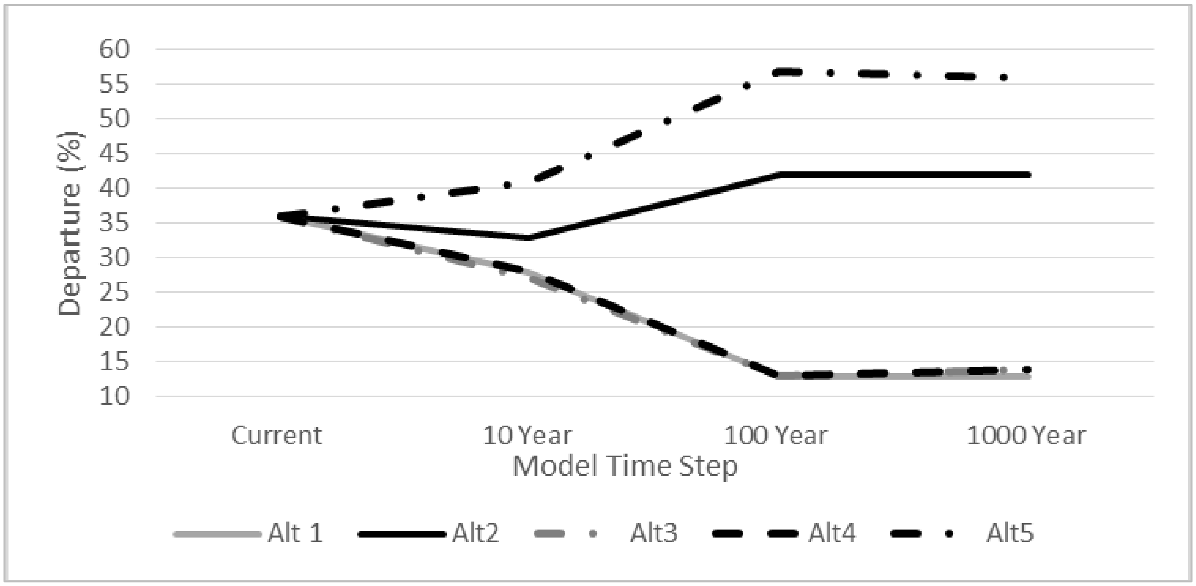


Figure 19. Pinyon Juniper Woodland seral state diversity departure from desired conditions

Table 19. Pinyon Juniper Woodland summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	+*	-	+*	+*	-
Area dominated by old trees	increase	increase	increase	increase	decrease
Coarse woody debris density	-	+	-	-	+
Snag density	-	-	-	-	-
Fire frequency	+	-	+	+	-
Fire severity	+	+	+	+	+
Ecological status	+	-	+	+	-
Patch size	+	-	+	+	-
Risk of epidemic levels of insects and disease	increase	decrease	increase	increase	decrease
Risk of invasive and noxious plant infestation	No change	increase	decrease	decrease	increase
Climate adaptation spectrum	R-R-T	T	R-R-T	R-R-T	T

Effects of Alternatives 1, 3, and 4

Very little difference is observed between these alternatives despite the different plan objectives. All these alternatives would trend all characteristics toward desired conditions except coarse woody debris and snag densities, which would continue to increase. The area dominated by old trees would increase under these alternatives. This represents conditions that are primed and ready for the kind of fire typical for this vegetation community—infrequent and high severity. While this may not be ecologically inappropriate, it can be problematic for wildland fire management depending on how contiguous an area could be affected. As conditions move toward desired, the diversity of this ERU under closed-canopy conditions would increase, as does the risk of epidemic levels of insects and disease. The risk of invasive and noxious weed species establishment and spread remains steady for alternative 1 and decreases for alternatives 3 and 4.

These alternatives would generally support the full adaptation spectrum. Projects informed with the spatial vulnerability analysis would most appropriately target areas of low vulnerability with Resistance-Resilience adaptation strategies and moderate and greater vulnerabilities with Resilience-Transition adaptation strategies. Transition would likely represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends in areas of moderate and greater vulnerability.

Effects of Alternatives 2 and 5

Increased use of wildfire on the landscape in alternatives 2 and 5 would lead to movement away from desired conditions for seral state diversity and snag density, but toward them for coarse woody debris. The area predicted to be dominated by old trees would increase under alternative 2 and decrease substantially under alternative 5. The trend away from desired conditions for seral state diversity is because more area would be moving from closed-canopy conditions to open-canopy conditions. This might reduce potential fire management problems and reduce the risk of epidemic levels of insects and disease. The risk of invasive and noxious weed species establishment increases due to more disturbance.

Given movement away from desired conditions for seral state diversity, these alternatives would generally promote the Transition end of the adaptation spectrum. However, there are opportunities in areas of low vulnerability to support Resistance and Resilience and there is nothing in alternative 2 that would prevent management from capitalizing on those opportunities where site characteristics lend themselves to management influence (Jones 2019). Alternative 5 would limit the ability of management to use Resistance-Resilience strategies by restricting mechanical treatments to the wildland-urban interface and requiring that treatments outside the urban interface meet a burden of proof that those treatments are necessary to allow more fire on the landscape.

Pinyon Juniper Grass Woodland

Pinyon Juniper Grass Woodland is a historically open-canopy, frequent-fire ERU, with tree canopy cover ranging from 10 to 30 percent. Alligator and one-seed junipers, and two-needle pinyon are the most common tree species. One or more species of evergreen oak may also be present but are typically subordinate. As currently mapped, this woodland represents approximately 9 percent of the forest. With higher representation in the forest than in the surrounding landscape, forest management is an important contributor to ecological integrity and sustainability.

This ERU's current seral state departure from desired conditions is estimated at 39 percent, due to more closed-canopy conditions, and higher densities of seedling, sapling, and small-sized trees. Patch sizes are also larger than desired. The 2010 FIA data summary predicts 58 percent of this ERU has a dominant story age of at least 100 years. Ecological status is in moderate departure. Coarse woody debris is currently higher than desired conditions, with an estimated average of 21 tons per acre rather than an average of 4 tons per acre. Estimated snag densities are within desired conditions at an average of one per acre. Fire frequency is highly departed with severity within desired conditions.

Based on RAVG data, approximately 1 percent of the Pinyon Juniper Grass Woodland exists within the perimeter of the 2022 Black Fire, totaling about 3.998 acres. Of the total acres, 3,658 experienced low-severity fire or were not burned. Roughly 326 acres experienced moderate severity and 14 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, or the modeling analysis.

Mechanical and prescribed fire treatment acres used in the models are presented in table 20. Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 20 displays model results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 20. Acres treated per decade modeled for Pinyon Juniper Grass Woodland under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	3,046	4,538	19,538	538	1,972
Prescribed Fire	5,350	2,500	500	0	24,000

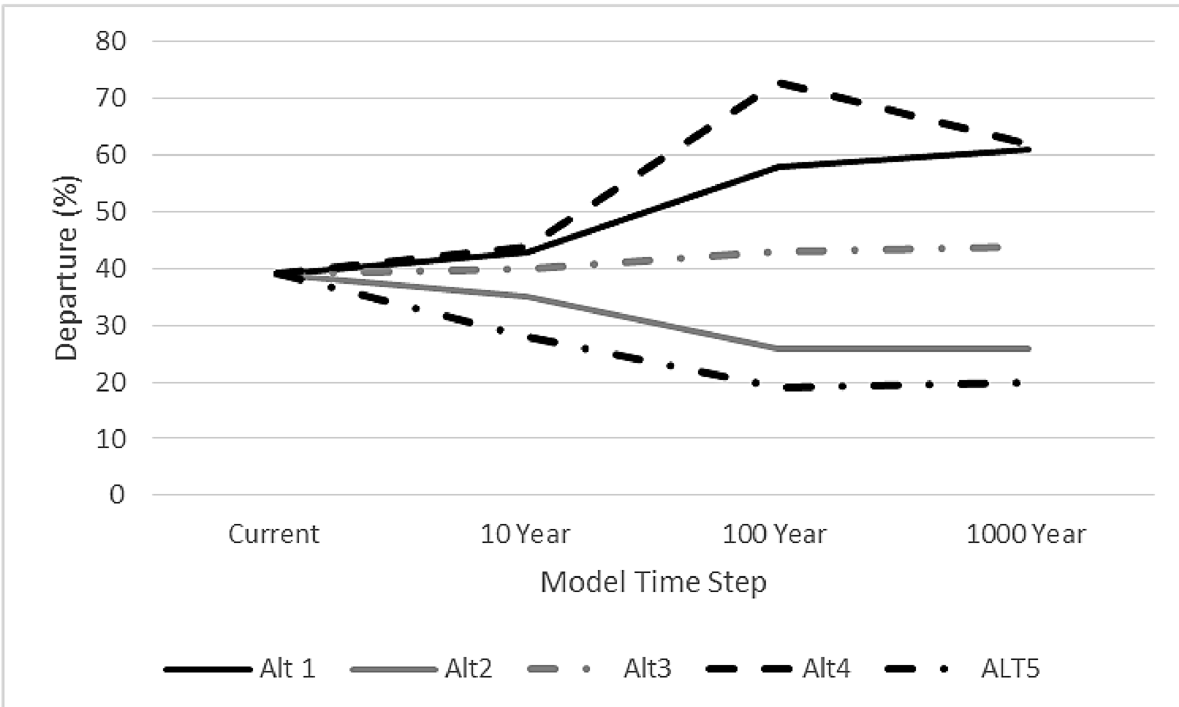


Figure 20. Pinyon Juniper Grass Woodland seral state diversity departure from desired conditions

Table 21. Pinyon Juniper Grass Woodland summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	-	+*	-	-	+*
Area dominated by old trees	increase	decrease	increase	increase	decrease
Coarse woody debris density	-	+	-	-	+
Snag density	o*	-	o*	o*	-
Fire frequency	-	+	-	-	+
Fire severity	o*	-	o*	o*	-
Ecological status	-	+	-	-	+
Patch size	-	+	-	-	+
Risk of epidemic levels of insects and disease	increase	decrease	increase	increase	decrease
Risk of invasive and noxious plant infestation	no change	increase	increase	decrease	increase
Climate adaptation spectrum	T	R-R-T	T	T	R-R-T

Effects of Alternatives 1, 3, and 4

These alternatives would trend all characteristics except snag density away from desired conditions, although this trend is far less substantial under alternative 3. None of these alternatives treat enough acres to keep pace with the rates of tree regeneration, re-sprout, and growth in the model. Fire frequency would continue to move away from desired conditions under these alternatives with more area being recruited to closed-canopy conditions over time. The area expected to be dominated by old trees increases under these alternatives, as does the risk of epidemic levels of insects and disease.

The risk of invasive and noxious species establishment and spread would increase under alternative 3, decrease under alternative 4, and hold steady under alternative 1 as a function of ground disturbance. All these alternatives support the Transition end of the adaptation spectrum as inferred by movement away from desired conditions. However, this ERU has low to moderate vulnerability. There are opportunities in areas of low vulnerability to focus on treatments that restore structure and function and support Resistance and Resilience. Nothing in these alternatives would prevent management from capitalizing on those opportunities, where site characteristics lend themselves to management influence (Jones 2019).

Effects of Alternatives 2 and 5

Alternatives 2 and 5 would increase the use of wildfire and accept more mixed severity on the landscape, which is responsible for trends toward desired conditions for most characteristics. Seral state diversity would reach desired conditions by the end of the first decade. Severity would trend away from desired conditions for prescribed fire to function as a restoration tool, which is responsible for the increasing snag densities. The area expected to be dominated by old trees would decline under both alternatives, most substantially with alternative 5. Both alternatives would increase the prevalence of open-canopy conditions, reducing the risk of epidemic levels of insects and disease and increasing the risk of invasive and noxious establishment and spread. These alternatives support the full Resistance-Resilience-Transition adaptation spectrum as inferred by progress toward desired conditions.

Juniper Grass Woodland

Like Pinyon Juniper Grass Woodland, this ecosystem is a historically open canopy, frequent fire ERU, with tree canopy cover ranging from 10 to 30 percent. The difference is that this ERU generally occurs in warmer, drier settings, beyond the environmental limits of pinyon. While there is less of this ERU in the forest (approximately 5 percent) than Pinyon Juniper Grass Woodland, and more in the surrounding landscape, management still has opportunities to contribute to ecological integrity and sustainability.

This ERU's current seral state departure from reference is estimated at 29 percent, due to more closed-canopy conditions, and higher densities of seedling, sapling, and small-sized trees. However, it is within desired conditions (less than 33 percent departure). Patch sizes are larger than desired. The 2010 FIA data summary predicts 8 percent of this ERU is occupied by a dominant age story of at least 100 years. Coarse woody debris is currently higher than desired conditions, with an estimated average of 10 tons per acre as opposed to an average of 3 tons per acre. Estimated snag densities are within desired condition at an average of one per acre. Based on current ERU mapping, this ERU was not impacted by the 2022 Black Fire.

Mechanical and prescribed fire treatment acres used in the models are presented in table 22. Wildfire acres are not included, as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 21 displays model results, followed by a tabular summary of trends for all characteristics and indicators. Results are discussed under the subsequent effects headings.

Table 22. Acres treated per decade modeled for Juniper Grass Woodland under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	208	4,147	13,147	147	537
Prescribed Fire	109	2,500	500	0	18,000

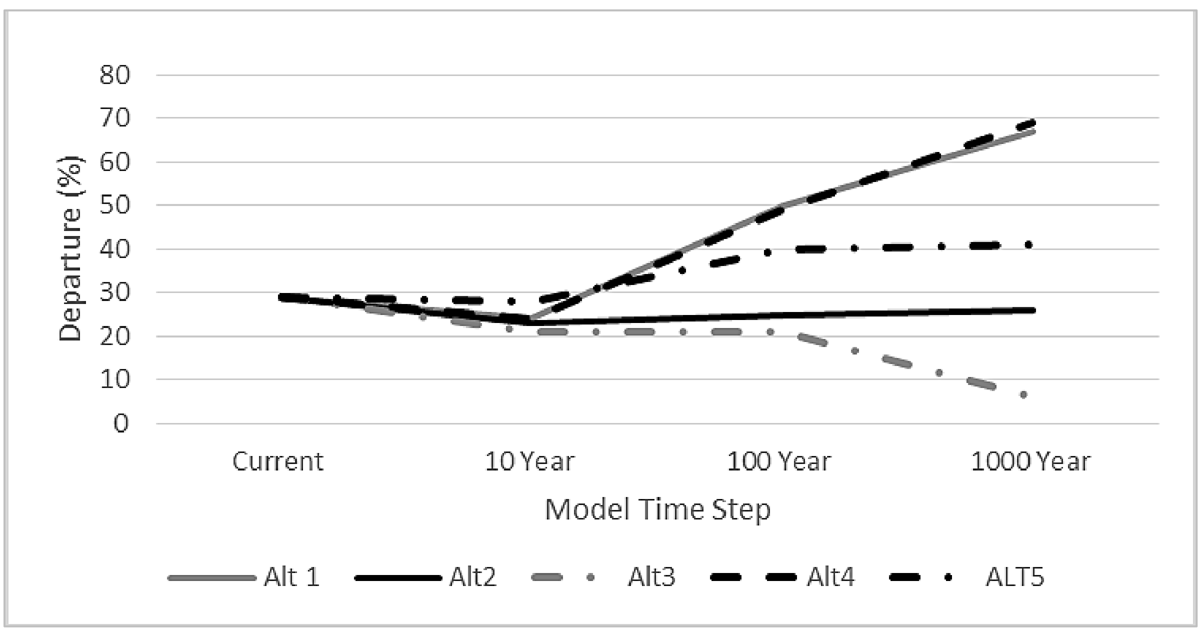


Figure 21. Juniper grass woodland seral state diversity departure from desired conditions

Table 23. Juniper Grass Woodland summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	-	o*	o*	-	-
Area dominated by old trees	increase	increase	increase	increase	decrease
Coarse woody debris density	-	+	-	-	+
Snag density	o*	o*	o*	o*	o*
Fire frequency	-	+	-	-	+
Fire severity	o*	-	o*	o*	-
Ecological status	-	+	+	-	-
Patch size	o	+	+	-	-
Risk of epidemic levels of insects and disease	increase	decrease	decrease	increase	decrease
Risk of invasive and noxious plant infestation	no change	increase	increase	decrease	increase
Climate adaptation spectrum	T	R-R-T	T	T	R-R-T

Effects of Alternatives 1, 4, and 5

These alternatives would move Juniper Grass Woodland away from desired conditions in seral state diversity, ecological status, and patch size but for different reasons. Alternatives 1 and 4 would not treat enough acres, and more area would move into closed-canopy conditions over time. While there is some uncertainty associated with the model, like that described for Ponderosa Pine Forest, alternative 5 would move 45 percent of the total ERU area into less than 10 percent tree canopy cover between the end of the first decade and the end of the 100-year model run, which is more consistent with desired conditions for a grassland ERU than an open-canopy woodland. The area dominated by old trees is predicted to increase substantially under alternatives 1 and 4 and decrease under alternative 5. Snag density would remain within desired conditions under all three alternatives. Coarse woody debris would trend away from desired conditions under alternatives 1 and 4 and toward desired conditions under alternative 5 due to the different emphasis on fire. Alternatives 1 and 4 would continue to move fire frequency away from desired conditions and given the increase in closed-canopy conditions, increase wildfire risk. By design, alternative 5 would move away from desired conditions for fire severity and toward them for fire frequency.

Alternative 5 would reduce the risk of epidemic levels of insects and disease over time and increase the risk of invasive plant species establishment and spread. The opposite case is expected with alternative 4. All these alternatives support the Transition end of the adaptation spectrum with alternative 5 providing the strongest support. Given moderate to high vulnerability to climate change, Transition would likely represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Effects of Alternatives 2 and 3

While both alternatives would maintain seral state diversity within desired conditions, alternative 3 would demonstrate improvement. There is only a 6 percent departure from desired conditions at the end of alternative 3's 1,000-year model run. Both alternatives would also reduce snag densities, maintaining them within desired conditions. However, coarse woody debris and fire frequency would trend toward desired conditions under alternative 2, and away from desired conditions under alternative 3 because of the different approaches to using fire. Both alternatives move ecological status and patch size toward desired conditions, decrease the risk of epidemic levels of insects and disease, and increase the risk of invasive and noxious species establishment and spread. The area dominated by old trees is expected to increase. Overall, these alternatives support the full adaptation spectrum but alternative 2 does a better job. The Resistance approach to adaptation may not be appropriate for this ERU given its moderate to high vulnerability to climate change.

Mountain Mahogany Mixed Shrubland

Mountain Mahogany Mixed Shrubland typically occurs in the foothills, on canyon slopes and lower mountain slopes of the Rocky Mountains, and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico and extends north into Colorado. These shrublands are often associated with exposed sites, rocky substrates, dry conditions, and recurrent but infrequent historic fire that limited tree growth. Scattered trees or inclusions of grassland patches may be present, but the vegetation is typically shrub-dominated.

The general description fits much of the Mountain Mahogany Mixed Shrubland mapped in the Gila National Forest; however, oak-dominated areas, primarily in the Gila Wilderness have been mapped as such when they are more accurately described as early seral states in Mixed Conifer-Frequent Fire or Ponderosa Pine-Evergreen Oak. This is the result of previous stand-replacement fire. Additionally, this ERU is mapped in gentle sloping terrain in the Burro Mountains where oak species dominate. Mountain mahogany, desert buckbrush, catclaw, silktassel, sumac, and beargrass are typically subordinate. In this area, the existing vegetation is strongly influenced by historic overgrazing and granitic soils, and most likely represents a permanently altered grassland state.

Mountain Mahogany Mixed Shrubland is relatively common in the forest, representing 5 percent of its land area, but it is rare in the surrounding landscape, providing the opportunity for Gila National Forest management to contribute to ecological integrity and sustainability. It currently has a 63 percent departure from desired conditions in seral state diversity. Ecological status departure is also moderate. Fire frequency is within desired conditions, but fire severity has been substantially lower than what is known about the historic fire regime.

Based on RAVG data, approximately 4 percent of the Mountain Mahogany Mixed Shrubland exists within the perimeter of the 2022 Black Fire, totaling about 6,876 acres. Of the total, 6,109 acres experienced low-severity fire or were not burned. Roughly 760 acres experienced moderate severity and 8 acres experienced high severity. Based on the worst-case scenario analysis (see Mixed Conifer-Frequent Fire), this does not warrant revisiting the need to change the plan, the alternatives, or the modeling analysis.

None of the alternatives has objectives for Mountain Mahogany Mixed Shrubland outside of the wildland-urban interface. Wildfire management is the primary influence. Figure 22 displays modeling results, followed by table 24 with a summary of trends. Results are discussed under the effects subheading.

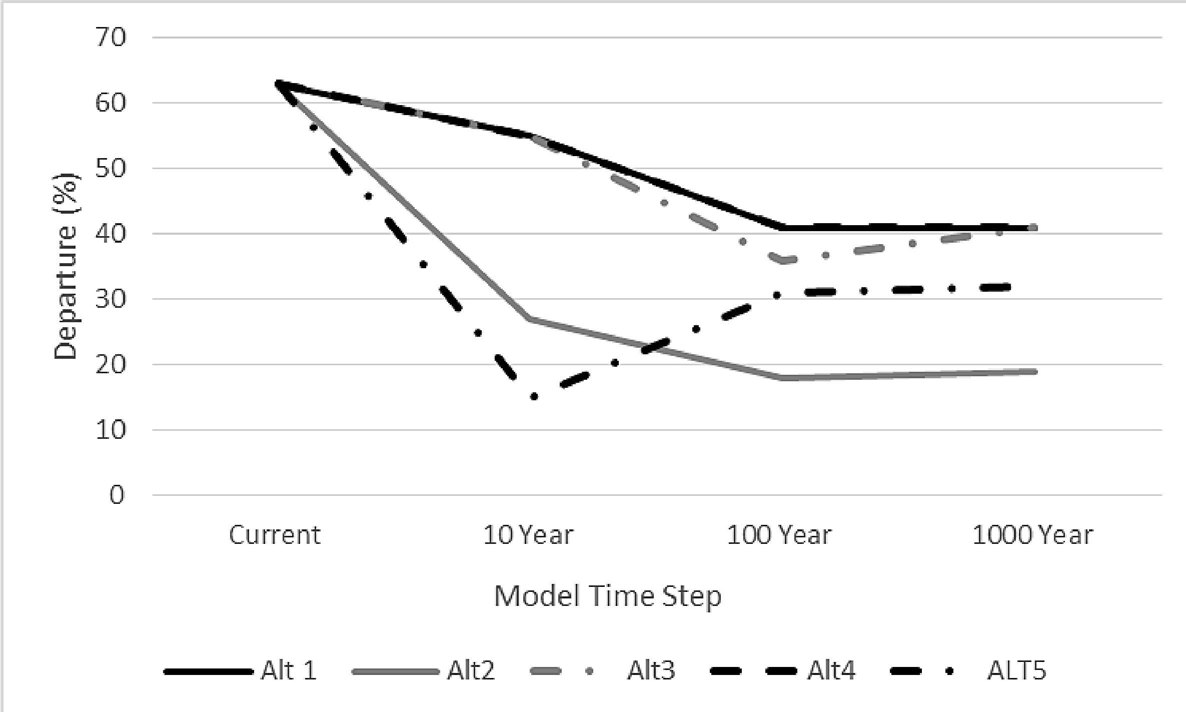


Figure 22. Mountain Mahogany Mixed Shrubland seral state diversity departure from desired conditions

Table 24. Mountain Mahogany Mixed Shrubland summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	+	+*	+	+	+*
Fire frequency	o*	o*	o*	o*	o*
Fire severity	o	+*	o	o	+*
Ecological status	+	+	+	+	+
Risk of invasive and noxious plant infestation	increase	increase	increase	increase	increase
Climate adaptation spectrum	R-R-T	R-R-T	R-R-T	R-R-T	R-R-T

Effects of All Alternatives

All alternatives would move seral state diversity and ecological status closer toward desired conditions, but only alternatives 2 and 5 would achieve and maintain them because more acres experience fire under these alternatives. All would maintain fire frequency within desired conditions, but only alternative 2 would move severity within desired conditions, as inferred by its ability to maintain desired conditions in seral state diversity. Alternative 5 would increase severity, which would move it toward desired conditions initially, but exceed it subsequently, as inferred from the divergence between alternatives 2 and 5 after the first decade. Epidemic levels of insects and disease are not a concern in this ERU. As seral state diversity moves toward desired conditions, the risk of invasive and noxious weed species establishment and spread would increase, as change is driven by disturbance. With low to moderate vulnerability to climate change, there are opportunities to support the full adaptation spectrum. All alternatives would do this, with alternative 2 providing the best support.

Montane/Subalpine Grasslands

Typically found above 8,000 feet, these grasslands often harbor, or have the potential to harbor several distinct plant associations with varying dominant herbaceous species. Such dominant species include Arizona fescue, mountain, screwleaf or Wright's muhly, pine dropseed, a variety of sedges, bulrushes, wire rush, Rocky Mountain iris, and corn lily. Trees that may occur along the periphery of these grassland meadows include Engelmann or blue spruce, corkbark, Douglas and white fir. Meadows are typically seasonally wet, which is tied to snowmelt. Montane/Subalpine Grasslands are frequently associated with the Herbaceous Wetland Riparian ERU. Tree and shrub cover were historically less than 10 percent each.

Current departure from desired conditions for seral state diversity is 64 percent due to woody species encroachment and altered herbaceous species composition, which is reflected by a moderate departure in ecological status. Fire is not occurring quite as often as desired, but severities are likely consistent with historic or desired severities. Based on current ERU mapping, this grassland was not impacted by the 2022 Black Fire.

Mechanical and prescribed fire treatment acres used in the models appear in table 25. Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 23 displays model results, followed by a tabular summary of trends. This information is referenced in the subsequent discussion of effects.

Table 25. Acres treated per decade modeled for Montane/Subalpine Grasslands under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	5,381	4,768	11,000	168	61
Prescribed Fire	5,381	10,000	500	0	12,000

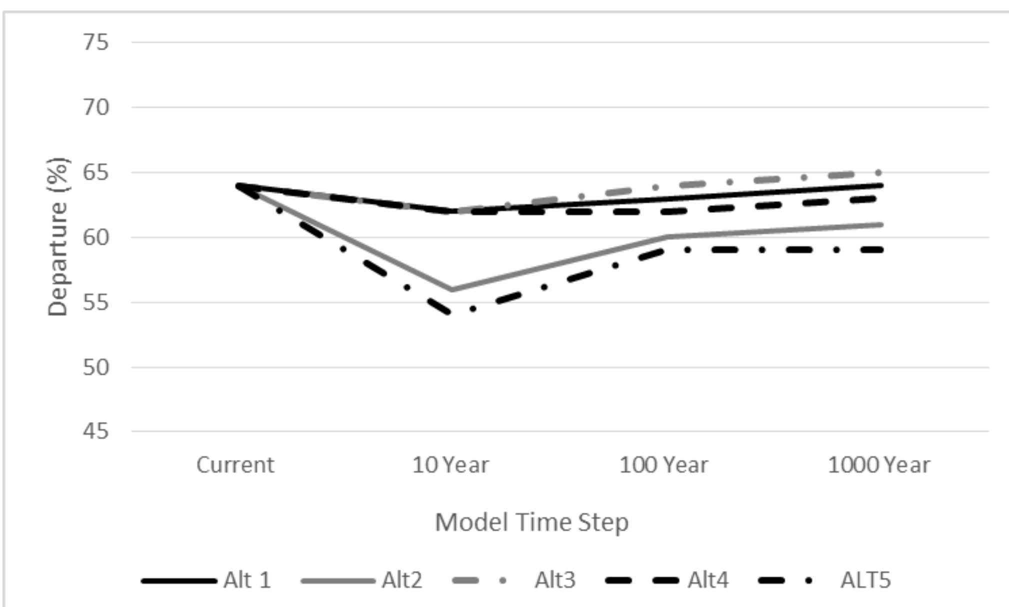


Figure 23. Montane/Subalpine Grasslands seral state diversity departure from desired conditions

Table 26. Montane/Subalpine Grasslands summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	o	o	o	o	o
Fire frequency	o	+	-	-	+
Fire severity	o*	o*	o*	o*	o*
Ecological status	o	o	o	o	o
Risk of invasive and noxious plant infestation	no change	increase	increase	no change	increase
Climate adaptation spectrum	R-T	R-T	R-T	R-T	R-T

Effects of All Alternatives

The alternatives would show initial movement toward desired conditions, but the overall trend would be to maintain existing departure in seral state diversity and ecological status. In part, this is simply due to not enough acres being treated to overcome tree encroachment, but also because the models cannot show movement toward desired herbaceous species composition. Any changes would be the result of combined changes in woody species encroachment, weather patterns, and herbivory by wildlife and livestock. Herbivory is not represented in the models as discussed in the analysis methodology. Alternatives 2 and 5 would make slightly better progress toward desired conditions, treating sufficient acres with fire to reduce areas of woody species encroachment.

Alternative 1 maintains existing levels of departure in fire frequency, while alternatives 3 and 4 would move away from desired conditions. Although there are different ways to think about fire severity in grasslands,[15] severity would likely be maintained. Historically, frequent surface fires were sufficient to kill invading seedling and saplings. Higher severity fires are needed to get tree mortality in encroached areas where trees have moved beyond the seedling or sapling stage.

Epidemic levels of insects and disease are not a concern in this ERU. The risk of invasive and noxious weed species establishment and spread would be lowest under alternative 4 because fewer acres are disturbed. It would be greatest under alternative 5, with the most acres disturbed. All the alternatives support the Resilience-Transition end of the adaptation spectrum. With moderate to high vulnerabilities to climate change, Transition would likely represent ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Colorado Plateau/Great Basin Grassland

This grassland is typically associated with woodland and forested ERUs where pinyon pine is part of the potential natural vegetation community. Common grasses may include but are not limited to blue grama, squirrel-tail, Wright's muhly, western wheatgrass, mountain muhly, Arizona fescue, pine dropseed, wolftail and threeawn species. Historically, this ERU may have had more than 10 percent shrub cover, but not more than 10 percent tree cover.

[15] LANDFIRE defines grasslands as being high-severity ecosystems, as fire results in total consumption of the herbaceous canopy. MTBS defines severity in terms of change and given post-fire herbaceous response in areas dominated by those species, fire severity is typically characterized as low.

Current departure from desired conditions for seral state diversity is 65 percent due to woody species encroachment and altered herbaceous species composition, as reflected by a moderate departure in ecological status. Much of it is a sod-bound blue-grama monoculture. Fire is not occurring as often as desired, but severities are likely consistent with historic or desired severities. Mechanical and prescribed fire treatment acres used in the models appear in table 27. Based on current ERU mapping, less than 1 percent of this grassland was impacted by the 2022 Black Fire.

Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 24 displays model results. This information is referenced in the subsequent discussion of effects.

Table 27. Acres treated per acre modeled for Colorado Plateau/Great Basin Grassland under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	1,564	2,171	8,800	171	62
Prescribed Fire	1,564	2,000	500	0	10,000

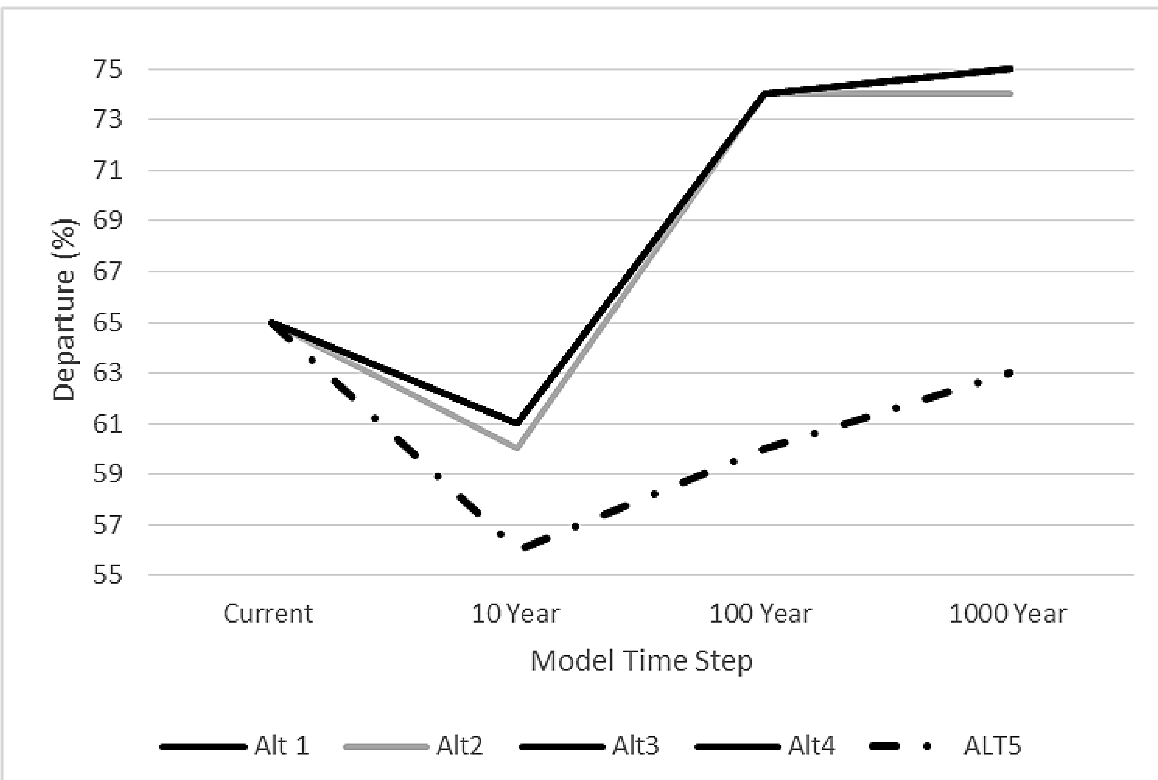


Figure 24. Colorado Plateau/Great Basin Grassland seral state diversity departure from desired conditions

Table 28. Colorado Plateau/Great Basin Grassland summary of trends by alternative
Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	-	-	-	-	+
Fire frequency	o	+	-	-	+
Fire severity	o*	o*	o*	o*	o*
Ecological status	-	-	-	-	-
Risk of invasive and noxious plant infestation	no change	increase	increase	decrease	increase
Climate adaptation spectrum	T	T	T	T	T

Effects of All Alternatives

Alternatives 1, 2, 3, and 4 would trend seral state diversity and ecological status further away from desired conditions because they are not treating enough acres, and because the models are not capable of reflecting changes in herbaceous species composition, as previously described in the analysis of Montane/Subalpine Grasslands. Alternatives 2 and 5 would move fire frequency toward desired conditions, but alternative 2 could not keep pace with natural regeneration and re-sprout. Alternatives 3 and 4 would move fire frequency further away from desired conditions compared to alternative 1.

Epidemic levels of insects and disease are not a concern in this ERU. The risk of invasive and noxious weed species establishment and spread would be lowest under alternative 4, with fewer acres disturbed. It would be greatest under alternative 5, which would have the most acres disturbed. Overall, these alternatives support the Transition end of the adaptation spectrum. With moderate to high vulnerabilities to climate change, Transition likely to represents ecological adjustment and the greater expression of long-term integrity and sustainability within climatic trends.

Semi-Desert Grassland

The Semi-Desert Grassland is the warmest and driest of the grassland ERUs in the forest and is typically associated with woodlands and the Mountain Mahogany Mixed Shrubland ERU. Historically, this ERU may have had more than 10 percent shrub cover, but not more than 10 percent tree cover. Sideoats; black, hairy, and blue grama grasses; wolftail; plains lovegrass; and a variety of threeawn and muhly species are common. Curly mesquite may be dominant in areas of heavier clay soils. While shrubs and sub-shrubs are clearly subordinate, they are common and sometimes abundant. The most diagnostic shrubs are sotol, beargrass, and yucca, although yerba de pasmo, Wrights beebrush, turbinella and gray oak, winterfat, and many other species may be present. The presence and abundance of acacia, mimosa, turpentine bush, and honey mesquite can be interpreted as indicators of drought, disruption in the natural disturbance regimes, or both.

Current departure from desired conditions for seral state diversity is 94 percent due to woody species encroachment and altered herbaceous species composition, as reflected by a moderate departure in ecological status. Fire is not occurring as often as desired, but severities are likely consistent with historic or desired severities. Based on current ERU mapping, 1 percent of this grassland was impacted by the 2022 Black Fire.

Mechanical and prescribed fire treatment acres used in the models appear in table 29. Wildfire acres are not included as this is better presented as a likelihood, or probability, because these events cannot be planned in the sense that mechanical treatments and prescribed fire are planned. Figure 25 displays model results. This information is referenced in the subsequent discussion of effects.

Table 29. Acres treated per decade modeled for Semi-Desert Grassland under each alternative

Treatment Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical	1,372	923	6,000	122	45
Prescribed Fire	245	500	500	0	8,000

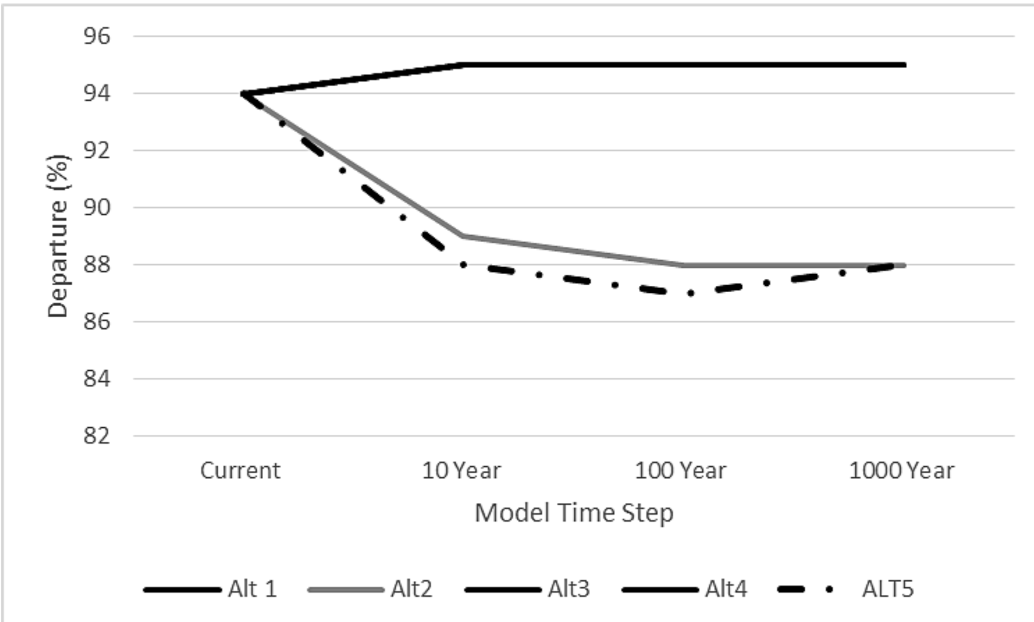


Figure 25. Semi-Desert Grassland seral state diversity departure from desired conditions

Table 30. Semi-Desert Grassland summary of trends by alternative

Unless otherwise indicated in the first column "+" = trend toward desired condition; "+*" = trend toward and achievement of desired condition; "-" trend away from desired condition; "o" maintains existing departure from desired condition; "o*" maintains within desired condition; "R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Characteristic or Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Seral state diversity	-	+	-	-	+
Fire frequency	o	+	-	-	+
Fire severity	o*	o*	o*	o*	o*
Ecological status	-	+	-	-	+
Risk of invasive and noxious plant infestation	no change	increase	increase	decrease	increase
Climate adaptation spectrum	R-R-T	R-R-T	R-R-T	R-R-T	R-R-T

Effects of Alternatives 1, 3, and 4

These alternatives would likely produce a slight trend away from desired conditions for seral state diversity and ecological status, simply because they would not treat enough acres. Fire frequency would move away from desired conditions under alternatives 3 and 4, as compared to alternative 1, which maintains existing departure. Similar to discussions for the other grasslands, all alternatives would maintain fire severity within desired conditions. The risk of invasive and noxious weed species establishment and spread would be lowest under alternative 4, given that fewer acres are disturbed. It would be greatest under alternative 3, with the most acres disturbed. With low to moderate vulnerability to climate change, there are opportunities to support the full adaptation spectrum. These alternatives would most strongly support the Transition end of the spectrum, as inferred by movement away from desired conditions. Opportunities exist in areas of low vulnerability to focus on treatments that restore structure and function and support the Resistance-Resilience end of the adaptation spectrum. There is nothing in the plan that prevents management from capitalizing on those opportunities, only limitations of the model in its ability to project those site-specific outcomes.

Effects of Alternatives 2 and 5

These alternatives would trend toward desired conditions because the use of prescribed fire and wildfire allows more acres to be treated. The risk of invasive and noxious weed species establishment and spread would be higher than alternatives 1, 3, and 4, with alternative 5 representing the greatest risk. Based on trends toward desired conditions, these alternatives would best support the full adaptation spectrum of Resistance-Resilience-Transition.

Effects to the Wildland-Urban Interface

All alternatives would make progress toward desired conditions for the wildland-urban interface, but none attains them. Even if treatments were effective for 20 years—which is unlikely to be the case where re-sprouting species such as alligator juniper and evergreen oak species are present—roughly 5 times more acres would need to be treated each decade than is fiscally achievable or proposed under any alternative. Where treatments occur and are maintained, firefighters would be able to engage in direct attack and risk to human values would be reduced. Where treatments do not occur, or are not maintained frequently enough, firefighters would not be able to engage in direct attack and risk to human values would either remain the same or increase, depending on site-specific circumstances. While additional partner investment could increase the rate and degree of progress being made toward desired conditions for the wildland-urban interface, the forest does not typically compete well for additional funding because of the low population densities within and surrounding the forest.

Alternatives 3 and 4 would be least likely to generate progress toward desired conditions for the wildland-urban interface, because the focus is on mechanical treatments and providing products to people. The wildland-urban interface is not likely to provide the type, quality, and quantity of products desired, which means this focus leads to fewer acres of treatment; fewer acres of treatments mean fewer opportunities for direct attack and greater risk to human values. In contrast, alternative 5 would restrict mechanical treatments to the wildland-urban interface, emphasizing fire management elsewhere. This provides the ability to treat more acres overall and, in the wildland-urban interface. Alternative 5 would provide the most opportunities for firefighters to engage in direct attack and the greatest reduction in risk to human values. Alternatives 1 and 2 are similar in their ability to move toward desired conditions, as alternative 2 would at a minimum, maintain the current emphasis on wildland-urban interface treatments. This means these alternatives would at a minimum, maintain the current ability to engage in direct attack and the risk to human values would likely remain the same.

Climate adaptation in the wildland-urban interface will require coordination, cooperation and shared risk management between public land managers, local governments, and private landowners. All alternatives support this with plan direction and management approaches in the Wildland, Fire and Fuels management and the wildland-urban interface management area. More discussion about opportunities to move toward shared goals and objectives for the wildland-urban interface can be found in the cumulative effects subsection of this section in the analysis.

Effects of Proposed Research Natural Areas Common to All Vegetation Types

Although research natural areas can be used to monitor climate change impacts (Massie et al. 2016), areas eligible for designation are in good condition, resulting from the predominance of natural processes. They do not need restoration treatments, although that would be allowable if needed to maintain the characteristics for which the areas were designated.

Alternatives 1, 2, and 5 carry forward the proposals for Turkey Creek and Rabbit Trap Research Natural Areas that were first brought forward during development of the 1986 forest plan. Alternative 1 also carries forward the proposals for Largo Mesa and Agua Fria Research Natural Areas, even though the updated evaluation found them ineligible for designation (see Research Natural Area evaluation process, appendix J). Alternatives 3 and 4 propose no new research natural areas. Despite these differences, there would be no substantial ecological effects to any of the ERUs associated with any of the alternatives due to the small number of acres involved, except for Rabbit Trap.

The proposed Rabbit Trap Research Natural Area has been excluded from livestock grazing since the 1940s. It was originally proposed during the last planning cycle as an example of recovery in a landscape that was historically overgrazed and will continue to experience grazing impacts. It also makes it an excellent candidate for monitoring climate change impacts and investigating relationships with land use. It may also serve as a refugial area for some species, such as Davidson’s cliff carrot (see Wildlife and Botanical species).

Research natural areas are intended to provide opportunities for research. Research can expand the scientific understanding and basis for land management decisions, potentially contributing to better management. On this basis, alternatives 2 and 5 would provide the greatest opportunities to advance scientific knowledge and improve management. Alternatives 3 and 4 would provide no such opportunities. Alternative 1 provides opportunities, but by including proposals for two research natural areas that don’t qualify for that status, it may also detract from these opportunities.

Effects of Recommended Wilderness Common to All Action Alternatives and Vegetation Types

Under alternative 2, the recommended areas are generally coincident with inventoried roadless areas and areas where terrain naturally constrains modes of access and mechanical treatments, and road infrastructure is essentially non-existent. The inventoried roadless area status, alone, does not preclude mechanical treatments; it just requires specific circumstances to be present and special permissions. On the Gila National Forest, inventoried roadless areas were delineated in large part, based on terrain. Whether within or outside inventoried roadless areas, steep and complex terrain increase the amount of engineering required and the cost of road infrastructure. Conventional ground-based harvesting equipment requires roads to enter an area and remove material. Conventional ground-based equipment cannot operate safely on slopes over 40 percent and specialized training and equipment are necessary. These areas also do not currently have a predicted potential for large, contiguous patches of high-severity fire, even under extreme fire weather conditions (see Wilderness Process, appendix H). They would not be high priority areas for restoration or adaptation projects that involve thinning treatments or require mechanized equipment.

Under alternative 3, the same general conditions are descriptive of recommended areas predominated by grasslands and historically open-canopy woodlands. However, where forested vegetation communities dominate, terrain may not be limiting and the potential for large contiguous patches of high-severity fire may occur under extreme fire weather conditions. Conversely, under alternative 4, the conditions described for alternative 2 are descriptive of recommended areas dominated by forested vegetation communities, but those dominated by grasslands or historically open-canopy woodlands may also be in relatively gentle terrain and have the potential for large, contiguous patches of high-severity fire under extreme fire weather conditions. Under alternative 5, recommended areas include all these conditions. All these alternatives include areas that could be targeted for restoration or adaption projects that necessitate thinning treatments or other mechanized equipment.

Table 31 displays the number of acres of each ERU that are recommended to Congress for wilderness designation by alternative.

Table 31. Upland ERU acres recommended to Congress for wilderness designation

ERU Name	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	478	1,994	0	2,387
Mixed Conifer with Aspen	4,636	6,121	0	8,970
Mixed Conifer-Frequent Fire	40, 620	44,678	403	98,080
Ponderosa Pine Forest	10,419	17,719	557	111,308
Ponderosa Pine-Evergreen Oak	9,961	12,369	2,568	66,766
Madrean Pinyon-Oak Woodland	782	272	1,674	10,278
Pinyon Juniper-Evergreen Shrub*	1,163	921	380	3,101
Pinyon Juniper Woodland	33,161	28,574	45,393	241,181
Pinyon Juniper Grass Woodland	1,410	2,524	4,327	74,972
Juniper Grass Woodland	0	11	7,464	35,943
Mountain Mahogany Mixed Shrubland	6,631	10,881	6,123	40,944
Montane/ Subalpine Grassland	0	456	183	13,711
Colorado Plateau-Great Basin Grassland	0	382	686	12,303
Semi-Desert Grassland	0	202	1,256	11,413
Total	**68,641**	**127,104**	**71,014**	**731,357**

* These acres have been reclassified and are now associated with the Pinyon Juniper Woodland ERU.

Plan direction for recommended wilderness areas precludes mechanical treatments as it does not conform to maintenance of wilderness characteristics. While this has the potential to impact management's ability to move vegetation communities toward desired conditions, modeling results generally do not suggest a compelling need for mechanical treatments to move toward desired conditions for each ERU. However, the models are not spatial, and the results do not describe the risk posed by spatially dependent processes such as fire. Where there are large, contiguous extents with relatively high probabilities of high-severity fire, strategic placement of mechanical treatments can enhance opportunities to manage fire on the landscape in such a way that the fire effects (identified previously) are mostly beneficial, vegetation conditions move toward desired conditions and adaptive capacity is restored (Krofcheck et al. 2018). Without mechanical treatments, the risk of detrimental effects, and movement away from desired conditions substantially increases.

Restrictions on mechanical treatments also have the potential to restrict future adaptation options. Evidence suggests that mechanical treatments could be necessary to maintain refugial areas (Krawchuck et al. 2016; Kolden et al. 2017). These areas might conserve biodiversity during times of unfavorable environmental conditions. The Climate Change Vulnerability Assessment provides a course, first approximation of where refugia are likely to be located (areas of low vulnerability), but it is not appropriate for identifying fine-scale refugial areas that might exist (in the sense of Ashcroft et al. 2009;

Krawchuck et al. 2016; Kolden et al. 2017). A fine-scale analysis of this type has not yet been conducted for the Gila National Forest.

While any recommended area represents a potential future constraint on management's ability to move toward and maintain desired conditions, including any refugia should they be present, the areas recommended under alternative 2 would not realistically ever going to need or see mechanical treatments. Alternative 5, however, recommends areas that could realistically be treated mechanically and have a need for treatment demonstrated by large contiguous areas susceptible to high-severity fire. While this alternative would provide for mechanical treatments outside of wildland-urban interface, if and where strategic placement is demonstrated by scientific analysis, the amount of area recommended to Congress for wilderness designation substantially reduces those opportunities. Alternatives 3 and 4 include some areas that could benefit from mechanical thinning treatments in the future, and some that are not realistically ever going to need or see mechanical treatments.

Cumulative Effects

Across the nation, federal and state land management agencies are focused on reducing wildfire risk and addressing climate change. These two focus areas are interrelated. Wildfire risk reduction aims to protect communities and critical ecosystem services like water supply from wildfire and undesirable post-wildfire effects. Factors that influence wildfire risk include fuel and weather conditions, which are influenced by climate change and disturbance history. Although the annual area burned generally remains below historical levels in the Southwest, wildfire activity has been increasing. Wildfire activity is expected to continue trending upward as climate change progresses, until fuels become limiting. Efforts to address climate change include mitigation (see Carbon and Climate cumulative effects section) and adaptation. Adaptation strategies have been and remain focused on restoring degraded or declining ecosystems and maintaining healthy ones to increase resistance and resilience to changing climatic conditions. This includes restoration of forest and woodland structure to that which we know supported the natural fire regimes that these ecosystems evolved with. In the southwestern United States, these were largely frequent, low-severity fires that would also be consistent with lower wildfire risk to human values.

National initiatives have recently made unprecedented levels of funding available, which has increased the importance of collaboration and coordination at federal, state, and local levels. In Arizona and New Mexico, strong alignment exists between federal and state strategic plans (NM EMNRD Forestry Division 2020; Arizona State Forestry Division 2020; NMDA 2019; USDA 2022; USDA FS 2015a; 2018a) and initiatives (USDA FS 2018a and 2022a) and the opportunities for shared efforts are many. Common themes include using a science-based approach; collaboratively solving forest issues; co-stewardship with tribal governments; shared stewardship with the states and other partners and stakeholders; and restoring and maintaining healthy, resilient, working landscapes. Together with their respective land departments, the New Mexico and Arizona State Forestry Divisions complete several thousand acres of fuel reduction treatments every year. Many of these treatments are developed in conjunction with private landowners and community wildfire protection plans, the county and municipal governments that helped develop those plans, or both. Wildland-urban interface treatments in the Gila and other national forests complement these activities.

To adapt to climate change, this work would include building resilience in urban-interface communities, especially those communities that have been historically underserved and are socially vulnerable to the impacts of climate change. New Mexico is working on an adaptation action plan to build resilience with grant funding from the Federal Emergency Management Agency (NM EMNRD Forestry Division 2020). New opportunities to move toward shared goals and objectives for climate resiliency in the face of the climate-driven wildfire threat are on the horizon. While Arizona's approach to adaption is driven more by its municipalities, all efforts contribute to achieving shared resiliency goals.

The Department of the Interior's Bureau of Land Management provides wildland firefighting for resource protection, as well as using fire as a management tool to improve the health of the land. In managing livestock grazing on public rangelands, the Bureau of Land Management's overall objective is to ensure the long-term health and productivity of rangelands and create the multiple environmental benefits that result from healthy watersheds. Treatment objectives in the revised forest plan are closely aligned with those of the Bureau of Land Management. Forest leadership and staff recently partnered with the Bureau of Land Management to conduct prescribed fires, and the opportunities for future joint efforts are many. These activities increase the capacity of both agencies to restore fire to the landscape and move toward desired conditions for vegetation communities and the wildland-urban interface.

The Department of the Interior's National Park Service contributes to the ecological integrity and sustainability of native vegetation communities and promotes restoring the natural role of fire on the landscape. The Gila National Forest has accepted the delegation for fire management on the closest National Park Service lands at the Gila Cliff Dwellings National Monument. Other National Park Service lands are located at a distance sufficient to limit opportunities.

Despite recent increases in funding and associated increases in staffing, there remains more work and greater urgency than resources are likely to be able to address. As the nation struggles to meet a diverse range of challenges (USGCRP 2018), resources have been and will likely remain focused near areas with higher population densities. Further, the escaped prescribed fires that resulted in the 2022 Hermits Peak and Calf Canyon fires within the Santa Fe National Forest, have reduced public support and acceptance of prescribed fire as a management tool. These fires are likely to have significant, lasting effects on the ability of the Forest Service to proactively address wildfire risk and other climate-related threats, especially in New Mexico. Over the near term, many areas in the Gila National Forest, and other remote public lands that could benefit from treatment are likely to remain untreated. This could lead to undesirable extents of stand-replacement fire, until fuels become limiting, particularly under more frequent, extreme fire weather conditions.

What are now considered extreme fire weather conditions, are likely to become the norm and fire seasons are also predicted to last longer. Some have projected that visitation to national forests will increase, with people taking trips to higher-elevation country seeking respite from the heat. This could lead to more human-caused wildfires. But these are not the only climate-driven changes that will affect vegetation communities. Climate change is also projected to amplify drought, and insect and disease activity. Drought alone is projected to lead to widespread regeneration failure in conifer species (McDowell et al. 2015 among others). Predicted increases in drought frequency, severity, and duration mean that many woody plants will require longer fire-free periods to produce enough seed to ensure species viability and that is not the most likely scenario (Enright et al. 2015). Compositional shifts in vegetation communities are predicted, and combined with amplified disturbance regimes, this could give non-native invasive or noxious species a competitive advantage. Vegetation productivity may decrease, but this could be partially offset by carbon dioxide fertilization.

The Climate Change Vulnerability Assessments conducted for national forests in Arizona and New Mexico suggest that high-elevation vegetation communities are at the greatest risk (Triepke 2015 and 2017a). For example, Spruce-Fir Forest occupies a small percentage of the landscape and is at the southernmost extent of its range on the Gila and Lincoln National Forests. Even a small rise in regional temperatures would likely lead to vegetation type conversions. While fine-scale refugia could be dispersed across the region, it is likely that areas of low vulnerability in the Santa Fe and the Carson National Forests would be the last remaining stronghold for these high-elevation plant communities. Middle elevation forests such as Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, and Ponderosa Pine-Evergreen Oak are also vulnerable because the area they occupied in the past is expected to shrink significantly. Refugia are likely dispersed across areas of low vulnerability but are probably limited in southeastern Arizona and southwestern New Mexico. On the Gila National Forest, only 1 to 8 percent of these middle elevation forest types are in areas of low vulnerability (Triepke 2015).

Pinyon juniper woodland types range from 4 percent (Pinyon Grass) to 57 percent (Pinyon Juniper Woodland) of their current extent on the Gila National Forest being mapped as low vulnerability; therefore, potentially containing refugial areas for the species occupying these systems. Forty-four percent of Mountain Mahogany Mixed Shrubland is mapped as low vulnerability. The vulnerability of Gila National Forest grassland systems varies from 1 percent of Montane/Subalpine Grasslands to 24 percent of Colorado Plateau/Great Basin Grassland, to 39 percent of Semidesert Grassland.

Warmer, drier conditions are generally expected to favor herbaceous cover, but elevated carbon in the atmosphere will favor woody species (Godde et al. 2021). There is already evidence to suggest that vegetation type conversions to desert shrub systems are in progress within the region's Semidesert Grassland (Triepke 2017a). However, there are multiple interacting causes of shrub encroachment. A study of central New Mexico shrub encroachment indicates that under past climate, grazing was the most important driver of encroachment but that as climate change progresses, climate will become the most important driver (Caracciolo et al. 2016). Signals of change are likely present (reduced snowpack) but not as readily measurable in the more vulnerable Montane/Subalpine Grasslands as reduced snowmelt contributions lead to lower soil moisture conditions and lower recharge to the shallow groundwater that often supports wet meadows.

Many jurisdictions embrace the Resistance-Resilience end of the climate adaptation spectrum, but there is a general inertia around Transition strategies such as assisted gene flow and range expansion (Butt et al. 2021). An example of assisted gene flow would be planting or seeding the local native species with plant materials from warmer, drier areas in the same species range. Assisted range expansion involves planting native species in areas where they may not have occurred previously but are expected to act as refugia for those species in the future. It can also involve moving other life forms such as insects, fish, and wildlife to sites that are expected to provide suitable habitat in the future.

Resistance-Resilience strategies are probably only viable long term in areas of low vulnerability. Areas of moderate and greater vulnerability may derive some benefit from these strategies, but Transition strategies would be necessary in some places and circumstances. Almost by definition, this would require coordinated, cross-jurisdictional removal of barriers and risk-sharing across state and international boundaries. Barriers are primarily psychological and sociopolitical (Butt et al. 2021) and those barriers can be overcome. Uncertainty and risk of unintended consequences are the reality, but there are management tools to help manage that risk and support decision making (for example, Karasov-Olson et al. 2021, Rodman et al. 2022, and Sample et al. 2022).

At a more local level, the opportunities for working across jurisdictional boundaries with agricultural extension services, soil and water conservation districts, county government, municipality governments, and volunteer fire departments are many. This includes making progress toward shared goals of reducing wildfire risk, expanding the adoption of Firewise practices in our communities, and managing non-native invasive species. The Town of Silver City Sustainability Plan 2030 recognizes that longer and more active fire seasons and more post-fire landscapes are expected in the Gila National Forest, which are likely to affect demand for public services (Susillo et al. 2013). In the future, local communities are likely to undertake more climate-resilient planning efforts and actions. Maintaining and strengthening relationships between local emergency services departments is a social Resilience adaptation strategy that Gila National Forest leadership and staff have and will continue to invest in during plan implementation.

Mining is not a currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. If mining expansion, or new mining activities that include lands managed by the Gila National Forest occur, desired conditions for those vegetation communities may become unattainable for the foreseeable future. These effects are not documented in the Gila National Forest because of current adjacent mining activities, but future mining expansion could change that.

Mining activities are subject to valid existing rights and the decision whether to allow mining is outside the authority of the plan. However, the Forest Service Southwestern Region intends to use a strategy to work toward jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups, and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b).

Military training flights over the Gila National Forest occur to some extent, although recent proposals to expand the use of airspace in the vicinity have been dropped in favor of other options. These flights may involve dropping flares that can start wildfires. There is no evidence that these military exercises have started wildfires, but it remains a threat.

Climate and Carbon

Affected Environment

Climate, or the average weather, is the primary system driver. Climate largely determines the timing, quantity, duration, and distribution of available water, and influences all ecological characteristics and processes including, but not limited to rates of soil formation and loss, fire regimes, patterns of insect infestations and disease outbreaks, and the distribution and abundance of plant and animal species.

Although regional climatic regimes persist for centuries, they do change, and vegetation responds on a similar scale (Delcourt and Delcourt 1983). While climate has always undergone change over time, a sizeable body of science suggests the extent, magnitude, and rate of change we are currently undergoing may prove to be unprecedented in the context of the last two million years (Safford et al. 2012). In the southwestern United States, climate modelers agree there is a drying trend that will continue well into the latter part the century (IPCC 2007; Seager et al. 2007). While some models have predicted an increase in precipitation (IPCC 2007), rising temperatures are the primary concern, as they are expected to increase evaporation such that an overall decrease in available moisture remains likely.

Evidence of predicted warming trends is demonstrated in the New Mexico Southwestern Mountains and Southern Desert climate divisions where the data reveal average annual temperatures in the area have not dropped below the period of record average since the mid-1990s (USDA FS 2017a). Additionally, streamflow data demonstrate average flow has decreased in the winter and spring months (December through May), peak snowmelt runoff is occurring earlier, and the snowmelt runoff period is shortening (USDA FS 2017a). Furthermore, there is a declining trend in the median and average annual streamflow for some streams within the Gila National Forest (England 2002; Triepke 2013; USDA FS 2017a). These changes are consistent with climate predictions for the southwestern United States.

Climate change is not just a predicted future event. Climate change is happening now, and it is happening much faster than predicted. Recently published studies reveal the recent drought across southwestern North America is on track to be a megadrought comparable to the event in the late 1500s and that human-caused climate trends explain almost half the drought severity (Park Williams et al. 2020). While the state of the knowledge needed to address climate change at a broad scale is still evolving, sufficient information is available to inform national forest management. Fortunately, many of the management approaches that managers can implement in the face of change and uncertainty, are supported by science under any climate scenario.

Current science suggests that forests and woodlands on both public and private lands could play a substantial role in the sequestration of carbon and climate change mitigation (USDA FS 2017a; among others). Carbon is stored primarily as soil organic carbon or vegetative biomass carbon. It has been estimated that lands within the Gila National Forest's administrative boundaries are currently sequestering approximately 211 million tons of carbon as above-ground vegetative biomass and soil organic carbon (USDA FS 2017a).

Despite some uncertainty in annual carbon stock estimates, there is a high degree of certainty that carbon stocks on the Gila National Forest were stable between 1990 and 2013, with about a 4 percent decrease due to wildland fire (Mizuno et al. 2022c). Stands on the Gila National Forest are mostly middle to older aged,[16] and the rate of carbon uptake and sequestration generally decline with age (Mizuno et al. 2022c). Data describing changes since 2013 are expected to become available in 2024.

Effects of future climate conditions on carbon storage are complex and remain uncertain. However, forests and woodlands may be increasingly vulnerable to a variety of stressors. While some treed areas may transition to other vegetation types, management efforts aim to keep forests as forests, and woodlands as woodlands, for the foreseeable future. This will allow for continuation of carbon uptake and storage over the long term (Hurteau et al. 2016, Hurteau 2017). Carbon carrying capacity is a term acknowledging that the amount of carbon that can be stored in an ecosystem has limits. It depends primarily on vegetation community characteristics under predominant climatic and natural disturbance regimes (Keith et al. 2009; Keith et al. 2010; among others), and on soil properties.

Carbon enters and exits the biomass and soil organic carbon pools through fluxes. The primary fluxes influenced by management on federal public lands are natural growth, wildland fire and mechanical thinning treatments. The balance between carbon uptake and storage, and release to the atmosphere, is vital to maintaining these lands as a net carbon sink. As the carbon stored by vegetation approaches or exceeds the carrying capacity of the ecosystem, it becomes a wildfire liability (Hurteau et al. 2008; Hurteau et al. 2016; Hurteau 2017; Liang et al. 2017). Today's carbon sink becomes tomorrow's carbon source. Retaining the maximum amount of carbon that a site can biologically produce is not sustainable over the long term.

Mechanical thinning treatments often involve the harvest and removal of carbon from the forest in the form of wood products. These types of activities are a tool to help ensure forests remain a net carbon sink by restoring the conditions that support natural fire regimes. Some of this carbon may remain in storage for a period as lumber for buildings, furniture, or pallets. Some of it is used for cooking, heating, or other types of biomass energy generation. There remains some debate about the release of carbon and other greenhouse gases from the combustion of these types of wood products. Some assert that wood products are replacing fossil fuels and thus mitigates climate change. Others suggest it still contributes greenhouse gases to the atmosphere and that avoiding wood products for these purposes is a "natural climate solution" (Griscom and others 2017 among others).

Smoke generated by wildland fire contains many greenhouse gases, including carbon dioxide (National Research Council 2004). To date, there has been no binding commitment by the federal government or Forest Service for regulating carbon dioxide and other greenhouse gases emitted from naturally ignited or

[16] Recall that tree age and tree size are not necessarily correlated. Old trees may be relatively small, like some of the aspen re-sprout from the 1950s McKnight Fire. The small stand of aspen trees along the ridge at the head of McKnight Canyon were not much more than 4 inches in diameter roughly 60 years later when the area re-burned in the 2013 Silver Fire. Conversely, large trees are not necessarily old. It depends on site conditions.

prescribed wildland fire. Smoke also contributes to so-called “global brightening and dimming effects.” Like climate change, brightening and dimming effects are a natural phenomenon influenced by human activities. These effects are tied to atmospheric concentrations of aerosols, which are basically very fine particulate matter in the air. Higher concentrations of aerosols absorb more of the sun’s heat energy, “dimming” the effect of that heat energy and keeping temperatures cooler. Lower concentrations of aerosols have a “brightening” effect, allowing more the sun’s heat energy to reach the Earth’s surface, contributing to warmer temperatures. Aerosol levels in the atmosphere naturally fluctuate with events like wildfire, volcanic eruptions, and dust storms.

Prior to implementation of the Clean Air Act and similar regulations elsewhere in the world, human-elevated levels of aerosols enhanced the dimming effect and reduced observed rates of climate change. Better air quality because of actions taken under air quality regulations have reduced aerosol concentrations, activated the brightening effect in some locations around the globe. Some speculate that it is accelerating the rate of observed climate change. However, the role of the brightening and dimming effect on climate change remains secondary to the role of greenhouse gases (Wild 2009). While wildland fire has been and is expected to remain the primary source of greenhouse gas and fine particulate matter emissions generated from lands managed by the Gila National Forest, other activities also contribute.

Activities dependent on the combustion of fossil fuels, specifically Forest Service operations, motorized uses including forest access, mechanical vegetation treatments, and mining generate greenhouse gases. Methane, another carbon-based molecule and greenhouse gas, is approximately 25 times more potent than carbon dioxide. It is released in combustion of vegetation and fossil fuels, and by the digestive processes of most grazing animals and microorganisms that inhabit saturated soils like wetlands. Livestock production and rice cultivation are two of the largest agricultural sources of methane globally. Grazing animals with two stomach compartments, like cattle, produce substantially more methane than those with a single stomach compartment such as elk, deer, or horses.

Additionally, any activity that generates dust, generates particulate matter that can contribute to aerosol formation; the extent of bare soil and moisture conditions are the primary factors influencing the amount of dust generated by activities in the forest.

Environmental Consequences

The following discussion of environmental consequences addresses the effects of the alternatives on climate and carbon. The effects of plan content on climate impacts on natural resources and resources uses are discussed in those sections of this chapter.

Analysis Methodology

Carbon Storage and Emissions

Carbon stored as above-ground vegetative biomass is analyzed quantitatively using coefficients that correspond to the various states that a particular vegetation community can express. For grasslands and shrublands, these coefficients were developed based on information gleaned from the scientific literature and web resources (Scott and Burgan 2005; USDA FS 2012a). For woodlands and forest/timber type vegetation communities, the coefficients were developed based on FIA data, collected across Arizona and New Mexico and the carbon sub-model of the Forest Vegetation Simulator-Fire and Fuels Extension (Weisz et al. 2010). These coefficients are available in the project record.

The average per acre biomass carbon stored in each vegetation type is calculated based on the current and modeled future distribution of vegetative states and compared to desired conditions in terms of percent departure. Desired conditions for biomass carbon are derived from the desired conditions for the distribution of vegetative states specific to each vegetation type. In this analysis, those desired conditions are synonymous with carbon carrying capacity. As this analysis relies heavily on the state-and-transition modeling done for vegetation, it carries with it all associated assumptions (see Upland Vegetation, Fire Ecology and Fuels analysis methodology).

The results are summarized and discussed for grassland, shrubland, woodland, warm-dry forest/timber types and cold-wet forest/timber types on an area-weighted basis. Alternatives are compared to one another based on whether they are trending conditions toward or away from desired conditions. Like the approach taken in the assessment with departure from reference conditions, if departure is 33 percent of or less, it is within desired conditions. As the models are only capable of reflecting woody vegetation dynamics, trends in understory biomass are not represented here (see Upland Vegetation, Fire Ecology and Fuels analysis methodology). This is addressed qualitatively. Soil organic carbon is also analyzed qualitatively, as it is not a model output. The scientific literature is used to support qualitative analyses.

Emissions associated with mechanical treatments and fire management activities are also analyzed quantitatively based on the smoke emissions modeling that supports the air quality analysis; therefore, carrying with it all the associated assumptions (see air quality analysis methodology). Greenhouse gases included in these model projections include carbon dioxide, carbon monoxide, methane, and non-methane hydrocarbons. Particulate matter is also a model output but is not analyzed here as brightening and dimming effects are a secondary driver of global change (Wild 2009). Inferences are also drawn from the state-and-transition modeling. Emissions generated by Forest Service operations motorized uses including forest access, energy and mineral development, and dust generation are analyzed qualitatively.

Changed Circumstances

Based on the evaluation of the changed circumstances introduced by the 2022 Black Fire in the Upland Vegetation, Fire Ecology and Fuels section of this document, it was determined that further evaluation for this analysis was not warranted as the information supporting the evaluation of carbon storage is reliant on the modeling analysis for Upland Vegetation, Fire Ecology and Fuels.

Livestock Emissions

McGinn and others (2011) estimate that cattle typically produce 141 grams of methane per day per animal plus or minus 147 grams (2011). This analysis assumes the worst-case scenario of 300 grams of methane per day per animal. Animal unit months (AUMs) are an estimate of how much forage a 1,000-pound cow with a calf less than 3 months old will eat in one month. The livestock grazing section in this chapter estimates a range of potential change in AUMs associated with each alternative. These values were converted to animal days to estimate annual and decadal methane emissions; therefore, this analysis carries with it all the assumptions associated with the estimation of AUMs.

Area Designations

Area designations can influence how the forest manages for ecosystem characteristics, including carbon. Designations that substantially change the allowable types of activities, equipment, and modes of access and travel have the potential to influence the extent and distribution of effects and at times, the outcomes of management activities. Area designations with this potential include designated wilderness, recommended wilderness, designated and proposed research natural areas, inventoried roadless areas, and other administrative designations. The effects depend on the designation, amount of area involved, vegetation types and conditions that exist within that area, and the terrain. Terrain can limit the types of activities, equipment, and modes of access and travel just as effectively as a designation. The effects of proposals or recommendations for new area designations contained within each alternative are discussed qualitatively relative to these management factors and evaluated based on whether they are consistent with opportunities to move toward desired conditions for carbon. Existing designated wilderness, research natural areas, and inventoried roadless areas are not discussed, as they do not contribute to differences in effects among alternatives. Special botanical areas proposed under alternatives 2 and 5 are not analyzed, as the plan direction for their management does not substantially change the types of activities, disturbances, or associated effects at the ecosystem level.

Climate Change Impacts and Mitigation

Plan direction is analyzed in terms of how well it maintains the forest as a net carbon sink and mitigates the contributions of forest management to carbon emissions. Climate change may impact our ability to manage toward desired conditions for carbon storage within the forest, which is considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

Although alternative 1 contains no provisions for sustainable Forest Service operations as the proposed action and the other alternatives do, it is an agency-wide initiative. As such, sustainable operations would be implemented under all alternatives, regardless of plan content. Sustainable operations include measures Gila National Forest staff take to increase energy efficiency, reduce energy consumption and other practices that reduce greenhouse gas emissions associated with the daily business of managing the forest.

Greenhouse gas emissions generated by forest users are primarily transportation related. Existing or proposed designations that limit the area where motorized travel is allowed are not expected to influence associated emissions. Motorized use would not decline because of these proposals, recommendations, or designations. Motorized use would only become more concentrated in the areas where it is allowed. Furthermore, increased visitation (see recreation section) and an aging population more dependent on motorized access could lead to increased emissions associated with motorized access.

Energy and mineral development can also be a source of greenhouse gas emissions, but these activities are driven primarily by law, regulation, and market forces rather than plan direction.

Herbivory by permitted livestock also removes biomass carbon (Erb et al. 2018), and many have speculated that this translates to a reduction in soil organic carbon. Some studies support this speculation (Schulz et al. 2016; Deng et al. 2017); however, some studies suggest that proper grazing management increases soil organic carbon over no grazing (Reeder and Schuman 2002; Schuman et al. 2002), and that grazing intensity and stocking rates may be determining factors in carbon storage outcomes (Conant and Paustian 2002; Liu et al. 2012). As all alternatives contain direction requiring the livestock grazing be compatible with movement toward desired conditions for vegetation and soil, no declines in soil organic carbon are expected and increases are possible.

While methane does not persist in the atmosphere nearly as long as carbon dioxide, methane is 25 to 30 times more potent. Methane emissions from permitted livestock would continue under all alternatives with fluctuations arising from allotment-specific decisions. There may also be some fluctuations that could be indirectly attributed to plan objectives for vegetation communities that aim to reduce woody vegetation densities and move toward desired conditions. To be clear, the plan does not propose a change in AUMs. Any such changes would be subject to separate allotment-specific environmental analysis and decision-making process in the future. However, relationships are present between woody vegetation density and herbaceous cover. This could mean a change in forage availability because of vegetation objectives. As forage availability is also dependent on climatic factors, there is substantial uncertainty associated with the estimation of changes in AUMs (see Livestock Grazing section in this chapter) and emissions. The vegetation objectives, and their estimated effects on methane emissions vary amongst alternatives, but not substantially. Table 32 displays the estimated methane emissions by alternative.

Table 32. Methane emissions (expressed tons) per 10-year period

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Minimum	26, 915	29, 255	29, 255	29, 255	29, 255
Maximum	29, 255	29, 840	28,963	29,401	30,425

Again, all alternatives have objectives for vegetation communities that include some combination of mechanical treatments and fire. As a result, all alternatives would have an initial carbon cost. Mechanical equipment runs on fossil fuels, which emit greenhouse gases to the atmosphere. Much of the biomass removed because of mechanical treatments will leave the forest as wood products. Most of those wood products are fuelwood or go to make pallets. Some of the higher quality products are saw logs that are milled locally. Burning of fuelwood results in greenhouse gas emissions. Moving away from using fuelwood for heating, cooking, and energy generation purposes is considered by some to be a natural climate solution (Griscom and others 2017). The plants that provide this fuelwood capture roughly as much carbon while they are growing as they emit when they are burned and are considered a carbon-neutral energy source by some (USEIA 2021).

Alternately, if fuelwood replaces the use of fossil fuels, it may result in lower emissions overall (USEIA 2021). Pallets and other products that are not burned immediately continue to provide carbon storage off-forest for the life of their use. The removal of this material also reduces the amount of biomass available to burn when mechanical treatments are followed by prescribed fire or wildfire, which can substantially reduce greenhouse gas emissions associated with those events (Hurteau et al. 2008 among others).

Fire-caused greenhouse gas emissions would continue under all alternatives, but would vary in frequency, magnitude, and duration, depending on a variety of factors. These factors include but are not limited to vegetation types and conditions targeted for treatment; preferred treatment tools and combinations of tools; and the number of acres proposed to be treated. Proposals for designations that limit treatment tools and extents also contributes to differences among alternatives in some cases. Regardless, wildfire remains the dominant driver of emissions under all alternatives, representing between 87 and 98 percent of the total greenhouse gas emissions.

In the Southwest, carbon emissions generated by fire can exceed fossil fuel emissions at regional scales (Wiedinmyer and Neff 2007 as cited in USDA FS 2017a). In their study of fire emissions, Wiedinmyer and Neff (2007, as cited in USDA FS 2017a) found that on average, 4 to 6 percent of the total human-caused emissions in the United States arise from wildland fire. In a separate study, Woodbury and others (2007, as cited in USDA FS 2017a) estimated that 10 percent of the total human-caused emissions in the United States are captured by forest vegetation, which suggests that forests can sequester more carbon than they emit and may become an offsetting solution.

Treatments in vegetation types that historically supported frequent surface fires would reduce the carbon stocks held in the forest and would likely result in greenhouse gas emissions over the short term. Over the long term, research demonstrates these treatments increase the likelihood of maintaining a net carbon sink into the future (Finkral and Evans 2008; Hurteau et al. 2016; Hurteau 2017; Hurteau et al. 2018). Post-treatment, biomass carbon stocks can recover quickly if the large fire-resistant trees remain (Hurteau and North 2010), which is easier to ensure with mechanical treatments, as fire is not a precise tool. A tradeoff associated with mechanical treatments is that they can increase nitrous oxide and methane emissions from the soil in some cases (Cambi et al. 2015).

Fire's influence on soil organic carbon stocks depends on severities and their extents. While mixed- and high-severity fire have been shown to result in the greatest soil organic carbon losses, low-severity fire has recently been demonstrated to lead to the loss of soil organic carbon as well (Jian et al. 2018). Low-severity fire leads to abrupt volatilization of water held in the pores of soil aggregates. The resulting changes in pressure expose organic carbon that had been protected in the aggregate structure, decomposition processes are initiated, and emissions from the soil increase (Jian et al. 2018). Fire also creates what is known as pyrogenic carbon, which includes soot, charcoal, biochar, and black carbon.

The physical and chemical characteristics of pyrogenic carbon depend on many variables, such as vegetative species it was formed from and the characteristics of the fire that created it. Initially, carbon in this form was thought to be highly stable for as long as centuries. Recent studies indicate that this may only be true for some types of pyrogenic carbon. A part of the carbon stored in pyrogenic forms is highly water soluble and degradable, and as a result, has a shorter residence time in the terrestrial carbon pools than the vegetative biomass from which it was formed (Santin et al. 2016). The potential role of soil organic carbon in mitigating climate change may be exaggerated. No organic carbon substance is resistant to the microbial decomposition processes that release greenhouse gases (Lehmann and Kleber 2015). Further, recent studies demonstrate the net loss of soil organic carbon due to warming has been substantially underestimated (Soong et al. 2021; Nottingham et al. 2020). Both short- and long-lived pyrogenic carbon would accumulate under each of the alternatives, but it isn’t possible to predict which would predominate.

Finally, dust would continue to be generated because of all the activities identified in this section. Dust generated by livestock is negligible and is expected to remain so or decrease as vegetation moves toward desired conditions. Dust generated by motorized travel across the forest, could increase with projected increases in visitation (see Sustainable Recreation section). Dust originating from patches of mixed- and high-severity fire are possible under all alternatives, with the significance depending on a variety of incident- and site-specific circumstances that make differentiating differences between alternatives highly speculative.

Effects Common to Alternatives 1, 3, and 4

Table 33 displays the greenhouse gas emissions projected to be generated because of the plan objectives for vegetation communities associated with these alternatives.

Table 33. Greenhouse gas emissions (expressed in millions of tons) generated because of prescribed and naturally ignited wildfire under alternatives 1, 3, and 4

Greenhouse Gas	Alternative 1	Alternative 3	Alternative 4
Methane	0.02	0.02	0.02
Carbon monoxide	0.46	0.40	0.41
Carbon dioxide	9.99	8.63	8.80
Non-methane hydrocarbons	0.02	0.02	0.02
Total	10.49	9.07	9.25

Differences between the alternatives are minimal with 13 percent separating the highest and lowest emissions scenarios. To place this in context, the carbon dioxide generated by alternative 1 represents the equivalent of 2.1 million passenger vehicles driven for one year, or the electricity used for one year in 1.7 million homes.[17] While these three alternatives represent the lowest greenhouse gas emission scenarios of all the alternatives, they do the least to prevent large emission pulses from wildfire events not predicted by the state-and-transition or emissions models (see Upland Vegetation, Fire Ecology and Fuels). This could manifest itself in higher actual emissions than projected.

[17] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Effects Specific to Alternative 2

Greenhouse gas emissions projected to occur under alternative 2 (46.92 million tons) are about five times higher than alternatives 1, 3, or 4. However, it is less likely that higher than projected emissions would occur, as this alternative does more to reduce the risk of large emission pulses from wildfire events not predicted by the state-and-transition or emissions models.

Effects Specific to Alternative 5

Greenhouse gas emissions projected to occur under alternative 5 (87.77 million tons) are about 10 times higher than alternatives 1, 3, or 4, or double that of alternative 2. However, it is less likely that higher than projected emissions would occur, as this alternative does more to reduce the risk of large emission pulses from wildfire events not predicted by the state-and-transition or emissions models.

Effects Common to Grasslands

In grassland ecosystems, most of the carbon is stored in the soil. It is inferred from the estimates contained in the assessment report that at least 93 to 95 percent of the total ecosystem carbon would be these grassland soils under reference conditions (USDA FS 2017a). Current biomass carbon is greater than desired in Montane/Subalpine Grasslands and Colorado Plateau/Great Basin Grasslands due to woody encroachment. Current biomass carbon is lower than desired conditions in Semi-Desert Grasslands due to a large reduction in the carbon-rich, high ecological status grassland state (USDA FS 2017a). Modeled results for biomass carbon under each alternative are presented in figure 26 and discussed relative to the alternatives in the subsequent subheading.

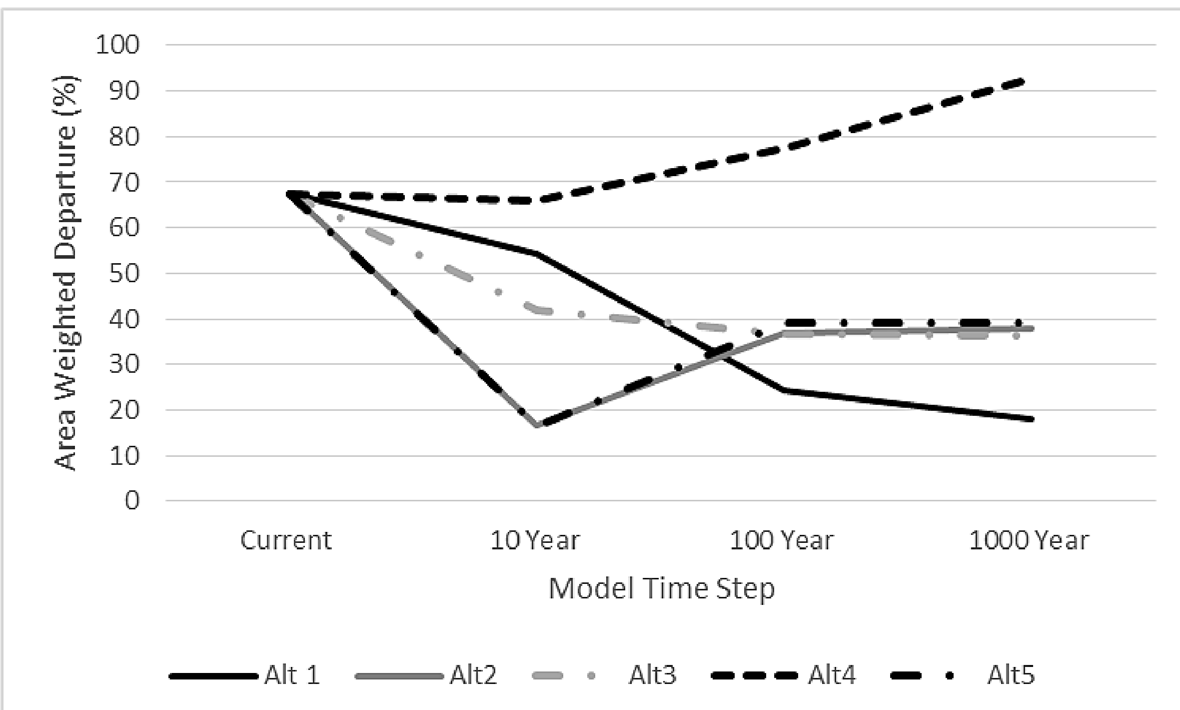


Figure 26. Grassland biomass carbon departure from desired conditions

Alternatives 1, 2, 3, and 5

Woody encroachment into grasslands is commonly thought to increase carbon storage; however, this is not universally true. A study by Jackson and others (2002) revealed that it depends on precipitation, with drier sites gaining soil organic carbon and wetter sites losing to the degree that gains in biomass carbon were offset (Jackson et al. 2002). The apparent tipping point between a net gain and a net loss in total ecosystem carbon appears around an average of 19 to 20 inches of precipitation annually (Jackson et al. 2002). The Gila National Forest contains grasslands both above and below the tipping point. The net reduction in woody encroachment observed for these alternatives would be responsible for moving toward desired conditions for biomass carbon. While ecologically appropriate in many regards, this is likely to lead to a net gain in total ecosystem carbon storage for upper elevation, higher precipitation grasslands and a net loss of total ecosystem carbon in lower elevation, lower precipitation grasslands. These alternatives would move biomass carbon toward desired conditions, although at different rates and through different treatment methods.

Alternative 4

Alternative 4 has no treatment objectives for grasslands outside the wildland-urban interface, which would result in an increase in woody vegetation and movement away from desired conditions for biomass carbon. This would lead to a net gain in total ecosystem carbon storage for lower elevation, lower precipitation grasslands and a net loss in upper elevation, high precipitation grasslands (Jackson et al. 2002).

Effects Common to Mountain Mahogany Mixed Shrubland

The distribution of total ecosystem carbon in shrublands differs from grasslands. Although most of it is still held as soil organic carbon, there is a larger percentage held as biomass carbon. It is inferred from the estimates contained in the assessment report that at least 61 percent of the total ecosystem carbon would be in these shrubland soils under reference conditions (USDA FS 2017a). Current biomass carbon stocks are higher than desired, due to higher diversity of tree-dominated sites. Modeled results for biomass carbon under each alternative are presented in figure 27 and discussed relative to the alternatives in the subsequent subheading.

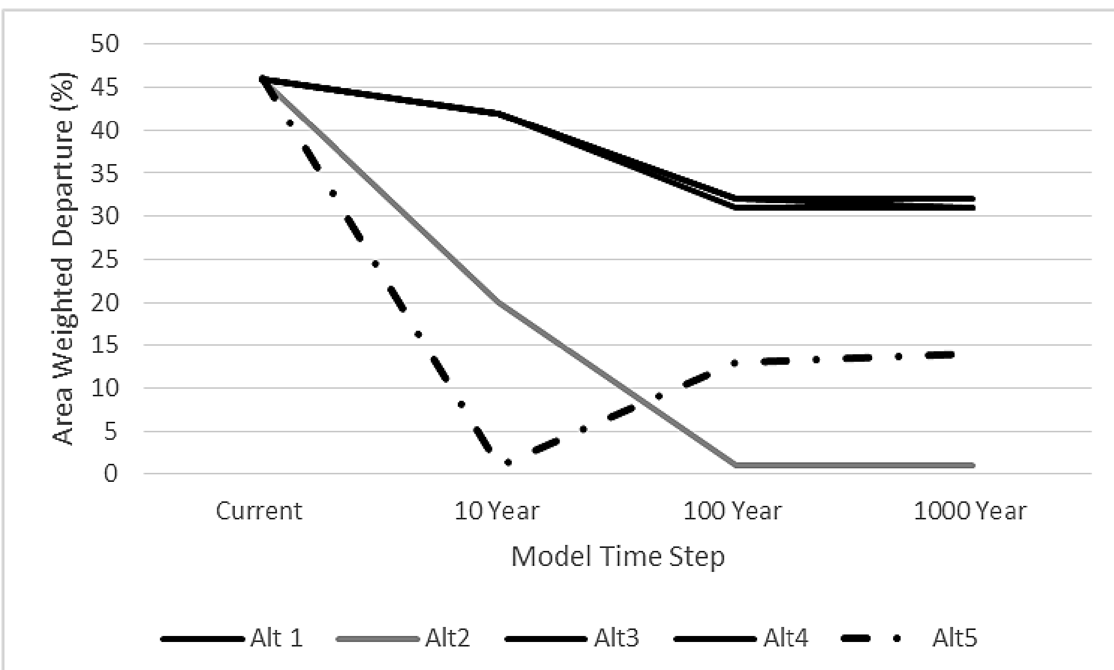


Figure 27. Shrubland biomass carbon departure from desired conditions

All Alternatives

No alternative proposes shrubland treatments. Wildfire is projected to continue moving biomass carbon toward desired conditions. While ecologically appropriate on many levels, this means less carbon is stored as biomass. Soil organic carbon may accumulate faster in shrublands because of mixed-severity fire (Feng et al. 1999). But the timing between fire, re-sprouting response of shrub species, slope gradient, and the precipitation events that follow fire may lead to different outcomes for soil carbon. All these factors influence erosion rates. Soil loss reduces the amount of carbon held on site. Where soil loss crosses a threshold, it can reduce the site's ability to generate the same quantity and quality of biomass and soil organic carbon into the future. There remains a fair amount of uncertainty though, as the limited research found on this topic comes from the chaparral systems of California.

Effects Common to Woodlands

Like other ecosystem types, most of the carbon captured by woodlands is held in the soil. It is inferred from the estimates contained in the assessment report that at least 60 to 71 percent of the total ecosystem carbon would be in these woodland soils under reference conditions (USDA FS 2017a). Current biomass carbon is within desired levels for all woodlands except Pinyon Juniper Grass Woodland, which is outside desired conditions due to young trees infilling openings. Modeled results for biomass carbon under each alternative are presented in figure 28 and discussed relative to the alternatives in the subsequent subheading.

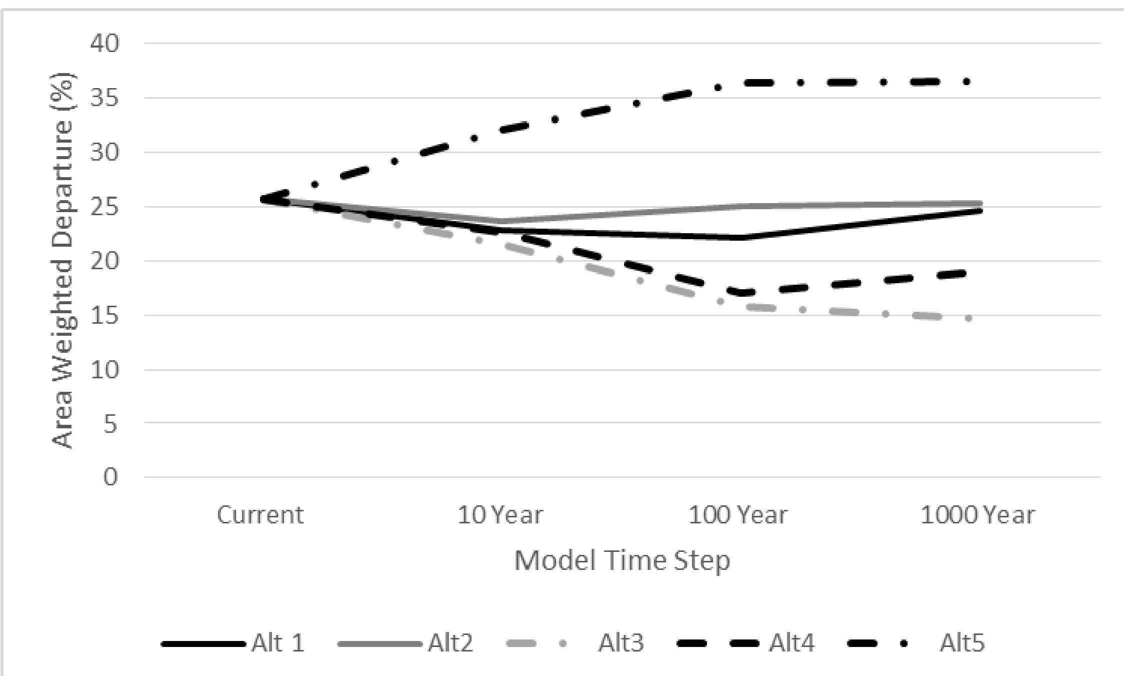


Figure 28. Woodland biomass carbon departure from desired conditions

Alternatives 1, 2, and 3

Carbon dynamics in woodland systems have not been specifically studied to the degree that grasslands and forest/timber types have been, but there are similarities. Work by Rau and others found reductions in biomass carbon following treatments had no effect on soil organic carbon (Rau et al. 2010); however, their study involved a single soil type. Given subsequent work has demonstrated that even low-severity prescribed fire can lead to losses in soil organic carbon (Jian et al. 2018), treatments are likely to maintain current carbon storage in the soil or lead to losses. However, the carbon preserved in the soil by preventing large, contiguous extents of high-severity wildfire are expected to far outweigh losses associated with treatment. These alternatives would maintain biomass carbon within desired conditions.

Alternative 4

Alternative 4 has no treatment objectives for woodlands outside the wildland-urban interface, yet it would still maintain biomass carbon within desired levels, because of naturally ignited wildfire.

Alternative 5

Alternative 5 would use no mechanical treatments outside the wildland-urban interface, relying entirely on prescribed fire and naturally ignited wildfire. However, the number of acres experiencing fire each decade would lead to movement away from desired conditions for biomass carbon, as tree densities on some sites dip below the 10 percent threshold that is used to differentiate between grasslands and woodland.

Effects Common to Warm Dry Forests

Like other ecosystem types, most of the carbon captured by warm, dry forests is held in the soil. It is inferred from the estimates contained in the assessment report that at least 49 to 79 percent of the total ecosystem carbon would be these forest soils under reference conditions (USDA FS 2017a). Current biomass carbon is within desired levels for Ponderosa Pine Forest and Mixed Conifer-Frequent Fire but is higher than desired in Ponderosa Pine-Evergreen Oak. Ponderosa Pine Forest and Mixed Conifer-Frequent Fire are the ecosystems that have been researched the most. These studies suggest these forest types have a greater likelihood of maintaining net carbon sink if biomass is reduced and fire is returned to its natural role (Hurteau 2017 among others). Modeled results for biomass carbon under each alternative are presented in figure 29 and discussed relative to the alternatives in the subsequent subheading.

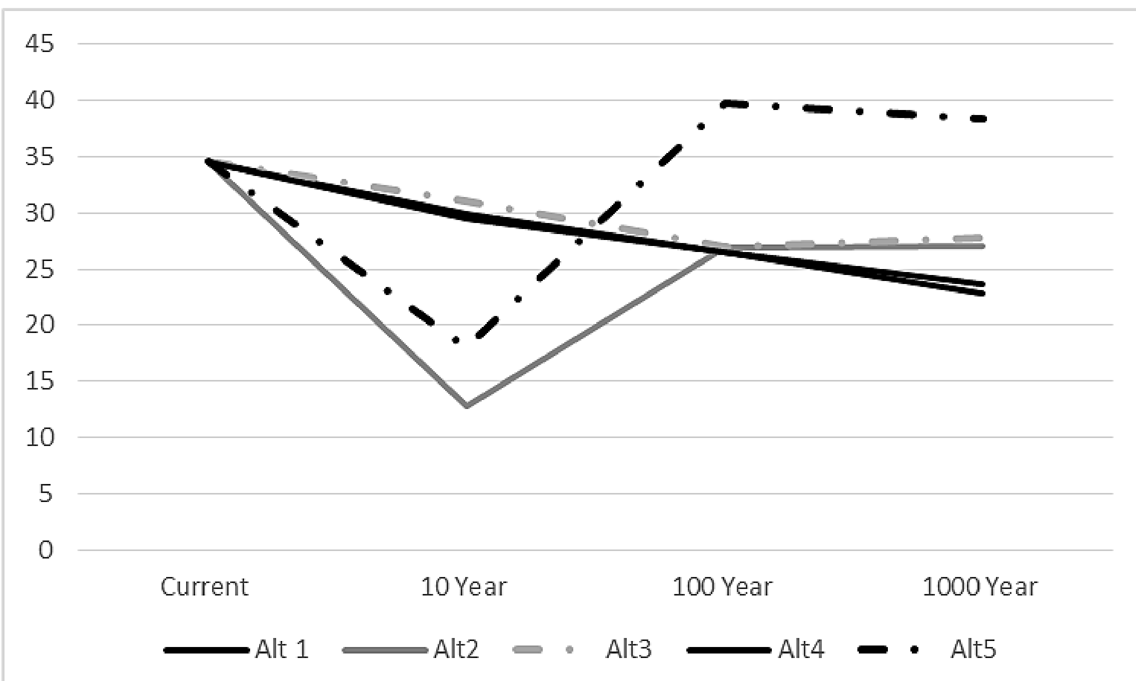


Figure 29. Warm dry forests biomass carbon departure from desired conditions

Alternatives 1, 2, 3, and 4

Under these alternatives, biomass carbon would remain within desired conditions for the warm, dry forests, and slow, steady reductions in biomass carbon would move it closer. The differences in treatment methods may contribute to differences in soil organic carbon.

Alternatives 1, 2, and 4

Mechanical treatments can reduce soil organic carbon in forested vegetation communities (Achat et al. 2015), with some studies demonstrating a 25 percent loss in deep carbon storage (Gross et al. 2018). Other studies have shown that the soil organic carbon response is specific to each site, the species it contains, and thinning intensity (Clarke et al. 2015). The carbon preserved in the soil by preventing large, contiguous extents of high-severity wildfire is also a consideration that must be weighed. Where treatments prevent such severity distributions, it is likely that retention of soil organic carbon storage outweighs the costs associated with treatment.

Alternative 4

This alternative would reduce the use of prescribed fire in favor of more mechanical treatments. Mechanical treatments alone have not been demonstrated to stabilize carbon stocks during future wildfire events to the degree that they can when combined with and are maintained by prescribed fire (Krofcheck et al. 2017).

Alternative 5

Alternative 5 is the only alternative that would move biomass carbon storage further away from desired conditions during the modeled time steps. This is due to an increase in open-canopy states dominated by medium to very large trees (see Upland Vegetation, Fire Ecology and Fuels section). Large trees[18] sequester carbon at a higher rate (Stephenson et al. 2014) and are typically more fire-resistant than smaller trees, which leads to more carbon stability over the long term. Given margins of error associated with the analysis methodology, it is likely that alternative 5 represents the maximum and most stable biomass carbon storage in the warm dry forest types, even though it shows up here as being outside of desired conditions.

Effects Common to Cold Wet Forests

Estimates contained in the assessment report for the Gila National Forest suggest the majority of the ecosystem carbon would be expected to be held as biomass under reference conditions (USDA FS 2017a). This may be the result of soil organic carbon data limitations. Current biomass carbon is within desired levels for Mixed Conifer with Aspen but is lower than desired in Spruce-Fir Forest due to recent high-severity fire. In these systems, carbon is accumulated and resides over longer time frames, punctuated by infrequent, large emission pulses as a result of high-severity fire. Modeled results for biomass carbon under each alternative are presented in figure 30 and discussed relative to the alternatives in the subsequent subheading.

[18] Recall that tree age and tree size are not necessarily correlated. Old trees may be relatively small, like some of the aspen re-sprout from the 1950s McKnight Fire. The small stand of aspen trees along the ridge at the head of McKnight Canyon were not much more than 4 inches in diameter roughly 60 years later when the area re-burned in the 2013 Silver Fire. Conversely, large trees are not necessarily old. It depends on site conditions.

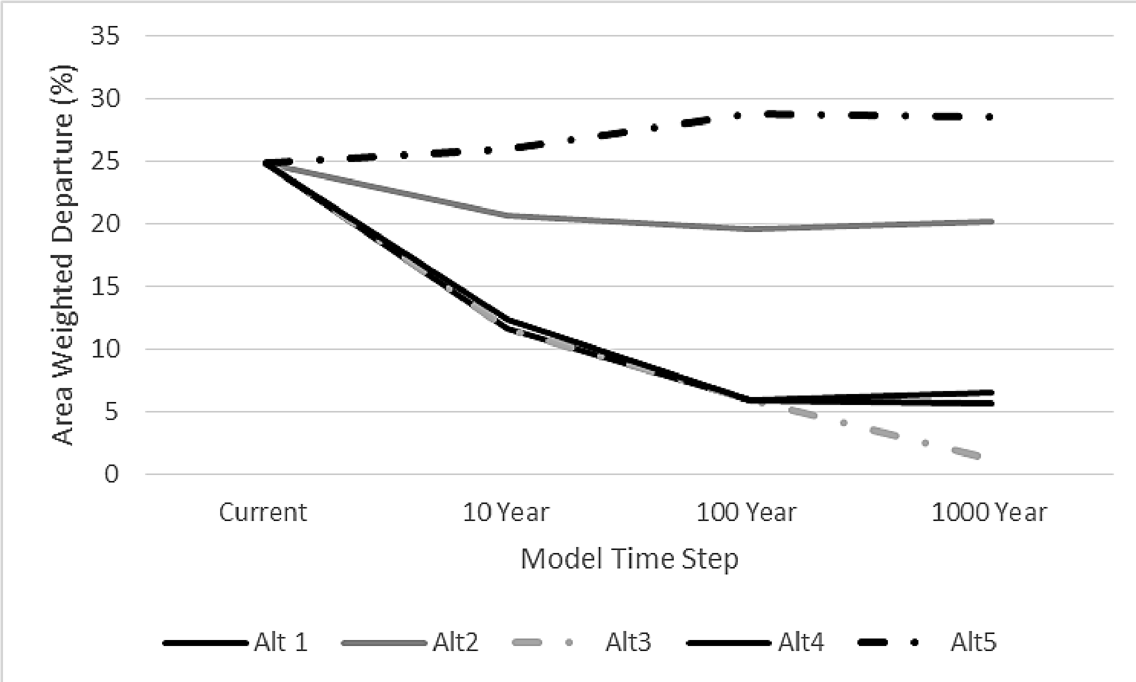


Figure 30. Cold wet forests biomass carbon departure from desired conditions

All Alternatives

The alternatives have limited to no treatment objectives for these vegetation communities, yet biomass carbon storage would remain within desired conditions and continue to accumulate into the future. Similarly, soil organic carbon would continue to accumulate. Carbon stocks would increase to a greater degree under alternatives 1, 3, and 4. Alternatives 2 and 5 would reduce carbon storage as the increased emphasis on using naturally ignited wildfire as a treatment tool leads to more acres experiencing wildfire. Under alternatives 2 and 5, a risk of permanently reducing carbon carrying capacity may be present as treatments to reduce wildfire risk in cooler and wetter environments may result in less productive vegetation communities (in the sense of Krofcheck et al. 2017). These forests are highly vulnerable to type conversions (see Upland Vegetation, Fire Ecology and Fuels section), and would likely be replaced by species from lower elevation systems that might not sequester as much carbon.

Effects Resulting from Proposed Research Natural Areas

None of the alternatives propose enough acres for addition to the research natural area system to make a measurable difference in terms of carbon emissions or management’s ability to move toward desired conditions for carbon storage.

Effects Resulting from Recommended Wilderness under the Action Alternatives

While some assert that wilderness mitigates climate change because of dedicating large land areas to low-disturbance activities, this isn’t necessarily true. Whether a particular recommendation has a positive, neutral, or negative effect on climate change depends on the carbon carrying capacity and current carbon status of the ecosystems contained within that land area.

Like the effects analysis of recommended wilderness described for upland vegetation communities, fire ecology, and fuels, alternatives 2, 3, and 4 would make little difference in management’s ability to manage toward desired conditions for carbon storage or emissions, but alternative 5 would make a difference. Some of the areas recommended to Congress for wilderness designation under alternative 5 contain large, contiguous areas with moderate or greater probabilities of high-severity fire. Without mechanical treatments, these areas are more likely to experience a net loss of biomass carbon because of such fire and generate large pulses of greenhouse gas emissions.

Cumulative Effects

While management of the Gila National Forest cannot mitigate global change by itself, its management is additive to similar mitigation and adaptation efforts being made on other public lands and lands under other jurisdictions and ownerships. Likewise, management of the Gila National Forest cannot generate enough greenhouse gases to cause or accelerate global change by itself, but it does contribute. While some governments, businesses, communities, and individuals are taking action to reduce their carbon footprints, it is not enough. Some degree of environmental change is now inevitable. Societal changes to reduce carbon emissions must be implemented at a larger scale to provide for the best possible outcomes (USGCRP 2018).

The 2020 New Mexico Climate Strategy reports that per capita, New Mexicans produce twice the national average of greenhouse gas emissions and most of it comes from the oil and gas industry, including transportation. The strategy provides a path forward to reduce emissions in the electricity, transportation, industrial, built environment, and natural and working lands sectors, as well as cross-sector emissions reductions. Of specific relevance to national forest management, the strategy reports that the state's natural and working lands are acting as a carbon source, rather than sequestering carbon (NMICCTF 2020).

The New Mexico Climate Strategy's recommendations for moving toward natural and working lands that sequester carbon include restoring the ecosystem characteristics and processes that support low-severity fire regimes. Collaborative efforts between land management agencies and the state's Forestry Division are key to accelerating the rate of progress toward this goal (NMICCTF 2020). The Forestry Division is also positioned to assist private landowners and has recently established policies and programs to help private landowners use prescribed fire for restoration and climate adaptation (NMICCTF 2020). The New Mexico Environment Department will also provide assistance for post-fire action plans and make funding available through the Clean Water Act to address wildfire impacts (NMICCTF 2020).

Where vegetation treatments restore the natural role of fire, there is a greater likelihood of maintaining a net carbon sink (Hurteau et al. 2016; Hurteau 2017 among others), but carbon carrying capacities across the Southwest are expected to decline. Furthermore, the ability of restored forests to maintain a net sink could be undermined if predicted widespread, drought-induced mortality events occur (Keith et al. 2009; McDowell et al. 2015). Further, recent studies suggest that maintaining forests as carbon sinks is unlikely to be part of the long-term solution (Brienan et al. 2020). Forests are stimulated to grow faster because there is more carbon dioxide available to them. Trees that grow faster have shorter lifespans. Brienan and others (2020) conclude that projections that include the persistence of global forest carbon sinks are overly optimistic and that reducing emissions is critical to a long-term solution (2020). Carbon uptake typically declines as trees age, but even old trees have responded to carbon dioxide fertilization with increased growth (Phillips et al. 2008). The value of old-growth forests as carbon sinks continues to be debated in the scientific community (Gunderson et al. 2021). Nevertheless, there is no future that doesn't involve fire, and climate-fire interactions, regardless of jurisdiction.

Greenhouse gas emissions are expected to increase as result of restoring the natural role of fire, and because of longer wildfire seasons and more frequent extreme weather conditions. A decline in emissions generated by cattle and other ruminants is possible as forage and water availability decrease, which could lower the carrying capacity of rangelands.

The New Mexico Climate Strategy highlights the recent New Mexico Healthy Soils Act as adding capacity to act on climate. The New Mexico Department of Agriculture administers the New Mexico Healthy Soil

Program and partners with the New Mexico State University Extension, Soil and Water Conservation Districts, and Cooperative Weed Management Areas to increase awareness of soil health principles in the farming and ranching communities. Soil carbon plays a role in healthy, functioning soils. Increasing soil organic matter has many benefits, one of which has been thought to be carbon sequestration.

Evidence suggests climate change could reduce soil carbon storage by increasing the metabolic activity of soil microbes, particularly in areas like Montane/Subalpine Grasslands (and Alpine Tundra), where temperature has historically limited decomposition for some part of the year (Wang et al. 2021). Further, warmer temperatures are likely to increase soil microbial activity such that carbon molecules once thought to be stable will be available for decomposition (Lehmann and Kleber 2015; Nottingham et al. 2020; Soong et al. 2021) and release into the atmosphere, creating a feedback mechanism and accelerating the rate of climate change (Nottingham et al. 2020; Soong et al. 2021).

Biochar production and application has received attention for its industry innovation potential and cross-sector carbon benefits. Wood products from forest restoration could be turned into biochar for application in crop production, reclamation and remediation settings, which would sequester carbon in the soil. There are already New Mexican businesses that can and are producing biochar and products containing biochar, including one local to the Gila National Forest. The current market is still small compared to what it could be, but local collaborations may grow local markets.

Reclamation and remediation related to mining, oil and gas could use large quantities of biochar and rates of adoption in crop production are also relatively low. Application method and rate determine whether there are carbon benefits or not. When applied to bare soil, studies suggest that the decrease in surface albedo might outweigh any carbon sequestration benefit (Meyer et al. 2012 as cited in Waqas et al. 2020). Albedo is a term that refers to the ability of a surface to reflect the sun's heat energy. This offset might be mitigated given the right application rate and depth of incorporation (Verheijen et al. 2013 as cited in Waqas et al. 2020), or in areas with enough vegetative cover (Usowicz et al. 2016).

Bare soils in crop production setting are becoming a bigger concern, both in terms of soil health and as a barrier to effective adoption of biochar application. The New Mexico Interstate Stream Commission has recently begun offering an incentive program for farmers who fallow their fields to conserve water as the recent drought conditions continue to worsen. Traditionally, to fallow a field means to leave it bare. The New Mexico Healthy Soils Program has launched its own incentive program, encouraging farmers to establish a cover crop before fallowing. This also opens opportunities for the cross-sector carbon benefits a biochar industry could realize in the state.

Climate change is expected to favor non-native invasive and noxious weeds. Noxious weeds may have a positive, negative, or neutral effect on carbon storage and greenhouse gas emissions (Cheng et al. 2007; Liao et al. 2008; Bradley et al. 2006). Other studies have found that climate change may reduce the effectiveness of herbicide treatments (Bailey 2004; Varanasi et al. 2016), which may make efforts to restore native plant communities and their carbon dynamics more difficult.

Movement toward sustainable operations in the Gila National Forest, and other national forests and grasslands, compliments the New Mexico Climate Strategy's emphasis on reducing emission in the electrical, industrial, transportation, and built environment sectors and is additive to similar initiatives that are ongoing in other federal and state agencies and many communities across the nation and the world. Unfortunately, global emissions have rebounded since the decline seen during the COVID-19 pandemic. The Forest Service has been and continues to work toward being a carbon neutral agency by 2030, and the number of carbon neutral entities and organizations is growing.

Under the clean air laws and regulations, any contributions that forest management might make toward slowing or stabilizing the rate of climate change through the dimming effect are negligible. Meaningful human influence on global brightening and dimming is largely controlled by developing countries without air quality regulations (Wild 2009), at least for the foreseeable future.

Mining is not currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. Mining expansion to fuel climate mitigation will have an up-front carbon cost but would contribute to long-term sustainability.

Air Resources

Affected Environment

The Clean Air Act of 1993 (P.L. 88-2006) authorized the Public Health Service, within the Federal Health and Welfare Department, to set standards for auto emissions, expanded local air pollution control programs, established air quality control regions, set air quality standards and compliance deadlines for stationary source emissions, and authorized research on low emissions fuels and automobiles. In 1970, amendments to the Clean Air Act required the Environmental Protection Agency (EPA) to establish national ambient air quality standards (NAAQS) to protect public health. The NAAQS are dynamic in that they change with the emergence of new pollution prevention and monitoring technology and scientific knowledge about effects. Today, there are six criteria pollutants for which standards have been set:

1. carbon monoxide (CO),
2. lead (Pb),
3. nitrogen dioxide (NO_2),[19]
4. particulate matter less than 10 micrometers in diameter (PM_{10}) and particulate matter smaller than 2.5 micrometers in diameter ($PM_{2.5}$),
5. ozone (O_3), and
6. sulfur dioxide (SO_2).

These are known as “primary” NAAQS, and they establish the maximum average volume (concentration) of each pollutant acceptable for inhalation by sensitive populations, such as people with heart or lung diseases, young children, developing fetuses and the elderly, over a given timeframe. “Secondary” standards have also been established for certain criteria pollutants to protect the “public welfare from adverse effects to visibility, building integrity, plants and animals.” The forest’s responsibility regarding primary and secondary NAAQS is met by applying basic smoke management practices (USDA NRCS and FS 2011; USDA FS 2014c; Blades et al. 2018) and best available control measures or emission reduction techniques (Blades et al. 2018). Smoke contains combustion gases as various diameters of particulates. The predominant pollutant in smoke is fine particulate matter, both PM_{10} and $PM_{2.5}$ (Ward and Hardy 1991).

If violations of NAAQS occur because of prescribed fire, they are subject to national administrative reporting and facilitated learning analyses. These accountability processes are designed to identify the conditions that contributed to the violation and identify measures to prevent violations in the future. Naturally ignited wildfire, regardless of how it is managed, is considered a “natural event” and as such, is exempt from Clean Air Act regulations. Despite the exemption, basic smoke management practices and best available control measures are implemented, whenever feasible, as standard practice.

[19] NO_2 is an ozone precursor, meaning that over time it breaks down into ozone.

Subsequent amendments to the Clean Air Act (1977 and 1990) established prevention of substantial deteriorations regulations. The pollutants targeted were those contributing to regional haze and visibility impairment, especially sulfates and nitrates, and wet and dry deposition of chemical elements and compounds that contribute to acid deposition. These regulations apply nationwide to designated sensitive air quality areas, nonattainment, and maintenance areas. A nonattainment area is a geographic area that does not meet one or more of the federal air quality standards. Maintenance areas are former nonattainment areas that are now meeting air quality standards. While there are no nonattainment or maintenance areas located in the Gila National Forest, a portion of Grant County was established as a nonattainment area for sulfur dioxide in 1992. This was associated with the old smelter in Hurley, New Mexico, which was demolished in 2007. This area was re-designated as a maintenance area in 2003 (USDA FS 2017a).

Designated sensitive air quality areas are described as being class I or class II. Class I areas are provided the highest level of air quality protection, while class II areas are subject to somewhat less stringent protection. Class I areas include international parks, national wilderness areas exceeding 5,000 acres, national memorial parks exceeding 5,000 acres, and national parks exceeding 6,000 acres that were established at the time the 1977 amendments were passed. International parks, national wilderness areas, national memorial parks, and national parks meeting the acreage criteria, but established after the 1977 amendments were passed as class II areas. The Gila Wilderness is a class I area. The Aldo Leopold and Blue Range Wildernesses are class II areas, as they were not added to the Wilderness Preservation System until 1980.

Natural events that decrease visibility include volcanic and seismic activity, wildfires, high winds, tornadoes, and hurricanes, among others. Natural visibility conditions and efforts to attain the national visibility goal of "no anthropogenic [human-made] impairment" by 2064 are defined in the Regional Haze Rule (40 CFR Part 51) and further documented in state implementation plans.

States are developing milestones for visibility improvements to reach natural conditions. New Mexico has established a Regional Haze State Implementation Plan designed to remediate current impairments of visibility, including smoke and smog, and to prevent future impairment. The state implementation plan establishes acceptable levels of criteria pollutants that affect visibility, such as particulate matter, and other chemical elements and compounds such as mercury (Hg), sulfates (SO_4) and nitrates (NO_3). The EPA approved the New Mexico state implementation plan in 2012, except for one component related to San Juan Generating Station 77.

The forest's responsibility regarding criteria and hazardous air pollutant emissions and impacts to air quality and visibility, including class I areas visibility involves coordinating with the EPA and state, county, and tribal air regulatory agencies in managing and mitigating the impacts related to prescribed fire activities. This is achieved through compliance with the state's Smoke Management Program. Again, naturally ignited wildfire, regardless of management strategy, is considered a "natural event" and is exempt from Clean Air Act regulations including the Regional Haze Rule. If conditions prescribed by the Regional Haze Rule and EPA-approved state implementation plan are met, visibility is expected to improve over time within and outside the forest.

According to the assessment report, air quality in the forest is within national and state ambient air quality standards. Based on current and projected emissions inventories, the trend appears to be stable or improving for most pollutants except for particulate matter and sulfur dioxide. While there is currently attainment of NAAQS for these two pollutants, conditions are declining for sulfur dioxide because of emissions along the U.S.-Mexico border. Particulate matter is expected to continue to have episodic periods of very high levels from wildfires and increases in airborne dust from effects associated with increased frequency and severity of drought. While prescribed fires may contribute particulate matter to the ambient air, it does not contribute to the predicted trends, as its associated emissions are typically lower than wildfire (USDA FS 2017a).

Regarding visibility, the 2064 Regional Haze Rule goal has not been attained, but conditions are stable to improving. While episodic periods of very high levels of particulate matter from wildfires and increases in airborne dust are expected to produce declines in ambient air quality, they are not expected to result in downward trends in visibility (USDA FS 2017a). This is because recent amendments to the Regional Haze Rule eliminate wildfire smoke and some prescribed fire smoke from the way visibility is assessed. Nevertheless, smoke from wildfires and prescribed fires originating from within and outside forest boundaries is a regular occurrence that has potential to affect the health and or quality of life for area residents for relatively short periods of time.

While wildland fire has been and is expected to remain the primary source of criteria pollutant emissions generated in the Gila National Forest, other activities that occur in the forest also contribute. Like sources of greenhouse gas emissions discussed in the previous Climate and Carbon section of this document, Forest Service operations; motorized uses including forest access, mechanical vegetation treatments, and energy and mineral development; and bare soil have potential to act as sources for criteria pollutants.

Environmental Consequences

Analysis Methodology

Although, under each alternative, there are several activities that could occur in the forest that would be sources of emissions, emissions from prescribed fire and naturally ignited wildfire are thought to be the only sources substantial enough to warrant consideration in this analysis. These fires release smoke in amounts relative to the volume of fuels consumed, type of fuels, fuel moisture, area burned, and duration of burning. The forest coordinates with the New Mexico Environment Department to ensure that every planned fire ignition complies with the Smoke Management Program, so no unacceptable adverse impacts to air quality or visibility should result from prescribed fire under any alternative. Naturally ignited wildfires, regardless of the fire management strategy, may adversely impact air quality.

Emissions were modeled using the Fuel Fire Tools (FFT) (v 2.0.1020) software application developed by the Forest Service's Fire and Environmental Research Applications Team. Basic input data include fuel moisture, the type of fire (prescribed or naturally ignited), pre-fire conditions (whether fire follows mechanical treatment or not), and severity distribution. The model produces estimates for criteria pollutants such as particulate matter ($PM_{2.5}$ and PM_{10}), and carbon monoxide. For this analysis, the alternatives were modeled based on the parameters used in the state-and-transition models supporting the upland vegetation, fire ecology, and fuels analysis. Alternatives 1, 2, 3, and 4 were modeled under the following assumptions:

- Where prescribed fire acres were less than mechanical treatment acres, it was assumed that all prescribed fire acres followed mechanical treatment.
- Where prescribed fire acres were greater than mechanical treatment acres, it was assumed that prescribed fire followed all mechanical treatments, with the acres above and beyond those associated with mechanical treatments being prescribed fire only.
- All naturally ignited wildfire acres are assumed to occur on acres not treated mechanically.

Alternative 5 was modeled under the assumption that all fire occurred independent of mechanical treatments. For all alternatives, BlueSky Playground v3.0 Fuel Bed Selector was used to approximate total fuel loading. The remaining inputs were selected based on correspondence with Roger Ottmar, one of the primary developers of the FFT application and a leading expert on fuels. All parameters used to populate the model are available in the project record.

Analysis Results

Figure 31 displays the decadal emissions projected by the FFT modeling by alternative. The results are discussed under the subsequent effects headings.

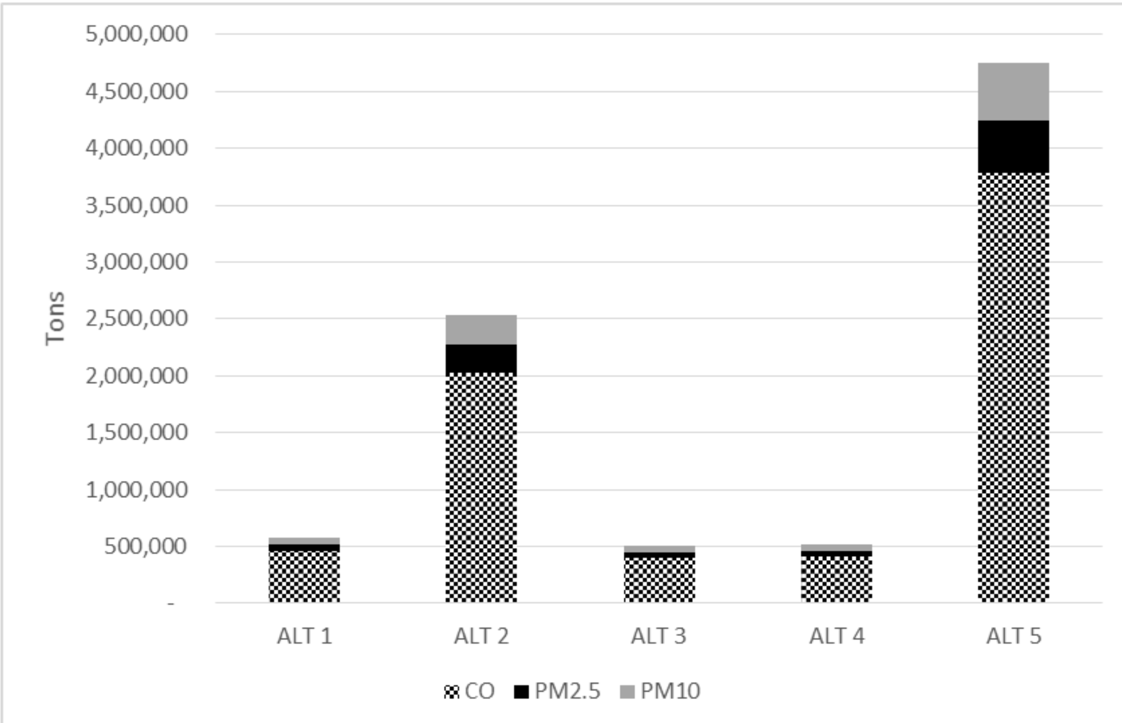


Figure 31. Projected decadal emissions of criteria pollutants

Effects Common to All Alternatives

Smoke from prescribed fire and naturally ignited wildfire is by far the most significant source of air quality and visibility impacts that originate in the forest. The predominant pollutant in smoke is fine particulate matter ($PM_{2.5}$ and PM_{10}). Fine particulate matter is known to lodge deeply in the human respiratory system and some may even work its way into the bloodstream (US EPA 2019). Consequently, fine particulate matter can significantly affect the health and well-being of sensitive populations. Sensitive populations include the elderly, young children, individuals with heart or lung disease or compromised immune systems. When fine particulate matter rises above a certain threshold concentration and duration, these individuals may experience decreased heart and lung function, which can, and does, lead to death in some cases. While difficult to research, Mokdad and others (2004) estimate that in the United States, 22,000 to 52,000 deaths annually can be attributed to fine particulate matter.

Carbon monoxide concentrations are generally a localized health concern, which is more likely to affect the health and safety of fire personnel. Carbon monoxide poisoning causes headaches, nausea and fatigue, with prolonged exposure leading to brain damage and even death. Brain damage and death is not known to have occurred because of occupational exposure within the wildland firefighting community. However, headaches, nausea, and fatigue can lead to reduced cognitive ability, which reduces an individual's ability to maintain situational awareness, recognize rapidly changing fireline conditions, and take appropriate actions to be safe.

Under all alternatives, prescribed fire and naturally ignited wildfire would continue to occur and be managed according to interagency guidance, which is supported by plan direction. Smoke from wildland fires may travel long distances, impairing local and regional visibility, within and outside class I and class II airsheds and degrading air quality far from their point of origin, depending on topography, wind speed and direction, and other atmospheric conditions. Smoke from naturally ignited wildfire is exempt from regulation and may lead to ambient concentrations of criteria pollutants that exceed NAAQS, regardless of which alternative is ultimately selected.

Emissions of criteria pollutants are driven by wildfire, accounting for 87 to 98 percent of the emission projections. Because naturally ignited wildfire is exempted from Clean Air Act regulations and prescribed fire is conducted in compliance the Smoke Management Program, all alternatives would be compliant with federal and state air quality and visibility regulations.

Effects Common to Alternatives 1, 3, and 4

No substantial differences exist between the criteria pollutant emissions that would be generated under these alternatives. As they represent the lowest emissions scenario, it might be expected that they would have the least associated effects to air quality. This is not the case. What they represent is the greatest likelihood of large emissions pulses associated with wildfire events that could not be predicted by the state-and-transition or emissions models because they do the least in terms of moving vegetation and thereby fuels, toward desired conditions.

Effects of Alternative 2

Alternative 2 represents a significant increase in emissions of criteria pollutants over alternatives 1, 3, and 4, and is anticipated to have greater effects to air quality because of vegetation and fuels management. Unanticipated effects to air quality because of wildfire emissions that could not be predicted by the state-and-transition or emissions models are reduced as compared to alternatives 1, 3, and 4.

Effects of Alternative 5

Alternative 5 represents the greatest increase in the emissions of criteria pollutants. Similar to alternative 2, the anticipated effects to air quality would be substantially increased over all the other alternatives, but the unanticipated emissions are least.

Cumulative Effects

While fire and vegetation management activities in the forest are not the only activities that influence air quality; those activities are additive to those occurring on other public lands and lands under other jurisdictions and ownerships. Population growth and development in Arizona and New Mexico are expected to continue over the life of the plan. As a result, residential and commercial development, including road construction, will contribute fugitive dust to the ambient air. Likewise, an influx of more people would trigger more vehicle traffic on local roads, increasing exhaust and dust emissions.

Industrial sources include power plants, factories, mines, and smelters. In the United States, these sources are regulated under permits by state and local environmental agencies. Therefore, if new significant sources of this kind are proposed, regulators would review the increment of criteria pollutants. Mitigation and monitoring would be required to ensure continued attainment of NAAQS. However, regulations lag in Mexico, where industrial sources of emissions have increased and are expected to continue to increase (USDA FS 2017a). Many federal, state, and local agencies; businesses; communities; and individuals are taking action to reduce their energy consumption, and therefore, their emissions of criteria pollutants. This helps to improve or maintain air quality within NAAQS.

Aviation, both civilian and military also impact air quality and visibility as recognized by the Federal Aviation Administration (FAA) (USDOT FAA 2015). Criteria pollutants emitted by aviation include nitrogen dioxide, carbon monoxide, sulfur dioxide, particulate matter, and hydrocarbons, some of which may have toxicity. All these criteria pollutants, except particulate matter, contribute to ozone formation, secondary particulate matter formation, or both. The FAA has forecasted that aviation emissions are expected increase slightly over the next decade unless industry efficiencies and technologies are able to offset increased demand for air travel. However, aviation is a "relatively small contributor" of emissions impacting air quality. Emissions inventories in major metropolitan areas such as Dallas, Denver, and New York, indicate less than 3 percent of nitrogen dioxide, volatile hydrocarbons and $PM_{2.5}$ can be attributed to aircraft (USDOT FAA 2015). Military training operations contribute criteria pollutants and may involve dropping flares that can start wildfires. While there is no evidence to attribute any wildfires on the Gila National Forest to military training flights, they could happen and would impact air quality over the course of the fire incident.

Wildfire emissions on federal public lands are likely to remain one of the Southwest's largest contributors of criteria pollutants, and those emissions are likely to increase with continued projected trends in climate. Emissions associated with prescribed fires on these lands are also expected to increase with continued emphasis on landscape-scale restoration and fuel reduction projects. Federal public lands near large population centers and designated municipal watersheds typically get the lion's share of funding to support these projects, which tend to lower the emissions of criteria pollutants when a wildfire does occur. This leaves the Gila National Forest and other remote forested areas more reliant on naturally ignited wildfire occurring under favorable fuel, moisture, and weather conditions. As a result, these areas are likely to be larger contributors of criteria pollutants, impacting both air quality and visibility now, and into the future.

Soil and Watershed Resources

Affected Environment

Soils and Soil Condition

The soil resource is a complex and dynamic system that consists of a mineral component, organic matter, air, water, and living organisms resulting from interactions between parent material,[20] climate, topography, and organisms over time and space. Soil condition is assessed in terms of its ability to support the long-term productivity of the land, maintain environmental quality, and promote plant and animal health (Doran and Parken 1994, USDA FS 2012a and 2023b). Soil condition is influenced by climate, landscape processes, and human activities. These assessments are based on the status of indicators that reflect the soil's ability to support essential functions, relative to their natural capability.

Current soil condition assessment criteria are found in Forest Service Manual 2550 and in regional technical guidance. The recently revised technical guidance classifies soil conditions as "satisfactory," "impaired," or "unsatisfactory." Conditions are satisfactory when all soil functions are maintained within the soil's natural capability. Conditions are impaired when soil functions are reduced or there is an increased vulnerability to degradation. When soil functions are reduced so that the soil is less resilient to disturbance and the long-term productivity of the land is compromised, conditions are unsatisfactory. Soil functions include biological, stability, hydrologic and climate regulation functions (USDA FS 2023b).

Soil functions provide ecosystem services, which are the benefits soil provides to people. Soil provides a medium for plant growth and wildlife habitat, as well as habitat for micro and macro soil organisms. A single handful of soil can contain more biodiversity than an entire forest. Soil provides forage for wildlife and domestic livestock, wood products and other construction, landscaping, and industrial materials. It is

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[20] Parent material describes both the primary origin of the matter from which soil is formed, either geologic or organic, and its last mode of transport. Modes of transport include flowing water, standing water, wind and gravity.

the foundation upon which the infrastructure we depend on every day is built. Soil regulates the cycling of nutrients, energy, and water. It contributes to the global regulation of greenhouse gases, including methane, nitrous oxide, and carbon dioxide, with the latter being stored as soil organic carbon. Soil also regulates water storage, release, and filtration, and provides for erosion control and sediment retention. It regulates thermal energy, absorbing heat energy when temperatures are high, and releasing heat when temperatures are cool.

Each soil has a natural capacity to support a specific level and quality of these services. When land use practices alter soil processes, they alter the ability of the soil to function within this natural capacity. Each individual function is an essential component of a properly functioning soil, and the status of each is interconnected. A change in the status of one function, either beneficial or detrimental, can affect other functions. Figure 32 shows soil conditions by vegetation type as determined during the assessment.[21] More information about how these interpretations were developed and associated assumptions and limitations can be found in that report (USDA FS 2017a).

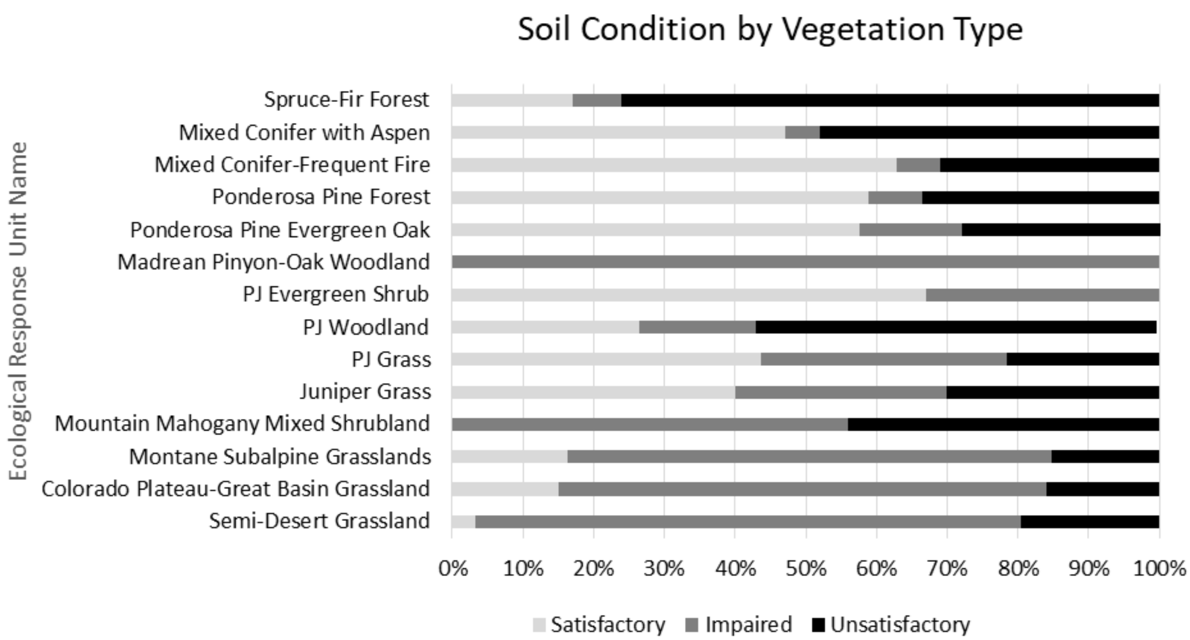

Figure 32. Soil condition distribution by ecological response unit in the Gila National Forest

Cycles of drought, fire, livestock grazing, timber harvest and fuelwood cutting, and road and trail construction and maintenance, have all caused varying degrees of soil impacts. None of these management factors have acted in isolation; rather, the combination of these management factors, historical and current, is responsible for existing soil conditions in most vegetation types.

Flatter landforms such as mesa tops and valley plains have experienced greater non-fire management impacts than steeper slopes, regardless of vegetation type. On steeper slopes, fire management is the primary activity influencing soil condition. Although some of these soils may be naturally unstable, fire management can and does accelerate soil loss on these already unstable slopes, as well as steep slopes that have more natural stability due to geology and soil properties.

[21] The 2022 Black Fire resulted in changed circumstances for soil and watershed resources. This will be discussed and evaluated in its own subsection at the end of the Affected Environment.

Post-fire effects are the primary driver of impaired and unsatisfactory conditions in Spruce-Fir Forest and Mixed Conifer with Aspen. This environmental analysis recognizes the scientific evidence that strongly suggests that fire and the associated fire effects in these two ERUs were probably not outside the historic range of variation (Margolis et al. 2011; Schoennagle et al. 2004). However, part of the Forest Service's charge is to maintain favorable conditions of water flow and manage for the long-term productivity of the land. Soil loss dramatically reduces the ability of the agency to meet these objectives and could become a more substantial management challenge in the future. While there is no vulnerability assessment specific to soils, climate change impacts to the soil resource are likely to follow vegetation impacts. Feedbacks between predicted hydrologic, disturbance regime, and vegetation changes could increase bare soil, reduce all soil functions, and affect the long-term productivity of the land and ecosystem service delivery.

Watersheds and Watershed Condition

Watersheds are a topographic extent, or area, that drains to a single point in a stream or river system. Watersheds are cataloged using a uniform hierarchical system developed by the U.S. Geological Survey. The United States is divided and subdivided into successively smaller "hydrologic units." There are six levels of hydrologic units: region (1st level), subregion (2nd level), basin (3rd level), subbasin (4th level), watershed (5th level), and subwatershed (6th level). The hydrologic units are arranged within each other from the smallest (subwatersheds) to largest (regions). This analysis uses the "subbasin," "watershed," and "subwatershed" terminology. Numeric hydrologic unit codes (HUCs) can be found in appendix D of the assessment report (USDA FS 2017a).

Watershed condition describes the status of the physical and biological characteristics and processes within a watershed that affect hydrologic and soil functions supporting riparian and aquatic ecosystems. Watersheds that are functioning properly have the following characteristics (Potyondy and Geier 2011):

- Provide for high biotic integrity, which includes habitats that support adaptive animal and plant communities that reflect natural processes;
- Resilient and recover rapidly from natural and human disturbances;
- Exhibit a high degree of connectivity longitudinally along the stream, laterally across the floodplain and valley bottom, and vertically between surface and subsurface flows;
- Provide important benefits to people, such as high-quality water, the recharge of streams and aquifers, the maintenance of riparian communities, and the moderation of climate variability and change; and
- Maintain long-term soil productivity.

The Watershed Condition Classification is an interdisciplinary evaluation of watershed condition used across all National Forest System lands and offers a systematic, flexible means of classifying watersheds based on a core set of national watershed condition indicators. The classification system uses existing data, local knowledge, professional judgment, written rule sets and criteria. Each of the 12 indicators is composed of one or more attributes. The attributes are scored, summed, and averaged to produce indicator scores, which are averaged within four process categories. The overall watershed condition score is then computed as a weighted average of the process category scores. The final score for each subwatershed results in an overall rating of functioning properly, functioning at risk, or impaired function (Potyondy and Geier 2011).

Table 34 summarizes subwatershed conditions across the Gila National Forest. Overall, about 60 percent of subwatersheds are not properly functioning.[22] More information about the Watershed Condition Classification can be found in the assessment report (USDA FS 2017a).

Table 34. Current watershed conditions in the Gila National Forest showing percentage of subwatershed area in each condition class

Subbasin	Forest Percentage of Subbasin	Functioning Properly	Functioning at Risk	Impaired
Plains of San Agustin	11	100	0	0
Elephant Butte Reservoir	3	58	42	0
Caballo	27	19	66	15
El Paso-Las Cruces	1	42	58	0
Mimbres	5	12	72	17
Little Colorado Headwaters	3	21	79	0
Carrizo Wash	14	75	25	0
Upper Gila	84	39	54	6
Upper Gila-Mangas	15	25	75	0
Animas Valley	4	0	100	0
San Francisco	81	15	68	17
Total Forest Subwatershed Area		**40**	**52**	**8**

Table 35 details the status of watershed condition indicators (Potyondy and Geier 2011) within Gila National Forest subwatersheds and overall watershed conditions (USDA FS 2017a).

Common management factors contributing to altered conditions include roads, fire exclusion, or post-wildfire effects including the loss of forest cover and altered streamflow patterns, the presence of non-native aquatic organisms, and rangeland vegetation condition. Rangeland vegetation condition is the result of four primary interacting factors: drought, historic grazing practices, current grazing management, and wildlife populations and patterns of use. Drought interacts with every management factor and contributes to aquatic habitat fragmentation and fuel conditions. Current grazing management has generally allowed for improvement over historic conditions, but predominantly static trends in range conditions (USDA FS 2017a) indicates current management generally maintains current conditions.

Soil, riparian and aquatic habitat, and water quality and quantity indicator ratings generally represent a combination of natural disturbance processes and management activities. Terrestrial invasive species and forest health agents, such as insects and disease, are not substantial contributors to poor conditions. However, the threat they pose, and the threat of large contiguous extents of stand-replacing fire is predicted to increase under current and future climatic trends.

[22] The 2022 Black Fire substantially changed watershed conditions in at least 13 subwatersheds in the Caballo, Mimbres, and Upper Gila basins. While a classification update has not been completed, four of these subwatersheds were functioning properly before the fire. They are not likely to maintain that classification when an update is done. Three are in the Upper Gila basin. One is in the Caballo basin. Eight of the remaining nine subwatersheds were functioning at-risk and may also see a change in classification. The last subwatershed was already impaired and no further decline in condition class is possible.

Table 35. Current status of watershed condition indicators (percentage of subwatershed condition indicators functioning properly)

Subbasin	Aquatic Biota	Water Quantity	Water Quality	Riparian/ Wetland Vegetation	Aquatic Habitat	Soil Condition	Roads and Trails	Forest Health	Fire Regime/ Wildfire Effects	Forest Cover	Terrestrial Invasive Species	Rangeland Vegetation
Plains of San Agustin	89	100	100	89	89	89	33	100	0	100	100	0
Elephant Butte Reservoir	75	75	100	75	50	25	0	100	0	75	100	50
Caballo	41	71	71	29	35	29	18	94	6	71	100	93
El Paso-Las Cruces	60	60	60	40	60	20	20	100	0	60	100	0
Mimbres	21	43	7	21	21	14	21	100	0	79	100	21
Little Colorado Headwaters	50	100	100	50	50	0	0	100	0	100	100	0
Carrizo Wash	80	87	83	80	80	7	60	100	20	100	100	13
Upper Gila	41	41	48	43	46	50	43	98	7	70	98	46
Upper Gila-Mangas	19	69	69	44	38	25	13	100	19	94	100	31
Animas Valley	0	86	29	14	0	0	14	0	100	100	100	14
San Francisco	24	47	56	22	29	25	15	100	4	80	98	7
Forestwide Area Weighted Average	**38**	**58**	**62**	**40**	**41**	**32**	**28**	**99**	**6**	**77**	**99**	**23**

The work of Parks and others (2018a) is summarized by subbasin in table 36, describing the relative probability of high-severity fire under average and extreme fire weather conditions—*if* a fire were to occur. Recall that this work does not include predictions for non-treed areas, regardless of how it is mapped in the ERU classification system, which means it is not valid in areas that were previously treed but are currently in grass or shrub states because of stand-replacement fire. Predictions are only valid in grasslands where woody encroachment is present. Predictions are also based entirely on standing fuels, as a comparable dataset for surface fuels is not currently available (Parks et al. 2018b). Probability data presented in the table do not include subbasin lands outside the forest's administrative boundary. While the data are available, we did not request it from the authors.

Table 36. Gila National Forest subbasin area with predicted moderate or greater probabilities of high-severity fire (2018), showing the percentage of the forest subbasin area in average and extreme fire season weather

Subbasin Name	Forest Subbasin Area (Acres)	Average Fire Season Weather (percentage of Forest subbasin area)	Extreme Fire Season Weather (percentage of Forest subbasin area)
Plains of San Agustin	135,981	34	80
Elephant Butte Reservoir	40,451	16	89
Caballo	211,635	13	57
El Pas-Las Cruces	37,572	5	53
Mimbres	210,291	3	32
Little Colorado Headwaters	13,510	19	71
Carrizo Wash	197,142	39	78
Upper Gila	1,069,298	8	53
Upper Gila-Mangas	198,660	22	71
Animas Valley	59,574	8	57
San Francisco	1,097,373	18	66

Under average fire season weather, the majority of the forest's watersheds are at relatively low risk. Conversely, the majority of the forest's watersheds are at much greater risk under extreme conditions. High-severity fire is a major concern for Gila National Forest leadership, staff and stakeholders, as recent wildfires with large patches of high-severity fire have resulted in damaging watershed responses. Some are also concerned about what this may signal, given current and predicted trends in climate. The Gila National Forest's Climate Change Vulnerability Assessment for vegetation communities was aggregated to a watershed scale (Triepke 2015). While this watershed vulnerability summary does not consider all elements of watershed function, or the disturbance factors that might result in change, it remains useful as an indicator of where changes are most likely to be observed, and how significant they might be. Table 37 displays the vulnerability summary by subbasin.

Table 37. Subbasin aggregated subwatershed vulnerabilities to climate change, showing percentage of Gila National Forest subwatershed area by upland vegetation vulnerability category

Subbasin	Low	Moderate	High	Very High
Plains of San Agustin	0	100	0	0
Elephant Butte Reservoir	0	100	0	0
Caballo	0	82	18	0
El Paso-Las Cruces	0	100	0	0
Mimbres	0	98	2	0
Little Colorado Headwaters	0	100	0	0
Carrizo Wash	0	100	0	0
Upper Gila	0	74	26	0
Upper Gila-Mangas	0	82	18	0
Animas Valley	0	2	96	2
San Francisco	0	96	4	0

Surface Water Quantity and Quality

Streams, springs, seeps, wetlands, lakes, stock ponds, reservoirs, and groundwater are important in terms of the forest's ecology, the well-being of people, and the sustainability of communities and ways of life. The forest contains a higher density of streams that flow year-round (perennial) than the surrounding landscape, largely because it contains many of the higher-elevation, mountainous watersheds where many streams originate, and where precipitation is higher and temperatures are cooler. Cooler temperatures reduce transpiration and evaporative demand, which helps keep water in streams for longer periods. Streams that flow seasonally (intermittent), and those that only briefly flow in response to precipitation (ephemeral) tend to occur at lower elevation and lower positions in the watershed where precipitation is generally lower, and temperatures are warmer. This makes bedrock type and topography, bank, floodplain and channel bed materials, channel geometry, and the valley size and shape relatively stronger controls on the amount and duration of water availability in these streams.

As these characteristics are highly variable from one watershed to another, intermittent and ephemeral stream density in the forest is highly variable. While hydrologically and ecologically important, there is limited information about water resources associated with intermittent and ephemeral streams. The Gila National Forest contains approximately 17 percent of the land area in its component subbasins and has about 957 perennial stream miles, which is about 57 percent of the total perennial stream miles within the component subbasins (USDA FS 2017a).

The quantity of perennial streamflow in the forest and in the watersheds beyond its boundaries is dependent on precipitation and temperature patterns. Rainfall runoff contributions are most important from July through October, with groundwater contributions being most important November through June. Although data to quantify streamflow are limited, the available streamflow data demonstrate a substantial decline in overall water quantity for the Mimbres River and San Francisco River near Reserve, but flow in the San Francisco appears to have increased near Glenwood. Other stream systems illustrate smaller upward or downward trends and either increased or decreased variability in flow. The data also demonstrate several trends that are consistent with climate change predictions (USDA FS 2017a):

1. Average flow in the winter and spring months (December–May) is decreasing.
2. Peak snowmelt runoff is occurring earlier, and the snowmelt runoff period is decreasing.
3. The duration of late spring-early summer low-flow periods is increasing.

These trends have serious implications, both in terms of ecological processes and functions, but also in terms of human uses. One of those implications is for water quality,[23] specifically stream temperature. Elevated stream temperature is the leading water quality impairment in the Gila National Forest's component subbasins, both within and outside forest boundaries (USDA FS 2017a). Water temperature influences the biological activity and growth, dissolution of minerals, and amount of dissolved oxygen the stream can hold, which governs the kinds of organisms that live in water bodies. Temperature impairments may be caused by reduction in riparian canopy cover, or changes in stream channel shape and function. Wide, shallow streams absorb more heat energy from the sun than deep, narrow streams. Stream temperatures can also be elevated during low-flow periods. There are also factors associated with measuring stream temperature that can lead to exceedances of the state standards, particularly the location of the temperature recorder in the stream. Most temperature impairments in the forest occur in areas where human influences are least prevalent, such as wilderness areas. At the time of the first documented impairments, these streams very likely expressed natural temperature conditions. Nevertheless, these streams remain impaired for temperature, based on state water quality standards.

The other major water quality issues in the forest are related to excessive nutrients and sediment. Nutrients chemically bond to soil particles, and often enter streams attached to sediment. Excessive concentrations of nutrients can lead to algal blooms, which eventually deplete oxygen concentrations, leading to the death of aquatic organisms. Like heat energy, nutrient and sediment concentrations increase during low-flow periods. Excess sediment concentrations, with or without nutrients, can increase turbidity, and negatively impact benthic macroinvertebrate communities. Benthic macroinvertebrates are aquatic organisms without backbones that live on the bottom of waterbodies. The status of benthic macroinvertebrate communities is an indicator of overall aquatic ecosystem health, as many are sensitive to water quality, and all are food for other aquatic species. There are a few potential sources of pollutants that could impact surface quality in and around the forest associated with old landfills, historic mining activity, underground storage tanks, and septic tanks. All causes of impairment considered, approximately 214 stream miles of the 740 miles assessed in the Gila National Forest meet all water quality standards. Approximately 526 stream miles are listed as impaired for one or more causes (NMED 2022).

There are no natural lakes within the forest, although a few depressions do occur that may hold water periodically. The remaining waterbodies are all constructed features. Most are earthen ponds built to provide livestock water, with a secondary potential benefit of providing water to wildlife (Rosenstock 1999). Not all stock tanks hold water year-round. Some are poorly located or designed, and many need maintenance. The most reliable stock ponds are associated with springs or seeps. The New Mexico Department of Game and Fish (NMDGF) has stocked a few of the ponds with non-native fish for recreational purposes. NMDGF also constructed and manages dams that create the three reservoirs located entirely, or in part, in the forest for recreational fisheries purposes. These reservoirs are Quemado Lake, Snow Lake, and Lake Roberts. Bill Evans Lake and Bear Canyon Reservoir are two additional reservoirs that are not located in the forest but are nearby.

All these reservoirs have water quality impairments. Quemado Lake, Snow Lake, and Lake Roberts are all listed as impaired for nutrients. Additionally, Snow Lake is listed as impaired for pH and Lake Roberts for mercury in fish tissue. Mercury enters waterbodies primarily through atmospheric deposition associated with pollutants released by coal-fired power plants. Bill Evans Lake is listed for mercury and

[23] Surface water quality is a function of natural physical, biological, and chemical variables such as elements present in soils and rocks and biological and chemical contaminants originating from a single point source or from runoff that carries contaminants that accumulate over a landscape. The Federal Clean Water Act is administered by the EPA, although the EPA delegates many functions to the Army Corps of Engineers and state governments. The New Mexico Water Quality Control Commission sets standards that define water quality goals by designating uses, setting criteria to protect those uses, and establishing provisions to preserve water quality. More information related to the regulatory process can be found in the Assessment report.

polychlorinated biphenyls (PCBs) in fish tissue. A PCB is a chemical compound that was used for a variety of industrial purposes. Even though it was effectively banned in the 1970s, it does not break down easily in the environment and remains a problem to this day. Bear Canyon is listed for nutrients, temperature, and mercury in fish tissue.

Constructed waterbodies such as stock ponds and reservoirs provide the benefit of storage, making surface water available to livestock, wildlife, and recreational purposes over a longer period of time. They also alter natural patterns of water flow. Constructed waterbodies act as a control on water flowing downstream, which can be both positive and negative. These features may serve to attenuate floodwaters and potentially reduce negative flooding impacts to human life and property downstream. On the other hand, these features can negatively impact natural streamflow patterns, hydrologic connectivity of stream systems and aquatic habitat. They also tend to increase evaporative losses and reduce groundwater recharge.

In 2010, the New Mexico Water Quality Control Commission designated all perennial streams and associated wetlands located within designated wilderness areas as Outstanding National Resource Waters. These waters are subject to the same water quality criteria as other waters but receive a higher degree of protection from human activities that could negatively alter their water quality status; however, many of these waters have impairments related to temperature, nutrients, sediment, or a combination of these pollutants. Naturally ignited wildfire and its management is the largest human factor influencing stream temperatures in wilderness. Many Outstanding National Resource Waters and other streams that are listed impaired for temperature are undergoing use-attainability studies to determine whether the state standards are appropriate (NMED-SWQB 2022).

Groundwater Quantity and Quality

Groundwater is equally as important as surface water. Most groundwater resources within the forest occur in fractured volcanic and sedimentary rock and are not officially considered important sources of groundwater by the state. Portions of basin-fill aquifers[24] that are considered important by the state do occur to a limited extent on the forest, but largely beneath surrounding lands under other jurisdictions (NMED 2001). While the forest may not be considered an important reservoir of groundwater overall, it is an important source of recharge in the basin-fill aquifers surrounding the forest. The Gila contributes to groundwater recharge in the Gila-San Francisco, Mimbres, Middle and Lower Rio Grande, Las Animas, Hot Springs Artesian, and Lordsburg Underground Water Basins declared by the New Mexico Office of the State Engineer.

Data provided by the State Engineer's Office indicate that within these subbasins, approximately 1 percent of groundwater wells occur on lands managed by the Gila National Forest. Wells constructed in the forest can be used for domestic, livestock, irrigation, municipal, industrial, and commercial purposes, although not all wells can be used for all purposes. Most are currently used to provide livestock water, providing a secondary benefit as water for wildlife. Wells in the Gila National Forest also provide water for 15 drinking water systems associated with recreation and administrative sites.

Groundwater recharge generally occurs by mountain-front or alluvial mechanisms. Mountain-front recharge is important in arid and semiarid regions like the Southwest. It occurs as the result of higher precipitation and lower temperatures in the mountainous areas, the relatively shallow nature of mountain soils compared to lower lying area, and fractured nature of the bedrock. Alluvial recharge occurs because of high-flow events, originating from forest streams. The importance of alluvial recharge has been emphasized in the Mimbres subbasin (Conover and Akin 1942). Recharge rates are very slow. Studies conducted in arid and semiarid regions suggest that groundwater flowing in these regional aquifers

[24] Basin-fill aquifers are thick deposits of sediment that accumulated in valley bottoms.

accumulated thousands of years ago, before and during the last ice age, and that very little has accumulated since, rendering groundwater a non-renewable resource (Taylor et al. 2012).

Locally important, but relatively small, shallow alluvial aquifers are found in valley bottoms across the plan area. Groundwater is both recharged and discharged in these aquifers. Zones of recharge and discharge may change over time along any stream in response to surface runoff contributions and changes in channel and floodplain location and materials. Perched aquifers are also locally important, although information describing their extent and distribution is not available. These aquifers support the forest's springs, seeps, and wetlands.

Springs, seeps, and non-riverine wetlands are areas of groundwater discharge. The perched aquifers previously mentioned, are a zone of saturated soils that form above a layer of low-permeability and the main water table. Depression springs are in low-lying areas where the surface topography corresponds with a near-surface groundwater table. In addition, these types of springs typically receive some contribution from surface runoff. Contact springs are associated with abrupt changes in rock type. Springs also occur along fault lines, or where joints or fractures are found in the rock. Springs or seeps may or may not be associated with wetlands or riparian vegetation and some wetlands are not supported by groundwater. Nor do all wetlands support riparian or wetland species; playa lakes are an example described in the next paragraph.

The Fish and Wildlife Service's National Wetlands Inventory describes wetlands in terms of riverine, freshwater emergent, and freshwater forested/shrub. Wetlands that do not rely on groundwater are typically seasonal and occur in low-lying areas where the surface topography does not correspond with a high in the water table, such as playa lakes. While they may support upland vegetation that are adapted to periods of inundation and the salt accumulations that can occur in these systems, species that are restricted to wetland or riparian habitats are typically not present. Very few of these types of wetlands are known to occur in the forest. They do exist to a larger extent outside the forest, notably in the Animas subbasin.

The forest does not have a detailed inventory or assessment of springs and seeps or non-riverine wetlands. Information about the extent and distribution of these features is limited to the National Hydrography Dataset and the National Wetlands Inventory. The National Hydrography Dataset documents what is known about the location and number of springs and seeps in the plan and context area, but does not indicate if they produce water seasonally, all year long, or if they no longer produce water. The wetlands inventory provides national coverage but has not been entirely verified on the ground. According to these datasets, the Gila National Forest contains 918 of the 2,211 springs and seeps and 2,718 acres of the total 26,579 acres of non-riverine wetlands within the 11 subbasins the forest is part of. There is no water quality information for these water resource features.

Because these features are relatively small, they are more susceptible to impacts related to management activities. Those that are seasonal or produce relatively small quantities of water may be more likely to dry up as droughts become longer and more frequent and severe. Development is a substantial risk to springs and seeps. Spring development involves any method or practice that diverts water produced by the spring or alters natural water flow paths. Based on the Gila National Forest's range improvements database, 49 percent of the springs occurring in the forest have been developed to provide livestock water. As with the earthen stock ponds previously discussed, no information is available on the reliability of the water produced from most springs. The relationship between how much water the spring produces, and how much is diverted is important to understand potential risks to ecological sustainability.

Not much information was found about groundwater quality, although the New Mexico Water Quality Control Commission has developed regulations to protect groundwater resources. The state of New Mexico also relies on its State Drinking Water Rules that incorporate regulations in the Federal Safe Drinking Water Act and establish additional requirements. The Safe Drinking Water Act and State

Drinking Water Rules only apply to public water systems. Groundwater quality monitoring is typically only conducted at facilities with a permit to discharge pollutants or when individuals test their own domestic well water. There are a few potential sources of pollutants that could impact groundwater quality in and around the forest associated with old landfills, historic mining activity, underground storage tanks, and septic tanks.

Changed Circumstances

The Forest Service assembled a Burned Area Emergency Response team to assess post-fire conditions resulting from the 2022 Black Fire. This update to the description of the affected environment for soil and watershed resources draws heavily on the work of that team. As opposed to the Rapid Assessment of Vegetation after Wildfire dataset used to evaluate the changed circumstances for vegetation communities, the Soil Burn Severity dataset produced by the Gila National Forest Burned Area Emergency Response team is used. Vegetation burn severity and soil burn severity are not equivalent. Soil burn severity may be higher or lower than the vegetation burn severity depending on how the fire burned. The soil burn severity mapping process is described in the technical guidance by Parsons and others (2010).

Soil and Soil Condition

The 2022 Black Fire created 74,594 acres (approximately 2 percent of the Gila National Forest) of unsatisfactory soil conditions that were most likely satisfactory before the fire (USDA FS 2022d). Most of these soils supported Mixed Conifer-Frequent Fire and Pinyon Juniper Woodland, although several other upland ecological response units were impacted to lesser degrees. Soil conditions have changed, but the need to change the plan and the responsiveness of the alternatives to those needs have not.

Watersheds and Watershed Condition

The Black Fire impacted 31 subwatersheds (USDA FS 2022d). This assessment of changed conditions is separate from the watershed classification update periodically completed by forest staff. The reclassification of these watersheds is not complete. Table 38 summarizes the subwatershed area experiencing high and moderate soil burn severities.

Table 38. Range of subwatershed area experiencing high and moderate soil burn severities in the 2022 Black Fire

Percent of Subwatershed Area High and Moderate Soil Burn Severity	Number of Subwatersheds
<1	6
1–5	9
6–10	8
11–20	3
21–30	1
31–40	2
40+	2

In addition to the changes in upland conditions, discussed in the previous subsection, several riparian/wetland vegetation communities and aquatic ecosystems were impacted. The hardest hit were those Upper Montane Conifer/Willow and Narrowleaf Cottonwood/Shrub communities and native aquatic and semi-aquatic species assemblages in the subwatersheds with the highest percentages of moderate and high soil burn severity. Some of the impacted streams supported significant and unique biotic assemblages, the status of which is not yet fully understood. Watershed condition was substantially reduced in at least five subwatersheds but the need to change the plan and the responsiveness of the alternatives to those needs have not.

Surface Water Quantity and Quality

The 2022 Black Fire substantially altered water flow, temperature, and sediment regimes in at least five subwatersheds. Combined with the record-breaking monsoon season, both short- and long-term water quality impacts are anticipated. These impacts will be reduced over time as watersheds establish a new equilibrium with their water and sediment supply and riparian vegetation communities recover or are restored.

There are 51 miles of Outstanding National Resource Waters within the fire perimeter. These waters were protected from human impacts to their water quality status during fire suppression activities through retardant avoidance zones and tactics to minimize impacts in wilderness.

Groundwater Quantity and Quality

Changes to patterns of groundwater exchange with surface water in streams are expected in the most impacted watersheds. Springs and seeps may also experience changes in surface water production. Like previous conclusions, this does not change the need to revise the plan or justify revisiting the alternatives or analysis. There is no information to indicate a change in groundwater quality because of the 2022 Black Fire.

Environmental Consequences

The following discussion of environmental consequences addresses the effects of the alternatives on soil and watershed resources. It does not discuss the effects of soil and watershed management on other resources or resource uses. Those discussions are housed under their respective topic headings. To avoid redundancy, watershed condition indicators relevant to riparian and aquatic ecosystems are not analyzed here. Although they are linked, riparian and aquatic ecosystems have their own section in this document due to their ecological importance.

Analysis Methodology

Soil Condition

Soil condition is analyzed qualitatively, with inferences drawn from the climate and Upland Vegetation, Fire Ecology and Fuels analyses, and peer-reviewed published literature as cited in the analysis. The types and amounts of planned activities, and the trends in biomass carbon and the ecosystem characteristics analyzed for vegetation communities provide a sense of what the effects to soil functions might be under a given alternative. This analysis draws on other analyses, so all the associated assumptions are also relevant here.

Watershed Condition

Watershed condition is analyzed qualitatively, with inferences being drawn from the soils, carbon, Upland Vegetation, Fire Ecology and Fuels analysis, and other peer-reviewed published literature as cited in the analysis. The assumptions relevant to the analysis of soil condition also apply to watershed condition.

Area Designations

Area designations can influence how the forest manages for ecosystem characteristics. Designations that substantially change the allowable types of activities, equipment, or modes of access and travel have the potential to influence the extent and distribution of effects, and at times, the outcomes of management activities. Area designations with this potential include designated wilderness, recommended wilderness, designated and proposed research natural areas, inventoried roadless areas, and other administrative designations. Those effects depend on the designation, amount of area involved, vegetation types and conditions that exist within that area, and the terrain. Terrain can limit the types of activities, equipment, or modes of access and travel just as effectively as a designation.

The effects of proposals or recommendations for new area designations in each alternative are discussed qualitatively relative to these management factors and evaluated based on whether they are consistent with opportunities to move toward desired conditions for soil and watershed resources or whether they detract from those opportunities. Existing designated areas are not discussed because they do not contribute to differences in effects between alternatives. Special botanical areas proposed under alternatives 2 and 5 are not analyzed, as plan direction for their management does not substantially change the types of activities, disturbances, or associated effects. Rather, that direction has effects on species because it provides avoidance or mitigation measures for rare and endemic plant species in specific areas. The effects to species are analyzed in the Wildlife, Fish and Plants section of this environmental analysis.

Climate Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

All alternatives include vegetation treatment objectives with some combination of wildland fire and mechanical vegetation treatments to move toward desired conditions. Effects of mechanical vegetation treatments may include reduction or enhancement of soil functions and watershed condition. Compaction caused by heavy equipment can alter patterns of gas and water exchange between the soil and the atmosphere, rates of water infiltration, moisture-holding capacity, root distribution, soil microbial activity and nutrient cycling, thereby, affecting all soil functions. There is disagreement in the scientific literature about whether these alterations are mostly beneficial, detrimental, or neutral (Burger et al. 2010, Cambi et al. 2015, Sánchez Meador et al. 2017) and more research is needed. Biological soil crusts, which contribute to nutrient cycling and stability function in some systems, are well adapted to climatic disturbances. However, they are poorly adapted to compressional disturbances such as mechanical treatments, and their contributions to soil functions are reduced.

Soils with higher clay content are more susceptible to compaction, as are those that are wet at the time the activity occurs. Pounds of equipment per square inch and operator skill are additional factors contributing to the degree of soil disturbance. Where compaction is an outcome of mechanical treatments, reductions in soil productivity have been demonstrated on clay soils, while increases have occurred on sandy soils. Loamy soils have not demonstrated a change in productivity (Burger et al. 2010). Natural freeze-thaw or shrink-swell cycles can break up compaction over time, although, depending on the soil and climate, it can persist for decades (Cambi et al. 2015). The depth and duration of compaction also depends on the time between re-entries.

Mechanical thinning has typically been accomplished with heavy timber harvesting equipment or chainsaws. These conventional thinning treatments reduce vegetative canopy cover, which reduces raindrop interception. This increases the amount of water that reaches the ground and is available for infiltration but can also increase the soil's exposure to raindrop impact, detachment, and movement off-site. Conventional thinning methods can also remove or redistribute or both vegetative groundcover, as well as the surficial soil itself. Destruction of surface soil aggregates can reduce soil organic matter (in the sense of Jian et al. 2018), which is important for hydrologic function, nutrient cycling and biological function, and climate regulation. Reductions in vegetative cover increase the potential for erosion and sediment delivery to streams, which can lead to declines in water quality. However, reductions in vegetative cover are short-term on most soils, as the herbaceous response to thinning treatments other than mastication is relatively quick.

Mechanical vegetation treatments have a limited ability to affect water quantity, given that the amount, timing, and distribution of precipitation exerts a far greater and more lasting impact on available surface water than does tree density (Feeney et al. 1998 as cited in Reynolds et al. 2013; Furniss et al. 2010). While small, temporary increases in available water have been measured in areas where total annual precipitation is greater than potential evapotranspiration,[25] those increases are temporary and not sustainable over the long term (National Research Council 2008 in Furniss et al. 2010; Ffolliott and Gottfried 2012). There is also conflicting science on whether these changes in water balance are likely to increase or decrease vulnerability to climate change (Moreno et al. 2016; Clark et al. 2016; Bradford and Bell 2017). In the arid and semi-arid Southwest, temporary increases in available water generally remain on site and are taken up by plants. Any increase in surface water quantity because of mechanical thinning treatments is typically associated with decreases in quality.

As opposed to conventional mechanical treatments, mastication can increase vegetative groundcover as it produces wood mulch but can still redistribute the surficial soil and destroy soil aggregates. The effects of this relatively new mechanical thinning method are not as well understood as other methods. While much remains to be learned, most effects seem to be dependent on mulch depth. Mastication has been shown to increase and decrease soil moisture during the growing season, increase or decrease the availability of some essential plant nutrients, increase vegetative biodiversity (Battaglia et al. 2015), and it can alter soil microbial communities (Gottfried and Overby 2009).

Masticated fuel beds remain on the ground for long periods of time and have been shown to alter fire behavior in “unexpected and contradictory ways” (Kreye et al. 2012). Given observed longer-duration flaming and smoldering (Kreye et al. 2012), soil burn severity is likely to be higher in these fuels and would result in reductions in soil functions for a period of time, depending on other site- and incident-specific factors. Fire effects to soils are discussed in more detail in subsequent paragraphs.

While the full range of effects associated with mechanical treatments are possible, detrimental effects would be localized and limited due to best management practices recommended at the project-level to fulfill the Forest Service’s legal obligations to the Clean Water Act and move toward desired conditions for soil and watershed resources. The action alternatives do contain standards and guidelines that are frequently recommended best management practices. This may result in some difference between the action alternatives and the no action alternative, but the differences would be relatively minor because all projects would include best management practices.

Wildland fire, both prescribed fire and naturally ignited, can be adaptation, restoration and fuels management tools when used alone, or in conjunction with mechanical treatments. However, the degree to which this long-term benefit to soil and watershed resources depends on a variety of incident and site-specific factors including, time between re-entries, severity patch size, depth and length of time at which soil heating occurs, the total watershed area occupied by moderate and high severity patches, and

[25] Potential evapotranspiration is a measure of the ability of the atmosphere to remove water from the land’s surface through evaporation and transpiration, assuming an unlimited water supply. It changes hourly, daily, monthly, and annually. It increases with exposure to solar radiation, wind, higher temperatures, and lower humidity. Conversely, it decreases with shade, less wind, cooler temperatures, and higher humidity.

landscape position. Fire effects are difficult to predict, given the highly variable circumstances under which fires can occur.

Fire can remove vegetative canopy and groundcover, resulting in effects similar to conventional thinning treatments in terms of the fate of precipitation and potential soil loss, depending on the degree of consumption. In terms of the effects on soil biological and nutrient cycling functions, a recent systematic review of the literature by Sánchez Meador and others suggests that neither mechanical treatments nor prescribed fire used alone produces a substantial effect on the soil microbial community or nutrient availability. However, when used in combination, the effects are generally both substantial and positive (Sánchez Meador et al. 2017). On the other hand, there is literature describing fire effects on soil biological and nutrient cycling functions that indicates the significance of fire effects on soil biological and nutrient-cycling functions, and whether those effects are positive or negative, is dependent on heating thresholds (DeBano 1990, Busse et al. 2014). While it might be that these thresholds are not reached under most prescribed burning conditions, it does happen and can result in enhanced or reduced nutrient availability and microbial activity for a relatively short period of time (Busse et al. 2014). Even low-severity fire can have both positive and negative effects on soil and watershed condition, depending on a variety of site-specific factors and the frequency at which the site is burned.

For prescribed fire and naturally ignited wildfire managed under favorable fuel and weather conditions, most negative effects can be mitigated by planning for and integrating fuel, soil quality (Busse et al. 2014), and watershed objectives at the incident level. Human-caused wildfires and naturally ignited wildfires managed under a full suppression objective are likely to result in the full range of these effects. Those emergency actions prioritize life and property and while incident-specific tactics would strive to limit the most detrimental impacts, they are not bound by plan guidance and do no differ between alternatives.

The effects discussed thus far are generally applicable to low and mixed severities, as these are most often associated with restoration and fuels management objectives. Perhaps the most substantial effect to soil and watershed conditions associated with mechanical treatments and mixed-severity fire is a reduction in the likelihood of high-severity fire and epidemic levels of insect and disease infestations. This protects favorable conditions of water flow, the productivity of the land, and supports the full Resistance-Resilience-Transition adaptation spectrum.

However, wildfires happen, and high-severity fire is a reality that remains under all alternatives and climate scenarios. Even when a wildfire happens under conditions that initially support achievement of resource objectives, conditions can change quickly. Unexpected wind events happen. Escaped prescribed fires have been rare, but they have and will continue to occur. With more woody vegetation on the landscape than was supported historically, uncharacteristic fuel loading will likely persist for many more decades. When high-severity fire occurs, the negative effects to soil and watershed resources will likely continue to be greater than they were in the past.

Regardless of whether it is characteristic of a given ecosystem, mixed to high-severity fire can have the following effects proportional to the extent and pattern of severities: removal of vegetative cover; accelerated erosion and sediment delivery to streams, accompanied by the loss of soil organic carbon, nutrients (Busse et al. 2014) and productivity; increased peak flow and stream power; alteration of groundwater recharge and discharge patterns; changes in stream channel geometry, gradient and elevation; removal of the riparian/wetland vegetation; changes in the amount and distribution of large woody debris; decreased water quality; and increased risk of invasive and noxious weed population establishment or expansion. Some noxious weed species, such as cheatgrass, can alter natural fire regimes potentially leading to a decline in soil functions and watershed condition.

In terms of biological and nutrient cycling function, high-severity fire can result in a net loss of nutrients and reduce the long-term productivity of the land (DeBano 1990). Although there can be great variability in effects of high-severity fire on soil biological function (Neary et al. 1999, Pourreza et al. 2014), there is evidence to suggest that fire-related decreases in fungi living on or near the soil surface, in close association with conifers, may be a concern for long-term productivity. High-intensity surface fires also kill biological soil crusts (Johansen et al. 1993; Belnap et al. 2001), and frequent burning can prevent the recovery of lichens and mosses, leaving only a few species of cyanobacteria (Whisenant 1990), both of which can result in reduced biological function and nutrient cycling.

In addition to total loss of vegetative cover, high-severity wildfire has the potential to sterilize some diversity of the seedbank and create water-repellent soils. Water repellency amplifies the detrimental effects described in the previous paragraph. A reduced or eliminated seedbank increases the amount of time before vegetation becomes established and soil functions begin to recover. Soil functions will recover over time but may never attain pre-fire levels. Depending on the amount of soil loss that occurs, the productivity of the land may only recover on geologic time scales.

Severely burned areas are more susceptible to invasive and noxious weed establishment and spread. The effects of noxious weed invasion can include displacement of the native vegetation community, a decrease in native species diversity and range, and disruption of fire regimes, decreases in infiltration rates (DiTomaso 2000), and increases in evaporation rates (Lauenroth et al. 1994) and erosion rates (Lacey et al. 1998) and nutrient cycling. All of which compromise the integrity of ecosystems, their resiliency, and their sustainability. The wind disperses many noxious weed seeds and a nearby seed source is not always needed for recently burned areas to experience invasion. Climate change is expected to favor non-native, invasive and noxious plant species establishment and spread. Plan objectives that move toward desired conditions for vegetation, limit the potential extents of high-severity fire and thereby noxious weed establishment and spread support the Resistance-Resilience end of the adaptation spectrum.

While herbicide is not included in any of the treatment objectives, its use is allowable under all alternatives as part of an integrated weed management approach. Even though the action alternatives contain standards and guidelines guiding its use and alternative 1 does not, there is no difference in effects to soil and watershed resources as constraints would be determined at the project-level to comply with laws and regulation. Herbicide use is a highly regulated management activity that requires multiple levels of permitting and reporting to other federal and state agencies. The action alternatives have standards and guidelines that are useful as baseline constraints and serve transparency and communication with those who are concerned about the use of chemicals and may or may not have familiarity with the law or regulatory procedures. The need for more restrictive or additional constraints would be determined at the project level when herbicide application is proposed.

Post-fire soil and watershed management would also continue in compliance with Forest Service policy under all alternatives, regardless of whether it is articulated in plan direction. This includes:

- Post-fire rehabilitation, including but not limited to those actions taken to mitigate potential adverse effects to soil stability and hydrologic functions because of fire management activities. Examples of post-fire rehabilitation include constructing water bars and scattering slash on dozer lines and clearing culverts of debris generated by line clearing along roads.
- Burned Area Emergency Response and emergency watershed stabilization actions taken to mitigate unacceptable risk to downstream values posed by the loss of soil stability and hydrologic function. Examples of emergency stabilization actions include aerial seeding, mulching, or both, channel clearing, and replacing culverts with low water crossings along roads in drainage bottoms.

Post-fire rehabilitation can restore natural drainage patterns and re-establish vegetative cover to reduce the decrease in soil stability and hydrologic functions that can result from disrupted drainage patterns and decreased vegetative cover. Emergency stabilization actions that establish vegetative canopy and ground cover at the beginning of the summer monsoon season mitigate the effects of high-severity fire previously discussed. The outcome of both activities is a reduction in risk to soil stability and hydrologic function caused by fire management activities and thereby retaining the long-term productivity of the land to the extent possible.

Post-fire rehabilitation and emergency stabilization activities could include the use of certified noxious weed-free seed and other materials as appropriate to site-specific determinations. Many of the areas that have been eligible for Burned Area Emergency Response are likely to re-burn in the future under all alternatives. A recent re-burn in the high country of the Coronado National Forest resulted in a similar watershed response as the previous stand-replacement fire that occurred roughly 18 years before, most likely tied to large quantities of dead and down logs and the longer fire residence time that woody debris created. More recently, areas burned in the 2013 Silver Fire that reburned in the 2022 Black Fire may further illustrate that post-fire watershed response depends on disturbance history, rather than a single event. All alternatives provide some degree of risk reduction in terms of future fire-caused watershed emergencies, but some are likely to perform better than others due to the differing plan objectives for vegetation communities.

Roads and trails facilitate vegetation treatments and wildland fire management. As fire management tools, they provide the ability to maximize the beneficial effects and minimize the detrimental effects previously discussed. They also have detrimental effects to soil and watershed resources that are disproportionately large, as compared to the actual area they occupy on the landscape. Motorized routes are responsible for the most impacts, with open road density, maintenance, and proximity to water largely determining the effects (USDA FS 2014b). The forest has a higher motorized route density than it can properly maintain under current and projected future budgets (USDA FS 2014a), and many motorized routes are under-engineered or poorly located.

Road and trail surfaces are necessarily compacted and have relatively little vegetative cover as compared to other areas. Road and trail prisms also alter water flow paths, capture overland flow, and concentrate it. This increases the velocities and erosive energy of runoff. With reduced infiltration rates and minimal vegetative cover present within the road prism, the only controls on runoff and erosion are the drainage features along the road that distribute and slow water. Unfortunately, many of these features can end up serving as nick points that initiate rill and gully erosion if they are not properly maintained. Roads located in drainage bottoms are a particular concern because they act as constraints on the extent riparian/wetland vegetation can occupy and are more effective at delivering sediment to nearby streams. Potential effects associated with the existing transportation system are anticipated under all alternative and those effects were analyzed as part of the travel management decision-making process (USDA FS 2014a and USDA FS 2014b). All alternatives contain the same set of desired conditions and an objective for decommissioning roads identified as unneeded. However, progress toward those desired conditions through road maintenance is driven by budget and staffing, which is outside the scope of the forest plan. The repairs and maintenance will help mitigate negative impacts to soil and watershed conditions caused by the transportation system.

The transportation system also provides permitted livestock producers access to their allotment and facilitates range management. All alternatives would provide direction to maintain and improve range condition. Declines in range condition would have detrimental effects on soil and watershed resources and would not be consistent with the plan under any alternative. Improved range condition would support movement toward desired conditions for soil and watershed resources. Still, localized impacts to soil and watershed resources are likely to occur, including areas of compaction, erosion, and sedimentation. Additionally, water intake for a beef cow may vary from 3 to 30 gallons per day depending on age, body size, stage of production, and the environment, making less water available to support wildlife, vegetation, and humans.

All alternatives include best management practices either by reference or as plan components, as mentioned previously related to the objectives for vegetation communities. Best management practices are activity-, project-, and site-specific methods or measures to prevent or mitigate potential adverse impacts to environmental quality, especially water quality. While their primary purpose is to protect against degradation of water quality, they can also protect soil, aquatic habitat, aquatic organisms, and riparian/wetland vegetation. As they are preventative, they cannot improve conditions; they only serve to lessen the degree, extent, and duration of the effects associated with a given activity or project. Some activity-specific best management practices are included as plan components in every alternative, although the action alternatives are more specific than the no-action alternative. Regardless, best management practices would be implemented for all projects and activities whether plan direction articulates it or not; they are required to comply with the Clean Water Act. Drainage features on the transportation system, restrictions on heavy equipment under wet conditions, and minimum distances between surface water sources and salt and other mineral supplements for livestock are examples of best management practices that have been incorporated into the action alternatives as standards or guidelines.

Effects of Alternative 1

Alternative 1 emphasizes timber production, range management, recreation, protection objectives for fire management, and managing for quality Mexican spotted owl and northern goshawk habitat. Direction specific to the management of soil and watershed resources is minimal. Desired conditions are articulated, but those desired conditions are defined by regulatory standards and lack the descriptive detail of the action alternatives.

Alternative 1 specifies that soil and watershed improvement "should be accomplished through a combination of resource management and watershed structures." This alternative puts the emphasis on structures through objectives for their construction and maintenance. Watershed structures are appropriate in some circumstances, and in those cases, this direction serves to improve soil and watershed conditions. Watershed structures aid in providing for favorable conditions of water flow, slow gully erosion, and over time, can contribute to the recovery of soil functions and watershed condition. However, the emphasis on watershed structures would promote treatment of symptoms, not necessarily the root causes of degraded conditions. The number of structures called for in the objectives has also proven to be outside the fiscal capacity of the forest in terms of both construction and maintenance. Under-engineered structures, especially those that fail to consider soil properties in the design phase, and lack of maintenance can lead to failure. Structural failure often ends up causing bigger problems than the ones they were intended to fix, exposing more area to headcutting and gullying and declines in soil condition.

In terms of livestock grazing and range management, this alternative establishes a standard that all allotments must, at a minimum, maintain their current range condition and trend. If current condition is "poor," but stable, it can remain poor and be consistent with the plan as long as the trend doesn't decline toward "very poor." This has the effect of maintaining the unsatisfactory or impaired soil and watershed conditions that often accompany poor and very poor range conditions. It does not promote the recovery of soil functions and the long-term productivity of the land. Alternative 1 does provide science-based utilization guidelines, tiered to existing range conditions, designed to promote improvement where needed, which in turn would lead to improvement in soil and watershed condition.

Under alternative 1, vegetation treatments continue to use mechanical methods, prescribed fire, and naturally ignited wildfire the way it has been done over the last decade. Vegetation treatments primarily target Ponderosa Pine Forest, and use prescribed fire where canopies are either already open, or if closed, in a single-storied state. Single-storied states have few ladder fuels, and it is much easier to keep fire on the ground and avoid some of the negative fire effects described previously.

On an average decadal basis, alternative 1 would likely include at least 129,024 acres of planned treatments, with 29 percent being mechanical treatments, and 71 percent being prescribed fire. Prescribed fire acres are anticipated to remain 90 percent low-severity and 10 percent mixed-severity. Also on an average decadal basis, the number of acres of wildfire and the severity distribution is anticipated to remain like the last decade, with 605,598 acres and roughly 77 percent being low-severity, 15 percent mixed-severity, and 8 percent high-severity. For more information about how these values were developed, and associated assumptions and limitations, see the Upland Vegetation, Fire Ecology and Fuels analysis methodology section. Model projections demonstrate progress toward desired conditions for vegetation communities is being made under this alternative. However, progress is slow, and some vegetation communities are moving away from desired conditions for one or more characteristics.

A combination of mechanical treatments and predominantly low-severity prescribed fire likely provides for mostly beneficial effects to soil and watersheds on the acres where they are used together (Sánchez Meador et al. 2017). Given predominantly low-severity prescribed fire is being used alone, nothing is substantially changed, and the risk of high-severity wildfire and its detrimental effects remain the same. While there are undeniable short-term negative effects resulting from mixed-severity fire, which have been described previously, mixed-severity wildfire provides the long-term benefit to both soil and watershed condition. The mosaic produced by mixed-severity fire limits probable extents of high-severity fire in the future. Overall, this alternative is projected to increase the risk of high-severity fire over time in all watersheds, based on a net increase in closed-canopy conditions across the forest. Alternative 1 likely fails to do enough to sustain fundamental ecosystem and watershed functions or support the Resistance-Resilience-Transition adaptation spectrum.

This alternative also includes slope restrictions for mechanical vegetation treatments, mostly in response to the previous Mexican spotted owl recovery plan, but also as an activity-specific best management practice based on the limitations of the harvesting systems and equipment that existed at the time. As a best management practice, the intent is to lessen the degree, duration, or both of soil stability and hydrologic function impairment because of these activities. These standards may also aim to meet a specific requirement of the National Forest Management Act. The National Forest Management Act requires forest plans to ensure that timber harvest does not occur where “irreversible damage to soil, slope or other watershed condition” is reasonably foreseeable.

Alternative 1 prohibits timber harvest in mixed conifer and pine oak systems on slopes over 40 percent, regardless of reason or equipment used unless it had been harvested in the previous 20 years. In that case, timber harvest is allowable on slopes over 40 percent if aerial equipment and cable yarding systems are used. In other vegetation types, it is allowable to use conventional, ground-based logging equipment on slopes less than 40 percent whether they were harvested previously or not. It is also allowable to use aerial equipment and cable yarding to slopes over 40 percent in other vegetation types other than mixed conifer and pine oak, whether they were harvested previously or not.

The no-action alternative also places slope restrictions on other types of mechanical treatments, specifically pushing or chaining. No slope restrictions are specifically provided for mastication, as it is a relatively new treatment method. The direction for pushing and chaining is as follows:

“…treatment through other than fuelwood harvest will be guided by the following criteria:

a) Site potential has a soil production potential rating of moderate or high.

b) Slopes generally less than 15 percent.

c) Limit treatment to soil with low or moderate erodibility index.

d) Treatment results are cost effective.”

Like the timber harvesting slope restrictions, there are circumstances under which treating slopes more than 15 percent is allowable, as indicated by the word "generally," but those circumstances are not defined. Additionally, no monitoring information sufficient to establish cost effectiveness has been collected on the forest, nor is there any known scientific literature sufficient to make this determination.

As a whole, these constraints on for mechanical vegetation treatments do not provide adequate consideration the following:

- Technological advances in ground-based harvesting equipment include steep slope capabilities.
- Slope being constant, some soils are naturally more susceptible to reductions in stability function than others, regardless of vegetation type.
- The limitations of the erodibility index interpretation.
- Potential fire behavior and the effects of stand-replacement fire on soil and watershed function relative to the effects of mechanical treatments.

Conventional ground-based harvesting equipment cannot safely operate on slopes over 40 percent. Technological advances have led to ground-based equipment that can operate safely on slopes up to 80 percent. However, there are few scientific studies related to the environmental effects of operating on these steep slopes. Those effects may be like those previously discussed, but they may be amplified or diminished, depending on a variety of factors including soil properties and the distribution of the weight of the equipment on the soil surface.

These slope restrictions provide no direct consideration for the fact that some soils are naturally more susceptible to reductions in stability function. The restrictions for pushing and chaining do, but the erodibility index may not be the best metric to identify these soils. This index is an interpretation derived from a soil loss model that is based on cultivated cropland data. New soil loss models based on wildlands data are available, as are new interpretations. Furthermore, the erodibility index does not necessarily identify soils prone to mass movements such as landslides and debris flows, or fully consider those soils with inherently low resistance and resilience.

Finally, failure to weigh the site-specific tradeoffs between the effects of mechanical treatments on soil condition and the long-term productivity of the land, and the likelihood of high-severity, stand-replacement fire poses a substantial risk. Both soil condition and the long-term productivity of the land are likely to decline should a fire occur in steep, untreated terrain with large, contiguous areas likely to experience stand-replacement fire.

Herbicide use is not included in the vegetation treatments but is allowable for both noxious and native species under alternative 1. Herbicide is often, but not always, the only effective tool to control, contain, and eradicate noxious weeds. Native species eligible for treatment are restricted to ponderosa pine, pinyon pines, juniper, rabbitbrush and snakeweed where they are encroaching grassland sites. Allowing herbicide as one of many tools to restore and maintain grasslands has the potential to benefit soil and watershed condition in those systems by reducing the need for frequent mechanical treatments where alligator juniper is present, as it typically re-sprouts after cutting or burning. Frequent mechanical re-entries tend to create more persistent changes in soil functions. However, it doesn't allow for herbicide use on evergreen oak species, which also re-sprout after cutting or burning and may be located on the same sites as alligator juniper. Furthermore, just 9 percent of the forest consists of grassland communities, and these re-sprouting species have the potential to be a problem in all but Spruce-Fir Forest and Mixed Conifer with Aspen. While their presence is desirable, substantial increases in the abundance and cover of evergreen oak and alligator juniper may be undesirable. Management intends to create and maintain conditions that support frequent, low-severity fire. However, when substantial increases in woody understory abundance and cover occur, the result is a self-perpetuating shift to conditions that support mixed- or high-severity fire.

No benefit to soil or watershed resources is attained by using herbicide to treat species that do not re-sprout, such as pines and juniper species other than alligator juniper.

Effects Common to All Action Alternatives

All action alternatives include the same detailed desired conditions for soils, watersheds, and water quality. Management directed toward these desired conditions would improve soil and watershed conditions. These alternatives also include objectives designed to benefit soil and watershed resources. This includes improving impaired or unsatisfactory soil condition, in addition to actions to address active headcuts or gully erosion. The objective to implement at least one action annually to improve rangelands in poor or very poor condition also generates movement toward desired conditions, as opposed to the no-action alternative. Grazing utilization guidelines are determined at the allotment level, rather than the plan level. Allotment-level National Environmental Policy Act processes would determine what utilization levels support movement toward the plan's desired conditions for all resources, activities, and uses.

Additionally, the action alternatives share common objectives for overall watershed condition, and for the resources affecting the water quantity, riparian/wetland vegetation, aquatic habitat, aquatic biota, and terrestrial invasive species indicators of watershed condition. The objectives for overall watershed condition set a minimum number of subwatersheds that would be improved, allowing for more as budget and partnership opportunities present themselves. They also aim to maintain watersheds that are currently in proper functioning condition, while being realistic in acknowledging wildfire impacts may be unavoidable.

All action alternatives would include a desired condition for a climate-resilient transportation network. To move toward this desired condition, a vulnerability assessment would be the first step, allowing managers to make risk-based, climate-informed decisions about the transportation system (Rasmussen et al. 2018). A vulnerability assessment that included an analysis of wildfire risk, sediment potential, and other values at risk, such as streams supporting at-risk species, would also support maintenance and movement toward desired conditions for soil and watershed resources; riparian and aquatic ecosystems; and wildlife, fish and plant species.

In terms of the water quantity indicator, which is intended to capture alterations in flow due to structural controls or diversions on stream hydrology, there is an objective to assess all constructed aquatic barriers over the planning cycle and take appropriate actions. These barriers are tools to aid the recovery of native aquatic species but can also alter flow depending on their design and location. These assessments have the potential to identify where appropriate actions could improve flow conditions. These assessments also serve to ensure the barriers are functioning as intended in terms of protecting native aquatic organisms, which has the potential to maintain or improve the aquatic biota indicator of watershed condition. The objective to restore or enhance at least 100 miles of stream habitat every 10 years would also support maintenance or improvement in both the aquatic biota and aquatic habitat indicators. The objective to implement at least one riparian improvement project annually, beyond any noxious or invasive weed treatments would provide an avenue to improve the riparian/wetland vegetation indicator, as well as the aquatics indicators. Finally, objectives for non-native invasive species have the potential to maintain or improve the aquatic biota or the terrestrial invasive species indicator over the no-action alternative. Taken as a whole, these objectives represent substantially better soil and watershed condition outcomes over the no-action alternative and stronger support for the full Resistance-Resilience-Transition adaptation spectrum.

All action alternatives also include plan standards that impose slope restrictions, allowing for exceptions under specified circumstances. The presence or absence of those circumstances would be determined through project-level analysis. These proposed slope restrictions take soil properties, potential fire behavior, watershed and urban-interface values, and all available treatment methods and equipment technologies into consideration. In contrast to the no-action alternative, these standards and the allowable exceptions would provide management the flexibility to weigh the tradeoffs between the effects of mechanical treatments and foreseeable fire behavior on soil, watershed, and other resource conditions.

Like the no-action alternative, herbicide use for invasive and noxious weeds is allowable under the action alternatives and all contain many standards and guidelines as baseline constraints. While many of these standards and guidelines reiterate regulation or policy, it helps build shared understanding of the many considerations when selecting and using herbicide.

Effects Common to Alternatives 2, 3, and 4

Under alternatives 2, 3, and 4, herbicide may be authorized for use on native re-sprouting species such as alligator juniper and evergreen oaks where their increasing abundance does not support movement toward desired conditions for vegetation communities, especially ecological status and the fuel structure that would support natural fire regimes. Herbicide use may also be authorized for use on native re-sprouting species in the wildland-urban interface where their abundance creates hazardous fuel conditions. This would lengthen the time between re-entries, reducing the impacts to the soil. While herbicide use is a highly regulated activity, the additional plan standards and guidelines will help prevent unintended consequences and ensure that when herbicide is one of the tools, soil and watershed resources and values are protected.

Effects of Alternative 2

Under alternative 2, vegetation treatments would continue to use mechanical methods, prescribed fire, and naturally ignited wildfire. However, it would shift emphasis to different vegetation communities, tackle more difficult acres, allow for more mixed-severity prescribed fire, and expand the use of natural ignitions. On an average decadal basis, alternative 2 would likely include at least 100,884 acres of planned treatments, with 34 percent being mechanical treatments and 66 percent being prescribed fire. Prescribed fire acres would aim for an 80/20 distribution of low- to mixed-severity fire, as opposed to the 90/10 distribution under alternative 1. The number of wildfire acres could increase as much as sixfold, remaining within historical frequencies. Although the wildfire severity distribution was necessarily held constant in the vegetation analysis (see the Upland Vegetation, Fire Ecology and Fuels analysis methodology), allowing this much more wildfire on the landscape could realistically change that distribution. As a result, the need for more Burned Area Emergency Response actions could potentially increase.

Model projections demonstrate slow progress toward desired conditions for many vegetation communities under this alternative (see Upland Vegetation, Fire Ecology and Fuels). However, there are significant differences between alternatives 1 and 2. Alternative 2 would make more progress toward desired conditions for vegetation communities, especially those that influence fire behavior such as tree density and coarse woody debris, as compared to alternative 1 (see Upland Vegetation, Fire Ecology and Fuels section or Summary of Environmental Consequences, both in this chapter of the environmental impact statement).

The combination of mechanical treatments and prescribed fire provides a net benefit as compared to alternative 1, but there are tradeoffs. More mixed-severity prescribed fire reduces the future extent of high-severity fire providing a long-term benefit to soil and watershed conditions, but by accepting more risk to get those effects, there is also a greater potential for undesirable fire effects, both short and long term because management cannot completely control the spatial distribution or patterns of fire severity. Progress toward more sustainable tree densities with greater reliance on fire as a management tool could have implications for soil and watershed functions and climate adaptation. Where progress is achieved with desired spatial patterns of severity, resistance and resilience would increase. Where undesirable spatial patterns of severity occur, resistance and resilience would decrease. This will ultimately depend on site characteristics, fire weather, and incident-specific management decisions, not on plan direction.

Alternative 2 also includes a guideline for livestock grazing that would lead to the establishment of a small system of swing allotments, or a forage reserve for current permit holders to use when drought, wildfire, prescribed fire, or other disturbance renders their primary allotment(s), or portions thereof unusable for a period of time. These swing allotments or forage reserves would be carefully selected from vacant allotments based on how well they would serve this purpose. Establishing swing allotments or forage reserves would support movement toward integrated desired conditions for soil and watershed resources and livestock grazing as a use of the forest. Establishing swing allotments or forage reserves also supports the Resistance-Resilience-Transition adaptation spectrum in a way no other alternative accomplishes.

Effects Common to Alternatives 3 and 4

Under alternatives 3 and 4, no system of swing allotments or forage reserves would be created. The management approach for vacant allotments would be focused on completing any National Environmental Policy Act procedures determined necessary, issuing a permit, and stocking those allotments to the maximum extent possible. This approach is unlikely to support movement toward integrated desired conditions as well as alternative 2, with implications for livestock grazing as a use of the forest (see Livestock Grazing section in this volume of the environmental impact statement) and does not support climate adaptation.

The vegetation treatments likely to occur under alternatives 3 and 4 would also contribute to progress toward desired conditions for some vegetation types and some characteristics. With fewer acres treated overall, limited areas where canopy cover would be reduced, and a general increase in coarse woody debris, the risk of high-severity fire would be greater than under alternative 1 (see Upland Vegetation, Fire Ecology and Fuels section or Summary of Environmental Consequences, both in this chapter of the environmental impact statement). over much of the forest.

Under alternative 3, vegetation objectives emphasize mechanical treatments, and outside of the wildland-urban interface, only historically open-canopy woodlands and grasslands are treated. There would be less prescribed fire than alternative 1, with a cap on the number of acres that could be treated with prescribed fire. On an average decadal basis, alternative 3 would likely include at least 64,208 acres of planned treatments, with 96 percent being mechanical treatments and 4 percent being prescribed fire. Under alternative 4, vegetation objectives emphasize mechanical treatments over prescribed fire, like alternative 3. Alternative 4 differs from alternative 3 in that forested vegetation types emphasized over grasslands and woodlands. On an average decadal basis, alternative 4 would likely include at least 92,799 acres of planned treatments, with 82 percent being mechanical treatments and 18 percent being prescribed fire.

The vegetation treatments likely to occur under alternatives 3 and 4 would also contribute to progress toward desired conditions for some vegetation types and some characteristics. With fewer acres treated overall, limited areas where canopy cover would be reduced, and a general increase in coarse woody debris, the risk of high-severity fire would be greater than under alternative 1 (see Upland Vegetation, Fire Ecology and Fuels section or Summary of Environmental Consequences, both in this chapter of the environmental impact statement). over much of the forest. Further, the synergistic effects of coupling mechanical thinning treatments and fire would be limited because of the cap on the number of acres that could be treated with prescribed fire. These alternatives would not substantially improve the resistance and resilience of soil and watershed resources.

Effects of Alternative 5

Under alternative 5, the use of prescribed fire and naturally ignited wildfires is emphasized. Mechanical treatments would be used only in the wildland-urban interface. At least 200,593 acres of treatments are planned, with 7 percent being mechanical treatments and 93 percent being prescribed fire. Prescribed fire acres aim for a 60/40 distribution of low- to mixed-severity fire as opposed to the 90/10 distribution under alternative 1. The number of wildfire acres could increase as much as elevenfold, remaining within historical frequencies. Like alternative 2, the wildfire severity distribution was necessarily held constant in the vegetation analysis (see the Upland Vegetation, Fire Ecology and Fuels analysis methodology), but allowing this much more wildfire on the landscape could realistically change that distribution. This will likely increase the need for emergency watershed stabilization actions beyond what might be expected for alternative 2.

Alternative 5 would prohibit the use of herbicide on native species, which would otherwise have been allowable. This additional constraint would have the most impact in the wildland-urban interface because mechanical treatments are generally restricted to that interface under alternative 5. Alternatives 2, 3, and 4 would allow herbicide to be authorized in conjunction with other treatments as appropriate for the site, so more wildland-urban interface area could be moved toward desired conditions because less maintenance would be needed where native re-sprouting species create hazardous fuel conditions. Alternative 5 would preclude that and more frequent work would be necessary to achieve and maintain desired conditions, which may concentrate the effects of mechanical treatment discussed in the section Effects Common to All Alternatives, but only in the wildland-urban interface.

Model projections demonstrate progress toward desired conditions for many vegetation communities (see Upland Vegetation, Fire Ecology and Fuels). This alternative would result in the greatest net reduction in canopy cover and coarse woody debris of all. Overall, this alternative does the best at reducing the risk of future high-severity fire, but that risk reduction would likely come at a cost to soil and watershed resources as there is a greater potential for undesirable fire effects, both short and long term, given management cannot completely control the spatial distribution or patterns of fire severity. Like alternative 2, where progress is achieved with desired spatial patterns of severity, resistance and resilience would increase and where undesirable spatial patterns of severity occur, resistance and resilience would decrease. This would ultimately depend on site characteristics, fire weather and incident-specific management decisions, not on plan direction. Given the greater risk inherent in the near total reliance on fire as a restoration tool there would be a much higher likelihood for undesirable spatial patterns of severity as compared to alternative 2.

Additionally, no system of swing allotments or forage reserves would be created. The approach to vacant allotments would be focused on keeping these allotments unstocked until completing any National Environmental Policy Act procedures determined necessary and determining future uses. This would provide those allotments rest from livestock grazing until future uses were determined and may or may not affect the rate of progress toward soil and watershed resource desired conditions depending on the existing condition of those resources. If it accelerates progress toward desired conditions, it would be only do so for that allotment. This would not support the Resistance-Resilience-Transition climate adaptation spectrum as well as alternative 2.

Effects Resulting from Proposed Research Natural Areas

There are no substantial effects to soil or watershed condition associated with any of the proposals at the plan scale across all alternatives due to the small number of acres involved.

Research natural areas are intended to provide opportunities for research. Research can expand the scientific understanding and basis for land management decisions, potentially contributing to better management of soil and watershed resources. On this basis, alternatives 2 and 5 would provide the greatest opportunities to advance scientific knowledge and improve management. Alternatives 3 and 4 would provide no such opportunities. Alternative 1 provides opportunities, but by including proposals for two research natural areas that do not qualify for that status, it may also detract from the quality of these opportunities and the network.

Effects Resulting from Recommended Wilderness Areas

The subsection, Effects Common to All Vegetation Types Resulting from Recommended Wilderness Under All Action Alternatives in the Upland Vegetation, Fire Ecology and Fuels section of this environmental impact statement provides a disclosure of impacts relevant to soil and watershed resources. Thinning treatments that reduce the risk of fire effects we don't want on the landscape support the full Resistance-Resilience-Transition adaptation spectrum. However, they are not the only activity that can support climate adaptation that would be limited by recommended wilderness. Projects designed to help improve water quality and support adaptation, such as floodplain and stream channel restoration after damaging wildfire, can be limited in scope and scale without mechanized equipment. Adaptation projects that aim to restore aquatic habitat connectivity and refugia after damaging wildfire may be similarly limited.

Cumulative Effects

The Gila National Forest manages watersheds within its boundaries, but federal, state, county, municipal, and private boundaries do not often follow watersheds. Successful management of shared watersheds requires a shared effort. Generally, the upper portions of watersheds are managed by the Gila National Forest and lower portions managed by other federal agencies, state and local government entities, and private landowners. The Forest Service will continue to work with other federal and state agencies, local governments, private landowners, and non-governmental organizations toward common watershed goals.

The American Southwest is a frequent fire landscape where livestock grazing and hunting have been and remain important to cultural identity and economic sustainability. Historically, overgrazing by livestock and fire suppression contributed to declines in watershed condition and increases in woody vegetation densities. While the fire suppression era has largely ended and contemporary livestock grazing practices have facilitated improved watershed conditions, herbivory by both livestock and wildlife continues to have impacts on watersheds across the landscape, regardless of jurisdiction or ownership.

The State Departments of Game and Fish manage large elk herds across the forest and the surrounding landscape. While livestock are moved out of pastures when utilization reaches specified levels, forage use by elk and livestock has resulted in detrimental effects to soil and watershed conditions in many locations across Arizona and New Mexico. Elk are an important game species that bring substantial revenue to state and local economies. Long-term solutions will require continued coordination between the Department of Game and Fish, the Forest Service, livestock producers, and New Mexico State University extension professionals (Smallidge et al. 2015).

Under current and predicted trends in climate, the collective impact of herbivory by wildlife and livestock is expected to reduce the amount and quality of benefits soil and watershed resources can provide to people (Beschta et al. 2013). Reduced cover of grasses and forbs can leave areas prone to increases in woody vegetation and without sufficient fine fuels to carry the frequent, low-severity fire that historically kept these areas open. Under an adaptive framework, livestock grazing managed toward desired conditions would improve soil and watershed condition, support the long-term productivity of the land, provide favorable conditions for water flow, regardless of jurisdiction or ownership. Partnerships between permittees and the Natural Resources Conservation Service, supported by their respective soil and water conservation districts and the Forest Service, offer many opportunities to develop and implement the full spectrum of adaptive management actions that can improve soil and watershed outcomes in the face of climate change.

Increases in woody vegetation leads to increases in potential fire behavior and severity. Mechanical vegetation treatments, herbicide, prescribed fire, and naturally ignited wildfire are tools the Forest Service and others will continue to use to reduce the potential for detrimental post-fire watershed effects. With the passage of the New Mexico's Prescribed Burning Act (2021), there are even more opportunities to use all the tools on all lands, in the right combination, in the right places, and at the right times. Although the Arizona state legislature has not passed a similar act, there are still opportunities to work across boundaries and implement complementary treatments. All this work supports climate adaptation and opportunities to contribute toward accomplishing shared goals and objectives. However, the current rate of progress toward these goals and objectives remains insufficient and will not keep pace with the need.

Further, the 2022 Hermit's Peak, Calf Canyon, and Cerro Pelado fires, which resulted from escaped prescribed fires on the Santa Fe National Forest, may have further slowed progress toward desired conditions for relationships, ecosystems, and watersheds. These destructive fires and the post-fire watershed responses have reduced public support of prescribed fire as a tool and public trust in the Forest Service. Prescribed fire programs will continue to adapt to the changing needs and public pressures in the aftermath of these recent events. It is likely that wildfires driven by climate change will continue to outpace progress towards the vegetation desired conditions (see also Upland Vegetation, Fire Ecology and Fuels cumulative effects).

While recent acts of Congress have made unprecedented funding available to do work on public lands, resources are not unlimited. Resources have been and will likely remain focused on watersheds upstream of population densities higher than those associated with the Gila National Forest and in designated municipal watersheds. Many areas in the forest and on all jurisdictions are likely to remain untreated for the foreseeable future. Where this is coincident with large, contiguous areas of higher probabilities of stand-replacement fire, soil and watershed conditions are expected to decline.

Along with fire-facilitated vegetation changes, increased variability and more frequent extreme precipitation events could further amplify post-fire watershed responses. While there are many interacting factors that influence soil erosion and sedimentation, most can be tied back to precipitation patterns and vegetative cover. Intense rain events can increase runoff, erosion, and sedimentation, even when soil and watershed conditions are good. Where conditions are poor because of high-severity disturbances or land use, the productivity of the land and conditions of water flow would likely be fundamentally and permanently altered.

Regardless of jurisdiction, the need for post-fire emergency stabilization to mitigate unacceptable risks to human life and property, and critical natural and cultural resources is likely to increase significantly over the near term. However, the success of those treatments could decline. Where emergency stabilization treatments involve aerial seeding, the timing between application date and the onset of the monsoons determines whether treatments are successful. With greater variability in precipitation patterns, it will become more difficult to get that timing right. Furthermore, emergency stabilization treatments involving watershed structures, may require more engineering and be designed for higher peak flows to avoid being breached; the sudden pulse of water and debris that results from breach hydrology can elevate downstream risk rather than mitigate it. Regardless, impacts to communities downstream of burned areas could become more frequent, more damaging, and require more cooperative leveraging of resources to address. Working together to be better prepared for and able to respond to the post-fire environment was identified as a critical adaptation action during the 2022 Southwest Adaptation Forum. The forum is a gathering of individuals representing federal and state agencies, tribes and pueblos, universities, and communities who are working on climate adaptation in the Southwest.

Although increased variability and more frequent extreme precipitation events are projected, higher temperatures are expected to lead to less available water overall. Mountain system groundwater recharge is also expected to decline (Meixner et al. 2016). And more water will be needed for plants, animals, and people to cope with heat stress. Studies suggest this shift has been underway for more than a decade (Seager et al. 2007). Indeed, the climate division data analyzed in the plan revision assessment report demonstrated the annual average temperature has not dropped below the period of record average since the mid-1990s (USDA FS 2017a). It is likely that water quality impairments for temperature would increase under the rising air temperatures and longer low flow periods predicted in the future. This poses a risk to state designated, beneficial water uses and may favor warm water aquatic species in streams that historically support cool or cold-water aquatic species.

Mining is not a currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. Mining removes vegetative cover and soil, alters surface and groundwater connections, lowers adjacent water tables, and can impact soil and water quality. These activities have the potential to alter surface and groundwater connections, water tables, and potentially lead to the decline of riparian and aquatic habitat on lands beyond those that are mined. These effects are not documented in the Gila National Forest because of current adjacent mining activities, but future mining expansion or mineral exploration activities could change that.

The Forest Service Southwestern Region will be working toward a strategic objective for jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b).

In historic mining districts, reclamation of contaminated abandoned mine lands in the forest, and elsewhere in the Southwest, is ongoing. In general, this will improve water quality where it has been degraded because of historic mining activity. However, the forest continues to be impacted by energy generation as far away as the Four Corners region, as emissions from the coal-fired San Juan generating station contribute to mercury deposition in surface water. Emissions will likely decrease in the future as the company that operates this generating station plans to close it in favor of moving toward cleaner sources of energy.

Climate change is hydrologic change, and the world is at the point where some degree of permanent change is inevitable. As drought and water scarcity have always been part of life in the Southwest, there is already momentum toward addressing and mitigating water shortages. Federal agencies, state and local governments, and private citizens across Arizona and New Mexico have been working together on water and watershed issues for decades. The New Mexico Office of the State Engineer (NMOSC), the New Mexico Water Resources Institute and others are leading the state's drought response planning efforts, with the most current plan being finalized in 2018. The 2018 State Water Plan is comprehensive and includes the New Mexico Drought Plan (NMOSC 2018a), Technical Report (NMOSC 2018b), and Legal Landmarks (NMOSC 2018c). The drought plan includes the operational framework, response actions, and mitigation actions to respond to drought and water shortages (NMOSC 2018a). The technical report characterizes water supply, demand, supply-demand gaps and strategies and key projects to address the issues (NMOSC 2018b). The legal framework, history and context within which water planning, allocation and use are governed is provided in part III of the plan (NMOSC 2018c). The State Water Plan is slated to be updated every 5 years as needed and based on the best available scientific information and citizen involvement. The Southwestern Region of the Forest Service will continue to lean into state and regional water planning efforts. Working together, across jurisdictional boundaries will provide for the best possible outcomes.

Military training flights over the Gila National Forest occur to some extent, although recent proposals to expand the use of airspace in the vicinity have been dropped in favor of other options. These flights may involve dropping flares that can start wildfires or impact water quality. There is no evidence that these military exercises have started wildfires or impacted water quality, but it remains a threat.

Riparian and Aquatic Ecosystems

Affected Environment

Riparian areas are affected by the presence of surface and subsurface, perennial or intermittent, flowing or standing bodies of water. Riparian areas are composed of distinctively different vegetative species than adjacent areas where water is more limited. In these systems, terrestrial and aquatic ecological processes are integrated within watersheds.

Riparian areas are more productive than other vegetation communities in terms of plant and animal biomass per acre. As a result, they provide some of the most important habitat in the Gila National Forest and in the Southwest and are vital to maintaining regional biodiversity (Gregory et al. 1991; Naiman et al. 1993; Patten 1998; Sabo et al. 2005). Aquatic habitats and fish productivity are directly related to the health and function of riparian systems (Knutson and Naef 1997). Therefore, riparian and aquatic ecosystem management have a strong and direct relationship.

The Gila National Forest contains 12 different riparian ERUs that make up approximately 2 percent of the forest. These ERUs and the relative proportion of the forest's riparian areas they represent are displayed in figure 33.

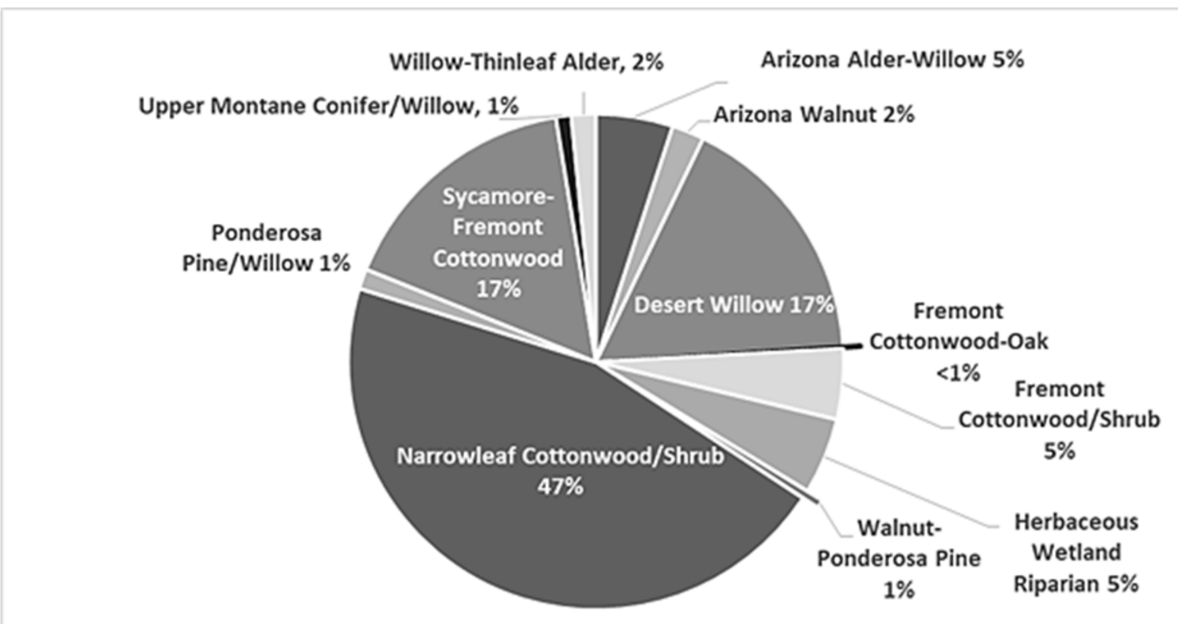

Figure 33. Riparian ecological response units of the Gila National Forest

The Herbaceous Wetland Riparian ERU may occur along streams, or in upland positions. The remaining riparian areas are predominantly streamside communities. Springs and seeps may support riparian species but are generally too small to be captured at the ERU scale. Wetlands occur in association with some but not all streamside riparian areas (riverine wetlands). According to the Fish and Wildlife Service's National

Wetland Inventory, the Gila National Forest's riparian ERUs collectively support roughly 2,700 acres of riverine wetlands and 2,500 acres of non-riverine wetlands (USDA FS 2017a).

Stream systems and their riparian zones function as important natural corridors for the movement of organisms and materials through landscapes. Riparian corridors are important for migrating animals, such as neotropical birds (Farley et al. 1994; Knutson and Naef 1997; Gentry et al. 2006) and for dispersal for plant propagules (Gregory et al. 1991; among others). Plant propagules include seeds, roots, and stems from which new plants can become established. Movements of species facilitate gene flow on a broad scale, thereby contributing to regional diversity in species and genetic information. Riparian ecosystems can also function as refuges during periods of widespread environmental shifts, such as periods of prolonged drought, thereby conserving regional biodiversity over the long term (Naiman et. al. 2005). Unfortunately, riparian corridors can also facilitate the dispersal of non-native invasive and noxious species that are a threat to local and regional biodiversity.

On the Gila National Forest, the Gila River supports some of the highest numbers of bird species in the lower 48 states of the United States, including important breeding habitat (Gori et al. 2014). This and other riparian areas on the forest provide essential habitat for wildlife and aquatic species, including federally listed and proposed threatened or endangered species, species of conservation concern, and rare or narrow endemic plants and macroinvertebrates such as snails. Rare species are those that are uncommon, scarce, or infrequently encountered even though they may not be endangered or threatened. Endemic species are only found in a specific region or location and nowhere else in the world. Narrow endemics have a very small geographic distribution and can be specific to a single drainage. Non-native invasive and noxious species are present in many of the forest's riparian and aquatic ecosystems. Non-native bluegrass species now dominate some herbaceous riparian communities. Saltcedar and Siberian elm are also notable problems, with many of the towns and villages surrounding the forest serving as source areas. These two species mostly occur as isolated individuals or small populations along the forest's streams, as healthy native riparian communities have not yet been displaced. There are a few places where this is not the case and Siberian elm has begun to dominate. Non-native aquatic species, such as brown trout, bull frogs and crayfish, are present in many aquatic communities and in some cases have displaced native species.

Despite these issues, the riparian and aquatic ecosystems in the Gila National Forest continue to support high levels of genetic and species diversity and numerous other ecological services. Riparian forests exert strong controls on stream microclimate, including temperature regimes, which regulates many biological processes and ecosystem functions. For example, the primary productivity of aquatic plants, organism behavior, and water temperature are strongly linked to the amount of solar radiation reaching a stream.[26] Water temperature influences the distribution, metabolism, behavior, and life cycle events of stream organisms (Blann et al. 2002; Naiman et al. 2005; Cross et al. 2013). Riparian forests also contribute substantial amounts of organic matter to streams, which is the foundation of stream food webs (Fisher and Likens 1973; Gurtz et al. 1988; Allan et al. 2003; Baxter et al. 2005; among others).

Along with providing nutrients, riparian zones also serve as buffers against pollution from upland runoff and are critical to protecting water quality (for example Clinton 2011; Laudon et al. 2016). Inputs of woody debris from riparian forests influence stream channel shape and function, sediment routing, and instream habitat (Anderson and Sedell 1979 among others). Riparian systems, including their soils, are regionally and globally important nutrient cycling (Naiman and Décamps 1997 among others) and water storage, availability, and distribution. Healthy riparian areas slow water movement, which raises the water table, expands the saturation zone, and recharges aquifers. They also dissipate stream energy, which can reduce flood damage. The diversity of species and ecological processes in riparian and aquatic ecosystems

[26] Groundwater interactions are also strongly linked to water temperature and may be a more important control than solar radiation.

is sustained by a dynamic water flow regime. Natural variability in sediment supply and water flow, including floods of different magnitudes, impart considerable habitat diversity across the landscape over time (Gori et al. 2014 among others). This mosaic of diverse habitats allows a wide variety of species to persist side by side (Poff et al. 1997).

Just as fire plays a role in upland vegetation communities, it also plays a role in riparian and aquatic communities. Fire's natural role within the riparian zone itself is different than those in adjacent upland ecosystems, but there are similarities. With few exceptions, the current scientific understanding is that historic fire frequency and severity in riparian areas may have been less than, greater than, or similar to the adjacent uplands depending on a variety of site-specific variables (Dwire et al. 2016). The available information to describe fire return intervals is limited to seven studies in the Sierra Nevada mountain range and the Pacific Northwest (Dwire et al. 2016), and what is known about severity is based on inferences drawn from fire behavior and plant species characteristics. There is very little specific evidence to support an assessment of fire regimes in Southwestern riparian systems.

The ability of riparian and aquatic ecosystems to maintain ecological integrity is strongly influenced by, and reflected in, the status of their condition. Based on the available information, some individual riparian areas are functioning properly, but as a whole, each riparian ERU is not in as good of condition or are as resilient as they could be (USDA FS 2017a). More than half of the subwatersheds containing riparian and aquatic ecosystems are either at risk or impaired (see also Soil and Watershed Resources Affected Environment). Riparian areas are adapted to disturbance and defined by change, they are susceptible to degradation and loss. These areas are focal points for humans, terrestrial wildlife, and livestock; both demand and impacts can be high.

These systems are also vulnerable to climate change. In 2022, the Forest Service Southwestern Region updated the 2021 watershed-based Aquatic-Riparian Climate Change Vulnerability Assessment based on additional water temperature information. Approximately 15 percent of the forest's subwatersheds have a vulnerability rating of low, 47 percent are rated moderate, and 38 percent are rated high. Figure 34 shows the vulnerability distribution across the forest.

Changed Circumstances

The 2022 Black Fire created changed circumstances and impacted several important riparian and aquatic ecosystems within the forest but did not create a change in the need to change the plan or alternatives. The description of changed circumstances in the Soil and Watershed Resources section discloses more detailed information about the changed circumstances for riparian and aquatic ecosystems resulting from the 2022 Black Fire.

Environmental Consequences

The following discussion of environmental consequences addresses the effects of the alternatives on riparian (including wetland riparian) and aquatic ecosystems. It does not discuss the effects to plant or animal species or resource uses. Those discussions are housed under their respective topic headings. However, the linkages between riparian and aquatic ecosystems and watershed conditions are discussed, as the health and function of each are inseparable.

Analysis Methodology

This qualitative analysis considers riparian and aquatic ecosystems on the forest generally, not as individual ERUs or groupings of ERUs. Inferences drawn from the Soil and Watershed and Upland Vegetation, Fire Ecology and Fuels analyses, and peer-reviewed scientific literature. Given this analysis draws on other analyses, all the associated assumptions are also relevant here.

Vegetation Structural Condition

Like upland vegetation communities, riparian community structural conditions can be described in terms of seral state diversity. Seral state diversity describes the percentage of a given ERU in each seral state. As defined by reference conditions established by LANDFIRE data, it reflects the structural variability in dominant vegetative lifeform (sparsely vegetated, herbaceous, shrub or tree), woody species canopy cover and size class. Structural variability is the result of ecological processes and patterns over time. It reflects the status of ecological processes, ecosystem function, integrity and resilience, and habitat abundance and quality. All these things reflect the sustainability of land use practices.

In contrast to upland vegetation communities, seral state diversity is not modeled because state-and-transition models have not been developed for riparian ERUs, although LANDFIRE data does provide a reference condition for riparian ERU groups that could form the basis for a qualitative analysis. However, the LANDFIRE reference condition is not used here. Gila National Forest staff decided that a watershed perspective on riparian vegetation structural conditions was more meaningful given the linkages between riparian areas and the upland watershed (Debano and Schmidt 1989 and Hornbeck and Kochenderfer 2000 in Potyondy and Geier 2011).

The Watershed Condition Classification's riparian/wetland vegetation condition indicator also addresses seral states (Potyondy and Geier 2011), at a 6th level watershed, but not an ERU level. The riparian/wetland vegetation indicator defines a functioning properly rating as "native mid to late seral vegetation appropriate to the site's potential dominates the plant communities and is vigorous, healthy, and diverse in age, structure, cover and composition on more than 80 percent of the riparian/wetland areas in the watershed. Sufficient reproduction of native species appropriate to the site is occurring to ensure sustainability. Mesic (riparian) herbaceous plant communities occupy most of their site potential. Vegetation is in dynamic equilibrium appropriate to the stream or wetland system" (Potyondy and Geier 2011). This analysis assumes that trends in vegetation structural conditions will generally follow trends in watershed condition.

Ecological Status and Vegetative Functional Diversity

Ecological status is a measure of the species composition of a vegetation community relative to the potential vegetation community. Functional diversity describes the range of characteristics contained in a vegetation community. The ability to re-sprout, or establish from broken stems transported downstream, or the ability to grow under low oxygen conditions are examples of important functional characteristics. Both the number of characteristics (richness) within a given system and the number of species with characteristic (redundancy) are important indicators of ecosystem function and resilience. For this analysis, it is assumed that trends in ecological status and functional diversity will generally follow trends in structural condition and watershed condition.

Vegetative Groundcover

Vegetative groundcover includes basal area, litter, biological crusts, lichens, and mosses. Basal area is the area covered by tree trunks and stems of shrubs and herbaceous species where they meet the ground. Litter includes all woody debris and finer plant debris, half an inch or more in depth. Vegetative cover is important for nutrient and energy cycling in riparian and aquatic systems and contributes to site stability. Its residence time on a particular site is naturally synchronized with high flow events, with litter being the most mobile component. For this analysis, it is assumed that trends in vegetative groundcover will generally follow trends in ecological status and structural conditions, and as well as watershed condition. All the assumptions made in the analysis of watershed condition also apply here.

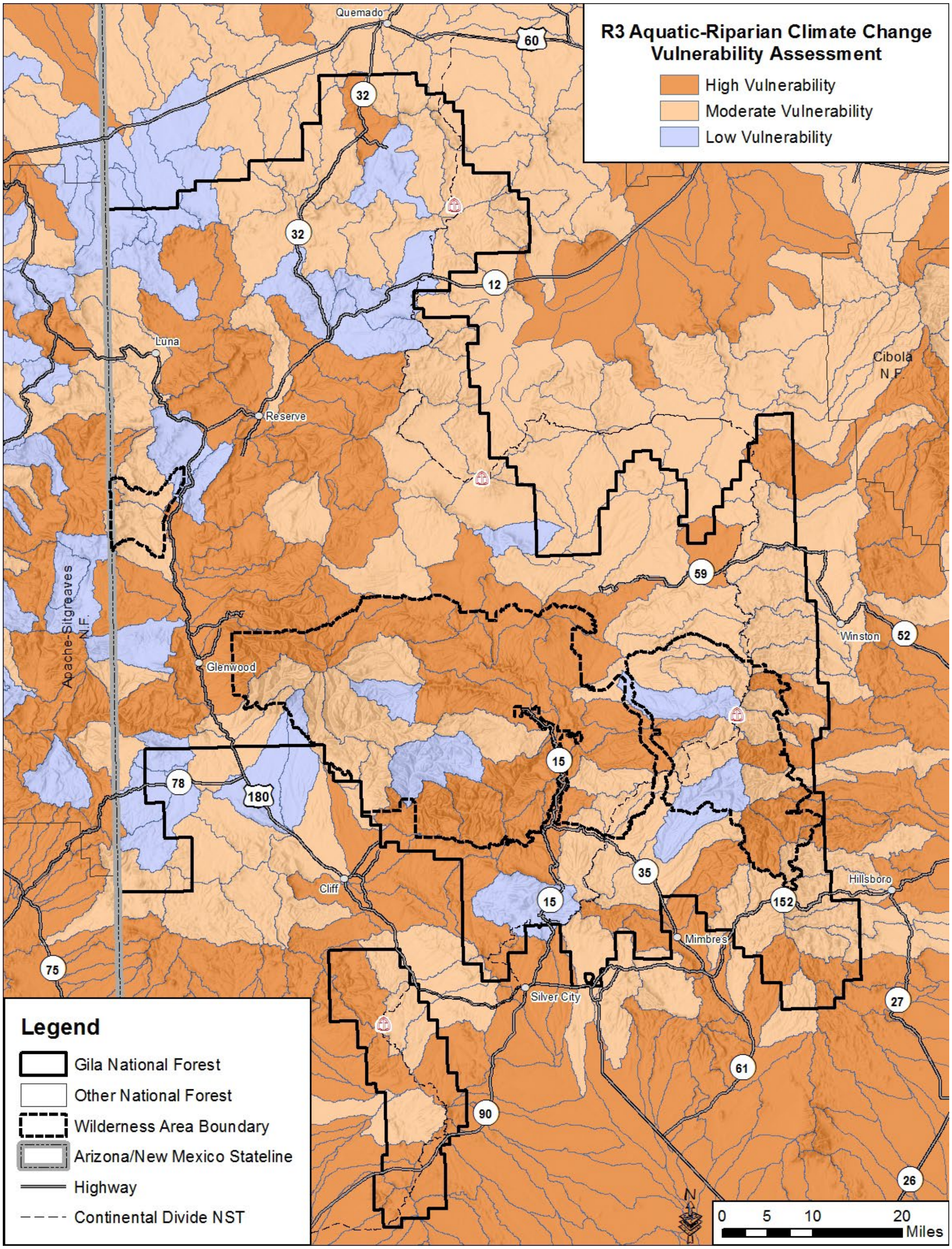

Figure 34. Aquatic-Riparian climate change vulnerability assessment for the Gila National Forest and vicinity

Channel Shape and Function

Channel shape and function are functioning properly when "channel width-to-depth ratios exhibit the range of conditions expected in the absence of human influence. Less than 5 percent of the stream channels (in a 6th level watershed) show signs of widening. Channels are vertically stable, with isolated locations of aggradation (sedimentation) or degradation (downcutting), which would be expected in near natural conditions. The distribution of channels with floodplain connectivity is close to that found in reference watersheds of similar size and geology" (Potyondy and Geier 2011). The status of channel shape and function influences vegetative structural condition, ecological status and functional diversity, water flow regime and aquatic habitat quality. For this analysis it is assumed that channel shape and function will generally follow projected trends in watershed condition. All the assumptions made in the analysis of watershed condition also apply here.

Large Woody Debris

Large woody debris is important for creating habitat in streams and influences channel shape and function. Large woody debris may originate within the riparian area or may be transported into the stream system from the adjacent uplands by gravity and surface water flow over time. For this analysis it is assumed that trends in large woody debris will follow riparian vegetative structural condition, and watershed condition. All the assumptions made in the analysis of watershed condition also apply here.

Hydrologic Regime

Variability in water flow or availability over time, or the hydrologic regime, influences wetland, riparian and aquatic community structure, function, patterns, and processes. Floods of varying magnitudes, and the timing thereof, are vital to the fulfillment of streamside riparian and aquatic species life history requirements (Gori et al. 2014 among others). For this analysis it is assumed that streamflow regimes will generally follow projected trends in watershed condition. Therefore, all the assumptions made in the analysis of watershed condition also apply to this analysis.

Area Designations

Area designations can influence how the forest manages for ecosystem characteristics. Designations that substantially change the allowable types of activities, equipment, and modes of access and travel have the potential to influence the extent and distribution of effects and at times, the outcomes of management activities. Area designations with this potential include designated wilderness, recommended wilderness, designated and proposed research natural areas, inventoried roadless areas, eligible wild and scenic rivers, and other administrative designations. Those effects depend on the designation, amount of area involved, vegetation types and conditions that exist within that area, and the terrain. Terrain can limit the types of activities, equipment and modes of access, and travel just as effectively as a designation.

The effects of proposals or recommendations for new area designations contained within each alternative are discussed qualitatively relative to these management factors and evaluated based on whether they are consistent with opportunities to move toward desired conditions for riparian and aquatic ecosystems or whether they detract from those opportunities. Existing designated wilderness, research natural areas, and inventoried roadless areas are not discussed. As these are designated through legislative or administrative processes and there is no authority provided to the revision process to modify them, they do not contribute to differences in effects among alternatives.

Eligible wild and scenic rivers also do not change with alternative and do not contribute to differences between alternatives. To be in alignment with law, regulation, and policy, management practices must maintain the free-flowing nature and outstandingly remarkable values specific to each eligible segment. Regardless of alternative, this would be how eligible segments are managed. Special botanical areas proposed under alternatives 2 and 5 are not analyzed as the plan direction for their management does not substantially change the types of activities, disturbances, or associated effects. Rather, that direction has effects on species because it provides avoidance or mitigation measures for rare and endemic plant species in specific areas. The effects to species are analyzed in the Wildlife, Fish and Plants section of this environmental analysis.

Climate Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

None of the alternatives contains objectives for riparian and aquatic ecosystems that specifically include mechanical treatments, but they could occur under any alternative as part of restoration activities. Where there is encroachment of upland species into the riparian area, removing them helps restore subsurface flows from the floodplain to streams (Huxman et al. 2005), community structure, ecological status, and functional diversity. When vegetation communities and flow regimes are restored, riparian and aquatic ecosystems are more resistant and resilient to drought and other disturbance events. However, when heavy mechanical equipment is used to accomplish these things, removal of vegetative groundcover, compaction, and rutting can occur. Rutting is always detrimental as it channelizes and concentrates water flow, increases potential erosion and sedimentation, and can lead to declines in water and aquatic habitat quality. However, this would be reduced or mitigated through best management practices such as the use of construction mats which improve the weight distribution of the machinery which reduces compaction and rutting. this work is conducted with handheld equipment such as chainsaws, these effects are negligible or do not occur.

In severely degraded riparian areas, mechanical equipment could be used to restore channel shape and function, floodplain connectivity, aquatic habitat connectivity, and as part of restoring native aquatic species to the system. Restoration of native aquatic species can require installation of structures, like fish barriers, that may require the use of mechanical equipment. In these cases, the short-term negative impacts associated with increased erosion and sedimentation are outweighed by long-term improvements in conditions of water flow, water quality, community structure, ecological status and functional diversity, aquatic habitat quality and overall resilience. Best management practices, such as temporary re-routing of flow, would also help mitigate short-term decreases in water and aquatic habitat quality. Some best management practices would be required as a matter of demonstrating compliance with the Clean Water Act, whether they are specified in plan direction or not (see also Soil and Watershed Resources). Additional mitigation measures may be identified during project-level consultation with the Fish and Wildlife Service if federally listed species habitat is involved.

Mechanical treatments targeting the uplands, and prescribed fire and wildfire activities, in general, are more likely to impact riparian and aquatic ecosystems than are mechanical disturbances within the riparian zone. Mechanical treatments in the uplands can lead to short-term declines in water quality, which will be mitigated with best management practices such as buffer zones (for example Laudon et al. 2016), or temporarily stopping operations when conditions are conducive to rutting. Mechanical treatments that reduce the risk of large, continuous extents of high-severity fire are a long-term benefit to riparian and aquatic ecosystems as they help sustain or restore the water, nutrient and sediment regimes that define a given watershed. The same can be said of prescribed and naturally ignited wildfire, under the right fuel and weather conditions.

Whether prescribed or naturally ignited, fire effects to riparian and aquatic ecosystems are largely a function of the fire history and severity distribution in a specific watershed. In general, low-severity fire supports characteristic water, nutrient, and sediment regimes, as well as riparian and aquatic ecosystem condition, function, and resilience. However, in steep watersheds, where geological erosion rates are already high and soils are naturally unstable, even low-severity fire can accelerate water, nutrient and sediment delivery to streams. This may not be uncharacteristic of those watersheds, but when multiple stressors interact in the post-fire environment, such as drought, extreme precipitation events, and herbivory, these ecosystems may remain vulnerable to degradation for longer periods of time.

Large, contiguous patches of mixed- or high-severity fire, whether characteristic of the vegetation communities in the watershed or not, can have effects on riparian and aquatic ecosystems. While more of an unintended consequence than a deliberate management action, such severities are likely to occur over the life of the plan regardless of which alternative is ultimately selected. Immediate effects include accelerated erosion, nutrient and sediment delivery to streams, increased peak flow and stream power, alteration of groundwater recharge and discharge patterns, changes in stream channel shape and function, removal of the riparian/wetland vegetation, increases in the amount and changes in the distribution of large woody debris, decreased water quality, and increased risk of invasive or noxious weed population establishment or expansion. On the other hand, sometimes post-fire changes to water flow regimes can favor native aquatic species over non-native species.

Within the riparian zone itself, timing as it relates to pre- and post-fire climatic conditions is an important determinant of ecological effects. Fires that occur early in annual dry periods tend to be lower in terms of severity as fuels and soil moisture remain relatively high. More of the riparian vegetation community is likely to remain intact and the mortality that occurs is more likely to be replaced by re-sprout. Fires that occur late in annual dry periods tend to occur at higher severity, as fuel and soil moistures are at their lowest. Less of the riparian vegetation community may remain intact, and root-kill may reduce re-sprout. Periods of drought magnify both fire risk and severity and reduces the ability of riparian vegetation to re-sprout or regenerate by seed (Dwire and Kauffman 2003; Pettit and Naiman 2007). Management is unlikely to be able to optimize the timing of naturally ignited wildfire, regardless of plan direction. However, management can influence fuel loading.

In some riparian areas, recent drought mortality, lack of flooding disturbance or fire or both has contributed to the accumulation of more large woody debris than is ecologically beneficial. While there are no specific objectives for it, pile and burn operations to reduce fuel loading would be allowable under all alternatives. This could lower fire severity and increase the resilience of the vegetation community when wildfire does find its way into already stressed environments. If left untreated, the vegetation community in these drainages may not be able to recover as quickly after a fire. Fortunately, if there is water, the post-fire trajectory would be toward recovery.

Livestock grazing would continue to affect many riparian and aquatic ecosystems under all alternatives. While livestock grazing would be managed to move toward desired conditions for riparian and aquatic ecosystems and other natural resources, impacts are likely to occur in some areas. The effects of which include reduced amount of water available to support riparian and aquatic communities, as well as terrestrial wildlife species (Rasby and Walz 2011); some amount of delivery of pollutants to surface water (Armour et al. 1991; Beschta 1997; Sheffield et al. 1997; Nader et al. 1998; Davies-Colley et al. 2004; among others); use of herbaceous and woody riparian species and physical stress applied to floodplain and streambank features that are essential for proper function (Warren et al. 1986; Abernethy and Rutherfurd 2001; among others).

The outcomes for riparian and aquatic ecosystems depend on how livestock grazing is managed (for example, Lucas et al. 2004; George et al. 2011). Through a mixture of desired conditions, standards and guidelines, livestock grazing under any of the action alternatives would support achievement and maintenance of desired conditions for all riparian and aquatic ecosystem characteristics. Although not articulated through desired conditions in alternative 1, the same effects are achieved through standards and guidelines requiring preferential consideration be provided to riparian areas and their dependent resources, with preferential consideration being established by a condition class of properly functioning, or a trend toward it.

The motorized transportation system facilitates mechanical treatments, fire management, and livestock grazing management. It also has disproportionate detrimental effects to riparian and aquatic ecosystems than the amount of area it occupies would suggest, as discussed in the Soil and Watershed Resources subsection of Effects Common to All Alternatives.

All alternatives contain some combination of desired conditions, objectives, standards, and guidelines designed to avoid, mitigate, and reduce these detrimental effects. The road maintenance, realignment or decommissioning that can be accomplished with available funds would reduce sediment delivery caused by the transportation system and improve water quality. Where decommissioning occurs on closed roads in drainage bottoms, the removal of constraints on natural water flow and channel movements, habitat connectivity, and the extent of riparian/wetland vegetation can occupy would also improve ecological processes, function, and resilience.

Just as roads allow for human access and travel across the national forest, they can also facilitate the introduction and spread of non-native invasive and noxious species. Similarly, streams and riparian corridors facilitate the movements and life cycle events of native species, but they also facilitate the spread of invasive and noxious species. Non-native invasive and noxious species, both animal and plant, are already present within or adjacent to many riparian and aquatic ecosystems. Non-native invasive species can displace native species, alter vegetation structure, and lead to declines in ecological status and functional diversity. They can also interfere with natural processes such as nutrient and fire cycles and alter water quality status, which reduces resilience and adaptive capacity. All alternatives direct the use of integrated pest management, but there are differences between alternatives in terms of how direction supports it and promotes prevention, early detection and rapid response to emerging threats.

While herbicide is not included in any of the treatment objectives, its use is allowable under all alternatives as part of an integrated weed management approach. Even though the action alternatives contain standards and guidelines guiding its use and alternative 1 does not, there is no difference in effects to soil and watershed resources as constraints would be determined at the project-level to comply with laws and regulation. Herbicide use is a highly regulated management activity that requires multiple levels of permitting and reporting to other federal and state agencies. The action alternatives have standards and guidelines that are useful as baseline constraints and serve transparency and communication with those who are concerned about the use of chemicals and may or may not have familiarity with the law or regulatory procedures. The need for more restrictive or additional constraints would be determined at the project level when herbicide application is proposed.

All alternatives provide necessary flexibility and direct management toward maintaining and achieving integrated desired conditions for all resources and uses. This supports the full Resistance-Resilience-Transition adaptation spectrum. The differences in how the revised plan and its alternatives support Resistance-Resilience-Transition are primarily related to vegetation treatment objectives, and non-native invasive species management.

Effects of Alternative 1

As described for the soil and watershed resources analysis, the upland vegetation treatments that are likely to occur under alternative 1 contribute to progress toward desired conditions for some vegetation types and some characteristics, but the risk of high-severity fire continues to increase. Not enough acres can be treated and a net increase in closed-canopy conditions is likely. This increases the likelihood of riparian and aquatic ecosystems experiencing fire and post-fire effects previously described as common to all alternatives.

Alternative 1 lacks detailed desired conditions for riparian and aquatic ecosystems, instead relying on a standard that requires preferential consideration be given to these ecosystems and their dependent resources. Preferential consideration is determined by a properly functioning condition class or a trend toward it. As a plan standard, this direction fails to provide the flexibility necessary to address situations where a trend is not apparent and lacks clarity about how compliance is determined. Trend can be difficult to determine. For example, a riparian area in proper functioning condition might become functioning at risk, or impaired function after a fire and post-fire flooding events. That doesn't represent a trend. It represents a changed condition. Compliance with the plan would take years to determine as establishing a trend requires repeated assessments. Given the complexity and diversity of riparian and aquatic management issues and the lack of clarity on compliance, this direction does not adequately support transparent and effective decision-making.

Similarly, alternative 1 provides no direction specific to preventing the establishment or spread of non-native invasive species, nor does it provide direction supporting early detection and rapid response to emerging threats. Without strategic, forestwide direction, there is a reduced likelihood that effective practices will be consistently implemented, which increases the risk to ecological integrity and sustainability posed by new or expanding invasive and noxious species populations.

Effects Common to All Action Alternatives

The action alternatives include detailed desired conditions describing properly functioning, resilient and sustainable riparian and aquatic ecosystems at multiple scales. Management directed toward these desired conditions would improve riparian and aquatic ecosystems and benefit the wildlife, fish, and human communities that depend on them. These desired conditions are supported by objectives, standards, and guidelines in the watershed, and riparian and aquatic ecosystems sections of the plan.

The action alternatives share common objectives for overall watershed condition, and for the resources affecting the water quantity, riparian/wetland vegetation, aquatic habitat, and aquatic biota as described in detail in the soil and watershed resources analysis. These objectives support achievement and maintenance of desired conditions to a greater degree than the no-action alternative and promote the full climate adaptation spectrum. Furthermore, all action alternatives have a guideline directing projects and activities to incorporate riparian and aquatic improvements where and when there are reasonable opportunities to do so, which could lead to more progress toward desired conditions than generated by plan objectives alone.

All action alternatives would include a desired condition for a climate-resilient transportation network. To move toward this desired condition, a vulnerability assessment would be the first step, allowing managers to make risk-based, climate-informed decisions about the transportation system (Rasmussen et al. 2018). A vulnerability assessment that included an analysis of wildfire risk, sediment potential, and other values at risk, such as streams supporting at-risk species, would also support maintenance and movement toward desired conditions for soil and watershed resources, riparian and aquatic ecosystems, and wildlife, fish and plant species.

Under the action alternatives, management would be directed toward maintaining and achieving desired conditions for riparian and aquatic ecosystems. This would essentially replace the standard in alternative 1. The action alternatives do have standards and guidelines for riparian and aquatic ecosystems, including one retaining the preferential consideration language. To help establish preferential consideration, the action alternatives would apply best management practices to specific activities at the project level. Relying on best management practices rather than trend in condition class to establish preferential consideration allows compliance with the plan to be determined during the decision-making process. This provides a measure of both accountability and flexibility.

The action alternatives include standards identifying the proper preventative measures and decontamination procedures to prevent the introduction or spread of non-native invasive and noxious species and disease agents. While these procedures exist as regulation and policy outside of plan direction, referencing them promotes awareness across different staff areas and the public, thereby contributing to application that is more consistent. All action alternatives also provide guidelines, objectives, and management approaches that promote early detection and rapid response to non-native invasive and noxious weed introduction and establishment. Riparian zones are one of the top priorities for noxious weed survey, as explained in the management approaches of the Non-native Invasive Species section of the plan. Early detection and rapid response increase the likelihood that infestations can be eradicated before they spread, which protects ecosystem condition, function, resistance, and resilience.

Effects Common to Alternatives 2, 3, and 4

Alternatives 2, 3, and 4 include a guideline directing that newly constructed or realigned roads and other motorized routes are not located within the 100-year floodplain or within 300 feet of a riparian zone. Allowances can be made where stream crossings are necessary if bridges or culverts are designed to not interfere with common high flow events or aquatic organism movements. To a greater degree than alternative 1, this reduces the detrimental effects of the transportation system on riparian and aquatic ecosystems that were previously identified as common to all alternatives.

These alternatives would allow the use of herbicide to be authorized to treat native re-sprouting species such as evergreen oak and alligator juniper. While this would more often be authorized in the uplands, it could also be authorized in the riparian zone where these upland species have invaded. While herbicide use is a highly regulated activity, the additional plan standards and guidelines would help prevent unintended consequences and ensure that when herbicide is one of the tools, riparian and aquatic ecosystem values are protected.

Effects of Alternative 2

The plan direction differentiating the effects of alternative 2 from those of the other alternatives are the objectives for upland vegetation treatments and the relative emphasis placed on fire as the primary restoration tool. While a mixture of both fire and mechanical treatments are included in this alternative, there is a greater reliance on fire.

As described for the soil and watershed resources analysis, the upland vegetation treatments that are likely to occur under alternative 2 contribute to progress toward desired conditions for some vegetation types and some characteristics, and a small net reduction in tree density would be likely. This would reduce the likelihood of large, contiguous extents of high-severity wildfire. However, the mechanism by which upland tree densities are reduced is fire. Fire is not a precise tool and treating more acres with fire necessitates less aversion to risk. Prescribed fire targeting more difficult acres and allowing for more mixed severity and allowing more acres to be treated with naturally ignited wildfire, would increase the likelihood that riparian and aquatic ecosystems would experience fire and post-fire effects, which were previously discussed as common to all alternatives. How this relates to condition, function, resistance, and resilience would be determined by spatial patterns of severity and extent, which cannot be predicted with the vegetation model used for this analysis (see Upland Vegetation, Fire Ecology and Fuels analysis methodology).

Effects of Alternatives 3 and 4

Under alternatives 3 and 4, no system of swing allotments or forage reserves would be created. The management approach to vacant allotments would be focused on completing any National Environmental Policy Act procedures determined necessary, issuing a permit, and stocking those allotments to the maximum extent possible. This approach is unlikely to support movement toward integrated desired conditions as well as alternative 2, with implications for livestock grazing as a use of the forest (see Livestock Grazing section in this volume of the environmental impact statement) and does provide the climate adaptation options that forage reserves would create.

The vegetation treatments likely to occur under alternatives 3 and 4 would also contribute to progress toward desired conditions for some vegetation types and some characteristics. With fewer acres treated overall, limited areas where canopy cover would be reduced, and a general increase in coarse woody debris, the risk of high-severity fire would be greater than under alternative 1 (see Upland Vegetation, Fire Ecology and Fuels section or Summary of Environmental Consequences, both in this chapter of the environmental impact statement). over much of the forest. Undesirable ire and post-fire effects to riparian and aquatic ecosystems are at least as likely to occur under alternative 3 as alternative 1, if not more so.

Effects of Alternative 5

Plan direction differentiating the effects of alternative 5 from those of the other alternatives are the objectives for upland vegetation treatments, and the relative emphasis placed on fire as the primary restoration tool. The emphasis on fire is much greater than under alternative 2, with alternative 5 containing a standard that restricts the number of acres that can be treated mechanically. As described for the soil and watershed resources analysis, the upland vegetation treatments that are likely to occur under alternative 5 would contribute to progress toward desired conditions for vegetation types that historically experienced frequent, low- to mixed-severity fire such that a net reduction in tree density twice that projected for alternative 2 would be likely. This reduces the likelihood of large, contiguous extents of high-severity wildfire. However, like alternative 2, the mechanism by which upland tree densities are reduced is fire and substantially more wildfire would be used in this alternative. Mechanical treatments are generally restricted to the wildland-urban interface.

Prescribed fire targeting more difficult acres, allowing for more mixed severity, and allowing more acres being treated with naturally ignited wildfire all increase the likelihood that riparian and aquatic ecosystems would experience the full spectrum of fire and post-fire effects as previously described as common to all alternatives. How this relates to condition and function would be determined by spatial patterns of severity and extent, which cannot be predicted with the vegetation model used for this analysis (see Upland Vegetation, Fire Ecology and Fuels Analysis Methodology). On the other hand, riparian areas experiencing fire and detrimental post-fire watershed responses would be far more likely to occur under alternative 5 as opposed to alternative 2.

Alternative 5 includes similar direction for new construction or realignment of roads and other motorized routes, as described for alternatives 2, 3, and 4, but the minimum distance from the riparian zone is increased to 500 feet for riparian zones around perennial streams or native trout-bearing streams. This restriction could reduce the detrimental effects of the transportation system, on riparian and aquatic vegetation communities to a greater degree than the other action alternatives for those qualifying areas, but there are some potential drawbacks.

Under all action alternatives the distance set is a minimum, meaning it could be made larger if site conditions warranted, so the additional 200 feet proposed as part of alternative 5 would not be necessary. Further, alternative 5 specifies the buffer applies to perennial streams or those that bear native trout, rather than riparian management zones generally, which does not account for connections between water flow and sediment transport between perennial and non-perennial reaches of the same drainage network.

Alternative 5's guideline would provide a lesser benefit to riparian and aquatic ecosystems than the other action alternatives.

Alternative 5 also prohibits the authorization of herbicide use on native species. This restriction would remove a tool in the toolbox that could have been used to restore riparian areas by removing encroaching upland species. Where alligator juniper or evergreen oak have invaded riparian areas, restoration and maintenance would be much more resource intensive and less effective.

Effects Resulting from Proposed Research Natural Areas

Although research natural areas are useful for monitoring climate change impacts (Massie et al. 2016), areas eligible for designation are in good condition, resulting from the predominance of natural processes. They are not in need of restoration treatments, although that would be allowable if needed to maintain the characteristics for which they were designated. Treating small populations of noxious weed species or removing non-native aquatic organisms would be examples of treatments that could be needed to maintain the characteristics for which riparian areas were designated. Livestock grazing is not compatible with research natural area status.

Of the proposed research natural areas within the alternatives, Turkey Creek and Rabbit Trap are the only ones that contain riparian ecosystems, and only Turkey Creek contains aquatic ecosystems. Alternatives 1, 2, and 5 carry forward these proposals and alternatives 3 and 4 do not. Despite these differences, there would be no substantial effects to riparian and aquatic ecosystems associated with any of the proposals at the plan scale because of the small number of acres involved.

The purpose of research natural areas is to provide specific types of opportunities for research. Research can expand the scientific understanding and basis for land management decisions, potentially contributing to better management of riparian areas. On this basis, alternatives 1, 2, and 5 would provide the greatest opportunities to advance scientific knowledge and improve riparian and aquatic ecosystem management. Alternatives 3 and 4 would provide no such opportunities.

Effects Resulting from Recommended Wilderness Areas

As described under this heading for the soil and watershed resources analysis, plan direction for recommended wilderness areas precludes mechanical treatments, as it does not conform to maintenance of wilderness characteristics. While this has the potential to impact management's ability to move upland vegetation communities and watersheds toward desired conditions, the vegetation modeling results do not suggest mechanical treatments are necessary to move toward desired conditions. However, the model is not spatial and where there are large, contiguous extents with relatively high probabilities of high-severity fire, strategic placement of mechanical treatments can enhance opportunities to manage fire on the landscape in such a way that the post-fire effects help sustain or restore the water, nutrient and sediment regimes that define a given watershed and minimize potential detrimental effects as previously described as common to all alternatives. Without those mechanical treatments, the magnitude of fire and detrimental post-fire effects could increase substantially.

Areas recommended under alternatives 2, 3, and 4 do not contain large, contiguous extents with relatively high probabilities of high-severity fire and are highly unlikely to be priority candidates for mechanical treatments given limitations imposed by their terrain. Their recommendation for wilderness would not have a substantial effect on management outcomes for riparian and aquatic species as fire is sufficient to maintain or improve watershed conditions. Alternative 5 includes some areas that do have large, contiguous extents with relatively high probabilities of high-severity fire that could be priority candidates for mechanical treatments at some point in the future. Recommendations for these areas restrict management's ability to mitigate future fire and post-fire effects to the associated riparian and aquatic ecosystems. Furthermore, these recommendations could also potentially restrict future adaptation options as mechanical equipment may or may not be necessary to restore or maintain riparian or aquatic refugia.

Cumulative Effects

The cumulative effects analysis for soil and watershed resources is directly applicable to riparian and aquatic ecosystems as terrestrial and aquatic processes are integrated within watersheds. They are also part of how watershed conditions are defined. This section expands on that analysis with specificity to riparian and aquatic ecosystems.

Many riparian areas in the Gila National Forest occur along streams that pass through other jurisdictions, including other national forests and federal public lands administered by Bureau of Land Management, and state, municipal and private lands. Most, but not all these streams originate in the forest or the adjacent Apache-Sitgreaves National Forests. Management of the streams themselves and the watersheds containing these streams can have profound beneficial or detrimental effects on riparian and aquatic ecosystems, as previously described, that can either accumulate or attenuate in both the downstream and upstream flow directions (Gori et al. 2014).

The presence of water is a prerequisite for the persistence of riparian and aquatic ecosystems, over which the states have primary control. Arizona recognizes instream water rights, which can provide for ecological flow needs, while New Mexico does not. Regardless, more water has been committed to users in the Southwest than is currently available (Phillips et al. 2011). In a drought with the magnitude of the worst 10-year drought on record, water demand may exceed supply by 58 percent (Lenart 2007). With current and predicted future trends in climate, riparian and aquatic ecosystems are highly vulnerable. Given no instream water rights, these ecosystems are at higher risk in New Mexico, as compared to Arizona.

In the Southwest, intense debate will continue over the highest use of limited water, which was illustrated by proposals associated with Arizona Water Settlements Act and the recent Federal Energy Regulatory Commission proposal associated with the San Francisco River. The Arizona Water Settlements Act approved the consumptive use of an additional 14,000 acre-feet of water from the Gila and San Francisco Rivers, their tributaries, and groundwater sources in New Mexico. The Federal Energy Regulatory Commission proposal involves damming the river and using hydropower to generate electricity. The Gila and San Francisco Rivers support the most extensive riparian and aquatic ecosystems in the Gila National Forest and provide habitat to many threatened, endangered and candidate species. These proposed projects have polarized communities throughout New Mexico over water allocation and use. While the immediate debate over proposals for diversion of the Gila and San Francisco Rivers as part of the Arizona Water Settlements Act has recently subsided, it is likely these issues will resurface as climate change progresses and water becomes even more limiting.

At present, there is a bill in front of Congress for these and many other streams within the Gila National Forest to be designated as wild and scenic rivers. If the bill were passed, these rivers would have to be managed under the provisions of the Wild and Scenic Rivers Act, including preservation of their free-flowing nature. This would limit the potential for human actions to exacerbate climate-driven drying and fragmentation of riparian and aquatic habitat connectivity but would not stop that fragmentation. Similarly, it could add to the complexity of water allocation and use discussions in a more arid future, but it won’t entirely settle disputes over water.

Whether driven by drought, use, or both, the area occupied by riparian and aquatic ecosystems in the Gila National Forest and across the Southwest is likely to shrink and become fragmented, but changes are likely to vary widely from place to place (Smith and Finch 2017). In the Gila National Forest, drought and current water withdrawals have already altered streamflow patterns and contributed to habitat fragmentation in several important stream systems supporting riparian and aquatic habitats. Those associated with intermittent, interrupted, and seasonal water sources, or small water features like springs are likely the most vulnerable. Increased variability of precipitation and more frequent extremes also has implications for the timing of life cycle events dependent on flows of particular magnitudes, which could eventually lead to changes in aquatic community composition (in the sense of Gori et al. 2014).

Water temperatures are likely to increase, creating additional stressors on cold and cool water species, which could also eventually lead to changes in aquatic community composition. For plant species, shorter, warmer winters are also projected to change the timing of life cycle events, like first bud, first flower, and seed set. Combined with changes in water flow, this could lead to fewer and less successful regeneration events for some species and changes in vegetation community composition (Gori et al. 2014; Smith and Finch 2017). Changes in composition that affect a single functional group could lead to declines in function and resilience. Riparian and aquatic ecosystems will become less able to recover from other disturbances, some of which many increase in magnitude and frequency because of climate change.

Whether because of not treating enough acres, not treating the right acres, or accepting greater risk with prescribed and naturally ignited wildfire to treat more acres, there will be more fire on the landscape. With average fire weather conditions moving toward what are currently considered extreme fire weather conditions, severity distributions are likely to shift toward more mixed- and high-severity fire until fuel becomes limiting. This could lead to more frequent and higher magnitude post-fire changes in water, sediment, and nutrient regimes. Where vegetation type conversions occur in the uplands, these regimes could be permanently altered, perhaps changing the kind, quality, extent, and connectivity of riparian and aquatic ecosystems that a given watershed can support. With more frequent disturbance, non-native invasive and noxious plants will be provided more frequent opportunities to become established and spread.

Integrated pest management is being used and will continue to be used to control noxious plants within riparian zones on all jurisdictions, but eradication is likely to remain elusive. The state Departments of Agriculture will continue to provide leadership and technical expertise for this effort, including sponsoring collaborative groups that unite agencies, organizations, and individuals in addressing both noxious plant issues and invasive animal species issues.

The Forest Service Southwestern Region's Aquatic-Riparian Climate Change Vulnerability Analysis describes vulnerability at a watershed scale. The Resistance-Resilience end of the adaptation spectrum is more likely to be successful in watersheds with low vulnerability. However, highly complex and variable terrain across the mountainous areas of the Southwest make the location of fine-scale riparian and aquatic refugia difficult to predict. Isolated pockets of subsurface flow capable of supporting riparian vegetation, and pool habitats capable of supporting a few aquatic organisms may be scattered across more vulnerable watersheds. In general, moderate and high vulnerability watersheds are likely to see the most fragmentation, reorganization, and decline in these ecosystems. The Resilience-Transition end of the climate adaptation spectrum is more likely to be successful in these watersheds. There is a lot of work to be done across the adaptation spectrum in all watersheds to conserve vulnerable riparian and aquatic ecosystems. Developing and implementing successful Resilience-Transition strategies and actions will require multi-jurisdictional efforts with broad support and the opportunities to contribute to shared goals and objectives in this work are many.

While the demands and impacts on riparian and aquatic ecosystems are high, and projected to increase, they are some of the most highly valued natural resources and the level of interest in their conservation by agencies, organizations, and individuals reflects that. As with other soil and water conservation issues, working together, across jurisdictional boundaries provides for the best possible outcomes and that work continues throughout Arizona and New Mexico.

Wildlife, Fish, and Plant Species

Affected Environment

Introduction

The Gila National Forest has 12 mountain ranges and an elevational range of 4,160 to 10,770 feet. Annual precipitation ranges from approximately 11 inches on the northern end of the forest near Quemado to over 35 inches in the higher elevations of the Black Range and Mogollon Mountains. The forest includes semi-desert grasslands and shrublands, woodlands, ponderosa pine, mixed conifer, and spruce-fir life zones. Three major streams flow through the Gila National Forest: Mimbres River, Gila River, and San Francisco River. These and other attributes of the Gila National Forest contribute to a diverse array of habitats, which support a great diversity of terrestrial and aquatic wildlife (including amphibians, reptiles, insects and other invertebrates, birds and mammals), fish and plant species.

At least 2,300 known native wildlife, fish, and plant species are found in the Gila National Forest. These species provide or contribute to supporting ecosystem services such as primary production, nutrient cycling, soil formation, and seed dispersal. They provide or contribute to regulating services such as climate regulation, pollination, erosion control, and water storage. Species also provide provisioning ecosystem services such as forage, wild foods, medicine, fiber, and building materials. Some species provide cultural ecosystem services including recreational opportunities such as hunting, fishing, wildlife viewing, and nature photography; opportunities for scientific discovery and education; and cultural, intellectual, or spiritual inspiration.

Wildlife, fish, and plant species in the Gila National Forest contribute to social well-being and quality of life by promoting recreational and educational opportunities. Hunting, fishing, or communing with nature are very important traditions for many of the families and communities who live near the forest. Wildlife and plants in the forest contribute to economic sustainability through employment opportunities, support of small businesses, and federal receipts shared with local governments. In 2013, New Mexico Department of Game and Fish (NMDGF) commissioned a study of fishing, hunting, and other wildlife-associated activities to estimate county-level and state-wide contribution to the state's economy (Southwick Associates 2014). The study found 247,600 New Mexico residents and nonresidents fished, hunted, or participated in other wildlife-associated activities in New Mexico in 2013. Of these participants, 24 percent (59,751) did so within the four-county area encompassing the Gila National Forest. These participants spent approximately $46,595,774 on these activities. Furthermore, in a national survey from 2016, more than 103.7 million U.S. residents, 16 years old and older, participated in some form of wildlife-related recreation. That number represents 41 percent of the nation's total population. Those same people spent $156.9 billion on their activities (USDI-USDC 2016). Given the amount of time and money invested in wildlife-related recreation or activities, society appreciates and desires robust populations of wildlife, fish, and plants as well as healthy habitats.

Plant and animal species are highly dependent on the function of ecosystems with specific conditions, such as local soil, air, water, aspect, elevation, precipitation, which combine to create areas favorable for species. Vegetation is one of the primary factors that influences species diversity and abundance; vegetation is one of the more obvious habitat components influenced by management, land use, and natural disturbance. Species presence and absence on the Gila National Forest is, in many cases, directly tied to the availability and status of vegetation community characteristics such as tree canopy cover and age class distribution, species composition, patch size, and snag and coarse woody debris density. The proposed action, alternatives, and this analysis use the Ecological Response Unit (ERU) vegetation classification system. More information about the ERU framework and the ERUs of the Gila National

Forest can be found in the Upland Vegetation, Fire Ecology and Fuels section and the Riparian and Aquatic Ecosystems section of this chapter.

To persist, all species need food, water, and suitable habitat. Habitat connectivity is crucial to daily and seasonal movements, finding mates, being able to use available habitat across the landscape, and finding new suitable habitats when landscape conditions change. Biological diversity in arid landscapes is highest where there is water. Stream corridors, springs, seeps, and some constructed waters (Rosenstock et al. 1999) collectively contribute to connecting habitat for wildlife across the landscape and may offer refugia for some species. Refugia are places where a population of organisms can survive through a period of unfavorable conditions.

Habitats in the Gila National Forest are varied and provide the necessary food, water, shelter, and space for all the organisms that live within. The diversity of plants supports and reflects the diversity of animal life that has co-evolved with various plant forms over time. Habitat for animals is an important supporting role of vegetation communities. The genetic variation inherent in the forest's biodiversity provides for resilience through adaptive responses to an ever-changing environment, including long-term climatic variability.

Some native wildlife and plant species found in the Gila National Forest are common nationally, like black bears (*Ursus americanus*) or regionally, like Abert's squirrel (*Sciurus aberti*). Others are uncommon, rare, or endemic. Endemic species have very limited distributions or sometimes isolated to a narrow elevational range in a single mountain range like Mogollon death camas (*Anticlea mogollonensis*) or a single canyon or talus slope like the Iron Creek woodlandsnail (*Ashmunella mendax*). Some of these species, particularly those with limited distributions or specific life-cycle needs are considered at-risk due to concerns about their capability to persist over the long term in the plan area.

The diversity and sheer number of wildlife and plant species found in the forest makes individual species management challenging; for discussion purposes, groups of species are classified as native terrestrial, aquatic and riparian, and at-risk species and non-native invasive species. Native terrestrial, aquatic and riparian, and at-risk species are managed for their persistence and recovery in the forest. Non-native invasive species are managed for their eradication, containment, or control because they are not native to the forest and are likely to cause economic or environmental harm or harm to human health. The following subsections describe terrestrial, aquatic, and riparian species and habitats as well as the ERUs they are associated with. Associating ERUs with specific species is critical for assessing future management needs. In acknowledgement of the coarse nature of the ERU map product, forest staff erred on the side of being overly inclusive of ERUs providing habitat to at-risk species. This approach likely over-estimates the amount of potential habitat for each species but ensures consideration of the species needs at the project level.

Terrestrial

Terrestrial plant and animal species include both common and uncommon species that spend all or most of their time on dry land and are usually represented by mammals, birds, reptiles, and land-based plants and invertebrates such as beetles, moths, and snails. Terrestrial species and habitats are associated with 13 upland ERUs in the Gila National Forest, including five forest, four woodland, one shrubland, and three grasslands that make up approximately 98 percent of the forest's lands and provide many ecosystem services (see Upland Vegetation, Fire Ecology and Fuels).

Forests and Woodlands

Forested ERUs comprise forests and woodlands and cover approximately 85 percent of the Gila National Forest. Forests cover approximately 46 percent of the forest and include Spruce-Fir Forest, Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, and Ponderosa Pine-Evergreen Oak.

Woodlands cover approximately 39 percent of the forest and include Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass Woodland, and Juniper Grass Woodland.

Trees and other overstory vegetation in forest and woodlands provide habitat, shelter from climatic conditions or predators, structures and cavities for nesting sites, food sources such as nuts or fruits, or perches for hunting prey. In addition, overstory vegetation provides shade over land and streams, which moderates air and water temperature, and trees can reduce erosion by protecting soil from falling rain and holding soil in place with their roots. In addition, grasses and forbs provide the organic matter needed for soil development and the fine fuels that maintain and support natural fire regimes.

Key threats to species within forest and woodlands include loss of ecological condition and habitat fragmentation from large extents of stand-replacement wildfire, woody species infill into openings, insect infestations and disease outbreaks outside the natural range of variability, drought outside the natural range of variability, and climate change.

Shrublands and Grasslands

Non-forested ERUs cover approximately 13 percent of the Gila National Forest and include one shrubland and three grassland types. Mountain Mahogany Mixed Shrubland covers 5 percent of the forest. Grasslands include Montane/Subalpine Grassland, Colorado Plateau/Great Basin Grassland, and Semidesert Grassland, and when combined, cover 8 percent of the forest.

Herbaceous (grasses and forbs) understory vegetation in the non-forest vegetation system provides habitat, hiding and thermal cover for smaller species, nesting sites for birds and small mammals, and food sources for a myriad of animal species. Grasses and forbs provide the organic matter needed for soil development and the fine fuels that maintain and support natural fire regimes.

Key threats to species within grasslands and shrublands include loss of ecological condition and habitat fragmentation from wildfire or drought outside the natural range of variability, woody species encroachment, and climate change.

Special Habitat Features

Some species in the Gila National Forest rely on special habitat features, which are not necessarily associated with specific vegetation types. Special habitat features such as caves, cliffs, talus slopes, scree, rock features, and abandoned mine lands are widespread microsites found in most, if not all vegetation communities. These special habitat features and the ecological conditions they provide are stable for long periods of time because they are changed primarily by geologic forces. Cliffs are used for nesting by many bird species, cave-like structures and crevices are used for rearing of young, foraging, roosting and hibernating by many bat species, and rock outcrops or boulder and talus accumulations are used by several land snails and plants for all life functions, as well as mammals for hibernation and shelter from the weather or predators. The Gila National Forest has seen an extensive amount of historic mining with several historic mining districts located within and adjacent to the forest boundary. Consequently, extensive abandoned mines and associated mining features (such as adits and shafts) are located within the forest boundary as well as adjacent lands. These mining features can function as foraging, maternity, roosting, or hibernating sites for a variety of bat species.

Provisioning and cultural ecosystem services such as recreational opportunities for rock climbing, rock hounding, and mineral exploitation are also associated with these features. Key threats to species within these special habitat features include loss or disturbance of nest or roost sites, disturbance from recreational activities like rock climbing, mine closures or reclamation, mining or borrow activities, and diseases like white nose syndrome in bats.

Aquatic and Riparian

Aquatic and semi-aquatic plant and animal species include common and uncommon species that spend all or most of their time in water including fish, amphibians, water dependent plants like cattails and pond weeds, and invertebrates like aquatic insects, clams and snails. Aquatic habitat consists of streams that can be broadly classified as perennial, intermittent, or ephemeral by seasonal variations of surface water flow. Perennial streams typically flow year-round as they receive contributions from both surface runoff and groundwater. Intermittent streams fall between perennial and ephemeral types as groundwater contributions may vary with a combination of factors including season and subsurface features like depth to bedrock. Ephemeral streams experience relatively short duration flow only in direct response to surface runoff from precipitation or snow melt. Streams, especially perennial and intermittent streams, are important water sources that support terrestrial, riparian, and aquatic ecosystems, as well as human uses. There are approximately 2,694 acres of riverine wetlands, 2,534 acres of non-riverine wetlands, 918 spring and seeps, 957 perennial stream miles, and 546 intermittent stream miles in the Gila National Forest (USDA FS 2017a).

Riparian obligate species are species that require streams or riparian areas for some portion of their lifecycle and include amphibians, water-dependent plants, small mammals, and insects. Riparian areas include wetland riparian and forest and shrub riparian vegetation communities. The wetland riparian vegetation communities include open water wetlands, slope wetlands, marshes, wet meadows, and cienegas. Riparian areas are affected by the presence of surface and subsurface, perennial or intermittent, and flowing or standing bodies of water. Riparian areas are composed of distinctively different vegetative species than adjacent areas where water is more limited. In these systems, terrestrial and aquatic ecological processes are integrated within watersheds. Aquatic habitats and fish productivity are directly related to the health and function of riparian systems (Knutson and Naef 1997); consequently, riparian and aquatic ecosystem management have a strong and direct relationship.

As previously mentioned in the Riparian and Aquatic Ecosystems Affected Environment section, stream systems and riparian zones provide important habitat for migrating animals and rare species, serve as natural corridors for the movement of organisms and plant propagules, and offer refuges for organisms during widespread environmental shifts. Additionally, riparian vegetation and soil serve various ecosystem functions including regulating water temperature, supplying organic matter such as leaves, which can be a food source for many benthic invertebrates, supplying large woody debris that can influence channel shape and water flow while providing refugia for fish and substrate for aquatic invertebrates, purifying water, regulating nutrient inputs to streams and lakes, dampening destructive forces of floods, stabilizing stream banks, decreasing surface runoff, and helping replenish groundwater (Naiman et al. 2005).

Aquatic and riparian species and habitats are associated with the riparian ecosystems in the Gila National Forest, which comprise only 2 percent of the forest (see Riparian and Aquatic Ecosystems). Like other forests in the Southwest, the Gila National Forest has limited riparian and wetland habitats to support riparian-obligate and water-dependent species. Many of the at-risk species are riparian-obligate and water-dependent.

Key threats to species within riparian and aquatic ecosystems include loss of riparian ecological condition due to large, contiguous high-severity fires or drought; water diversions; invasive species; sedimentation and soil compaction from motorized use and the road system; disease; non-native aquatic species competition, predation, and hybridization; and grazing. While the plan does not authorize any of these activities that would intentionally contribute to these threats, projects under the plan would be designed to maintain or make progress toward desired conditions that could mitigate these threats.

Invasive Species

Invasive species are non-native species whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health. Invasive species are detrimental, destructive, or difficult to control or eradicate. Across the nation's forests, invasive species have caused disruptions in ecosystem function, reducing biodiversity, and degrading ecosystem health. Invasive species are a concern for at-risk species because they can threaten native communities through direct competition and predation or by altering the frequency and intensity of fires and other ecosystem functions. Riparian and aquatic communities have been especially affected over time, and many other ecosystems and native species remain at risk of further invasion of harmful non-native species.

Invasive plants generally tend to inhabit areas that have similar characteristics to their native habitats. In their place of origin, invasive species are controlled by predators, grazers, and other mechanisms that ensure their population numbers remain at a reasonable amount for that given ecosystem. When invasive plants occupy a foreign area, the foreign area may lack those limiters or inhibitors that are present in the original ecosystem. While eradicating invasive species is not always possible or needed, aggressive control of populations may be important to ensure that native ecosystems are protected. Changing conditions due to climate change and increased human impacts on many systems may alter the spread and establishment of non-native, invasive species in the Gila National Forest.

Freshwater systems are particularly affected by the introduction of non-native species. Hybridization, depredation, and competition from stocking non-native fish for sport fishing or by accident through bait bucket transport have contributed to declines in native fish diversity and distribution and may also affect macroinvertebrate and aquatic plant species. The continued stocking of non-native fish is important for supporting sport fishing, but limits opportunity for the reintroduction of native fish species. Progress has been made in the last decades; the NMDGF ceased stocking nonnative rainbow trout in streams and rivers within the Gila River basin in the early 2000s due to conflicts with native fish populations including the federally listed Gila trout. Additionally, the NMDGF now only stocks the forest's reservoirs with rainbow trout that cannot reproduce.

Other examples illustrate non-native occurrences on the Gila National Forest. The San Francisco River within the Lower San Francisco River Wilderness Study Area is designated as critical habitat for both the loach minnow and spikedace species. Currently, the native fishery within this reach of river has been severely degraded due to the dominance of non-native fish. Additionally, known infestations of saltcedar (*Tamarix* spp.) are scattered throughout the San Francisco River corridor from the confluence of Whitewater Creek downstream to the border of Arizona/New Mexico (USDA FS 2017a). Stands of saltcedar alter the ecology and hydrology of native riparian systems, which generally diminishes habitat quality in aquatic and riparian ecosystems (USDA FS 2014d). Other non-native invasive species such as crayfish, bullfrogs, Siberian elm, cheatgrass, bull and musk thistles, and others have established in the Gila National Forest.

Existing Designations

Effects to species will continue to be influenced by travel management and existing designations such as Research Natural Areas, Wilderness Study Areas, and congressionally designated wilderness under all alternatives. All alternatives are consistent with the Travel Management Rule. Under any of the alternatives, forest visitors would continue to follow stipulations regarding cross-country motorized travel. Existing designated areas will continue to pose limitations on modes of access and the use of mechanized equipment for infrastructure maintenance, consistent with the legislation or policy direction that establishes those designations.

Research Natural and Wilderness Study Areas

All alternatives include the designated Gila River Research Natural Area (402 acres); however, the congressionally designated Hell Hole and Lower San Francisco Wilderness Study Areas (18,860 and 8,800 acres, respectively) are both recommended for wilderness designation only under alternative 5, and the Lower San Francisco Wilderness Study Area is recommended for wilderness designation under alternative 4. The 1986 Gila Forest Plan did not recommend either wilderness study area for wilderness designation. However, until such time that Congress acts on final planning recommendations one way or another, the New Mexico Wilderness Act of 1980 and forest plan direction mandate that the wilderness study areas be managed to maintain existing wilderness characteristics (see Wilderness Study Area for more details).

Currently, there is one existing designated research natural area (Gila River Research Natural Area) and four existing proposed research natural areas that will be carried forward. The existing proposed research natural areas include Turkey Creek, Rabbit Trap, Agua Fria, and Largo Mesa. Alternatives 2 and 5 are proposing two of the original four potential research natural areas that were proposed during the last planning cycle. The Largo Mesa and Agua Fria proposed research natural areas are not taken forward because they were found ineligible for the designation (see appendix J). Also, many areas identified in the current forest plan are not proposed for research natural area designation because they do not qualify for various reasons. Only Turkey Creek and Rabbit Trap proposed research natural areas will be carried forward in alternatives 2 and 5 (see appendix J). Alternatives 3 and 4 contain no recommendations for research natural areas.

The research natural areas and wilderness study areas would provide areas of habitat connectivity and minimize disturbances to federally listed species through primitive area management as well as having little to no road construction or maintenance. However, management activities to help improve habitat conditions or minimize the possibility of large-scale, uncharacteristic fire impacts would not be allowed and the chance for undesirable effects would be increased.

Eligible Wild and Scenic Rivers

An eligibility study conducted in 2002 identified 129 miles of eligible wild and scenic river segments. Under the current planning process, a comprehensive evaluation of wild and scenic rivers was conducted. This built upon the previous study, checking these rivers for changed circumstances, as well as including rivers that were not included in the previous study, which resulted in approximately 225 miles of eligible wild and scenic river segments identified in the forest that will be analyzed in all alternatives.

The previous and current eligibility studies conducted are only the first two steps in a three-step process, and do not constitute a recommendation for designation to Congress. Any rivers recommended for designation would be determined by step three of the process, which is a suitability study. A suitability study will not be undertaken as part of the plan revision process. The forest is obligated to protect, within our authorities, the free-flowing nature and outstandingly remarkable values that led to these sections' eligibility. Any congressional designation of these wild and scenic river segments would have potentially beneficial impacts of providing habitat connectivity for aquatic species by limiting the types of instream infrastructure and minimizing ground disturbance on terrestrial species that use riparian habitat.

Designated Wilderness and Inventoried Roadless Areas

Designated wilderness (792,585 acres) and inventoried roadless (771,436 acres) areas provide for habitat connectivity and minimize disturbance to federally listed species through managing for wilderness character and roadless characteristics, respectively, as well as having little to no road construction or maintenance. These acreages are the same and apply to all alternatives. Mechanical vegetation management activities to help improve habitat conditions or minimize the possibility of large-scale, uncharacteristic fire impacts would not be allowed within designated wilderness, and only with special permission as outlined in the Chief's Review Process for Activities in Roadless Areas (2012), where the chance for undesirable effects would be increased.

At-Risk Species

At-risk species include native aquatic, semi-aquatic, riparian and terrestrial species for which the best available scientific information suggests there is a substantial concern about the species' capability to persist within the Gila National Forest over the long term. At-risk species include those listed under the Endangered Species Act and species of conservation concern. Fifteen species recognized under the Endangered Species Act as either endangered, threatened, or candidate species are known or are likely to occur in the plan area: five endangered, seven threatened, two candidate species, and one endangered non-essential experimental population of Mexican wolves.

A species of conservation concern is a plant or animal for which the Forest Service has concerns about its capability to persist over the long term in the plan area. Species of conservation concern are a planning tool, not a protected status like those listed under the Endangered Species Act. Species of conservation concern are used to inform the development of plan components to provide for the habitat conditions that will enable the species to persist in the forest. It is a proactive step intended to ensure that the plan components provide for the ecological conditions upon which they depend.

Between finalizing the Gila National Forest Assessment Final Report of Ecological/Social/Economic Sustainability Conditions and Trends (USDA FS 2017a) and publishing the draft EIS, circumstances changed and new information about species and status was brought forth from stakeholders that resulted in modifications to the initial proposed list of species of conservation concern. Changes in the federal listing status of the monarch butterfly (candidate) and lesser long-nosed bat (de-listed) and re- classification of three fish (headwater, roundtail, and Gila chub) resulted in changes to the initial recommended list. Additional survey effort and new locations in the Gila National Forest resulted in adding New Mexico jumping mouse to the threatened and endangered species list and a change in the Nature Serve status for the pinyon jay resulted in its inclusion as a species of conservation concern. Eight species were added to the initial list, and one species was removed in response to information provided by the Gila Native Plant Society and New Mexico State Botanist. Wright's dogweed was once recognized as a separate species but was found not be genetically distinct from a more common species. The resulting final number of species recommended as species of conservation concern totals 57 species.

Note that the species of conservation concern list is not intended to be a static list. There is a process for adding or removing species from the list when changed circumstances or new information point to a needed change. Detailed information about the Gila National Forest species of conservation concern selection process, federally listed species identification process, individual at-risk species' description, distribution, and habitats in the forest, and threats to persistence of species in the forest can be found in chapter 8 of the Gila National Forest Final Assessment Report of Ecological/Social/Economic Sustainability Conditions and Trends (USDA FS 2017a) and Appendix G - Documentation of the Analyses of At-Risk Species.

Federally Listed Species

Endangered species are any species in danger of extinction throughout all or a significant portion of its range. A non-essential experimental population is a population that has been established within its historical range under section 10(j) of the Endangered Species Act to aid recovery of the species; the U.S. Fish and Wildlife Service (USDI FWS) has determined a non-essential population is not necessary for the continued existence of the species. Threatened species are any species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Candidate species are plants and animals for which the USDI FWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. A list of federally listed species with potential to occur in the plan area was identified by using USDI FWS's Information for Planning and Consultation.

Critical Habitat

Section 4 of the Endangered Species Act requires the USDI FWS to identify and protect all lands, water, and air necessary to recover an endangered species; this is known as critical habitat. Critical habitat is the specific areas within the geographic area, occupied by the species at the time it was listed. Critical habitat contains the physical or biological features that are essential to the conservation of endangered and threatened species and that may need special management or protection. Critical habitat may also include areas that were not occupied by the species at the time of listing but are essential to its conservation. Critical habitat may include an area that is not currently occupied by the species but will be needed for its recovery. Critical habitat does not preclude activities within its borders; however, conservation of the habitat is an important consideration when planning or allowing activities in these areas. The Chiricahua leopard frog, narrow-headed gartersnake, Mexican spotted owl, western yellow-billed cuckoo, southwestern willow flycatcher, Gila chub, loach minnow, and spikedace have designated critical habitat within the Gila National Forest. The amount of critical habitat for eight federally listed species in the Gila National Forest is shown in table 39.

Table 39. Federally listed species, designated critical habitat in the Gila National Forest, and associated ecological response unit types

Common Name	Scientific Name	Federal Status*	Critical Habitat in Gila NF	Associated ERU
Chiricahua leopard frog	*Lithobates chiricahuensis*	T	2,478 acres	Riparian
Narrow-headed gartersnake	*Thamnophis rufipunctatus*	T	7,585 acres	Riparian
Northern Mexican gartersnake	*Thamnophis eques megalops*	T	No	Riparian
Mexican spotted owl	*Strix occidentalis lucida*	T	Yes, 1,122,944 acres	Spruce-Fir Forest Mixed Conifer w/ Aspen Mixed Conifer-Frequent Fire Ponderosa Pine Forest Riparian
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	T	Yes, 1,676 acres	Riparian
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	Yes, 1.541 acres	Riparian
Chihuahua chub	*Gila nigrescens*	T	No	Riparian
Gila chub	*Gila intermedia*	E	Yes, 764 acres	Riparian
Gila trout	*Oncorhynchus gilae*	T	No	Riparian
Loach minnow	*Tiaroga cobitis*	E	Yes, 11,673 acres	Riparian
Rio Grande cutthroat trout	*Oncorhynchus clarkia virginalis*	C	No	Riparian
Spikedace	*Meda fulgida*	E	Yes, 9,968 acres	Riparian

Common Name	Scientific Name	Federal Status*	Critical Habitat in Gila NF	Associated ERU
Monarch butterfly	*Danaus plexippus*	C	No	All ERUs
Mexican gray wolf	*Canis lupus baileyi*	EXPN	No	All ERUs excluding: Semi-Desert Grassland Riparian
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	E	No	Riparian

* E stands for endangered, T stands for threatened, EXPN stands for experimental population, non-essential, C stands for candidate

The Forest Service has analyzed federally listed species and critical habitat in a separate biological assessment and consulted the USDI FWS in accordance with section 7 of the Endangered Species Act. In response to the biological assessment, the USDI FWS issued a biological opinion on September 14, 2022. Federally listed species known to occur in the Gila National Forest are listed in table 39 along with the ERU in which they are found and whether critical habitat has been designated on the forest.

Amphibians and Reptiles

Chiricahua leopard frog (*Lithobates chiricahuensis*) is federally listed as threatened with approximately 2,488 acres of designated critical habitat in the Gila NF. In New Mexico and in the Gila NF, Chiricahua leopard frogs are thought to be most abundant in the Gila and San Francisco River drainages (Degenhardt et al. 1996), but they also occur in Beaver Creek (tributary to the East Fork Gila River), North Seco Creek, and in the Mimbres River drainage. Chiricahua leopard frogs prefer habitat with a variety of structure and cover, including emergent and submergent vegetation, overhanging banks and organic debris (Degenhardt et al. 1996). Although they can survive drought by burrowing in the mud, they require a perennial source of running or standing water in the form of streams, springs, stock tanks, ponds, or lakes (a). Threats include disease (particularly chytrid fungus), reduced water sources, habitat degradation, and recreation or other factors altering hydrologic function, and predation from non-native aquatic species (USDI FWS 2007a).

Narrow-headed gartersnake (*Thamnophis rufipunctatus*) is federally listed as threatened with approximately 7,585 acres of critical habitat in the Gila NF. The New Mexican distribution includes the Gila and San Francisco River drainages in Catron, Grant, and Hidalgo Counties, at elevations of 1,125 to 2,100 meters (3,690 to 6,890 feet) (Degenhardt et al. 1996, NMDGF 1997 as cited in NatureServe 2016). This species is regarded as one of the most aquatic of all gartersnakes (Conant 1963 as cited in NatureServe 2016). It often occurs along well-lit sections of rocky streams with abundant riparian vegetation. It is reported to eat fish, tadpoles, frogs, and salamanders (Stebbins 1985 as cited in NatureServe 2023, though in New Mexico, it feeds exclusively on fishes (NMDGF 1985 as cited in NatureServe 2016). Threats include direct predation from non-native aquatic species, competition by non-native fish, loss of riparian habitat, and recreational uses.

Northern Mexican gartersnake (*Thamnophis eques megalops*) is federally listed as threatened with no critical habitat in the Gila NF. In New Mexico, this snake is known from the lower Gila River basin, along Duck and Mule Creeks in Grant County and near Virden in Hidalgo County (Hubbard and Eley 1985 as cited in NatureServe 2016). It may now be eliminated from Duck Creek (NMDGF 1997 as cited in NatureServe 2016). A record from a single locality along Mule Creek is the only recent evidence of the presence of this species in New Mexico, but the current status of that population is unknown (Center for Biological Diversity 2003 as cited in NatureServe 2016). This snake is strongly associated with permanent water with vegetation, including stock tanks, ponds, lakes, cienegas, cienega streams, and riparian woods (Degenhardt et al. 1996, Manjarrez 1998). The diet includes fishes, amphibians, earthworms, leeches, and various other small animals (NatureServe 2016). Threats include loss of streams, wetlands, and riparian zones through water diversions, decline of native fish, and predation and competition from non-native aquatic species.

Birds

Mexican spotted owl (*Strix occidentalis lucida*) is federally listed as threatened with approximately 1,122,944 acres of designated critical habitat in the Gila NF. The Mexican spotted owl inhabits mixed coniferous and pine-oak forests, canyons, desert caves, cliff faces, and riparian areas throughout the Southwest. In the Gila NF, mixed conifer and pine-oak habitat is considered either protected or recovery habitat in the recovery plan for this species. Protected activity centers are protected habitat and unoccupied mixed conifer and pine-oak is considered recovery habitat (USDI FWS 2012a). Many timber management activities negatively affected habitat before the Mexican spotted owl was listed as threatened in 1995. Timber harvest, prescribed burning, and other management activities are now designed following the 2012 Mexican Spotted Owl Recovery Plan along with consultation with the USDI FWS. These management activities can still have disturbance effects to the Mexican spotted owl and its habitat. The most substantial current and potential future threats to the owl include habitat alteration and destruction due to high-intensity, landscape-scale wildland fire and long-term drought and habitat changes resulting from climate change (USDI FWS 2023b).

Southwestern willow flycatcher (*Empidonax traillii extimus*) is federally listed as endangered with approximately 1,541 acres of designated critical habitat in the Gila NF. The species has been documented in the Gila and San Francisco River drainages. Habitat includes riparian and wetland thickets, generally of willow, tamarisk, or both, sometimes boxelder or Russian olive (USDI FWS 2013). In the Gila NF, two sites have been consistently occupied for over 10 years along the Gila River. These two areas are in locations known as the Gila Bird Management Area and the Fort West ditch site. In 2008, seven territories were found at the Gila Bird Management Area and four territories at the Fort West ditch site (Shook 2009). In 2007, a new breeding site was discovered in the forest along the San Francisco River (Keller Canyon site). The Keller Canyon site, located on the reach between Deep Creek and Alma Highway 180, had three flycatcher territories in 2007, 2008, and 2009. Threats include loss of riparian habitat from floods, uncharacteristic fire, nest parasitism, and recreational uses.

Yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is federally listed as threatened with approximately 1,676 acres of designated critical habitat in the Gila NF. The western population of the yellow-billed cuckoo, an insect-eating bird found in riparian woodland habitats, winters in South America and breeds in western North America (USDI FWS 2014b). In the Gila NF it is found in the Gila and San Francisco River drainages. Threats include loss or degradation of riparian habitat, agriculture, water diversions, uncharacteristic wildfire, and non-native plant invasion, particularly tamarisk (USDI FWS 2014b).

Fish

Chihuahua chub (*Gila nigrescens*) is federally listed as threatened with no designated critical habitat in the Gila NF. Chihuahua chub is native to the Mimbres River drainage in New Mexico and the Guzmán and Laguna Bustillos basins in Chihuahua, Mexico (Smith and Miller 1986). Specimens were first collected in the Mimbres River in 1851 (Baird and Girard 1853), but it was not again found in the Mimbres River drainage until 1975. Chihuahua chub probably occupied all warmwater reaches in the Mimbres River drainage, but their distribution was confined to only Moreno Spring prior to restoration efforts (Propst 1999). Surveys have found that currently they occur in the upper reaches of the Mimbres River near Cooney Place and in the Mimbres River from the confluence of Allie Canyon downstream to the New Mexico Department of Game and Fish Mimbres Property south of Mimbres. Ash-laden flows from wildfires in 2013 and 2022 reduced Chihuahua chub abundance in the Mimbres River but their distribution has maintained (Myers 2016, Forest Service eDNA Data). Threats include changes in flow regimes and stream characteristics from uncharacteristic fire in the uplands, agricultural, water diversions, and competition and predation by non-native aquatic species.

Gila chub (*Gila intermedia*) is federally listed as endangered with approximately 764 acres of designated critical habitat in the Gila NF. Gila chub have been recorded in approximately 43 rivers, streams, and spring-fed tributaries throughout the Gila River basin in southwestern New Mexico, central and southeastern Arizona, and Northern Sonora, Mexico (Minckley 1973; Rinne 1976; DeMarais 1986; Bestgen and Propst 1989). There is taxonomic uncertainty within the group of species of the Gila River basin within the genus *Gila*, which also contains headwater and roundtail chubs that may affect the listing status of Gila chub in the future. Gila chubs commonly inhabit pools in smaller streams, springs, and cienegas (a desert wetland), and can survive in small artificial impoundments, such as human-made ponds (Miller 1945; Minckley 1973; Rinne 1975). Gila chubs are highly secretive, preferring quiet, deeper waters, especially pools, or remaining near cover including terrestrial vegetation, boulders, and fallen logs (Minckley 1973). Threats include changes in flow regimes and stream characteristics from uncharacteristic fire in the uplands, unauthorized use, and competition and predation by non-native fish species. Currently Gila chub populations in the Gila are found in Turkey Creek and Mule Creek.

Gila trout (*Oncorhynchus gilae*) is federally listed as threatened with no designated critical habitat in the Gila NF. Gila trout was native to the Gila River drainage (including the San Francisco) in New Mexico and the Verde River drainage in Arizona (Behnke 1992). Gila trout are found in moderate- to high-gradient perennial mountain streams above 1,660 meters (5,400 feet) elevation. Streams typically flow through narrow, steep-sided canyons and valleys. Abundant invertebrate prey, cover, and water free from contaminants are also required. Cover typically consists of undercut banks, large woody debris, deep pools, exposed root masses of trees at water's edge, and overhanging vegetation (USDI FWS 2003). A great deal of time and effort has been invested in Gila trout restoration as much of the cold water habitat in the Gila NF has been affected by recent large-scale fires and may not recover to cold water status without restoration. Many streams have been cleaned out of non-native species using piscicide, while other streams have had non-native species eradicated by ash flows from wildfire, and Gila trout have been repatriated into those streams. Two areas (Main Diamond and South Diamond) affected by the 2022 Black Fire may not be suitable for fish in the foreseeable future. Threats include changes in flow regimes and stream characteristics from uncharacteristic fire in the uplands; competition, predation, or hybridization by non-native salmonid species; climate change; and long-term habitat changes from fire, drought, and increased water temperature.

Loach minnow (*Tiaroga cobitis*) is federally listed as endangered with approximately 11,673 acres of designated critical habitat in the Gila NF. The loach minnow is endemic to the upper Gila River drainage of southwestern New Mexico, southeastern and east-central Arizona, and northeastern Sonora, Mexico (Miller and Winn 1951; Koster 1957). The minnow was found throughout the San Francisco and Gila Rivers in New Mexico, as well as lower-elevation reaches of several tributaries (Koster 1957; Propst et al. 1988). Loach minnows are now restricted to the following areas: portions of the Gila River and its tributaries; the West, Middle, and East Fork Gila River (Grant, Catron, and Hidalgo counties, New Mexico); San Francisco and Tularosa rivers and their tributaries; Negrito and Whitewater Creeks (Catron County, New Mexico); Blue River and its tributaries; and Dry Blue; Campbell Blue, Pace, and Frieborn Creeks (Greenlee County, Arizona, and Catron County, New Mexico) (NatureServe 2016). Loach minnows persist mainly in streams having relatively natural flow regimes and a predominance of native species (Propst and Bestgen 1991).

Recurrent flooding is important in keeping substrate free of sediments and in helping this species maintain a competitive edge over invading non-native fishes (NatureServe 2015). Threats include changes in flow regimes and stream characteristics from uncharacteristic fire in the uplands and competition and predation by non-native fish species.

Rio Grande cutthroat trout (*Oncorhnychus clarkii virginalis*) is federally listed as a candidate species. It is a subspecies of cutthroat trout that is found in the Rio Grande, Pecos, and the Canadian River Basins in New Mexico and Colorado. This species occurs in clear, cold water with pools and runs that have clean gravel substrates. They also require riparian cover. The only location in the Gila National Forest where this species occurs is in a recently established population in Holden Prong and Animas Creek. In 2022, the Black Fire impacted these drainages; therefore, the current status of that population is unknown. Once status is determined, if needed, this species will be restocked once these creeks recover and are able to support the species. Threats to the species include water diversions, dams, grazing, drought, fire, disease, flooding, habitat degradation and fragmentation, climate change, and hybridization and competition with other non-native trout species (USDI FWS 2014a).

Spikedace (*Meda fulgida*) is federally listed as endangered with approximately 9,968 acres of designated critical habitat in the Gila NF. The spikedace is endemic to the Gila River drainage of southwestern New Mexico and southeastern and central Arizona, and perhaps northern-most Sonora (Koster 1957). In New Mexico, spikedace was moderately common to abundant in the San Francisco River, the mainstem Gila River, and lower reaches of the three forks of the Gila River (Anderson 1978; Propst and Bestgen 1986). Spikedace were extirpated from the San Francisco River (Anderson 1978; Propst and Bestgen 1986) but have been reintroduced and appear to be established (Paroz 2016). The spikedace has a discontinuous distribution in the Gila River in New Mexico. It has historically been irregularly collected in low numbers in the East Fork Gila River although they have not been found there since the 1980s (Paroz 2016), regularly collected, but in declining numbers, in the West Fork Gila River, and are uncommon in the Middle Fork Gila River (Propst and Bestgen 1986; NMDGF unpublished data as cited by NatureServe 2016). The Cliff-Gila Valley as recently as the mid-1980s supported the largest New Mexico population of spikedace (Propst and Bestgen 1986), but its abundance there declined considerably in the late 1990s (NMDGF unpublished data as cited by NatureServe 2016). Threats include changes in flow regimes and stream characteristics from uncharacteristic fire in the uplands, and competition and predation by non-native fish species.

Invertebrates

Monarch butterfly (*Danaus plexippus*) is a federally listed candidate species of butterfly globally distributed throughout 90 countries, islands, and island groups (USDI FWS 2020). These butterflies are well known for their long-distance migration in the North American populations. The monarch butterfly occurs in habitats that have milkweed or flowering plants, which could include every ERU in the Gila NF. Milkweed plants are essential for breeding as the butterfly will only lay its eggs on milkweed plants. The monarch butterfly overwinters in Mexico and California and is not known to breed in the Gila National Forest but passes through the forest during migration to its wintering grounds (Zimmerman 2001). Because this species is primarily observed migrating through and using the Gila only temporarily, the species is not normally subject to impacts from management activities. Threats to the monarch butterfly include loss and degradation of habitat from the conversion of grasslands to agriculture, herbicides, insecticides, logging and thinning at overwintering sites in Mexico, urban development, drought, and effects from climate change (USDI FWS 2020).

Mammals

Mexican gray wolf (*Canis lupus baileyi*) is federally listed as an experimental, non-essential population in the Gila National Forest. Mexican gray wolves are the southernmost occurring (Nowak 1995 and 2003 as cited in Mexican Wolf Blue Range Adaptive Management Oversight Committee and Interagency Field Team 2005), rarest, and most genetically distinct gray wolf in North America (Garcia-Moreno et al. 1996). Historically, the Mexican gray wolf primarily inhabited forested, mountainous terrain. The wolf does not require specific vegetation; however, it reportedly most often occurred above 4,500 feet elevation in or near pine, oak, or pinyon-juniper woodlands, interspersed with grassland. They occurred in the mountainous regions of the Southwest from throughout portions of southern Arizona, New Mexico, and Texas into central Mexico (NatureServe 2016). Mexican gray wolves were extirpated in the United States by aggressive predator control programs. Mexican gray wolves were reintroduced into the Blue Range Wolf Recovery Area within the Apache-Sitgreaves National Forests in Arizona in March 1998 (USDI FWS Mexican Wolf Recovery Program website). In March 2000, Mexican gray wolves were translocated into the Gila Wilderness. At the end of April 2016, the wild Mexican wolf population consisted of 53 wolves with functional radio collars dispersed among 19 packs and two single wolves. The reintroduced wolves are classified as a "non-essential, experimental" population. Threats include in-breeding and human harassment.

New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) is federally listed as endangered and has only recently (summer 2018) been found in the Gila National Forest in a portion of Dry Blue Creek adjacent to the Arizona border. Subsequent surveys in other areas with likely habitat have not detected the species. The New Mexico meadow jumping mouse has exceptionally specialized habitat requirements to support these life history needs and maintain adequate population sizes. Habitat requirements are characterized by tall (averaging at least 61 centimeters (24 inches)), dense riparian herbaceous vegetation primarily composed of sedges and forbs. This suitable habitat is only found when wetland vegetation achieves full growth potential associated with seasonally available or perennial flowing water (USDI FWS 2014a). Since 2005, there have been 29 documented remaining populations spread across the 8 geographic management areas: 2 in Colorado, 15 in New Mexico, and 12 in Arizona. Nearly all the current populations are isolated and widely separated, and all the 29 populations located since 2005 have patches of suitable habitat that are too small to support resilient populations of the New Mexico meadow jumping mouse. In addition, 11 of the 29 populations documented since 2005 have been substantially compromised since 2011 due to water shortages, excessive grazing, or wildfire and post-fire flooding, and these populations may already be extirpated. Seven additional populations in Arizona may also be compromised due to post-fire flooding following a large recent wildfire (USDI FWS 2014a). Similarly, the population at Sugarite Canyon State Park has been significantly impacted since the 2011 Track Wildfire (Frey and Kopp 2013 as cited in USDI FWS 2014a). At this rate of population extirpation based on known historical population losses and possible recent population losses, the probability of persistence of the subspecies is severely compromised in the near term (USDI FWS 2013). Threats include loss of suitable habitat through grazing in riparian and adjacent upland habitat, modification of flow through water use or human-made structures, and stand-replacing wildfire (USDI FWS 2023a).

Species of Conservation Concern

Species of conservation concern are native species known to occur in the Gila National Forest and that the regional forester of the Southwest Region has determined substantial concern for its capability to persist over the long term in the plan area. Those species that are known to occur on the Gila National Forest are listed in table 40 along with the ERU in which they are found and preferred habitat features. The Forest Service's sensitive species and management indicator species concepts are not carried forward as part of the 2012 Planning Rule, and species of conservation concern replaces these concepts in land management plans going forward.

The guidance provided in the final directives for the 2012 planning regulations (FSH 1909.12 – Land Management Planning, Chapter 10) is used to develop the species of conservation concern list for the Gila National Forest. Species considered for inclusion within the list included terrestrial, aquatic, migratory, endemic, and rare species and were derived from various sources including but not limited to:

- Species with specific status ranks on the NatureServe ranking system.
- Species listed as threatened, endangered, or ranked as a high priority by relevant States (e.g., NMDGF), federally recognized Tribes, or Alaska Native Corporations.

- Rare plants as identified by the New Mexico Rare Plants Technical Council.
- Birds of Conservation Concern List by the USDI FWS.
- New Mexico Avian Conservation Partners Bird Conservation Plan 2.1 bird list.
- Stakeholder input during and after the 2017 Gila National Forest Final Assessment Report of Ecological/Social/Economic Sustainability Conditions and Trends (USDA FS 2017a).

Designating species of conservation concern is not a forest plan decision. The regional forester has authority to change species of conservation concern lists to reflect new information. The Forest Service determined these species of conservation concern were at risk due to small or endemic populations, limited habitat, current degraded habitat or specific ecological conditions, or current Forest Service management activities or other threats which may result in negative impacts to the species.

Table 40. Species of conservation concern on the Gila National Forest and associated ecological response unit types and habitat features

Common Name	Scientific Name	Habitat Features	Associated ERU
Amphibians			
Arizona toad	*Anaxyrus microscaphus*	Actively moving water	Riparian, Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
Birds			
Gila woodpecker	*Melanerpes uropygialis*	Riparian woodlands dominated by mature cottonwoods and sycamores; Large snags	Riparian
Lewis's woodpecker	*Melanerpes lewis*	Riparian woodlands; Large snags	Riparian, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, and Ponderosa Pine-Evergreen Oak
Pinyon jay	*Gymnohinus cyanocephalus*	Pinyon and juniper woodlands; recent surveys in the Gila National Forest indicate this species is using transitional ponderosa pine habitat	Ponderosa Pine-Evergreen Oak, Pinyon Juniper Woodland and Pinyon Juniper Grass Woodland
Fish			
Rio Grande sucker	*Catostomus plebeius*	Rocky pools, runs, and riffles of small to medium rivers	Riparian
Roundtail (Headwater) chub27	*Gila robusta/Gila nigra*	Deep pools and eddies of large streams	Riparian
Invertebrates			
A stonefly	*Capnia caryi*	Low gradient, clear, cool stream of Iron Creek	Riparian

[27] Under consideration for splitting these species. Currently considered together due to similar habitat requirements and plan components that address ecological conditions and threats.

Common Name	Scientific Name	Habitat Features	Associated ERU
Bearded mountainsnail	*Oreohelix barbata*	Igneous rock in talus on moist northern slope; Riparian with deciduous leaf litter in rocks	Riparian
Black Range mountainsnail	*Oreohelix metcalfei acutidiscus*	Igneous rock, limestone talus or outcrops	Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
No common name	*Oreohelix metcalfei hermosensis*	Igneous rock, limestone talus or outcrops	same as Black Range mountainsnail
Black Range woodlandsnail	*Ashmunella cockerelli*	Igneous rock, limestone talus or outcrops	same as Black Range mountainsnail
Cockerell Holospira snail	*Holospira cockerelli*	Igneous rock, limestone talus or outcrops	same as Black Range mountainsnail
"Gila" may fly	*Lachlania dencyanna*	High gradient, warm portion of Gila River	Riparian
Gila springsnail	*Pyrgulopsis gilae*	Cool to warm springs in rhyolite fissures	Riparian
Iron Creek woodlandsnail	*Ashmunella mendax*	Wooded zones of Black Range	Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
Marsh slug snail	*Deroceras heterura*	Mesic habitat	Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, and Ponderosa Pine Forest
Mineral Creek mountainsnail	*Oreohelix pilsbryi*	Igneous rock, limestone talus or outcrops	same as Black Range woodlandsnail
Morgan Creek mountainsnail	*Oreohelix swopei*	Riparian with deciduous leaf litter in rocks	Riparian
New Mexico hot springsnail	*Pyrgulopsis thermalis*	Thermal springs along Gila River	Riparian
Nitocris fritillary butterfly	*Speyeria nokomis nitocris*	Moist, montane, alpine meadows	Spruce-Fir Forest, Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, Montane/Subalpine Grasslands and Riparian (esp. Herbaceous Wetland)
No common name (snail)	*Ashmunella cockerelli argenticola*	Riparian with deciduous leaf litter in rocks	Riparian
No common name (snail)	*Ashmunella cockerelli perobtusa*	Igneous rock, limestone talus or outcrops	same as Black Range woodlandsnail

Common Name	Scientific Name	Habitat Features	Associated ERU
No common name (snail)	*Ashmunella tetrodon animorum*	Igneous rock in talus on moist northern slope; Riparian with deciduous leaf litter in rocks	Riparian
No common name (snail)	*Ashmunella tetrodon inermis*	Igneous rock in talus on moist northern slope; Riparian with deciduous leaf litter in rocks	Riparian
No common name (snail)	*Ashmunella tetrodon mutator*	Igneous rock in talus on moist northern slope; Riparian with deciduous leaf litter in rocks	Riparian
No common name (snail)	*Oreohelix metcalfei radiata*	Igneous rock, limestone talus or outcrops	same as Black Range woodlandsnail
No common name (Black Range mountainsnail)	*Oreohelix metcalfei concentrica*	Igneous rock, limestone talus or outcrops	same as Black Range woodlandsnail
Silver Creek woodlandsnail	*Ashmunella binneyi*	Rocky outcrops	Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, and Mountain Mahogany Mixed Shrubland
Sonoran snaggletooth snail	*Gastrocopta prototypus*	Igneous rock in talus on moist northern slope; Riparian with deciduous leaf litter in rocks	Riparian
Stonefly	*Taenionema jacobii*	Stream of Gila River watershed	Riparian
Tiger moth	*Alexicles aspersa*	Unknown	Unknown (assume all ERUs)
Western bumblebee	*Bombus occidentalis*	Grassy areas, mountain meadows, shrubland	All ERUs
Whitewater Creek woodlandsnail	*Ashmunella danielsi*	Igneous rock in talus on moist northern slope; Riparian with deciduous leaf litter in rocks	Riparian
Plants			
Arizona crested coralroot	*Hexalectris arizonica*	Heavy litter in oak, pine, or juniper woodlands over limestone	Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
Chiricahua Mountain mudwort	*Limosella pubiflora*	Muddy edges of ponds and perhaps streams; 1,500-2,000 ft. elevation	Riparian
Cliff brittlebush	*Apacheria chiricahuensis*	Limestone or rhyolitic rock outcrops; 5,500-7,000 ft. elevation	Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak, and Mountain Mahogany Mixed Shrubland

Common Name	Scientific Name	Habitat Features	Associated ERU
Davidson's cliff carrot	*Pteryxia davidsonii*	Sheer, rocky north facing cliffs; 6,500-8,000 ft. elevation	Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
Gila morning glory	*Ipomoea gilana*	Steep slopes (>45%), shallow soils, exposed rhyolitic outcrops; 6,600 to 6,700 ft. elevation	Ponderosa Pine-Evergreen Oak, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands
Goodding's onion	*Allium gooddingii*	Under canopy of mixed conifer forest	Spruce-Fir Forest, Mixed Conifer with Aspen, and Mixed Conifer-Frequent Fire
Greene milkweed	*Asclepias uncialis* ssp. *uncialis*	Sandy to rocky soils in grasslands; 5,000-7,000 ft. elevation	Juniper Grass Woodland, Colorado Plateau/Great Basin Grassland, Semidesert Grassland, and possibly Montane/Subalpine Grasslands based on elevational range of ERU as mapped
Heartleaf groundsel	*Packera cardamine (=Senecio cardamine)*	Understory of wet mixed conifer and spruce-fir; above 8,000 ft. elevation	Spruce-Fir Forest and Mixed Conifer with Aspen
Hess's fleabane	*Erigeron hessii*	Exposed rock or rocky outcrops; 9,500-10,200 ft. elevation	Spruce-Fir Forest and Mixed Conifer with Aspen
Metcalfe's penstemon	*Penstemon metcalfei*	Cliffs and steep north slopes; 6,600-9,500 ft. elevation	Riparian, Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, and Ponderosa Pine Forest
Mimbres figwort	*Scrophularia macrantha*	North-facing slopes; 6,500-8,200 ft. elevation	Riparian, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
Mogollon clover	*Trifolium neurophyllum*	Wet meadows, springs, and riparian corridors; 6,500-9,000 ft. elevation	Riparian, Montane/Subalpine Grasslands, Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, and Ponderosa Pine Forest
Mogollon death camas	*Zigadenus mogollonensis*	Understory of wet mixed conifer and spruce-fir; Above 8,700 ft. elevation	Spruce-Fir Forest and Mixed Conifer with Aspen
Mogollon hawkweed	*Hieracium brevipilum (=H. fendleri* var. *mogollense)*	Understory of pine and mixed conifer; 8,200-10,500 ft. elevation	Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest
Mogollon Mountain lousewort	*Pedicularis angustifolia*	Mature forest understory; 7,000-9,000 ft. elevation	Spruce-Fir Forest, Mixed Conifer with Aspen, and Mixed Conifer-Frequent Fire

Common Name	Scientific Name	Habitat Features	Associated ERU
Piños Altos flameflower	*Talinum humile*	Rocky south-facing slopes on shallow, gravelly, usually clayey soils overlaying rhyolite	Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass and Juniper Grass Woodlands, and Mountain Mahogany Mixed Shrubland
Porsild's starwort	*Stellaria porsildii*	Understory of mixed conifer; 7,900-8,200 ft. elevation	Mixed Conifer with Aspen and Mixed Conifer-Frequent Fire
Ray Turner's spurge	*Euphorbia rayturneri*	Desert grasslands; 4,600-5,600 ft. elevation	Juniper Grass Woodland and Semidesert Grassland
Wooton's hawthorn	*Crataegus wootoniana*	Riparian habitat in montane conifer forest; 6,500-8,000 ft. elevation	Riparian
Wright's catchfly (campion)	*Silene wrightii*	Cliffs and rocky outcrops; 6,800-8,000 ft. elevation	Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, Ponderosa Pine Forest, and Mountain Mahogany Mixed Shrubland
Yellow lady's-slipper	*Cypripedium parviflorum* var. *pubescens*	Wet meadows and streamsides; acidic soils	Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, and Ponderosa Pine Forest
Mammals			
Arizona montane vole	*Microtus montanus arizonensis*	Wet meadows	Riparian, Mixed Conifer with Aspen, Mixed Conifer-Frequent Fire, and Ponderosa Pine Forest
Gunnison's prairie dog (prairie population)	*Cynomys gunnisoni*	Open grasslands and shrublands	Pinyon Juniper Grass and Juniper Grass Woodlands, Colorado Plateau/Great Basin Grassland, and possibly Montane/Subalpine Grasslands based on elevational range of ERU as mapped
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	Caves and mines; Columnar cacti and agaves	Riparian, Madrean Pinyon-Oak Woodland, Pinyon Juniper Woodland, Pinyon Juniper Grass Woodland, Semidesert Grassland, and Mountain Mahogany Mixed Shrubland

Of the 57 species of conservation concern listed above, five species were not included in the Gila National Forest Final Assessment Report of Ecological/Social/Economic Sustainability Conditions and Trends (USDA FS 2017a). New information has been provided to and acquired by the Forest Service since 2017 to warrant inclusion of these species in the species of conservation concern list.

Since detailed information regarding species' description, distribution, and habitats on the forest and threats to persistence of species on the forest are not found within that referenced 2017 report, we provide the detailed information for these five species below. One species, Wright's dogweed, has also been removed from the species of conservation concern list found in the 2017 report, and the rationale for removing this species is discussed below. Changes were reviewed by Southwestern Regional Office wildlife staff and concurrence was received from the Regional Forester on the revised species of conservation concern list on March 24, 2023.

Pinyon jay (*Gymnorhinus cyanocephalus*) is widely distributed across the Gila National Forest and commonly found (Zimmerman 1995), but this species has experienced significant population declines and is of increasing conservation concern (Somershoe et al. 2020). From 1967 to 2015, populations declined by 3.69 percent annually for an estimated total loss of 83.5 percent (Somershoe et al. 2020). Pinyon jays are predominantly associated with pinyon juniper habitat, due to the species' tightly co-evolved relationship with pinyon pines. In New Mexico, pinyon jays are associated primarily with Colorado pinyon (*Pinus edulis*). The species may be found in foothills throughout the state, wherever large blocks of pinyon juniper woodland habitat are present (NMPIF 2007). Extensive pinyon jay home ranges mean that only land managers with jurisdiction over very large pinyon-juniper landscapes can effectively manage for the year-round habitat needs of even one pinyon jay flock (Johnson et al. 2016). The species occurs in woodlands with pinyon pine but may also occur in pine-oak woodlands as well as shrubland ERUs on the Gila National Forest, which is well distributed across the forest. Despite the potential importance of the Gila National Forest to the pinyon jay's range-wide population, no systematic surveys of the area were previously performed before 2021. Surveys for pinyon jays in the Gila National Forest occurred in March and April of 2021, 2022, and 2023, and suggest that pinyon jays are scarce in the south, common in the east, and abundant in the north of the forest. This indicated that the Gila National Forest has significant management responsibility for pinyon jays (Johnson et al. 2023). As pinyon jay populations have declined, the pinyon juniper woodlands that provide most of their habitat across the species' range continues to also face potential threats, including removal of trees to accomplish other management priorities, long-term fire suppression, changes in woodland age and tree density, changing climatic conditions that cause reduced pinyon nut production and increased pinyon pine mortality (Somershoe et al. 2020), and continued grazing pressure that reduces habitat. The State of New Mexico has designated the pinyon jay as a species of greatest conservation need. The species was petitioned to be listed under the Endangered Species Act as either threatened or endangered in April 2022; the USDI FWS found the petition may be warranted and initiated a status review in August 2023. NatureServe (2023) lists the pinyon jay as globally vulnerable (G3) and imperiled (S2) in New Mexico.

Arizona crested coralroot (*Hexalectris arizonica*) occurs in heavy litter in oak, pine, or juniper woodlands in mesic to dry soils, often in limestone from 5,000 to 7,000 feet elevation (NMRPTC 2023, SEINet 2018). This species has been found in one location in the Gila National Forest in the canyon bottom of Middle Percha Creek approximately 1.7 miles west of the village of Kingston, New Mexico. The area where this species was found has seen heavy flooding, and the canyon bottom has seen heavy scouring from flood waters. A forest access road is in the canyon bottom and has been reconstructed after the flood events. More survey work is needed to determine abundance, distribution, and specific habitat requirements as current distribution and abundance is not currently known. This species is considered at-risk in the Gila National Forest because this species is not known to occur elsewhere in the forest, and the only known location for this species has been altered by post-fire flooding and management activities. NatureServe (2023) lists the Arizona crested coralroot as a vulnerable sub-species (G5T3) and imperiled (S2) in New Mexico.

Chiricahua Mountain mudwort (*Limosella pubiflora*) occurs in wet sand and mud flats at the edges of ponds, lakes, or cienegas (NMRPTC 2023, SEINet 2018, NatureServe 2018). This species requires surface water for its survival and appears to do well where slopes are essentially level (NatureServe 2018 as described by Malusa and Warren 1994). Populations of this species have been found at the edges of cattle tanks in New Mexico where they have not appeared to suffer (NMRPTC 2023). This species has also been found in the mud flats adjacent to the boat ramp at Quemado Lake. This mudwort has not been found in any of the areas of the Animas Valley where it was originally described in 1973 and where it was last found during surveys in 1991. The species was thought to be extirpated from New Mexico (NatureServe

2018) until it was found at Quemado Lake in 2009 (SEINet 2018). Overall, trend for this species has been in decline as it has not been found in other areas it has been originally described. This species is considered at-risk in the Gila National Forest, because it has limited distribution in the forest, the forest contains the only known location of this species in New Mexico, and the species is identified as globally "critically imperiled" (G1Q) in NatureServe.

Gila morning glory (*Ipomoea gilana*) occurs in open woodlands of pinyon, juniper, and evergreen oak on southern to eastern slopes and occurs in mid-elevations (6,600 to 6,700 feet) of the Black Range on the eastern edge of the Gila National Forest. In the location where this species has been found, surrounding topography consists of a landscape featuring steep slopes (greater than 45 percent) with shallow soils and exposed rhyolitic outcrops. This species is only known to occur in this location. One researcher estimates less than 300 individual plants are found within 3.5 kilometers (2.2 miles) of each other (Keith et al. 2017). Trend for the species is not known at this time, and since there are approximately 300 individuals or less, abundance is low. Risks to the species are also not known; however, risks from management activities in this area could tend to be very low as plants are on steeper slopes with shallow soils and exposed outcrops. This would reduce the potential effects of any fuelwood cutting or timber harvest with the use of manual or mechanical methods, and livestock would likely avoid the area as the shallow rhyolitic soils and exposed outcrops would have minimal forage. The Silver Fire of 2013 did not reach the area where this plant was found as this area is broken with rocky terrain. The plant was found at the end of a prolonged drought period, so it is not known how drought, or a changing climate may or may not affect this species. This species is considered at-risk in the Gila National Forest because there is only one location that this species is known to occur, and it is identified as globally "critically imperiled" (G1) in NatureServe.

Ray Turner's spurge (*Euphorbia rayturneri*) occurs in desert grasslands from 4,600 to 5,600 feet elevation (NMRPTC 2023, NatureServe 2018) in sandy, moist soils (Gila Flora 2018). This plant has only been found to occur in Juniper Grass Woodland as mapped in the Gila National Forest, and only in one location in the forest in Gold Gulch in the Burro Mountains. More work is needed to determine effects from management activities, as well as determining abundance and specific habitat requirements. This species is considered at-risk in the Gila National Forest because it is only found in one location, and it is identified as globally "critically imperiled" (G1) in NatureServe.

Wright's dogweed (*Adenophyllum wrightii var. wrightii*) is an annual plant that flowers in September. The plant is often found in open grasslands with igneous gravel and cobble substrates, but also sandy or silty soils in swales and drainages in pinyon juniper woodland (Sivinski 2007) at 7,000 to 7,200 feet elevation in New Mexico (NMRPTC 2023). The plant occurs in Catron, Grant, and Sierra Counties, New Mexico; adjacent southeastern Arizona; and in northern Chihuahua, Mexico (NMRPTC 1999 updated 2023). This plant was formerly known from a few very old collections made near the Santa Rita copper mines and in the Black Range, New Mexico; near Springerville, Arizona; and in Chihuahua, Mexico (NMRPTC 1999 updated 2023). Once poorly known and overlooked, recent collections and observations suggest this species is common to possibly abundant in the region of southwestern New Mexico where it is known to occur (NatureServe 2023). Threats to the plant are generally unknown but may include livestock grazing (NatureServe 2023). However, Spellenberg and Anderson (2010) located the plant in Chihuahua, Mexico, within a heavily grazed pasture, where livestock had completely avoided it and commented that the plant was so numerous that he deemed it "weedy." The presence of populations in Mexico increased the total range of this plant well over 100 miles. The Wright's dogweed is no longer considered rare under NMRPTC criteria (NMRPTC 1999 updated 2023). NatureServe (2023) lists the variety as vulnerable (T3) and the species is apparently secure (G4) globally, and the plant is no longer ranked at the state level. Due to the recent increase in the species range and the potential threat of grazing being less of an issue, the Wright's dogweed has been removed from the Gila National Forest species of conservation concern list.

Regional Forester's Sensitive Species

The regional forester's sensitive species program was originally developed to conserve and recover plant and animal species under the direction of Forest Service policy (FSM 2670). Sensitive species are those plant and animal species identified by a regional forester for which population viability is a concern. They were identified through a regional process considering evidence of significant current or predicted downward trends in population numbers or density or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Regional forester sensitive species will be replaced by species of conservation concern when the revised plan is approved. They are included in this analysis because they remain in effect until the revised plan is signed. Table 41 lists the special habitat features deemed essential to each species, and the corresponding ERU in which that habitat occurs for the species. Regional forester sensitive species for which there was a persistence concern were included in the analysis of species of conservation concern. All others were determined to be secure, with the assumption that managing toward the desired conditions for their respective habitat will provide for their viability.

There are 69 regionally sensitive species known to occur in the Gila NF as shown in table 41, which also shows the amount of habitat potentially available by vegetation community. Information in the table is derived from the Ecological Assessment (USDA FS 2017a), Gila National Forest GIS files, and the VDDT model runs from the vegetation analysis.

Table 41. Regional forester sensitive species in the Gila National Forest and primary habitat needs

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Birds				
Northern goshawk	*Accipiter gentilis*	Multi-storied canopy	PPE, PPF, MCD, MCW	1,578,006 acres
Burrowing owl	*Athene cunicularia hypugaea*	Prairie dog or other burrows	Grassland ERUs	258,790 acres
Common blackhawk	*Buteogallus anthracinus*	Large gallery cottonwood and sycamore	Riparian	31,252 acres
Costa's hummingbird	*Calypte costae*	Xeric hillside vegetation near riparian habitat	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group 8,929 acres Desert willow group 918 springs/seeps 2,718 acres of non-riverine wetlands

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Common ground dove	*Columbina passerina*	Riparian shrubs and weedy areas	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group 8,929 acres Desert willow group 918 springs/seeps 2,718 acres of non-riverine wetlands
American peregrine falcon	*Falco peregrinus anatum*	Rocky cliffs	Woodland to Forested ERUs	2,860,513 acres with an unknown number of cliff and rocky sites
White-eared hummingbird	*Hylocharis leucotis*	Pine-oak forests near flower banks	PPE, PPF	1,080,528 acres
Gila woodpecker	*Melanerpes uropygialis*	Large snags, riparian	Riparian with large cottonwood/ sycamore	31,252 acres
Abert's towhee	*Melozone aberti*	Woodlands and thickets along rivers and streams	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group 8,929 acres Desert willow group
Arizona Bell's vireo	*Vireo bellii arizonae*	Desert shrubland/woodland in lowland stream courses	Riparian	31,252 acres Cottonwood/sycamore group 1,655 acres Walnut/evergreen tree group 8,929 acres Desert willow group
Gray vireo	*Vireo vicinior*	Pinyon juniper savannahs and woodlands	Woodland ERUs	1,282,507 acres
Fish				
Desert sucker	*Catostomus clarkia*	Aquatic	Riparian	323 miles of perennial stream
Sonora sucker	*Catostomus insignis*	Aquatic	Riparian	323 miles of perennial stream
Rio Grande sucker	*Catostomus plebeius*	Aquatic	Riparian	47 miles of perennial stream

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Roundtail (Headwater) chub	*Gila robusta*	Aquatic	Riparian	153 miles of perennial stream
Rio Grande cutthroat trout	*Oncorhynchus clarki virginalis*	Aquatic	Riparian	6 miles of perennial stream
Invertebrates				
A Stonefly	*Capnia caryi*	Aquatic	Riparian	957 miles of perennial stream 546 miles of intermittent stream
Dashed ringtail	*Erpetogomphus heterodon*	Aquatic	Riparian	957 miles of perennial stream 546 miles of intermittent stream
Notodontid moth	*Euhyparpax*	Unknown	Unknown	Unknown
"Gila" may fly	*Lachlania dencyanna*	Aquatic	Riparian	957 miles of perennial stream 546 miles of intermittent stream
Bearded mountainsnail	*Oreohelix barbata*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
Black Range mountainsnail	*Oreohelix metcalfei acutidiscus*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops
Black Range woodlandsnail	*Ashmunella cockerelli*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops
Gila springsnail	*Pyrgulopsis gilae*	Cool to warm springs in rhyolite fissures by Gila River	Riparian	918 springs/seeps
Iron Creek woodlandsnail	*Ashmunella mendax*	Wooded zones of Black Range	PJO, PPE, PPF, MCD, MCW	530,019 acres
Mineral Creek mountainsnail	*Oreohelix pilsbryi*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Morgan Creek mountainsnail	*Oreohelix swopei*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
New Mexico hot springsnail	*Pyrgulopsis thermalis*	Thermal springs along Gila River, aquatic	Riparian	918 springs/seeps
No common name snail	*Ashmunella cockerelli argenticola*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
No common name snail	*Ashmunella cockerelli perobtusa*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops
No common name snail	*Ashmunella tetrodon animorum*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
No Common name snail	*Ashmunella tetrodon inermis*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
No common name snail	*Ashmunella tetrodon mutator*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Dry Creek woodland snail	*Ashmunella tetrodon tetrodon*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
No common name snail	*Oreohelix metcalfei radiata*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops
No common name (Black Range	*Oreohelix metcalfei concentrica*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops
No common name snail	*Oreohelix metcalfei metcalfei*	Igneous rock, limestone talus or outcrops	Woodland ERUs	1,282,507 acres with unknown number of outcrops
Silver Creek woodlandsnail	*Ashmunella binneyi*	Rocky outcrops	PPF, MCD	1,079,561 acres with unknown number of outcrops
Whitewater Creek woodlandsnail	*Ashmunella danielsi*	Riparian with deciduous leaf litter in rocks	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
Plants				
Arizona crested-coralroot	*Hexalectris arizonica*	Heavy litter in oak, pine, or juniper	PJO, MPO, PPE, PPF	1,946,329 acres
Davidson's cliff carrot	*Pteryxia davidsonii*	Sheer, rocky north facing cliffs	Woodland ERUs	1,282,507 acres with unknown number of north facing cliffs and outcrops
Gila thistle	*Cirsium gilense*	Moist areas, mountain meadows in montane coniferous forest	PPF, MCD	1,079,561 acres with unknown number of moist, montane meadows 5,808 acres Montane conifer/willow group 918 springs/seeps 2,718 acres of non-riverine wetlands
Gooding's onion	*Allium gooddingii*	Under canopy of mixed conifer forest	MCD, MCW, SFF, Riparian	521,257 acres 5,808 acres Montane conifer/willow group

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Greene milkweed	*Asclepias uncialis* ssp. *uncialis*	Grasslands sandy to rocky soils 5,000-7,000 ft elevation	CPGB, JUG	165,924 acres
Heartleaf groundsel	*Packera cardamine (=Senecio cardamine)*	Understory of mixed conifer and spruce/fir	MCW, SFF	125,013 acres
Hess's fleabane	*Erigeron hessii*	Exposed rock or rocky outcrops	MCW, SFF	125,013 acres with unknown number of rocky outcrops
Maguire's beardtongue	*Penstemon linarioides* spp. *maguirei*	Sandy soil	PJO limestone cliffs	848,440 acres with unknown number of limestone cliffs
Metcalfe's penstemon	*Penstemon metcalfei*	Cliffs and steep slopes	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group
Metcalfe's tick-trefoil	*Desmodium metcalfei*	Rocky slopes	Grassland ERUs and PJO	1,107,230 acres with unknown amount of rocky slopes
Mimbres figwort	*Scrophularia macrantha*	North-facing slopes	PJO, PPE, PPF, MCD Riparian	2,325,212 acres with unknown amount in north aspects
Mogollon clover	*Trifolium neurophyllum*	Aquatic, wet meadows, springs	PPF, MCD, Riparian	1,079,561 acres with unknown number of wet meadows 5,808 acres Montane conifer/willow group 918 springs/seeps 2,718 acres of non-riverine wetlands
Mogollon death camas	*Zigadenus mogollonensis*	Understory of wet mixed conifer and spruce/fir	MCW, SFF	125,013 acres
Mogollon hawkweed	*Hieracium brevipilum (=H. fendleri* var.	Understory of pine and mixed conifer	PPF, MCD, MCW	226,247 acres
Piños Altos flameflower	*Talinum humile*	Rocky south facing slopes over rhyolite	PJO, MPO, PPE	1,263,012 acres with unknown amount of south-facing slopes over rhyolite
Porsild's starwort	*Stellaria porsildii*	Understory of mixed conifer	PPF, MCD, MCW	226,247 acres

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Rusby hawkweed	*Hieracium abscissum (=H. rusbyi)*	Understory of mixed conifer	MCD, MCW, SFF	521,257 acres
Villous groundcover milkvetch	*Astragalus humistratus var. crispulus*	Xeric pine on sandy volcanic soils	CPGB, JUG, PJO, PPE	1,411,575 acres with unknown amount on sandy, volcanic soils
Wooton's hawthorn	*Crataegus wootoniana*	Riparian habitat in montane conifer forest 6,500-8,000 ft elevation	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group 918 springs/seeps 2,718 acres of non-riverine wetlands
Wright's dogweed	*Adenophyllum wrightii* var. *wrightii*	Sandy, silty soils in swales or drainages	PJG, PJO	1,151,149 acres with unknown amount of sandy, silty soils
Yellow lady's-slipper	*Cypripedium parviflorum* var. *pubescens*	Mesic meadows and wet streamsides	PPF, MCD, MCW	226,247 acres with unknown amount of wet meadows 5,808 acres Montane conifer/willow group 918 springs/seeps 2,718 acres of non-riverine wetlands
Mammals				
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Caves and mines	Most ERUs on forest	Unknown number of caves and 353 documented mines
Gunnison's prairie dog (prairie population)	*Cynomys gunnisoni*	Open grasslands and shrublands	MSG, CPGB, PJG, JUG	590,016 acres
Gunnison's prairie dog (montane population)	*Cynomys gunnisoni pop. 1*	Open grasslands and shrublands	MSG, CPGB, PJG, JUG	590,016 acres
Spotted bat	*Euderma maculatum*	Cliffs	Multiple ERUs	Unknown amount of cliff habitat

Common Name	Scientific Name	Special Habitat Features	Ecological Response Unit (ERU)	Potentially Suitable Habitat or Features Forestwide
Allen's Lappet-browed bat	*Idionycteris phyllotis*	Rocky slopes and cliffs	Riparian, woodland ERUs, PPE, PPF	3,026,857 acres with unknown amount of rocky slopes and cliffs
Western red bat	*Lasiurus blossevillii*	Riparian areas and caves	Riparian, grassland and woodland ERUs	1,541,297 acres with unknown number of caves and 353 documented mines
Hooded skunk	*Mephitis macroura milleri*	Rock/talus scree, low riparian, desert, low grasslands and low woodlands	Grassland and woodland ERUs	1,541,297 acres
Arizona montane vole	*Microtus montanus arizonensis*	Mesic meadows	PPF, MCD, MCW, Riparian	1,180,795 acres with unknown number of mesic meadows 5,808 acres Montane conifer/willow group 918 springs/seeps 2,718 acres of non-riverine wetlands
Arizona gray squirrel	*Sciurus arizonensis arizonensis*	Mid-elevation riparian areas	Riparian	31,252 acres Cottonwood/sycamore group 5,808 acres Montane conifer/willow group 1,655 acres Walnut/evergreen tree group 918 springs/seeps 2,718 acres of non-riverine wetlands

Migratory Birds

The Gila National Forest Migratory Bird Assessment identified migratory bird species that occur or have the potential to occur in the forest by reviewing information from the Birds of the Gila checklist, New Mexico Partners in Flight, USDI FWS, and the National Audubon Society. The Migratory Bird Act prohibits the "taking" and "killing" of migratory birds. The Forest Service memorandum of understanding with the USDI FWS identifies specific activities for bird conservation, pursuant to Executive Order 13186 including striving to protect, restore, enhance, and manage habitat of migratory birds, and prevent the further loss or degradation of remaining habitats on National Forest System lands. This includes identifying management practices that affect populations of high priority migratory bird species such as the prairie falcon, long-billed curlew, Wilson's phalarope, elf owl, Lucy's warbler, MacGillivray's warbler, and painted redstart.

Bald and Golden Eagles

Golden eagles are known to occur in the Gila NF, but no nest sites have been documented on National Forest System lands. Bald eagles are common winter residents in the Gila NF, and there is a documented nest site at Quemado Lake that has been occupied by a resident pair. There are few large bodies of water with adequate prey species for bald eagle in the Gila NF to support many nesting pairs. The agency is required by law to protect eagles in accordance with the Bald and Golden Eagle Protection Act (16 U.S.C. 668–668c).

Environmental Consequences

The following section focuses on at-risk species identified by the Forest Service and the plan components that would contribute to their persistence on the Gila National Forest. Many more common native wildlife such as elk, deer, beaver, common black hawk, and others are not analyzed in detail. This is because there is an assumption that providing for quality habitat through ecosystem plan components are expected to provide the broad ecological conditions that support native species' persistence.

A forest plan does not authorize site-specific projects or activities; therefore, there are no direct effects from adopting any of the alternatives. Direct and indirect site-specific effects from projects will be analyzed when future projects are proposed. At such time, mitigation measures, timing restrictions, and conservation measures would be applied through design features consistent with the USDI FWS consultation, recommendations provided by the NMDGF, and best available scientific information.

Analysis Methodology

Due to the programmatic nature of the plan, this analysis focuses on the ecological characteristics and conditions important to wildlife, fish, and plants. Many species are strongly tied to specific vegetation communities, and structural characteristics, such as degree of tree canopy closure, number of canopy layers, large and old trees, snags, and downed logs. This approach assumes that if a species, genetics, functions, and processes are provided for, then most of the species needs, both known and unknown, would be met (course filter). Where they do not, species-specific (fine-filter) plan components were developed. Part of this coarse- and fine-filter approach also assumes that focusing on the rare species whose persistence is at risk would also provide for diversity of plant and animal communities necessary to meet the diversity requirement of the National Forest Management Act and 2012 Planning Rule. A crosswalk of the needs of at-risk species and the associated plan components can be found in appendix G.

This analysis evaluates two primary aspects for at-risk species. First, the adequacy of plan direction in each alternative to protect, maintain, and restore habitat elements identified for species and primary constituent elements of designated critical habitat and to provide for recovery of listed species. Second, the adequacy of plan direction to avoid, minimize, or mitigate potential short-term adverse effects to them. The analysis also considers the authority of the Forest Service, and the inherent capability of the plan area to provide for at-risk species. While the forest plan does not authorize site-specific projects or activities, direct and indirect site-specific effects are described as appropriate where they may result in increased disturbance, direct mortality, or increased susceptibility to mortality from implementing the plan's objectives. For the most part, this analysis focuses on longer term indirect and cumulative effects that may occur over the 10- to 15-year life of the forest plan.

Ecological Conditions

Indicators for this analysis are trends toward or maintaining desired ecological conditions represented by key ecosystem characteristics, and how well the plan components address the threats to persistence that are under the Forest Service's ability and authority to control or influence. Key ecological characteristics are those analyzed in the Upland Vegetation, Fire Ecology and Fuels section and summarized in the Summary of Effects section toward the end of chapter 3 of this environmental impact statement. Conclusions about ecological conditions are also drawn from the qualitative analyses in the Riparian and Aquatic Ecosystems and the Soil and Watershed Resources sections. Therefore, the assumptions associated with those resource analyses are the source of anticipated effects to their associated habitats.

Alternatives are compared to one another based on whether they are trending ERU conditions toward or away from desired conditions using the following ecosystem characteristics: seral state diversity (percent), old-growth components (old trees, snags, and coarse woody debris), fire frequency and severity, ecological status or species composition, patch size, risk of invasive and noxious plant species, and risk of uncharacteristic insects and disease. These ecosystem characteristics are defined and discussed in detail within the Upland Vegetation, Fire Ecology, and Fuels section.

The diversity of seral states within an ERU can be related to other ecological conditions necessary for some species, such as vegetative lifeform, dominant species, species composition, structure, number of age classes, size class, and canopy cover. Seral state diversity reflects the status of ecological processes, ecosystem function, integrity, and resilience. A diversity of seral states is a desirable ecosystem characteristic that supports biodiversity. Vegetation communities with trends toward or maintaining desired seral state diversity conditions are likely to provide better ecological conditions for wildlife (Werner and Glennemeier 1999).

When a large tree falls, it becomes coarse woody debris and provides habitat for small animals and insects. As these logs are decomposed by microorganisms, they store water and provide nutrients for the continued growth of the forest and its soil. The importance of coarse woody debris is not limited to upland habitats, it has significant impact on riparian areas as well and many aquatic species depend on downed woody material within and along the stream course. Coarse woody debris not only provides foraging and escape cover for fish, but it contributes to the creation of optimum aquatic ecological condition by slowing down water and contributing to pool development. If the amount of coarse woody debris load trends away from desired conditions, there may be significant negative impacts to species. If coarse woody debris is not in adequate supply or departed from desired conditions, it may result in lack of prey for carnivorous birds or mammals (Mac Nally et al. 2002). Additionally, if coarse woody debris exceeds the desired conditions, it may create unfavorable soil conditions, especially for plant species, by prohibiting growth or germination or support uncharacteristic intense fires that alter or remove habitat. This is also a key factor in proper functioning aquatic ecological conditions. Therefore, the desired condition for coarse woody debris loads should provide optimum ecological conditions for terrestrial and aquatic animal species as well as optimum soil conditions for plant species. Vegetation communities that are trending toward or maintaining desired coarse woody debris are likely to provide better ecological conditions for wildlife and plants.

When a tree dies but remains standing, it becomes a snag and provides habitat for an array of animals including but not limited to the Mexican spotted owl, Gila woodpecker, Lewis's woodpecker, and a variety of bat species. Ecologically, a dead tree is as important to the forest ecosystem as a live one, and according to Marcot (2002), provides several key ecological functions that influence the ecosystem. Snags provide homes for birds and foraging opportunities for insectivorous animals. If snags are not in adequate supply or below desired conditions, it may result in a lack of nesting locations or foraging areas for insectivorous birds or mammals. Conversely, large-scale fire often results in too many snags per acre and not enough live trees. Therefore, ERUs trending away from or maintaining a departure from desired snag density conditions are likely to provide poorer ecological conditions for wildlife, while ERUs trending toward or maintaining desired snag density conditions are likely to provide better ecological conditions for wildlife.

Another issue caused by departure in seral state proportion, coarse woody debris, and snag density is the potential for large, contiguous extents of high-severity fires. In both forested and non-forested ecosystems, fuel loads can build to levels that increase the potential for large uncharacteristic, high-intensity fires. Besides dramatically altering vegetative conditions within an ecological response unit, they can also potentially wipe out populations of at-risk species that reside in those systems, especially if they are sessile like plants, less mobile like snails, rare, or endemic.

The following assumptions enable the analysis.

- Impacts on at-risk species are directly related to impacts on habitats.
- If a species is associated with a particular habitat, then the ecological conditions, amount, and distribution of those habitat elements available to the species on the landscape help to predict its distribution and abundance.
- In general, the further ecological condition is departed from desired conditions, the greater the risk to persistence of the associated at-risk species. Conversely, the closer ecological conditions are to desired conditions, the lower the risk to persistence of associated at-risk species.
- Project-level design features, such as seasonal and spatial restrictions, can limit direct impacts on some species.
- Terms and conditions and reasonable and prudent measures resulting from USDI FWS consultation on the programmatic framework of the forest plan will be followed when planning or implementing new site-specific projects and activities, unless modified by site-specific consultation.

Climate Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

Vegetation Treatments

All five alternatives would use mechanical vegetation treatment and wildfire to varying degrees to manage all upland ERUs, and mechanical vegetation treatment or structural improvement to manage riparian and water resources (such as aquatics, riparian ERUs) to improve ecological condition, abundance, and distribution for species that depend on those vegetation communities. Depending on the alternative, the acreage difference varies as well as the ERUs in which the activities would take place. These systems have varying departure ratings (low to high) from reference condition. Fuel-reduction treatments in frequent fire-adapted systems of the West and Southwest in particular have been shown to improve resiliency (Stephens et al. 2012). While these activities have the potential to modify habitat and create disturbance, mechanical thinning and prescribed fire activities under all alternatives would make progress toward the desired structure and function of the ERUs. This would improve the ecological conditions for all species, including at-risk and regional forester sensitive species by increasing resilience of ERUs to uncharacteristic disturbances and improving habitat, thereby increasing the likelihood of long-term persistence and viability.

Vegetation treatments and stream restoration activities would occur under all alternatives and could cause direct impacts to some wildlife species, which may favor some species and not others. Wildlife and fish species could be disturbed by noise or human presence associated with treatments, which could lead to such impacts as stress, displacement, or habitat avoidance. Less mobile at-risk wildlife species such as amphibians, invertebrates, small mammals, and others could be injured or killed from fire or from the use of vehicles and tools to carry out vegetation treatments. Some disturbances to bird species, including at-risk, regional forester sensitive species, and migratory birds, may occur during management activities; mortality, nest destruction or abandonment, and temporary habitat displacement during management activities resulting in unintentional take are expected to be infrequent and expected to not rise to a level that affects the total population size of any species. Thinning and burning in uplands adjacent to fish habitat especially before spawning may cause an increase in sedimentation and render gravel beds unusable for egg laying that year. These potential detrimental effects may be offset by the long-term benefit of the area being less likely to sustain large, contiguous extents of high-severity wildfire.

These impacts would be most substantial on the individual level that may be generally unavoidable in the short term. The extent of displacement would be related to the timing, duration, and magnitude of the activity. After initial avoidance, individuals may begin to re-occupy areas previously avoided. These types of impacts would generally be analyzed at the project level and would be reduced by incorporating surveys, avoidance areas, or timing restrictions for at-risk species into project-level activities. Under all alternatives, treatment activities would be designed to enhance habitat conditions over the long term and reduce the risk of habitat degradation or loss to large stand-replacement fire. While there is extensive scientific information demonstrating the benefits of forest fuel-reduction treatments in terms of improving resiliency in frequent fire-adapted systems of the West and Southwest (for example, Stephens et al. 2012), debate remains within the scientific community regarding the long-term impacts of mechanical thinning treatments and high-severity fire on specific species, like the Mexican spotted owl (for example Ganey et al. 2017). The recovery plan monitoring would be conducted with any of the fire treatments under all alternatives to help inform this discussion and potential future science-based conservation measures to be specified during section 7 consultation.

All alternatives would reduce or mitigate soil loss, erosion, and sedimentation that occur from ground-disturbing activities and wildland fire, in compliance with the Clean Water Act and applicable executive orders. This would benefit at-risk species, as well as many other common and uncommon species.

Herbicide Use

All alternatives would allow use of herbicide as a management tool for controlling non-native, invasive plant species. Herbicides are a class of pesticides that are formulated to kill problematic plants by disrupting plant-specific metabolic or other plant processes. Herbicides are one of several tools to protect native plant communities from being displaced by invasive and noxious weeds. Even though the action alternatives contain many standards and guidelines that serve as baseline constraints, herbicide use is a highly regulated management activity, subject to project-level environmental analysis and section 7 consultation. There would be very little difference between alternatives in terms of effects to wildlife species.

Livestock Grazing

All alternatives would continue to authorize grazing by domestic livestock and provide opportunities for ranching consistent the agency’s multiple-use sustained-yield mandate, and other applicable laws and regulations. While the detrimental effects of poorly managed livestock grazing are well documented in the scientific literature, livestock management that leads to unsustainable condition are not consistent with law, regulation, and policy or any of the alternatives. Rangeland fences that help manage livestock grazing or tall woven wire fences that exclude large ungulates from sensitive habitats have the potential to affect wildlife movements. Most of the rangeland fences in the Gila National Forest are multiple-strand, barbed wire fences, but historical remnants of short woven wire fences may still be found in a few isolated places. While there are no objectives for constructing riparian exclosures under any alternative, they may be constructed under all alternatives. Exclosures are one of the effective management strategies to exclude livestock and native ungulates from sensitive areas such as springs, seeps, riparian, or wetland areas and can help degraded riparian areas trend toward proper functioning condition to benefit at-risk and common riparian-dependent species. Depending on design, these fences may prevent entry of large mammals like elk, deer, and wolves and could cause injury or death to animals that unsuccessfully negotiate fences (NMDGF 2003), but most would enclose relatively small areas so impacts to wildlife movement is expected to be minimal.

Land Exchanges

All alternatives would allow some sort of land exchanges, purchases, donations, and sales to occur, which can add and subtract portions of the National Forest System land area. Parcels of private land have been acquired by the forest in the past through donation, purchase, and exchange (trade), and these opportunities would continue to arise to some degree under any alternative. Parcels identified for disposal and exchange are typically those that have become difficult to manage because surrounding ownership conditions have changed, or the lands no longer represent forest characteristics or qualities. These are often former administrative sites, isolated tracts, or scattered parcels, and rarely impact access for public use or administration. The disposal or exchange of these sites would help allocate resources to other areas of the forest that were more useful or productive. Acquisition of some private parcels can be helpful in achieving a desired forest landownership pattern that enhances public access, supports resource management goals, addresses fragmentation, and reduces future management costs. For example, acquisitions of specific properties may assist in recovery efforts of threatened and endangered species.

Recreation

Recreation will continue under all alternative and can include temporary displacement and avoidance of habitat, vegetation trampling, soil compaction, and temporary vegetation loss at camp sites. Although the alternatives differ in terms of allowable group sizes in wilderness areas and forestwide length of stay limits, effects to wildlife, fish, and plants are not expected to be substantially different between the alternatives. As disclosed in the Sustainable Recreation analysis, forest visitation is not anticipated to change substantially as a result of implementing any alternative; there are other socioeconomic and geographic influences that exert a stronger influence on visitation patterns than forest plan direction.

Designated Areas

Existing area designations (wilderness, inventoried roadless areas, research natural areas, and wilderness study areas) are carried forward through all alternatives and do not contribute to differences in effects between alternatives. Designated wilderness (792,585 acres), inventoried roadless (771,436 acres), research natural areas, and wilderness study areas provide for habitat connectivity and minimize disturbance to federally listed species through managing for wilderness character and roadless characteristics, respectively, as well as having little to no road construction or maintenance. These acreages are the same and apply to all alternatives. Mechanical vegetation treatments to improve habitat conditions and minimize the possibility of large-scale, uncharacteristic fire impacts would not be allowed within designated wilderness, and only with special permission as outlined in the Chief's Review Process for Activities in Roadless Areas (2012). As a result, these areas may be more susceptible to undesirable fire effects from high-intensity fire.

Federally Listed Species

The primary needs for federally listed species are addressed through law, regulation, and policy such as recovery plans and conservation agreements and would be followed under all alternatives. For federally listed species, the greatest contemporary threats are loss of habitat related to large, stand-replacement fire, improperly managed or unmanaged livestock grazing, sedimentation and reduced instream flows, competition with and predation by non-native species, surface and noise disturbance, and climate change (see also appendix G for additional detail).

Conservation Measures

If projects or activities might affect federally listed species or designated critical habitat, the Forest Service consults with the USDI FWS to mitigate potential impacts to listed species under section 7(a)(2) of the Endangered Species Act. While the consultation requirement does not apply to proposed species or proposed critical habitat, the Forest Service may confer with the USDI FWS. Activities that may negatively affect federally listed species or critical habitat in the short term may still be permitted or authorized; while some individuals of these species may be impacted, the conservation measures agreed upon during the consultation process would maintain species viability and support recovery over the long term. In addition, section 7(a)(1) of the act directs federal agencies to use their authorities to carry out programs for conserving federally listed species. Below are some examples of completed and ongoing conservation measures and program activities the Gila National Forest would continue under the plan alternatives. These examples do not represent an exhaustive list of program activities or conservation measures agreed upon through consultation.

Chiricahua leopard frog

- In partnership with the USDI FWS and Ladder Ranch, a steel rim tank refugia was created to mitigate population losses associated with chytrid fungus.
- Known populations are monitored, including surveys prior to any project decision or implementation.
- Protective measures and best management practices are incorporated into fire management activities to prevent the spread of chytrid fungus and the introduction or spread of non-native species.

Mexican spotted owl

- Surveys are conducted prior to the implementation of projects in Recovery habitat.
- If surveys in Recovery habitat indicate that protected activity centers are to be established, the Forest Service will consult with USDI FWS in establishing them.
- Protected activity centers are monitored to determine occupancy status.
- Survey and monitoring results are provided to USDI FWS annually.

Southwestern willow flycatcher

- Survey and monitoring efforts are ongoing through partnerships with the Rocky Mountain Research Station, Western New Mexico University, with the additional capacity provided by contractors.
- Livestock grazing is excluded along large portions of the San Francisco and Gila Rivers through section 7 consultation.
- Restored riverine wetlands at the Gila River Bird Management Area and closed travel to off-highway vehicle use.

Chihuahua chub

- Annual monitoring and supplemental stocking at occupied sites in partnership with The Nature Conservancy and New Mexico Department of Game and Fish.
- Established livestock grazing management plans that exclude livestock from Mimbres River including the occupied sites and along potentially suitable habitat in McKnight Creek.
- Cooperation with New Mexico Department of Game and Fish and University of New Mexico to collect tissue samples for genetic analysis and individuals for transport to the Southwestern Native Aquatic Resources and Recovery Center to supplement existing brood stock as needed.

- Developed a conservation agreement with the New Mexico State Engineer to allow water rights owned by the Forest Service to act as instream flow for the protection of Chihuahua chub within the Mimbres Valley. The conservation agreement allows additional parties to place water rights into the agreement on an annual basis, and the water is then unavailable for other uses (such as irrigation) for that year.

Gila chub

- Provided funding to Dr. Thomas E Dowling, University of Arizona, to initiate genetic work on the unresolved complex of chubs in the Gila River.
- Partnered with New Mexico Department of Game and Fish to survey and evaluate streams in the San Francisco River Basin of New Mexico for Gila chub presence, and to determine streams for possible repatriation.
- Monitoring known populations, status, and habitat conditions

Gila trout

- In partnership with New Mexico Department of Game and Fish and USDI FWS, efforts to translocate and supplement existing populations, and to preserve genetic diversity and unique lineages are ongoing.
- In partnership with New Mexico Department of Game and Fish and USDI FWS, efforts to remove non-native trout and reestablish populations in suitable Gila trout habitat are ongoing.
- Annual monitoring
- Evacuation of Gila trout in the path of wildfires, which are subsequently transported to Mora National Fish Hatchery for rearing and post-fire release back into the affected streams.

Loach minnow and spikedace

- Partnering annually to complete monitoring within the forest at eight long-term monitoring sites located in loach minnow habitat and five long-term monitoring sites located in spikedace habitat.
- Initiated a 4-year partnership project to determine the efficiency of physical non-native fish removal and effects on native and non-native fish communities in a 3-mile reach of the West Fork Gila River.
- Partnered with New Mexico Department of Game and Fish, Arizona Game and Fish Department, and USDI FWS to collect individuals from the main stem Gila River for captive breeding at the Bubbling Ponds Hatchery.

Mexican gray wolf

- Efforts to improve shared understanding of the Mexican wolf reintroduction program, roles and responsibilities, proactive management measures and logical support to the interagency field team are ongoing.
- Logistical, communication and coordination support efforts to improve the annual count and capture are ongoing.
- Reducing the potential for wolf and livestock conflicts in cooperation with grazing permittees by identifying and implementing adaptive management actions on allotments where wolves are denning.
- Ongoing efforts to find funding for range riders on active grazing allotments where there are conflicts with wolves.

- Coordination with the interagency field team on all fire incidents to avoid impacts to denning or rendezvous sites when practicable.

New Mexico meadow jumping mouse

- Ongoing survey work.
- Efforts to maintain or improve habitat are ongoing, in partnership with USDI FWS, New Mexico Department of Game and Fish, and others.

Regional Forester's Sensitive Species

All five alternatives would use mechanical vegetation treatment and wildfire to varying degrees to manage all upland ERUs, and mechanical vegetation treatment or structural improvement to manage riparian and water resources (such as aquatics, riparian ERUs) to improve ecological condition, abundance, and distribution for species that depend on those vegetation communities. Depending on the alternative, the acreage difference varies as well as the ERUs in which the activities would take place. These systems have varying departure ratings (low to high) from reference conditions. Any of these activities has the potential to modify habitat and create a disturbance for Regional Forester Sensitive Species, but all activities in the alternatives are intended to move ecological conditions closer to desired conditions. This would improve the ecological conditions for sensitive species increasing resilience of ERUs to uncharacteristic disturbances and improving the likelihood of long-term persistence. All action alternatives include plan direction designed to maintain the diversity of plant and animal communities and support persistence of native species within the plan area, subject to Forest Service authority and the inherent capability of the plan area. Current science demonstrates the positive benefits that forest fuel-reduction treatments can have in terms of improving resiliency in frequent fire-adapted systems of the West and Southwest (Stephens et al. 2012).

Migratory Birds

Migratory birds are ubiquitous and use numerous habitat types across a range of elevations. Restoration of many vegetation types at various elevations would benefit habitat for migratory bird species, especially in cases where restoration focuses on moving the vegetation toward desired conditions that would improve resilience to wildfire and changing climate conditions, protect and restore riparian and watershed conditions, and control or eradicate invasive species. The plan revision process addressed the needs of migratory birds by considering the habitat upon which these birds depend during the development of plan components for the action alternatives.

Bald and Golden Eagles

Under all alternatives, there would be no programmatic take under the Bald and Golden Eagle Protection Act. Golden eagle nest on cliffs and snags near open areas but have not been documented nesting within the Gila NF. Cliffs and rock features are widespread microsites within all vegetation communities in the plan area. These ecological conditions are inherently stable for long periods of time because they are changed primarily by geologic forces. Bald eagle use in the forest is mostly for foraging and migration and winter use although there has been a pair documented nesting near Quemado Lake. The plan revision process addressed the needs of eagles by considering the habitat upon which these birds depend during the development of plan components for the action alternatives.

Effects of Alternative 1

Alternative 1 is the no-action alternative that would continue managing under the 1986 forest plan including all associated amendments. The 1986 plan lacks detailed desired conditions for most resources and uses. It is generally more prescriptive in terms of providing constraints on activities and projects but mostly silent about what management was to achieve. This would make it difficult to ensure projects are implemented in a consistent manner and that projects are moving toward a common set of desired conditions and long-term goals. Because the current forest plan did not use a coarse-filter, fine-filter approach to ensure the plan provided for the persistence of species (a key tenet of the species diversity requirements under the 2012 rule), alternative 1 would be largely limited to plan direction from the 1996 Amendment, and best management practices and site-specific mitigations done at the project level.

Vegetation Treatments

While there are no specific vegetation objectives in the 1986 plan, ongoing management and activities would continue with treatment emphasis on restoring Ponderosa Pine Forest, Ponderosa Pine-Evergreen Oak and Pinyon Juniper Woodland ERUs. Alternative 1 would continue to maintain current rates of planned and unplanned natural ignition and mechanical vegetation treatment, which would make some progress toward the desired conditions for vegetation, but at a slower rate than most of the action alternatives. Mixed Conifer with Aspen would move closer to desired conditions at a faster rate than other action alternatives, improving to a low departure rating of 30 percent from moderately departed 40 percent under this alternative desired condition after 10 to 15 years. This is likely because there is very little treatment in this ERU and the larger, more closed forest conditions would improve toward desired conditions. None of the other ERUs change departure ratings and remain relatively stable with slight changes in departure percentages. This would be a slight overall improvement from current conditions, but the total number of acres treated by mechanical thinning, prescribed fires, and naturally ignited fire would not be enough to mitigate the risk of large, continuous extents of high-severity fire or post-fire watershed effects in upland and riparian ERUs.

The only two upland ERUs that would be expected to trend toward, achieve, or maintain desired conditions for most key ecological characteristics are Spruce-Fir Forest and Mountain Mahogany Mixed Shrubland (see Upland Vegetation, Fire Ecology and Fuels or the Summary of Environmental Consequences section for more information). Therefore, alternative 1 does the least to address threats to most at-risk species as compared with other alternatives.

Livestock Grazing

Because the 1986 plan lacks detailed desired conditions for most resources and uses, it would be more difficult to identify unsustainable management and make adjustments. The 1986 plan also does not provide specific direction on management of vacant allotments. The status and use of vacant allotments has been and would continue to be determined on a case-by-case basis within the existing regulatory and policy framework. This makes the availability of vacant allotments to provide for flexibility during times of drought, fire, or wildlife conflict a matter of happenstance, which may not adequately support adaptive management into the future.

Climate Change

Further, the 1986 plan does not reflect current scientific understanding or explicitly incorporated current management issues like climate change into the framework it provides. While constraints can still help keep management on the path toward desired conditions, more flexibility is needed to incorporate the quickly evolving science of climate adaptation. Still, the vegetation treatments that would occur under alternative 1 would generally support the Resilience-Transition end of the climate adaptation spectrum (see analysis methodology subsection Climate Adaptation and Impacts), based on the Upland Vegetation, Fire Ecology and Fuels analysis (see also Summary of Environmental Consequences section).

Riparian Areas

The 1986 plan lacks detailed desired conditions for riparian and aquatic ecosystems. Instead, it relies on a standard that requires preferential consideration be given to these ecosystems and their dependent resources. Preferential consideration is determined by a proper functioning condition class or a trend toward it. As a plan standard, this direction fails to address situations where a trend is not apparent. Such a situation might occur if a riparian area in proper functioning condition become functioning at risk, or impaired function after a fire and post-fire flooding and debris flow events, but that is a changed condition and not a trend.

Under the 1986 plan, forest staff and partners would continue following guidance for the removal of non-native invasive aquatic species on a site-specific basis. Measures that prevent the spread of chytrid fungus would be implemented for the Chiricahua leopard frog and other amphibians that occur in different drainages and watersheds. Additionally, the 1986 plan, as amended, contains the following requirements:

> Manage riparian areas to protect the productivity and diversity of riparian dependent resources by requiring actions within or affecting riparian areas to protect, and where applicable, improve dependent resources. Give preferential consideration to resources dependent on riparian areas over other resources. Other resource uses and activities may occur to the extent that they support or do not adversely affect riparian-dependent resources. Improve riparian ecosystems in unsatisfactory condition to satisfactory condition. Maintain riparian ecosystems currently in satisfactory condition.

Management Areas

Alternative 1 would recommend no new areas for wilderness designation nor propose any areas to become botanical areas but it does include four proposals from the original plan for research natural area designation totaling 1,878 acres (Largo Mesa, Agua Fria, Turkey Creek, and Rabbit Trap). Research natural areas are established for the primary purposes of non-manipulative research, observation and study, education, and the maintenance of biological diversity. A research natural area designation for these areas would not substantially affect the diversity of plants and animals, or the persistence of at-risk species in the plan area because of their current condition, small area, location, or a combination of these factors (see appendix J for more information).

Federally Listed Species

The 1986 Gila National Forest Land and Resource Management Plan, as amended, includes numerous requirements related to the evaluation and protection of federally listed species that were evaluated in the Biological Assessment for the Continued Implementation of the Land and Resource Management Plans for the Eleven National Forests and National Grasslands of the Southwestern Region (USDA FS 2011), subsequent Land and Resource Management Plan re-initiation of consultation for new species listings (western yellow-billed cuckoo, northern Mexican gartersnake, and narrow-headed gartersnake; USDA FS 2015a), and the resulting 2012 Programmatic Biological Opinion (USDI FWS 2012c). According to the 2012 biological opinion, the 1986 forest plan, as amended, would not appreciably impact federally listed species in the forest or their critical habitat. The 2012 biological opinion also found that forest management actions, standards, and guidelines may have short- and long-term benefits to federally listed species including but not limited to increasing the sustainability and resiliency of federally listed species habitat and improving riparian habitat conditions for species that use riparian areas. The 2012 biological opinion concurred with the Forest Service determination that the continued implementation of the 1986 plan, as amended, would not likely jeopardize the continued existence of federally listed species and would not likely destroy or adversely modify critical habitat.

The reintroduced population of Mexican gray wolves in the Blue Range Wilderness Recovery Area has been designated as an experimental, nonessential population. By definition, a nonessential experimental population is not essential to the continued existence of the species. Therefore, no proposed action impacting the experimental, nonessential population designated under the Endangered Species Act section 10(j) could lead to a jeopardy determination for the entire species. Additionally, the forest coordinates with the Wolf Recovery Team to ensure any activities occurring on National Forest System lands minimize any impacts to wolf breeding and denning activities. In 2011, the Forest Service submitted a biological assessment to the USDI FWS, which determined that the continued implementation of the Gila forest plan is not likely to jeopardize the continued existence of the Mexican gray wolf.

The 2012 biological opinion concurred with the Forest Service determination that the continued implementation of the standards and guidelines within the Gila NF forest plan is not likely to jeopardize the continued existence of the section 10(j) nonessential, experimental population for the following reasons:

1. Overall, the Gila NF forest plan is generally positive for the long-term conservation and recovery of the experimental population due to land acquisitions for threatened and endangered species; a focus on watershed restoration; management of threatened and endangered species habitat prioritized over other species; standards for reintroduction of threatened and endangered species; management directed at de-listing threatened and endangered species; planning emphasis on threatened and endangered species; management for indigenous species; and maintenance of threatened and endangered species habitats forestwide in Management Areas 2A, 2B, 2C, 3D, 4A, 5B, and 5C.
2. The 1996 amendment to the plan is neutral toward the long-term conservation and recovery of the Mexican gray wolf.
3. By definition, a nonessential experimental population is not essential to the continued existence of the species; therefore, no proposed action impacting the experimental, nonessential population so designated under the endangered Species Act section 10(j) could lead to a jeopardy determination for the entire species.

The 1986 plan, as amended, also contains management direction to manage for a diverse, well-distributed pattern of habitats for wildlife populations in cooperation with state and other agencies as well as objectives for habitat improvement projects. These plan components would generally benefit federally listed species, as well as other common and uncommon species.

Species of Conservation Concern and Regional Forester Sensitive Species

While the 1986 plan did not use species of conservation concern as a planning tool, conservation measures would be incorporated at the project or activity level for regional forester sensitive species and other species of concern based on technical guidance documents, best management practices, and as identified in the project biological evaluation.

There are no specific plan components that are geared toward species-specific (fine-filter) wildlife, plant, and aquatic ecological condition such as guidance for rare endemic species, protections for cave-dwelling mammals like bats, and measures that prevent the spread of certain invasive species including wildlife diseases (such as white nose syndrome, chytrid fungus) and predators (such as the bull frog), there are guidance documents, best management practices, and project-level design features that currently address these management issues.

- For state endangered species: identify forest portions of recovery objectives in conjunction with the New Mexico Department of Game and Fish. Refine habitat requirements and identify specific habitat projects needed to achieve recovery objectives for individual species habitats. Accomplish recovery projects included in approved recovery plans. Projects will be coordinated through integrated forest management practices. Consult with the New Mexico Department of Game and Fish on forest projects that may affect state endangered wildlife species.
- Integrate specific wildlife habitat needs with timber and fuelwood harvest projects, livestock grazing plans, and other management activities with habitat interactions.

Effects Common to All Action Alternatives

The action alternatives 2 through 5 are more integrated and strategic in nature than the 1986 Gila Forest Plan (alternative 1). All action alternatives include desired conditions that were developed using the coarse- and fine-filter approach specified in the 2012 Planning Rule. This process developed plan components to support native wildlife species, and specifically federally listed species and species of conservation concern (see appendix G).

All action alternatives include plan direction designed to maintain the diversity of plant and wildlife communities and support the persistence of native species within the plan area, subject to the extent of Forest Service authority and the inherent capability of the plan. All action alternatives include desired conditions that would support and enhance habitat quality, distribution, abundance, and connectivity for self-sustaining populations of all native and desirable non-native plant and animal species that are healthy, well distributed, and genetically diverse, including at-risk, rare, and endemic species (for example, Wildlife, Fish, and Plants desired conditions 1–3). Desired conditions would provide for life history requirements, predator-prey interactions, and natural population fluctuations of all species within the capability of the landscape (for example, Wildlife, Fish, and Plants desired condition 5). Additionally, the action alternatives also make better use of partnerships and collaboration to maintain ecosystem integrity and resilience.

Vegetation

All action alternatives include desired conditions for vegetation communities, which include important habitat features for cover, nesting, roosting, hibernation, and other life cycle requirements for common and uncommon species. This includes old and large trees, a diversity of tree and shrub species, canopy layers and age classes, a range of tree densities and openings, snags, downed logs, herbaceous vegetation, and ground cover, consistent with the existing scientific information available for each ERU. Ecosystem-based (coarse-filter) plan components such as desired conditions for upland ERUs apply across all action alternatives. These desired conditions would benefit most species that depend on upland ERUs because they direct management toward maintaining or restoring vegetation community structure, composition, and function at multiple scales, including reduction in the risk of large stand-replacement type fires. Desired conditions incorporate varying structural stages, including uneven-aged forest with openings, occasional even-aged structure, old, young, and mid-aged trees, large snags, coarse woody debris, litter, grasses, and forbs. Where Gambel oak and other hardwoods occur as a component in conifer forest, desired conditions would promote appropriate canopy cover and moister site conditions for small mammals, plants, and insects. Each forest and woodland type ERU have desired conditions that would require projects to maintain sufficient levels of woody debris, such as desired condition 5 in both the Mixed Conifer-Frequent Fire and Ponderosa Pine Forest mid-scale desired conditions. These desired conditions were designed to provide the full range of life stage needs for all species as well as conditions that would support an adequate prey base.

All action alternatives contain objectives for management activities to make progress toward desired conditions for vegetation communities. While the action alternatives include plan components to reduce or mitigate soil loss, erosion, and sedimentation that can occur from ground-disturbing activities and wildland fire associated with the objectives, the effects would vary between alternatives and are discussed in the effects subsections for each action alternative.

Plan components that support resilient and resistant ecosystems and watersheds, would protect species from the negative effects of climate change and would give wildlife species the best opportunity to adapt to changing conditions. These plan components would be beneficial for all wildlife, plant, and aquatic species but especially those species that depend on riparian systems, aquatic systems, endemic species or species with restricted distributions, and species that move across large landscapes and use habitat at multiple spatial scales.

The action alternatives include a Wildlife, Fish, and Plants desired condition that addresses flowering plants and pollinators. This plan component, in conjunction with the desired conditions and objectives for upland ERUs and desired conditions for riparian vegetation communities (for example Riparian and Aquatic Ecosystems 4th and 5th level watershed scale desired conditions 4 and 5, and 6th level watershed scale DC 8e), would maintain or enhance foraging habitat for pollinators, including the nitocris fritillary butterfly, western bumblebee, and the monarch butterfly. This would include promoting a diverse mix of native grasses, wildflowers, cactus, shrubs, and trees across multiple vegetation communities and developmental stages.

Livestock Grazing

All action alternatives include a standard or a guideline that would require all new livestock handling facilities such as corrals, traps, and water developments be constructed outside riparian management zones and occupied sites of at-risk plant species; buffer distances would be determined on a case-by-case basis in coordination with the permittee to address the site and species-specific issues and management needs (Livestock Grazing standard 3; guideline 3). These types of facilities concentrate use and cause surface disturbance, which can negatively impact habitat quality, species movements and cause direct mortality of individuals or populations of at-risk plants depending on the site. This direction would maintain or enhance habitat, support species movements, and contribute to persistence of at-risk species.

All action alternatives include a standard or guideline that would require new and reconstructed livestock water developments to provide access and escape considerations for wildlife (Livestock Grazing Standard 2). This direction could improve habitat connectivity for some species and would reduce mortality for those species that are susceptible to entrapment. All action alternatives have standards or guidelines for mineral placement, including distance from water, like that for handling facilities (Livestock Grazing guidelines 4 and 5).

To reduce the impact of rangeland fences on wildlife, all action alternatives have plan components that direct the Forest Service to design fences to prevent wildlife entrapment and allow wildlife passage, except where specifically intended to exclude wildlife or to protect human health or safety (Livestock Grazing standard 2).

All alternatives contain a standard or a guideline requiring prescribed fire implementation to include interdisciplinary evaluations of range readiness, in coordination with the livestock grazing permittee (Livestock Grazing guideline 6). This approach to prescribed fire implementation would promote achievement and maintenance of integrated desired conditions for the ecological conditions that support native biodiversity, fire and fuels management, and livestock grazing as a use of the forest.

Herbicide Use

As a standard across all action alternatives, aerial application of herbicides would be prohibited (Non-native Invasive Species standard 12). Another standard for herbicides would only allow them to be authorized on native species where they are deemed necessary to move toward desired conditions for vegetation communities or the urban interface (All Upland ERUs standard 5). Depending on climate change vulnerability of vegetation communities and needs of at-risk species, the Forest Service would determine the appropriateness of herbicide use on native regeneration such as resprouting juniper trees after vegetation treatments at the project level.

Road System

All action alternatives include an objective for road decommissioning and describe the criteria that would generally be used to prioritize unneeded roads for decommissioning in an accompanying management approach (Roads objective 1). This would support movement toward the alternative’s desired conditions for habitat connectivity, soil and watershed conditions, and riparian and aquatic habitat conditions, benefiting many common, uncommon, and at-risk species. The action alternatives include guidelines that would establish a minimum buffer zone for riparian management areas when project activities include the construction or realignment of motorized routes, recreation sites and other infrastructure (Roads guideline 3). While the minimum buffer zone varies between alternatives, the effects to species would not be substantially different as buffer zones would be designed at a site-specific level to move toward desired conditions, benefitting many common, uncommon, and at-risk species that depend on riparian and aquatic ecosystems.

All action alternatives also require the construction and maintenance of roads to include design features that accommodate terrestrial and aquatic species movement and habitat connectivity (Roads guideline 2). This could include aquatic organism passage design features where roads cross drainages or escape features in cattle guards for small animals. Although recent forest-cover weighted human modification modeling indicates most of the Gila National Forest provides high terrestrial connectivity (Belote et al. 2020)[28] indicating that the forest's road system generally does not impede species movements, there are problem areas adjacent to and within the forest along state highways (Cramer et al. 2022). While the Forest Service does not have jurisdiction, leadership and staff would work with the appropriate state agencies to help address the issue within Forest Service authorities and capacity (Wildlife, Fish, and Plants management approach Wildlife Corridor Action Plan). If localized problem areas along National Forest System roads within the forest are identified in the future, this guideline provides the flexibility to assess the site- and species-appropriate accommodation with tools such as Forest Service Wildlife Crossings Toolkit.[29]

Allowable Group Size

While the effects to wildlife, fish, and plants are not expected to be substantially different between the alternatives with regard to allowable group sizes in wilderness areas and forestwide length of stay limits, the action alternatives that do contain plan components for group size and length of stay limits would better maintain desired conditions for recreation opportunities and address future threats to species persistence if visitation does substantially increase.

Invasive Species

Alternatives 2, 3, 4, and 5 better recognize and address the negative effects non-native invasive species and disease can have on ecosystem integrity and biological diversity. Direction for invasive species was updated and expanded to recognize the threats to ecosystem resilience from all non-native invasive aquatic and terrestrial plants and animals likely to cause harm to ecosystems.

The action alternatives better recognize and address the potential negative effects of non-native invasive species and disease agents with desired conditions for native plant and animal communities and objectives for addressing noxious weeds and non-native invasive aquatic species (Non-native Invasive Species objectives and Wildlife, Fish, and Plants objectives 3 and 4). The action alternatives specifically include standards and guidelines to address known threats to species (Non-native Invasive Species S1), including bats as previously described, and bighorn sheep (Livestock Grazing S4 and Sustainable Recreation S5), Maintaining plant communities dominated by native species maintains existing ecological structures and functions, which aligns with the Resistance end of the climate adaptation spectrum.

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[28] This data can be viewed on the Forest Service Climate Risk Viewer at https://storymaps.arcgis.com/collections/87744e6b06c74e82916b9b11da218d28).
[29] https://www.fs.usda.gov/wildlifecrossings/index.php.

Climate Change

The action alternatives specifically address climate change and support the full spectrum of adaptation options, although the treatment objectives for vegetation communities would generally lead toward the Resilience-Transition end of the spectrum (see Summary of Effects section toward the end of chapter 3). the monitoring program incorporated into the action alternatives.

The action alternatives include a monitoring plan designed to support adaptive management and better inform the effects and effectiveness of management and progress toward desired conditions that would inform management of trends in key ecosystem characteristics across landscape and enable management to adjust as needed to maintain species viability. Adaptive management would be essential to effectively manage for climate change and associated impacts from disturbance events and invasive species in changing and uncertain conditions.

All action alternatives would include a desired condition for a climate-resilient transportation network. To move toward this desired condition, a vulnerability assessment would be the first step, allowing managers to make risk-based, climate-informed decisions about the transportation system (Rasmussen et al. 2018). A vulnerability assessment that included an analysis of wildfire risk, sediment potential, and other values at risk, such as streams supporting at-risk species, would also support maintenance and movement toward desired conditions for soil and watershed resources, riparian and aquatic ecosystems, and wildlife, fish and plant species.

Finally, climate change may push at-risk species, particularly those that are rare or endemic, to the limits of their range and evolutionary capacity. This is expected to be especially significant in the Southwest, an area already affected by long-term drought. The action alternatives recognize and include plan components to help address that threat and to reduce the risk of loss of ecological conditions important for federally listed species.

Federally Listed Species

All four action alternatives incorporate the most recent approved USDI FWS recovery plans for federally listed species by reference, which would allow them to adapt to new information, changes in status and updated guidance as recovery plans are updated over time (Wildlife, Fish, and Plants standard 4). This is a key difference compared to alternative 1, which repeats the provisions outlined in the original recovery plans that are now outdated.

Mexican spotted owl

Key Ecological Conditions: Mixed coniferous and pine-oak forests, canyons, desert caves, cliff faces, and riparian areas. Forested habitat is typically uneven-aged, multi-storied, and has high canopy closure.

Key Threats: Habitat alteration and destruction due to high-intensity, landscape-scale wildland fire and long-term drought and habitat changes resulting from climate change.

Mexican spotted owls would benefit primarily from plan components that move moderately to highly departed ERUs required for nesting and roosting (PPF, MCD, and MCW) toward desired conditions. The objectives and effects differ across the action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies across alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative in their respective vegetation sections. Mexican spotted owls need diverse forest structure, old-growth components, and are dependent on large trees, coarse woody debris, snags, and tree-related components for roosting, foraging, and nesting. Downed, woody material and logs provide important ecological condition for small mammalian prey species. In addition to the components described above, Mexican spotted owls would also benefit from a number of ecosystem-level plan components, which would protect these key ecological conditions.

Coarse-filter plan components that would benefit Mexican spotted owls that depend on Forested Ecosystems include desired conditions for PPF, MCD, and MCW ERUs to maintain appropriate structure, composition, and function at the landscape-, mid-, and fine-scales while reducing fire risk through vegetation management and fuels reduction projects. Desired conditions that incorporate varying structural stages, including uneven-aged forest with openings and occasional even-aged structure with large snags and abundant understory (such as coarse woody debris and logs), and old-growth components would guide the implementation of forest management activities that would move these ERUs toward a more favorable departure and trend from that which currently exists. Structural departure from desired conditions tend to equate to departure of the fire regime for these vegetative ERUs. Restoring structure of these ERUs would also contribute to restoring natural fire regimes and reduce the risk of large extents of high-severity fire and associated effects. The full range of life stage needs for Mexican spotted owls (fledgling, nesting, dispersal, roosting), as well as conditions that would support an adequate prey base for foraging are provided for in the desired conditions at all scales. There are also coarse-filter plan components to maintain appropriate levels of old trees, snags, nesting structures (such as witches brooms), and downed wood at multiple spatial scales for Mexican spotted owls. (See all desired conditions for all scales for PPF, MCD, and MCW ERUs.)

Where Gambel oak and other hardwoods occur as a component in conifer forest, desired conditions (All Upland ERUs – DC 1, 2, 6, and 8, GL 1 and 2, MCW, MCD, and PPF – DC 1, and PPF DC 3) would promote their retention during project design to promote canopy cover and moister site conditions for small mammals, plants, and insects.

Desired conditions mentioned above, plus additional coarse-filter plan components under the Wildland Fire and Fuels Management resource area promote endemic levels of disturbance, natural fire regimes, and restoration activities that would allow all forested ERUs to be resilient in the face of climate change, drought, and other disturbance. These include (DC 2 and 5, and GL 1). These desired conditions and guidelines would also protect or enhance Mexican spotted owl habitat, including critical habitat from wildland fire and fuels management activities.

Current silvicultural treatments are no longer considered threats to Mexican spotted owls as they are planned and implemented to modify forest structure to promote Mexican spotted owl habitat. There may be short-term impacts due to disturbance but that does not contribute to habitat loss. The Timber, Forest, and Botanical Products resource area would ensure that silvicultural treatments are used as a restoration tool and desired conditions for this resource (DC 1a-c) would ensure these types of activities are done in a way that enhances Mexican spotted owl ecological condition requirements. Desired conditions mentioned previously for vegetation ERUs would also contribute toward improving Mexican spotted owl habitat, particularly with regard to snags and dying trees (MCW Landscape DC 3 and 4, Mid-scale DC 3 and 4, MCD Landscape DC 3 and 4, Mid-scale DC 4 and 5, and PPF Landscape DC 4 and 5, and Mid-scale DC 4and 5).

Chiricahua leopard frog, narrow-headed garter snake, and Northern Mexican garter snake

<u>Key Ecological Conditions:</u> Variety of structure and cover, emergent or submergent vegetation, abundant riparian vegetation, overhanging banks, rocky streams, and permanent water.

<u>Key Threats:</u> Disease, particularly chytrid fungus, reduced water sources, predation and competition by non-native aquatic species, altered hydrologic functions, water diversions (none planned by the Gila NF), and decline of native fish.

Plan components would minimize impacts of activities in riparian areas. Standards and guidelines for livestock grazing (Livestock standard 1 and guidelines 2 and 4) describe project-specific best management practices, annual operating instructions, and optimal mineral or vitamin supplement placement. Sustainable Recreation guideline 5 would issue temporary closure orders or rehabilitation to minimize impacts to special status species in riparian management zones. Roads guideline 2 provides for construction and maintenance of roads that accommodate species movement and habitat connectivity.

Federally listed amphibians and reptiles would benefit from improved and functioning riparian systems. Riparian and Aquatic Ecosystems 6th Level Watershed Scale desired condition 3 provides an important fine filter for the Chiricahua leopard frog (floodplain and streambank conditions that support burrowing) and the narrow-headed gartersnake (well-lit floodplain sections of rocky stream corridors). Plan components for Wildlife, Fish, and Plants also provide for the ecological conditions these species require, including prey abundance and predator-prey interactions. Wildlife, Fish, and Plants desired condition 4 ensures that locations of rare species and their habitat requirements abundance, threats and responses to management are known, providing for species persistence.

The plan components would help maintain primary constituent elements for critical habitat for Chiricahua leopard frogs by protecting and enhancing aquatic breeding sites. Plan components also support primary constituent elements for narrow-headed gartersnakes, such as maintaining a prey base and habitat connectivity. For northern Mexico gartersnakes, plan components support habitat conditions for controlling non-native species, which cause predation and competition.

Threats posed by direct predation by or competition with non-native aquatic species are addressed by Non-native Invasive Species desired condition 1 and guideline 12, objectives for Non-native Invasive Species and Wildlife, Fish and Plants, as well as desired conditions for native biodiversity in the All Upland Ecological Response Unit and Wildlife, Fish, and Plants sections of the plan. These plan components, and those providing for the ecological conditions necessary to support native fish, also address the threat of losing the native fish populations, which are the primary prey of the narrow-headed gartersnake.

Multiple plan components address the threats posed by disease agents such as chytrid fungus, including Non-native Invasive Species standard 1, Riparian and Aquatic Ecosystems standard 2, Wildland Fire and Fuels Management desired condition 9, and Wildlife, Fish, and Plants guideline 9. Most importantly, and as mentioned in the Biological Opinion (dated September 14, 2022), the plan proposes to: “Implement at least 20 activities that contribute to the recovery of federally listed species of each 10-year period.” This objective would help address the site-specific needs and make progress toward desired conditions.

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

Key Ecological Conditions: For the southwestern willow flycatcher and western yellow-billed cuckoo, riparian and wetland thickets generally of willow, tamarisk, or both, sometimes boxelder or Russian olive. The New Mexico meadow jumping mouse habitat requirements are characterized by tall (averaging at least 61 centimeters (24 inches)), dense riparian herbaceous vegetation (plants with no woody tissue) primarily composed of sedges (plants in the Cyperaceae Family that superficially resemble grasses but usually have triangular stems) and forbs (broad-leafed herbaceous plants) adjacent to seasonally available or perennial flowing water and adjacent uplands that can support the vegetation characteristics needed for foraging, breeding, and hibernating.

Key Threats: For the southwestern willow flycatcher and western yellow-billed cuckoo, loss of riparian habitat from floods, uncharacteristic fire, nest parasitism, agriculture (not on National Forest System lands), water diversions (none planned by the Gila NF), and non-native plant invasion, particularly tamarisk. New Mexico meadow jumping mouse threats include water shortages, excessive grazing, or wildfire and post-fire flooding.

Riparian habitat includes wetlands and forested riparian (willow, cottonwood, and sycamore) areas surrounding seeps and springs, perennial streams, lakes, and other water features. According to the Gila NF Final Assessment (2017), riparian habitat occupies a very small portion of the forest and riparian conditions range from low to moderate departure, so maintaining the low departure riparian systems while improving the moderately departed riparian systems would likely improve ecological conditions for these species. These species would benefit from plan components that maintain or improve riparian and aquatic conditions toward reference conditions. All action alternatives would maintain riparian management zones in, or trending toward proper functioning condition (or equivalent condition class). No new construction or realignment of roads and motorized routes, recreation sites or other infrastructure should be located within the 100-year floodplain, or within 300 feet of a riparian management zone for alternatives 2, 3, and 4, and 500 feet of a riparian management zone containing perennial streams or native trout populations in alternative 5. Also, improving conditions in the upland systems would further improve ecological conditions across the landscape, and minimize impacts to riparian systems from disturbances in the uplands.

Coarse-filter plan components that would benefit the species that depend on these vegetation communities can be found under the Watershed, Water Quality, Riparian and Aquatic Ecosystems, All Upland ERUs, Non-native Invasive Species, and Wildlife, Fish, and Plants plan sections of the action alternatives. Additional plan components, which balance multiple use with wildlife needs, can be found under the Wildland Fire and Fuels Management; Water Uses; Livestock Grazing; Timber, Forest, and Botanical Products; Roads; Minerals; and Dispersed Recreation sections.

Plan components within all the above-mentioned resource sections would help to move these systems toward proper functioning condition (such as Riparian and Aquatic Ecosystems Watershed Scale DC3, Fine Scale DC1) while balancing multiple uses with ecological integrity (Livestock Grazing GL1) to avoid excessive grazing impacts. This would provide the key ecological conditions needed for the species life functions. These components would help to minimize water diversions and improve hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances, such as fire (Livestock Grazing GL4). There are also standards and guidelines within several sections (Watershed STD1, Livestock Grazing STD1) that would ensure that best management practices are applied to every site-specific project that has the potential to affect watershed conditions such as erosion and flooding effects due to wildfires. Several standards and guidelines would mitigate adverse effects from road construction or reconstruction (Roads DC4, GL1-4), which can cause sedimentation, and would rehabilitate in-stream structures (Wildlife, Fish, and Plants DC9), which could improve hydrologic function.

Desired conditions and standards within the Timber, Forest, and Botanical Products section (DC1, STDs 1, 3, 5) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion and sedimentation during timber harvest operations. Plan components for Livestock Grazing (DC 3 and 4, STDs 1 and 3, GL 1, 2, 4, and 5), Riparian and Aquatic Ecosystems (Watershed Scale DC1 and 3, Fine Scale DC1 and 2, STDs 1 and 2), Water Uses (DC1), and Roads (DC 4 and 5, GL 1, 3, and 4) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities, including in wetland and riparian management zones. Many of these same plan components would also protect riparian areas from streambed and floodplain alteration and would minimize disturbance (such as water flow and sedimentation) from the construction of roads and energy corridors by including mitigations to limit disturbance during project-level design.

Chihuahua chub, Gila chub, Gila trout, loach minnow, and spikedace

<u>Key Ecological Conditions</u>: Chihuahua chub and Gila chub require deeper waters, especially pools, or remaining near cover including terrestrial, overhanging vegetation, boulders, large woody debris, exposed

root masses of trees at water's edge, fallen logs, undercut banks, streams having relatively natural flow regimes, and a predominance of native species. Loach minnow and spikedace need streams with flow conditions that maintain diverse shallow water habitats with loose substrates.

Key Threats: Changes in flow regimes and stream characteristics from uncharacteristic fire in the uplands, agricultural (not on National Forest System lands), water diversions (none planned by the Gila NF), and competition, predation, or hybridization by non-native aquatic species.

Aquatic habitats these species use would benefit primarily from some of the same plan components that go toward improving riparian habitat. Additionally, plan components that improve upland conditions would benefit aquatic habitats by reducing the amount of sedimentation after disturbances and maintaining or improving hydrologic flows.

Riparian habitat includes wetlands and forested riparian (willow, cottonwood, and sycamore) areas surrounding seeps/springs, perennial streams, lakes, and other water features. According to the Gila NF Final Assessment (USDA FS 2017a), riparian habitat occupies a very small portion of the forest and riparian conditions range from low to moderate departure, so maintaining the low departure riparian systems while improving the moderately departed riparian systems would likely improve ecological conditions. These species would benefit from plan components that maintain or improve riparian and aquatic conditions toward reference conditions. All action alternatives would maintain riparian management zones in, or trending toward proper functioning condition (or equivalent condition class). No new construction or realignment of roads and motorized routes, recreation sites or other infrastructure should be located within the 100-year floodplain, or within 300 feet of a riparian management zone for alternatives 2, 3, and 4, and 500 feet of a riparian management zone containing perennial streams or native trout populations in alternative 5. Also, improving conditions in the upland systems would further improve ecological conditions across the landscape, and minimize impacts to aquatic systems from disturbances in the uplands.

Plan components that would benefit the species that depend on aquatic systems that are surrounded by these vegetation communities can be found under the Watershed; Water Quality; Riparian and Aquatic Ecosystems; All Upland ERUs; Non-native Invasive Species; and Wildlife, Fish, and Plants plan sections of the action alternatives. Additional plan components, which balance multiple use with wildlife needs, can be found under the Wildland Fire and Fuels Management; Water Uses; Livestock Grazing; Timber, Forest, and Botanical Products; Roads; Minerals; and Dispersed Recreation sections.

Plan components within all of the above-mentioned resource sections would help to move these systems toward proper functioning condition (Riparian and Aquatic Ecosystems Watershed Scale DC3, Fine Scale DC1), while balancing multiple uses with ecological integrity (Livestock Grazing GL1) to avoid excessive grazing impacts. This would provide the key ecological conditions needed for the species life functions. These components would help to minimize water diversions and improve hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances, such as fire (Livestock Grazing GL4). There are also standards and guidelines within several sections (Watershed STD1, Livestock Grazing STD1) that would ensure that best management practices are applied to every site-specific project that has the potential to affect watershed conditions such as erosion and flooding effects due to wildfires. Several standards and guidelines would mitigate adverse effects from road construction or reconstruction (Roads DC4, GL1-4), which can cause sedimentation, and would also rehabilitate in-stream structures (Wildlife, Fish, and Plants DC9), which could improve hydrologic function.

Desired conditions and standards within the Timber, Forest, and Botanical Products (DC1, STDs 1, 3, 5) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion and sedimentation during timber harvest operations. Plan components for

Livestock Grazing (DC 3 and 4, STDs 1 and 3, GL 1, 2, 4, and 5), Riparian and Aquatic Ecosystems (Watershed Scale DC1 and 3, Fine Scale DC1 and 2, STDs 1 and 2), Water Uses (DC1), and Roads (DC 4 and 5, GL 1, 3, and 4) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities, including in wetland and riparian management zones. Many of these same plan components would also protect riparian areas from streambed and floodplain alteration, and would minimize disturbance (such as water flow and sedimentation) from the construction of roads and energy corridors by including mitigations to limit disturbance during project-level design.

For species that use any of the Upland ERUs, Riparian (wetlands and Forested Riparian), and aquatic systems (see table 39 and table 40), the primary contemporary threats are loss of habitat related to large stand-replacing wildfire and its associated increased runoff and sedimentation that could affect riparian and aquatic habitat, and potentially reduce instream flow. All alternatives would move ecological condition for these species toward desired conditions, but would vary in magnitude, intensity, and location of treatments. There could be some localized impacts to these species, but overall, species would continue to persist. Beneficial impacts include improvement in potentially suitable ecological condition in Upland Vegetation ERUs, Riparian, and Aquatic systems by increasing the amount of habitat in the desired seral states or proper functioning condition for breeding, roosting, and foraging. Objectives to treat acres in these departed systems would move those systems toward a vegetative or aquatic state to which these species have adapted.

There could be some localized short-term adverse impacts to federally listed species and their critical habitat, but overall, actions would result in long-term beneficial effects. All action alternatives have the plan components that provide the ecological conditions necessary to contribute to recovery of federally listed threatened and endangered species and conserve candidate species.

Species of Conservation Concern

Ecological conditions and threats for species of conservation concern were addressed through plan development using the coarse-filter/fine-filter process. As a result, the action alternatives provide guidance for persistence of species of conservation concern in the plan area. For species-specific or guild-specific plan components, see appendix G.

Cliffs, Caves, and Rocky Features

Plan components for all action alternatives promote persistence for species that use cliffs, caves, abandoned mines, and rocky features, including the lesser long-nosed bat and other bat species. For example, Caves and Abandoned Mine Lands desired conditions 1 and 2 specifically describe the habitat elements that make these features suitable bat habitat. Standard 2 in this same section would require projects involving gate closures to do so in a way that would protect the lesser long-nosed bat, and other bat species. Standard 3 requires any activity conducted or authorized by the agency to include the most current disease prevention protocols to prevent the spread of the virus that causes white-nose syndrome.

Plan components for Cliffs and Rocky Features follow a similar pattern, with descriptive desired conditions for the ecological conditions that support dependent species, including many of the endemic snails on the species of conservation concern list. These desired conditions are supported by guidelines that place constraints on authorization of activities such as recreational rock climbing, rock collecting permits, borrow pits, or road-related activities that could threaten these and other species.

For species using Cliff, Caves, Mines, and Rocky Features, the primary threats are ground-disturbing activities such as mining, road construction or maintenance, and recreational activities (such as rock climbing) as well as climate change. Ecological conditions of cliffs, caves, and talus slopes have not and likely would not change substantially over time and geologic forces act on them over long time periods.

Species in these areas would also likely be impacted by activities that may occur within the ERUs where the features are located. Therefore, moving the ERUs toward desired conditions along with plan components developed specifically for these features would likely provide benefits to the species that occupy these sites and provide conditions for their persistence.

Riparian and Aquatic

For species that rely on riparian and aquatic ecosystems for all or part of their life cycle, the action alternatives contain detailed desired conditions at multiple scales that include important habitat elements, ecological conditions, and ecological processes. The Chiricahua leopard frog, New Mexico meadow jumping mouse, and the Arizona montane vole would benefit from many of the desired conditions for riparian and aquatic ecosystems, and 6th level watershed scale desired conditions 3 and 6 specifically. These desired conditions would provide the floodplain habitat features and soil conditions that support extended periods of inactivity. Other species rely on the large trees and snags within the riparian corridor, such as beaver, bats, the yellow-billed cuckoo, Gila woodpecker, and Lewis' woodpecker, are provided for by Riparian and Aquatic desired conditions at multiple scales (including but not limited to 6th level watershed desired condition 4). The action alternatives do have objectives for improving riparian and aquatic habitat, but they are not prescriptive.

At-risk species including native fishes, insects such stoneflies and mayflies and some snails have specific water temperature and other water quality requirements. While the Forest Service has a legal obligation under the Clean Water Act to work toward, achieve, and maintain water quality standards set by the states, the action alternatives would provide additional direction to achieve that aim (for example Water Quality desired condition 1, Watersheds standards 1 and 2; Riparian and Aquatic Ecosystems standard 1 and guideline 4; and Wildlife, Fish and Plants guideline 13).

All activities authorized under the action alternatives would either make progress toward or maintain Riparian and Aquatic Ecosystems desired conditions. The action alternatives would require preferential consideration be provided to riparian and aquatic habitats by implementing site and activity appropriate best management practices (Riparian and Aquatic Ecosystems standard 1) and have several supporting standards and guidelines throughout the plan (for example, Roads guidelines 2 and 3 and Sustainable Recreation guidelines 5, 7 and 12–16).

Livestock Grazing guidelines 1 and 3 would prevent the construction of new structures in riparian management zones and minimize potentially adverse effects that the construction of such structures may have on soils and hydrologic function of streams.

Non-native plant species (such as tamarisk) can outcompete native species, causing a reduction in suitable habitat for these species and alterations in riparian function, while non-native invasive animals and disease pathogens (such as chytrid) can cause direct mortality and predation. These threats would be reduced through plan components in the Non-native Invasive Species (DC1 and 2, STDs 1-3, 7, and 9, GL 1, 4-7) and Wildland Fire Management (DC 6, STDs 4-6, GL 2) that minimize impacts to wildlife in riparian areas and would also prevent pathogen transmission.

Plan components have been developed to implement 20 activities and projects that contribute to the recovery of federally listed species and maintain or enhance upland habitat connectivity over each 10-year period (Wildlife, Fish, and Plants OB-3 and 5), and objectives to restore, enhance, or maintain 100 stream miles (Wildlife, Fish, and Plants OB-4).

Plan components designed to reduce non-native fish and other aquatic species within native aquatic populations in at least four to six stream reaches and eradicate non-native fish populations to reduce impacts from predation, competition, or hybridization from at least one stream reach containing a natural or constructed barrier in compliance with recovery plans during each 10-year period (Non-native Invasive Species OB-3 and 4, respectively) would further address threats to these species.

Plan components that would benefit the species that depend on these vegetation communities can be found under the Watershed; Water Quality; Riparian and Aquatic Ecosystems; All Upland ERUs; Non-native Invasive Species; and Wildlife, Fish, and Plants plan sections of the action alternatives. Additional plan components, which balance multiple use with wildlife needs, can be found under the Wildland Fire and Fuels Management; Water Uses; Livestock Grazing; Timber, Forest, and Botanical Products; Roads; Minerals; and Dispersed Recreation sections.

Effects of Alternative 2

In addition to the effects described as common to all action alternatives, there are effects unique to alternative 2 associated with vegetation treatment objectives, management of vacant allotments, and botanical areas and direction related to rare and endemic plant species conservation.

Vegetation

Alternative 2's vegetation treatment objectives would make the most progress toward desired conditions for key ecological conditions across more ERUs than any other alternative (see Upland Vegetation, Fire Ecology and Fuels and Riparian and Aquatic Ecosystems, or the Summary of Environmental Consequences section for more information). Alternative 2's objectives would substantially reduce the threat large, stand-replacement fires pose to federally listed species, species of conservation concern, and other uncommon and common species.

Livestock Grazing

Alternative 2 includes a guideline that would require vacant allotments be considered for their appropriateness and utility as swing allotments or forage reserves that current permit holders in good standing could be authorized to use when their allotments are not available because of wildfire, drought, or other disturbance, or to avoid seasonal conflicts with wildlife (Livestock Grazing guideline-6). It also contains a management approach describing the intent of the guideline, which is to strategically select a few allotments to serve as swing allotments or forage reserves. This would better enable adaptive management and the Resilience-Transition end of the climate adaptation spectrum for both livestock grazing and species (see also the Livestock Grazing section of chapter 3 in this environmental impact statement).

Management Areas

Recommended Wilderness

Alternative 2 recommends approximately 110,402 acres to Congress for wilderness designation. Effects of recommending these areas for wilderness designation is discussed later in "Effects Common to Alternatives 2, 3, and 4."

Botanical Areas

Alternative 2 proposes three areas totaling 68,171 acres for establishment of botanical areas. Alternative 2 would establish portions of 3 of the 12 important plant areas within the Gila National Forest identified in the New Mexico Rare Plant Conservation Strategy (NM EMNRD 2017) as botanical areas (see appendix K for details on botanical area proposals and alternative development). It would also include a guideline constraining authorization of permits for collection (Timber, Forest, and Botanical Products guideline-1 and Rare and Endemic Plant and Animal Species and Habitat guideline-2) and a guideline consistent with policy direction for reviewing species of conservation concern status (Rare and Endemic Plant and Animal Species and Habitat guideline-1). Botanical area direction would include more detailed desired conditions, and standards and guidelines establishing constraints on the construction and maintenance of motorized routes, non-selective herbicide use, siting of developed recreation facilities such as trailheads, campgrounds, and parking areas, and interpretative signage. While these plan components would serve as conservation measures for the rare and endemic species populations within their boundaries, projects and activities could include similar conservation measures outside of botanical areas but would not be required to do so by plan direction.

Proposed Research Natural Areas

Alternatives 2 (and 5) carries forward proposals for research natural area designations of two areas (Turkey Creek and Rabbit Trap) totaling 1,500 acres. These designations, in and of themselves, do not have effects on ecological conditions, the diversity of plant and animal communities, or species viability. Effects are largely dependent upon existing ecological conditions, differences between current management and the management direction that would be imposed by establishing these areas, as well as size and location.

The research natural area proposals would not substantially change the management and would not result in a substantial adverse or beneficial impact on species. The proposed Turkey Creek Research Natural Area lies entirely within an unallotted portion of the Gila Wilderness. As such, management activities are generally limited to non-mechanized primitive recreation, fire management, non-native species, and native species management activities. It is withdrawn from mineral entry through its wilderness designation. Recreation is not encouraged in research natural areas, which would be the only change in management direction the establishment of a research natural area would incur.

The Rabbit Trap area is a 300-acre pasture that is excluded from livestock grazing by National Environmental Policy Act decision and has been excluded for decades prior to the 1986 plan decision. Access and vegetation conditions make it an unlikely area for fuelwood gathering or mechanical vegetation treatments. It is also withdrawn from mineral entry. For these reasons, this proposal would not result in a substantial adverse or beneficial impact on species, including the population of Davison’s cliff carrot within the area.

Federally listed species

The USDI FWS concurred with Forest Service biologists’ assessment that some short-term consequences may occur as part of implementing the management direction within the revised forest plan, but that the plan contained components that would help minimize them (USDI FWS 2022). Many of these plan components are common to all action alternatives, but consultation was focused on alternative 2- proposed action. Further, the USDI FWS concurred that forest health and resiliency would be expected to improve over the long term because of implementing the revised plan, which benefits federally listed species. The USDI FWS issued their biological opinion that implementation of the revised plan would not jeopardize the continued existence of the species consulted on and would not destroy or adversely modify critical habitat (USDI FWS 2022). Alternative 2 has the plan components that provide the ecological conditions necessary to contribute to recovery of federally listed threatened and endangered species and conserve candidate species.

Mexican spotted owl

Vegetation modeling also indicates alternative 2 would best support the recovery of the Mexican spotted owl by maintaining sufficient nesting and roosting habitat and providing for the continuous recruitment and development of replacement nesting and roosting habitat over time and space. Nesting and roosting habitat is generally found within closed canopy, multi-storied mixed conifer and ponderosa pine dominated forests containing Gambel oak, old or large trees, snags, and downed logs.

Effects of Alternative 3

Alternative 3 was developed to respond to issues by placing more emphasis on mechanically treating grassland and open woodland vegetation to maintain or move toward desired conditions for those vegetation types. These efforts would prioritize restoring understory vegetation that could be used as forage for livestock grazing, which contributes to local and regional economic sustainability. In addition to the effects described as common to all action alternatives, there are effects unique to alternative 3 associated with vegetation treatment objectives. Alternative 3’s vegetation treatment objectives are projected to maintain or move some ecological conditions toward desired conditions for some ERUs, but not as many as alternative 2 or 5 (see Upland Vegetation, Fire Ecology and Fuels and Riparian and Aquatic Ecosystems, or the Summary of Environmental Consequences section for more information). This is largely due to the constraints placed on the use of prescribed fire and the allocation of resources to working only in grassland and historically open-canopy woodlands. Alternative 3 does reduce the threat of large, stand-replacement fires but only to species restricted to these habitats.

While some individuals could be impacted by actions in the forest, the alternative management activities would not adversely affect the viability of the species in treated habitats. Overall species viability would be maintained for all these species. Beneficial impacts include an improvement in watershed and riparian conditions.

Effects of Alternative 4

Alternative 4 was developed to respond to issues by placing more emphasis on mechanically treating forested/timberland vegetation to maintain or move toward desired conditions. Objectives under alternative 4 would prioritize mechanical treatments in forested ERUs, with no objectives or restoring woodland ERUs. These efforts would prioritize restoring forested vegetation that could also produce forest products, which contributes to local and regional economic sustainability. This alternative identifies more land suitable for timber production and would offer more wood products.

Alternative 4's vegetation treatment objectives are projected to maintain or move some ecological conditions toward desired conditions for some ERUs, but not as many as the other action alternatives. This is largely due to the constraints placed on the use of prescribed fire and the allocation of resources to working only in timber-producing forest ERUs. Alternative 4 would reduce the threat of large, stand-replacement fires but only to species restricted to these habitats. Further, vegetation modeling suggests alternative 4’s estimated vegetation practices and intensity of treatment would push mixed conifer and ponderosa pine-dominated forests toward a prevalence of even-aged, single-storied conditions, and the second largest decline in the area expected to be dominated by old trees (see Upland Vegetation, Fire Ecology and Fuels the Summary of Environmental Consequences section for more information).

There would be an emphasis on using guidelines rather than standards for livestock grazing plan direction, and vacant allotments would be stocked to the maximum extent possible.

Land adjustments would be balanced so that no net loss of private property in a county occurred. Wilderness recommendations would be avoided in areas identified as needing restoration in forested vegetation or being suitable for timber production, and areas providing access to traditional recreational, cultural, and historical uses of the forest.

Alternative 4 would not address the threats to at-risk species, or provide the ecological conditions needed for many at-risk species, such as the Mexican spotted owl, as well as other action alternatives or the no-action alternative. There could be some localized adverse impacts to the Mexican spotted owl and its critical habitat by actions in the forest, but overall, species viability would be maintained through this alternative’s management activities. Beneficial impacts would include improved resiliency of the suitable or potentially suitable nest and roost habitat in the ERUs used by Mexican spotted owls for these activities by reducing fuel loads and returning disturbance regimes toward reference conditions. However, acreage amounts would be lower than alternatives 2 and 5, and as a result, improve conditions at a slower rate than either of those alternatives.

Effects of Alternative 5

In addition to the effects described as common to all action alternatives, there are effects specific to alternative 5 associated with vegetation treatment objectives and guidelines restricting the use of mechanical thinning to the wildland-urban interface; management of vacant allotments; herbicide use on native plant species; avoidance areas for Mexican spotted owl protected activity centers; botanical areas and direction related to rare and endemic plant species conservation; and recommended wilderness. Alternative 5's vegetation treatment objectives are projected to maintain or move some ecological conditions toward desired conditions for some ERUs, more than all the other alternatives except alternative 2 (see Upland Vegetation, Fire Ecology and Fuels and Riparian and Aquatic Ecosystems, or the Summary of Environmental Consequences section for more information). This is largely due to the constraints placed on mechanical thinning treatments and the rate at which the landscape would experience fire. Alternative 5 reduces the threat of large, stand-replacement fires better than any other alternative, but there are tradeoffs.

Based on the vegetation modeling, this much fire on the landscape would push many systems toward a prevalence of even-aged dynamics, single-storied conditions in the Ponderosa Pine Forest, as well as substantial declines in the area expected to be dominated by old trees across all ERUs (see Upland Vegetation, Fire Ecology and Fuels the Summary of Environmental Consequences section for more information). Alternative 5 would come closest to achieving desired conditions for fire frequency in most ERUs, but longer fire-free periods may be necessary for successful regeneration in a warmer, drier climate (Enright et al. 2015). Alternative 5 would likely not provide the ecological conditions needed for several at-risk species, such as the Mexican spotted owl, Mogollon death camas, heartleaf groundsel, and Mogollon mountain lousewort.

Alternative 5 would not establish a guideline that requiring vacant allotments be considered for their appropriateness and utility as swing allotments or forage reserves. Rather, decisions about the future management of vacant allotments would be made similar to alternative 1, consistent national policy direction. Decisions would be made on an allotment basis (project-level), based on environmental conditions and the effects of the alternatives, including the no-grazing alternative. Effects to species would be like alternative 1.

Alternative 5 contains a guideline that would expand protections from new construction and realignment of motorized routes to create an additional half-mile buffer zone around Mexican spotted owl protected activity centers. This would reduce future noise disturbance, temporary displacement, nest abandonment, and habitat avoidance. It would also reduce potential future loss of habitat components (large logs, large snags, hardwoods) from people accessing these areas for fuelwood cutting. However, this guideline goes well beyond the necessary constraints identified in the approved USDI FWS recovery plan by almost doubling the size of protected activity centers. Realignment of motorized routes is often undertaken because of natural or cultural resource damage being caused by the existing alignment. As a guideline, management would retain the flexibility to do so in situations where the soil, slope or other terrain feature makes the additional half-mile buffer impossible to implement.

Alternative 5 would prohibit the use of herbicide on native species (All Upland ERUs standard 5). While this may prevent some unintended impacts to non-target species, it would likely have little additional effect on at-risk species. This is because of the highly regulated nature of herbicide use, the plan direction in place as baseline constraints for herbicide use on non-native invasive plants (Non-native Invasive Species standards and guidelines), and there are additional measures restricting the use of certain kinds of herbicides in areas occupied by rare and endemic plants. Additional constraints may be identified at the project level when species, site characteristics, herbicide characteristics, application method and alternatives are known and could be considered in the appropriate environmental analysis. Therefore, such a prohibition within the plan would not be expected to have a substantially different impact on at-risk species. However, by limiting the ability to treat and prevent the spread of invasive species, invasives would be more likely to compete with at-risk plants and prevent at-risk habitats from maintaining or making progress toward desired conditions.

Alternative 5 proposes three areas totaling 150,590 acres for establishment of botanical areas. Alternative 5's botanical areas differ from alternative 2's only in the size of the three areas, and therefore, the number of species and populations that would be included within their boundaries (see appendix K for details on botanical area proposals and alternative development). Plan direction would be the same as alternative 2. There would still be rare and endemic plant species, and populations outside of the botanical areas. Projects and activities could include similar conservation measures outside of botanical areas but would not be required to do so by plan direction.

Alternative 5 recommends approximately 745,286 acres to Congress for wilderness designation. Again, effects of recommendations would largely depend on existing ecological conditions, differences between current management and the management direction that would be imposed by establishing these areas. Based on the criteria used to develop alternative 5 (see appendix H), some recommended wilderness areas are more likely to experience large extents of stand-replacement fire, if a fire occurs, and might benefit from mechanical thinning treatments before being managed with fire alone. In these recommended areas, there may be less surface and noise disturbance because mechanical thinning treatments would not be authorized, but the threat of stand-replacement fire would not be addressed.

Other areas recommended as part of alternative 5 could largely be maintained or enhanced by using naturally ignited wildfire alone because there is a relatively low risk of large, continuous extents of stand-replacement fire. These areas have also largely been managed this way in that past due to terrain and access. Many of the recommended acres are inventoried roadless area. Thus, the level of surface and noise disturbance would be unlikely to change. A recommendation does not change the ecological conditions, or management. A wilderness designation by Congress would withdraw the area from mineral entry, but that would be the effect of the designation, not the recommendation. Therefore, these recommendations for wilderness under alternative 5 would not have appreciable positive or negative impacts on species.

Alternative 5 includes the proposed research natural areas and acres described in Effects of Alternative 2 with the same effects.

Effects Common to Alternatives 2, 3, and 4

The main differences between alternatives 2, 3, and 4 that could impact at-risk species is the amount of acreage recommended to Congress for wilderness designation and the associated limitations on mechanical treatments, wildland fire, and riparian and aquatic systems that would likely be restored.

Alternative 2 recommends approximately 110,402 acres to Congress for wilderness designation. Alternative 3 recommends approximately 130,012 acres to Congress for wilderness designation. Alternative 4 recommends approximately 72,901 acres to Congress for wilderness designation.

Effects of recommendations are largely dependent upon existing ecological conditions, differences between current management and the management direction that would be imposed by establishing these areas. Based on the criteria used to develop alternatives 2, 3, and 4 (see appendix H), all recommended wilderness areas have ecological conditions that could largely be maintained or enhanced by using naturally ignited wildfire alone because there is a relatively low risk of large, continuous extents of stand-replacement fire. These areas have also largely been managed this way in that past due to terrain and access. Most of the recommended acres are inventoried roadless area. Thus, the level of surface and noise disturbance would be unlikely to change. A recommendation does not change the ecological conditions or management. A wilderness designation by Congress would withdraw the area from mineral entry, but that would be the effect of the designation, not the recommendation. Therefore, the recommendations for wilderness under alternatives 2, 3, and 4 would not have appreciable positive or negative impacts on species.

Effects Common to Alternatives 3 and 4

Alternatives 3 and 4 stipulate that land adjustments would be balanced over time so that no net loss of private property in a county occurred. This could limit opportunities for the Gila National Forest to acquire lands from willing sellers that contain important or high-quality habitat for both common and uncommon species in a way the other alternatives do not.

Alternatives 3 and 4 do not establish botanical areas but adopt a forestwide approach to rare and endemic plant species conservation, including the desired conditions, standards, and guidelines that only apply to botanical areas in alternatives 2 and 5. This would benefit all rare and endemic species, regardless of where they occur in forest.

Alternatives 3 and 4 would not establish a guideline that requiring vacant allotments be considered for their appropriateness and utility as swing allotments or forage reserves. Rather, decisions about the future management of vacant allotments would be made similar to alternative 1, but the management approach would be to reissue a permit as soon as possible and stock the allotment to its maximum capacity as determined through the environmental analysis and decision-making process. While these decisions would be made on an allotment basis (project level) under all alternatives, the management approach of alternatives 3 and 4 would not support flexibility and adaptation as effectively as alternatives 2 or 1.

No positive or negative effects to species or habitat are expected to occur in the absence of research natural area proposals in these alternatives because of factors discussed previously relative to alternatives 1 and 2. Research with the potential to inform biodiversity conservation would continue to occur within the Gila National Forest, wherever there was interest from the research community (see appendix J for more information on the research area evaluation).

Cumulative Effects

Cumulative effects from implementation of the Gila NF forest plan include potential effects of forest management on the wildlife resource, plus potential effects from land management on adjacent lands of other ownership (private, state, tribal, other federal agencies, county, etc.). In general, cumulative effects include impacts from past activities and potential future activities, such as agricultural use, forestry, fire, human development, and recreation. Past activities or actions are only considered if their contribution to the existing condition is still ongoing.

To compare the effects of proposed management under the Gila plan to the surrounding landscape, cumulative effects are evaluated considering the management actions of other entities of a similar planning scope within a relevant spatial and temporal context.

The analysis area for wildlife includes the Gila NF and the counties immediately adjacent to or surrounding the Gila NF. This accounts for effects for most wide-ranging species that can travel across numerous land jurisdictions. The analysis area encompasses similar habitat types as identified in the proposed action area and reflects similar ecological settings that wildlife species referenced in this report could or would use. These effects were evaluated for the life of the forest plan, approximately 10 to 15 years.

Departures from reference conditions exist in all vegetation types in the forest, and most continue to trend further from reference conditions. This trend is also common on adjacent lands. Forests have become denser, and conifers are invading grasslands. The landscape has become more fragmented because of activities that include urban development, ranching, and fire suppression. As a result, there has likely been a net loss of intact, potential habitat and an increased risk to viability for wildlife on adjacent lands; this trend is expected to continue in the future. Consequently, the Gila NF will play an increasing role in the conservation of these habitats and associated wildlife species on National Forest System lands.

The action alternatives strive to create and maintain natural communities and habitats in the amounts, arrangements, and conditions capable of providing for species persistence in the plan area, while contributing to broader landscape-scale initiatives where appropriate. As such, wildlife and fish are distributed throughout their natural potential range. The adaptive management process should also help to inform and realize these conditions on the ground.

Federal and state agencies and local governments have land management plans or land use strategies that address coordinated efforts for species-related issues, including connectivity. Land resource management plans have been completed by the Las Cruces and Socorro Field Offices of the BLM to manage lands adjacent to the Gila NF. These resource management plans encompass lands that may be adjacent to the Gila NF in Sierra, Otero, Dona Ana, Grant, Hidalgo, Catron, Luna, and Socorro Counties. Because the Bureau of Land Management and the Forest Service both have a multiple-use sustained-yield mandate and must comply with same federal and state laws, there is a high degree of compatibility between land and resource management plans. While collaborative efforts between the Gila National Forest and the Bureau of Land Management Las Cruces and Socorro Field Offices have primarily focused on fire management, there are many opportunities for future joint efforts to improve ecological conditions, enhance habitat connectivity, and implement climate change solutions across jurisdictional boundaries. Even though the New Mexico State Land Office seeks to maximize revenues, it also seeks to protect the health of the land for future generations. State trust lands are often located adjacent lands managed by the Forest Service, including the Gila National Forest, and lands managed by the Bureau of Land Management.

The wide range of planning and land use strategies adopted by Catron, Grant, Hidalgo, and Sierra Counties address land use (including interface with public lands) and suggest ways to foster more communication and collaboration between local governments and federal land management agencies. Local soil and water conservation districts have also written land use plans to promote responsible and effective use and management of soil and water resources in their districts.

The State of New Mexico has issued a Statewide Natural Resources Assessment and Strategy and Response Plan that guides planning and implementation of natural resource management and restoration activities for the state. It also provides strategies for working with and integrating resources across boundaries with federal, tribal, and private landowners. Implementation of all these plans in combination with the Gila NF forest plan contribute to the cumulative effects of species that occur within and adjacent to the forest, including species that travel between multiple jurisdictions.

The U.S. Department of the Interior National Park Service administers the Gila Cliff Dwellings National Monument, which shares boundaries with the Gila National Forest. The Monument does not yet have a comprehensive land and resource management plan. There may be future opportunities to collaborate with Monument staff on studies and conservation education related to wildlife, fish, and plant species. These types of efforts could increase public understanding about species and threats and garner greater public support for management actions taken to maintain native biodiversity across agency jurisdictions and missions.

Many of the same activities that occur on National Forest System land are the same activities being conducted on lands adjacent to the forest. Land management activities adjacent to the forest as outlined in the above-mentioned plans, include manual and mechanical cutting of vegetation, herbicide use, livestock grazing, recreational activities, prescribed and naturally ignited fire, and road construction and maintenance to name a few. Timber harvest, fire suppression, thinning, and wildfires are the past activities that have had the greatest influence on the amount and distribution of forested habitat on National Forest System lands as well as Bureau of Land Management, state, and private timberlands. These activities have created a variety of successional stages, structures, tree species mixes, and forest patterns that have been neutral for some wildlife species, beneficial to some wildlife species, and detrimental to others.

Timber harvest occurring on private, state, Bureau of Land Management, or National Forest System lands may cumulatively affect the quantity and quality of wildlife habitat. If harvesting moves vegetation toward desired conditions for wildlife, the effects would be beneficial. This could result in better retention of very large-size class trees. In the wildland-urban interface, precommercial thinning, timber harvest, and prescribed burning would reduce stand densities, would increase survival of retained trees, and could increase the rate at which very large trees develop. On managed lands, active vegetation restoration actions could mimic natural disturbances in areas where natural disturbances are not compatible with multiple-use objectives of the forest plan or the objectives of other landowners.

The impacts from these activities could affect connectivity and dispersal of species that are crossing jurisdictional boundaries as well as add to disturbances during critical times such as breeding season. Additionally, activities within the uplands could increase amount of sedimentation into stream courses and affect species that rely on riparian and aquatic areas. The goal of any of these management activities on public lands is to improve conditions of the landscape to provide for a healthy, resilient ecosystem. Overall, the activities should improve ecological conditions of the native wildlife within these ownerships.

Development of lands adjacent and within the forest can alter habitat conditions for species and increase disturbance in areas that may have had little in the past. Activities associated with land development could also impact springs through water developments, sedimentation from road construction, and potential vegetation changes from land clearing for construction or fire protection of structures. Other land ownerships may differ in the amount and type of treatment that is appropriate within ERUs that may occur adjacent to the national forest. Alternative energy development (wind farms and solar arrays) appear to be increasing in their technological advances as well as popularity, and there are already wind and solar farms adjacent to the forest. These have been known to cause mortality to bird and bat species, which could potentially increase with further development.

With the expected increase in the pace and scale of vegetation treatments to address the wildfire crisis, restore landscapes, and adapt to climate change, the short-term impacts of surface and noise disturbance on species would be expected to increase the area affected at any given time. The impacts from these activities could affect connectivity and dispersal of species that are crossing jurisdictional boundaries as well as add to disturbances during critical times in the breeding season. Additionally, activities within the uplands could increase the amount of sedimentation into stream courses and affect species that rely on riparian and aquatic areas. The goal of any of these management activities on public lands is to improve conditions of the landscape to provide for a healthy, resilient ecosystem. Overall, the activities should improve ecological conditions of the native wildlife within these ownerships.

Resistance-Resilience strategies are probably only viable long term in areas of low vulnerability. Areas of moderate and greater vulnerability may derive some benefit from these strategies, but Transition strategies would be necessary in some places and circumstances. Almost by definition, this would require coordinated, cross-jurisdictional removal of barriers and risk-sharing across state and international boundaries. Barriers are primarily psychological and sociopolitical (Butt et al. 2021) and those barriers can be overcome. Uncertainty and risk of unintended consequences are the reality, but there are management tools to help manage that risk and support decision making (for example, Karasov-Olson et al. 2021, Rodman et al. 2022, and Sample et al. 2022).

Visitation has increased during the last 10 years, but it is unknown whether this trend will continue. There is a potential of increased disturbance from the increase in visitation. Caving and rock climbing are popular recreational activities in some areas and may increase in the future, but these activities require specialized training and equipment and they are not likely to increase as rapidly as other types of recreation. Recreational cave and mine exploration on all land ownerships can lead to an increased rate of the spread of diseases such as white-nose syndrome. There is a decontamination protocol in place for cavers on National Forest System lands, which should aid in slowing the spread on National Forest System lands, but diseases may continue to be spread elsewhere. Because both people and bats may carry diseases and travel long distances, disease can be spread across a wide area. Disease control requires a cooperative effort. Multiple agencies are monitoring bats, which will help support adaptive management and response to outbreaks.

Introduction of aquatic invasive species or contaminants in waterbodies resulting from recreational, agricultural, or industrial activities may have negative impacts on species associated with aquatic, wetland, and riparian habitats. The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area, often as an indirect result of water-based recreation. Many management agencies have increased inspections and public education efforts in recent years to reduce these risks.

Climate change has occurred to some degree and will continue in the future. It is projected to increase the frequency, severity, and duration of droughts (IPCC 2007; Seager et al. 2007). Climate change is likely to modify ecological conditions, processes and ecosystem services in many regions and ecosystems (Westerling et al. 2006; Bowman et al. 2009; Flannigan et al. 2009) including the cumulative effects analysis area, by altering precipitation patterns, and the timing, quantity, duration, and distribution of available water. Plants in the arid Southwest already live near their physiological limits for water and temperature stress (Archer and Predick 2008).

Climate change projections suggest negative impacts across the southwestern United States and include (USDI FWS 2012a):

(1) Increased water temperatures and air temperatures (warming trends)

(2) Decreased streamflow

(3) Changes in hydrographs

(4) Reduced snowfall and early snow melt in the spring

(5) Extended periods of drought or extended dry periods

(6) More frequent wildfires/larger wildfires

(7) Increased insect and disease induced mortality

(8) Changes in site characteristics that promote type conversion or vegetation community changes

Temperatures in the Southwest have been exceeding global averages and are predicted to continue. Unfortunately, increased temperature impacts to water supplies are not likely to be offset by moderate increases in precipitation. The effects of climate change could be particularly profound for native fishes and aquatic ecosystems of the Rocky Mountains and Arizona-New Mexico Mountains because those systems often lack resilience and are strongly dependent on temperature and stream flow regimes that are already documented to be changing (Rieman and Isaak 2010).

Reduced snowpack and changes in precipitation can affect aquatic species by decreased stream flow and shifts in runoff patterns that could affect spawning success. Warming and drying of streams due to increased air temperatures would likely reduce the amount of suitable habitat for some cold-water species such as the Rio Grande cutthroat trout and Gila trout. The reduction of suitable habitat could lead to increased fragmentation, increased extirpation, and decreased size of occupied segments. These changes would also lead to reduced water supplies in the uplands, increase competition between domestic livestock and native species, and require adaptive management actions.

Drought is expected to increase along with high-severity fires. High-severity fires increase the risk of high ash flows to streams. The loss of stream shading from fires would lead to increased water temperatures and soil erosion. Drought can also impact prey abundance for some species such as the Mexican spotted owl. A study conducted on spotted owls in Utah demonstrated reproduction was reduced during severe drought (Willey and Van Riper 2007). Another study showed that when there was an increase in precipitation, there was an increase in spotted owl prey abundance and species richness (USDI FWS 2012a), which leads to the conclusion that with declining precipitation there would be a decrease in prey abundance and richness.

The timing of spring green-up can also affect food availability, change seasonal ranges, and affect the timing of reproduction for migratory birds. The availability of pinyon pines, which are a food staple for pinyon jays, are likely to decrease since climate models are trending toward the mortality of pinyon juniper woodlands. The importance of the Gila National Forest to the persistence of the pinyon jay is uncertain, with the forest being the southernmost extent of the jay's range and having predominantly low vulnerability to climate change mapped for the Pinyon Juniper Woodland ERU within the forest (see also Upland Vegetation, Fire Ecology and Fuels Affected Environment).

There are non-climatic factors that can affect a species within its climate envelope; however, population size, limited dispersal capabilities, and narrow physiological tolerances greatly increase the susceptibility of some species to extinction. If a species is restricted to a certain type of habitat or is restricted to a certain range, this could also increase the risk of extinction to a species. In some instances, species may move into adjacent habitats or into habitats that they did not occupy before. For example, if canyon habitats become hotter and drier, Mexican spotted owls that once occupied those canyon habitats could potentially move into unoccupied canyon habitat or move into higher elevational canyon habitat (USDI FWS 2012a).

The Climate Vulnerability Assessment for the Gila National Forest (USDA FS 2017a) provides additional information on the vulnerability of other vegetation communities and habitat types to climate change. Some plants in the arid Southwest already live near their physiological limits for water and temperature stress (Archer and Predick 2008). The Climate Vulnerability Assessment suggests that high-elevation vegetation communities are at the greatest risk (Triepke 2015 and 2017a). The Spruce-Fir Forest ERU occupies a small percentage of the landscape and is at the southernmost extent of its range on the Gila and Lincoln National Forests. Climate adaptation options for at-risk species dependent on late-seral Spruce-Fir Forest and endemic to the Gila National Forest, such as Mogollon death camas, will likely require close collaboration amongst multiple stakeholders, including the New Mexico State Forestry Department's Rare Plant program staff and the Rare Plants Technical Council.

Even a small rise in regional temperatures is likely to lead to vegetation type conversions. These conversions could benefit some species but could be detrimental to others. For example, the Greene milkweed occupies grassland habitats, and this species habitat could become more arid, shifting toward desert shrublands, which could harm the species' persistence in the forest (Decker 2006).

Addressing climate change is a key consideration for Forest Service plan revisions under the 2012 Planning Rule. Forest plan revision efforts have recently been completed or are under way for all national forests and grasslands in the Forest Service Southwestern Region. The plans are based upon the same regional desired conditions for terrestrial vegetation communities. They also share similar desired conditions for riparian and aquatic ecosystems. These restoration and climate adaptation activities would strive to create and maintain the necessary ecological conditions in the amounts and arrangements capable of supporting viable populations of at-risk species while contributing to broader landscape-scale initiatives as appropriate. These restoration and climate adaptation activities would support better distribution of species throughout their natural potential range. The adaptive management process and collaborative efforts with partners should also help to inform and realize these conditions on the ground.

National initiatives have increased the importance of climate change collaboration and coordination at federal, state, and local levels. In New Mexico, there is strong alignment between federal and state strategic plans (New Mexico State Wildlife Action Plan 2016, USDA 2022; USDA FS 2015a; USDA FS 2018b) and initiatives (USDA FS 2018c). There is also good alignment between the revised forest plan's approach to climate change and the New Mexico State Wildlife Plan, which intends to address climate change by:

(1) Implementing management actions that enhance populations of species,

(2) Controlling and applying eradication programs for exotic species and preventing habitat loss and fragmentation,

(3) Managing woody plant (such as juniper) encroachment into grassland ecosystems,

(4) Conserving genetic diversity,

(5) Maintaining habitat connectivity,

(6) Applying flexible management and innovative approaches to conserve species, and

(7) Implementing monitoring programs to ascertain population trends.

Land Use Changes

Land use changes such as conversion of wildland to cropland or housing developments has been a contributing factor to both habitat fragmentation and climate change world-wide. Development of lands adjacent to and within the forest can alter habitat conditions for species and increase disturbance in areas that may have had little in the past. Activities associated with land development could also impact springs through water developments, sedimentation from road construction, and potential vegetation changes from land clearing for construction, agriculture, or fire protection of structures. This type of development is not expected to increase on National Forest System lands but could increase on lands of other jurisdictions, potentially impacting species movements across the landscape.

National Forest System lands in the southwestern United States often represent core habitat areas for many at-risk and common species. While a large area of high and very high forest habitat connectivity includes the Gila National Forest extends northwest through central and into northern Arizona, the surrounding matrix poses limitations. Some of these barriers to connectivity are natural features of the southwestern landscape with forested mountain ranges separated by large swaths of grasslands and shrublands. Other barriers are contemporary human modifications to the natural environment, like interstate freeways and state highways.

These roads not only disrupt species movements, but they also lead to wildlife-vehicle collisions. The New Mexico Department of Game and Fish and the Department of Transportation recently published a Wildlife Corridor Action Plan. The action plan prioritizes five wildlife vehicle collision hotspots in the state, one of which is near the town of Silver City and the Gila National Forest. The 27-mile-long hotspot is the state's second highest priority and includes sections of U.S. Highway 180 and New Mexico Highway 90. Private lands border most of this hotspot, but small portions of New Mexico State Land Office, U.S. Department of Defense, and National Forest System lands are also present (Cramer and others 2022). Implementation of the action plan would likely be a concerted, collaborative effort that would benefit species, habitat connectivity, people, and relationships.

Another major issue affecting habitat connectivity in the southwestern United States is the border wall with Mexico, which is within the jurisdiction of the Department of Homeland Security (U.S. Customs and Border Protection). The border wall has been shown to hinder the movement of species, which could reduce the genetic diversity of some. In one instance, there were reports of a male Mexican gray wolf that was traveling south potentially searching for a mate when he reached the border but was unable to continue south because of the border wall. This wolf traveled 23 miles along the border wall before heading back toward the Gila National Forest. Other species that have used the types of habitats within the Gila National Forest in the past and traveled into Mexico may no longer be able to do so as habitat connectivity would be hindered by the border wall. The border wall issue is one that has been in flux for many years and continues to evolve.

With a national initiative to move energy production from fossil fuels to sources such and wind and solar, the demand for copper is anticipated to grow, with demand expected to exceed supply. An increased demand for copper would reasonably result in mine expansion, which could impact many national forests in southwestern New Mexico and Arizona, as well as state trust lands and lands managed by the Bureau of Land Management. Efforts toward achieving the Forest Service Southwestern Regional Strategic Plan's objective for mining projects to be jointly conceived to drive ecological protection and reclamation (USDA FS 2022b) would benefit affected forests.

Wind and Solar

Wind and solar installations are also known to cause mortality to bird and bat species, which could also become larger conservation issues in the future. There are already wind and solar farms on Bureau of Land Management jurisdictions, and more are likely to be installed in the future. These installations could be proposed on National Forest System Lands as well, but the Gila National Forest is not ideally situated for that use, given the existing electrical distribution lines.

Military Flight Noise

Military training flights over the Gila National Forest occur to some extent, although recent proposals to expand the use of airspace in the vicinity have been dropped in favor of other options. These flights disturb wildlife and may involve dropping flares that can start wildfires or impact water quality. There is no evidence that these military exercises have started wildfires or impacted water quality, but it remains a threat.

Recreational Caving

Many factors impact visitation rates in particular areas and the popularity of various types of outdoor recreation. Caving, rock climbing, and hiking are popular recreational activities in some areas and may increase in the future. Caving and rock climbing require specialized training and equipment and are thus not likely to increase at the same rate as hiking. Recreational cave and mine exploration on all land ownerships can lead to an increased rate of the spread of diseases such as white-nose syndrome. There is a decontamination protocol in place for cavers on National Forest System lands, which should aid in slowing the spread on National Forest System lands, but diseases may continue to be spread elsewhere. Because both people and bats may carry diseases and travel long distances, disease can be spread across a wide area. Disease control requires a cooperative effort. Multiple agencies are monitoring bats, which would help support adaptive management and response to outbreaks.

Invasive Species

Introduction of aquatic invasive species or contaminants in waterbodies resulting from recreational, agricultural, or industrial activities may have negative impacts on species associated with aquatic, wetland, and riparian habitats. The potential for introduction of disease and aquatic nuisance species exists on all jurisdictions that offer opportunities for water-based recreation. Many management agencies have increased inspections and public education efforts in recent years to reduce these risks, including the New Mexico Department of Game and Fish and their Clean, Drain and Dry education program.

While recreationists are not the only way non-native invasive species may be introduced or spread between areas, increased visitation could also increase the rate of introduction and spread. However, many non-native invasive and noxious weed species seeds are easily dispersed by wind and water. Wind dispersed seeds, are a particular threat to native plant and animal communities that may be strongly influenced by how counties, municipalities, and private property owners manage their lands. Local communities often have limited resources with which to manage their properties and provide the public services residents depend on. Currently, none of the county or municipalities' plans address non-native and noxious weeds and there are no city ordinances about how these species are managed. Species such as Siberian elm and tree of heaven, and many other species listed as noxious by the New Mexico Department of Agriculture flourish adjacent to the Gila National Forest, and other public lands. Cooperative Weed Management Areas have been underutilized in the four-county area the Gila National Forest lies within. Cooperative Weed Management Areas represent a program through the New Mexico Department of Agriculture that can provide technical assistance and sometimes financial assistance to collaborative groups seeking to address noxious weed species. Future collaborative work with these entities would be a good investment for all involved, including native plant and animal communities. This work may be increasingly important as climate change is expected to favor non-native invasive species. Many non-native invasive plant species are quick to reach reproductive maturity, giving them the advantage when moisture is available for plant growth.

Wildlife Connectivity

Some wildlife species are especially at risk with regard to development. For example: birds, bats, and wide-ranging species can be affected by transmission lines, turbines, roads, and other activities associated with renewable energy endeavors. These types of activities, which occur on lands of different ownerships and jurisdictions, are anticipated to increase in the future.

One of the approaches to conserving biodiversity in a time of rapid change that continues to receive attention and resources is the protected area network. What lands are considered protected is something that continues to be debated. Some conservation organizations and conservation advocacy groups argue that only designated wilderness areas, national parks, and national monuments are effectively protected. Others have argued that lands managed on multiple-use sustained-yield principles should be considered part of the protected area network. Regardless, the idea is that these areas would be managed for the conservation of nature and to help mitigate and adapt to climate change. Ideally these areas would be strongholds for biodiversity and connected so that species movements in response to climate change would be facilitated. Another way these protected areas have been thought about in the scientific literature is as steppingstones for species in a time of climate change.

The International Union for Conservation, an organization whose work is cited by the Intergovernmental Panel on Climate Change, classifies protected areas as (I) a strict nature reserve or wilderness area; (II) national park; (III) national monument; (IV) habitat or species management area; (V) protected landscape or seascape; and (VI) lands managed on multiple-use, sustained-yield principles, like general National Forest System lands. A recent study on the protected area network and the climate connectivity concept included all class I through VI areas except marine, aquatic, or those listed as proposed (Parks et al. 2023a). Parks and others analysis suggests that this global network of protected areas is not likely to provide steppingstones without human intervention (Parks et al. 2023a).

In summary, the cumulative effect of these planning efforts, when combined with the preferred alternative, is expected to be beneficial for wildlife by providing for better coordination across the landscape and perpetuating the habitat conditions necessary to provide for at-risk species into the future. Alternatives 3, 4, and 5 would have similar effects; however, in some areas in ponderosa pine, frequent fire-mixed conifer, and woodlands there would be less benefit than in alternative 2. Alternative 1 (no action) would not contribute to a cumulative benefit for wildlife species.

Alternative Comparison Summary

Alternative 1 would be the least effective at achieving the desired conditions for wildlife persistence. It has no articulated desired conditions (coarse or fine scale) to aim toward; it does not include direction based on the best available scientific information, particularly related to climate change and climate adaptation; it contains no objectives to restore habitat; and does not contain standards and guidelines for preventing the spread of invasive species or zoonotic disease. While all three action alternatives would achieve some progress toward desired conditions, alternative 2 would be the most effective. Alternative 2 retains the flexibility and tools to manage where most needed in all ERUs and provides objectives to reduce risk of uncharacteristic fire for the most critical ones. Alternatives 3 and 4 focus on either forested (timber) or woodlands (fuelwood) ecosystems, respectively. Alternative 5 would rely primarily on fire as a restoration tool, which could reduce habitat quality and quantity for several at-risk species.

Timber, Forest, and Botanical Products

Affected Environment

National Forest System lands were established with the intent of providing goods and services to satisfy public needs over the long term, which includes the production of a sustainable supply of timber, forest, and botanical products. Timber products include but are not limited to fuelwood (firewood), sawtimber, pulpwood, non-sawlog materials removed in log form and biomass for electricity. Forest products include but are not limited to Christmas trees, posts, poles and vigas. Botanical non-forest products include but are not limited to pinyon nuts, bark, berries, boughs, cones, herbs, wildlings (plant transplants), mushrooms, pine needles, and wildflowers. Harvesting these resources is a traditional use of the forest that precedes establishment of the national forests and grasslands, is important to the cultural identity of local communities, and contributes to socioeconomic sustainability.

In recent years, the Gila National Forest has provided approximately 3,020 Christmas trees, 350 wildlings, 1,140 pounds of nuts and seeds, 8.5 tons of limbs and boughs on an average decadal basis. In addition, on a decadal average, the forest provides 4.1 million cubic feet of fuelwood to area residents, many of whom rely entirely on wood to heat their homes in the winter months. The Gila National Forest also provides approximately 3.7 million cubic feet of saw timber, and 1.9 million cubic feet of other wood products[30] for both personal and commercial use (such as posts and poles).

This use has changed dramatically over the years with national and regional shifts in social values, environmental regulations, and forest conditions. Historic overgrazing, fire suppression and even-aged management resulted in homogenous stands at greater risk to wildfire and epidemic-level insect and disease outbreaks. In the 1990s, timber harvest methods shifted away from even-aged management to uneven-aged thinning and group selection in ponderosa pine and mixed conifer forests. This shift in

[30] Volumes reported in the assessment were found to be in error. The corrected volumes presented here were calculated from the volume of products sold between 2005 and 2018.

management was the result of changing management objectives, generally geared toward reducing the impacts of timber harvesting on habitat for endangered species such as the Mexican spotted owl and reducing fuels to lessen the threat of wildfire in the wildland-urban interface. Since the adoption of the 1986 forest plan, changes in vegetation management have resulted in a steady decline in timber harvesting, forest industry, and infrastructure.

Despite these reductions, the harvest of forest products remains a benefit to people, wildlife habitat, and ecosystem and watershed health. Recent harvesting activities have been focused on these objectives, rather than solely a timber production objective. With the help of partners, an average of 17,986 acres per year were treated between 1996 and 2014 (USDA FS 2017a). The forest currently supports only local operators and mills due to low product value and long haul distances. Industry capacity and product value is low compared to what it was once, due to the prevalence of small-diameter trees that provide less volume per acre. In the warm, arid to semi-arid climate of the forest, growth rates are very slow compared to many other areas in the United States, lengthening the amount of time between harvests in the same area. Challenges to providing forest products have included litigation, economic constraints, and declining Forest Service budgets.

In terms of timber, most of the commercially available species in the forest are ponderosa pine, Douglas-fir, southwestern white pine, and spruce (FIA EVALIDator 2018), although other desirable species are present in low numbers. A periodic national inventory is conducted by the Forest Service's Forest Inventory and Analysis (FIA) program. FIA plot data were summarized using EVALIDator standard reports from 2005 to 2016 inventory data to produce statistically valid estimates of stocking characteristics of these species on Gila National Forest lands, excluding those lands removed from timber harvest by legislation, such as designated wilderness areas. These estimates follow in table 42 and table 43.

Excluding designated wilderness, these data also suggest an average annual net loss of live volume of 2.3 million cubic feet due to mortality of these species (FIA EVALIDator 2018). This is not to say tree mortality is not occurring in designated wilderness, just that it is not relevant in terms of product or socioeconomic contributions and not tracked in this database. Tree mortality may result from several different causes, or combination of causes, including drought, fire, insects, or disease. Salvage harvest of dead volume occurs where it is economically viable and local operators or individuals are interested in the available products.

Table 42. Number of commercially desirable tree species and volume estimates for the Gila National Forest lands outside of existing designated wilderness (FIA EVALIDator 2018)

Tree Species	Stocking Variable					
	Number of Growing Stock Trees (millions)	Number of Live Seedlings (millions)	Net Merchantable Volume of Live Trees All Slope Gradients (million cubic feet)	Net Merchantable Volume of Live Trees Slopes ≤ 40%	Sawlog Volume of Live Trees All Slope Gradients	Sawlog Volume of Live Trees Slopes ≤ 40%
Ponderosa pine	57.2	30.8	819.5	741.6	716.3	646.2
Douglas-fir	9.8	18.6	103.6	75.6	82.7	60.9
Southwestern white pine	2.5	6.5	24.5	11.6	20.0	8.8
Spruce	0.4	No data	6.9	6.9	6.0	6.0
Totals	69.9	55.9	954.5	828.9	825.0	721.8

Table 43. Estimated size class distribution (by diameter class in inches) of all commercially desirable species of live trees in the Gila National Forest at least 5 inches in diameter outside of designated wilderness areas (FIA EVALIDator 2018)

Estimated diameter class in inches	Percentage of commercially desirable species
5.0–6.9	26
7.0–8.9	23
9.0–10.9	17
11.0–12.9	12
13.0–14.9	8
15.0–16.9	6
17.0–18.9	3
19.0–20.9	2
21.0–22.9	2
23.0–24.9	1
25.0–26.9	<1
27.0–28.9	1
29.0–30.9	<1
31.0–34.9	<1
41.0+	<1

The availability of products is likely to change in the future with predicted increases in frequency, duration, and severity of drought conditions and a corresponding shift in natural disturbance regimes. Some evidence suggests the type, amount and distribution of available forest products could change substantially in future decades (Parks et al. 2018a; Stevens-Rumann et al. 2018; McDowell et al. 2015 among others) making local communities vulnerable to potential socioeconomic impacts (Borchers et al. 2021 and Hand et al. 2018). Nevertheless, the harvest of timber, forest, and botanical products are expected to remain economically and ecologically important over the life of the revised forest plan. Furthermore, if harvest can facilitate ecological restoration at landscape scales, it may increase the availability of forest products over the life of the revised forest plan as climate change adaptation actions are implemented.

Environmental Consequences

The following discussion of environmental consequences addresses the effects of the alternatives on timber, forest, and botanical product extraction as a use of the forest. It does not discuss the effects of their uses on natural resources or other resource uses. Those discussions are housed under their respective topic headings.

Analysis Methodology

The National Forest Management Act of 1976 (16 U.S.C. 1600) is the basic law that guides land management planning on national forests and grasslands. Congress enacted the National Forest Management Act in 1976, and, like all laws, it is a product of the social and political issues at that time. Beginning in the 1950s, the Forest Service was called upon to provide large amounts of wood products for the marketplace and did so, using industrial forest management techniques that emphasized maximum production. As harvest levels increased over time, Congress and members of the public became increasingly concerned about the impacts of such intensive forest management. The National Forest Management Act was enacted in response to those public concerns, most notably concerns associated with clearcutting. Consequently, the law has numerous specific timber management requirements that focus on the regulation of timber harvesting practices, especially clearcutting. The political environment and social values have changed substantially since the act was enacted, and the largely utilitarian views of the 1950s have given way to a more balanced and integrated view of national forest management.

Nevertheless, the National Forest Management Act requires the agency to determine the suitability of National Forest System lands for timber production and has specific requirements for timber production suitability analyses in land management plans. These requirements are supported by the 2012 Planning Rule and associated Forest Service directives, which add additional analysis requirements and considerations. Under the 2012 Planning Rule and directives, land management plans now focus on desired conditions (outcomes) rather than the production of goods and services (outputs) to better provide for multiple use on a sustained yield basis, in perpetuity.

Four of these requirements are used to evaluate the effects of plan direction on the sustainable extraction of forest products: timber production suitability, sustained yield limit, estimated vegetation management practices, and projected harvest levels. These requirements and the methodology used to analyze them are described in the following subsections.

Timber Production Suitability

Timber harvest may be considered a resource use (timber production) or a tool (activity to improve or restore healthy forest conditions). As a resource use, the timber production objective31 is defined as the growing, tending, harvesting and regeneration of crops of trees on a regulated basis to produce logs or other products for industrial or consumer use. Under the timber production objective, regular, periodic timber harvest is predictable and supports the achievement and maintenance of non-timber related desired conditions. The objective does not require or imply that timber yields be maximized.

Where timber production is not the objective, harvest may be unpredictable, unnecessary, or undesirable based on desired conditions and management goals, but may be permitted as deemed necessary to achieve resource protection, restoration, and human safety objectives. Removing encroaching trees from historic grasslands, or hazardous fuels reduction in an overgrown forest are examples of restoration and resource protection objectives.

The 2012 Planning Rule, supported by the Forest Service national directives, specifically, Forest Service Handbook 1909.12 chapter 60, outlines two steps in the interdisciplinary, timber production suitability process:

Step 1: Identification of lands that may be suited for timber production and those that are not suited for timber production based on legal and technical factors

Step 2: Identification of lands suited and not suited for timber production based on compatibility with desired conditions and objectives

To complete Step 1, the interdisciplinary team applies a set of screening criteria to identify:

1. Lands on which timber production is prohibited (by Executive order or regulation) or lands withdrawn from timber production (by the Secretary of Agriculture or Chief of the Forest Service).[32]

[31] The term objective is used generally here, not as a reference to an objective in the plan.
[32] These are designated wilderness, wilderness study areas, designated research natural areas, and eligible wild and scenic river segments.

2. Lands on which technology to harvest timber is not currently available without causing irreversible damage to soil, slope, or other watershed conditions in the plan area.
3. Lands on which there is no reasonable assurance that lands can be adequately restocked within five years of final regeneration harvest.
4. Lands that are not forest lands.

Appendix C: Timber Production Suitability, Estimated Vegetation Management Practices and Projected Harvest Levels Methodology provides details about the Gila National Forest interdisciplinary approach, rationale and assumptions associated with Step 1. Lands that meet one or more of these criteria are identified as lands that are not suitable for timber production. Lands that do not meet any of the legal or technical criteria are considered lands that may be suitable for timber production. Lands that may be suitable move on to be evaluated in Step 2. However, identified lands are subject to a mandatory review every 10 years at a minimum. The purpose of this mandatory review is to determine if conditions have changed such that a new suitability analysis is warranted. As a result of this review, the plan may be amended to reflect any relevant changes.

In Step 2, all lands that *may* be suitable for timber production are determined to be either suited or unsuited for timber production based on compatibility with desired conditions and objectives. While the outcomes of Step 1 are the same for every alternative, the outcomes of Step 2 vary by alternative. The primary considerations involved in Step 2 are desired conditions and objectives for inventoried roadless areas, recommended wilderness and other proposed designations, soil and watershed, and upland vegetation. Each alternative has its own suitability analysis, including alternative 1. Per the National Forest Management Act, even though alternative 1 is the no-action alternative, this new suitability analysis replaces the one supporting the 1986 forest plan.

Sustained Yield Limit

Timber harvest must be based on the principle of sustained yield. The sustained yield limit is an estimate of the amount of timber that could be sustainably harvested from lands that *may* be suitable for timber production in perpetuity under a set of specified management practices. It serves as a benchmark to ensure the supply of timber is sustainable and represents the maximum volume of timber which could be sold, except under certain circumstances defined by National Forest Management Act (16 U.S.C. 1600, 36 CFR 219.11(d)(6)). The process of calculating the sustained yield limit was developed by the Forest Service Southwestern Regional Office (Youtz and Vandendriesche 2015) and is described in more detail in appendix F. The process includes the following assumptions relevant to the Gila National Forest and the plan alternatives.

- The management of Ponderosa Pine Forest and Ponderosa Pine-Evergreen Oak favors ponderosa pine.
- The management of Mixed Conifer-Frequent Fire favors the dominance of shade-intolerant species such as ponderosa pine, Douglas-fir, and southwestern white pine.
- The management of Mixed Conifer with Aspen and Spruce-Fir Forest favors dominance of wind-firm species such as Douglas-fir and southwestern white pine.
- Group selection cutting methods on a 30-year cutting cycle with six age-classes. Intermediate thinning may be combined with group selection cutting methods.
- Group and patch sizes and density increase by ecological response unit (ERU) as forest conditions become progressively cooler and wetter.
- Target matrix density varies by ERU.

Estimated Vegetation Management Practices

Estimated vegetation management practices describe the general types of cutting methods that are likely to be prescribed in each forest or timber type ERU and how many acres of each type of cutting method are anticipated. The practices do not include woodland or grassland ERUs. These are derived from vegetation objectives associated with each alternative, the silvicultural input used for the state-and-transition modeling, and model outputs. This is described in detail in appendices B and C.

The objectives for each alternative were developed under the assumption that future congressionally allocated dollars for vegetation management in the Gila National Forest will remain like the 2007–2017 time period. Perhaps, what is more important is what is not assumed. While the forest has been fortunate to have many partners who have generously contributed time, dollars, and other resources to accomplish restoration treatments over the years, staff and leadership believe that partnership dollars cannot be taken for granted. Competition for those dollars is high, and their availability can vary widely based on numerous factors beyond the potential influence of Gila National Forest staff and leadership. Therefore, the objectives were developed under the assumption that no partnership dollars are available. If budgeted dollars change substantially from the 2007–2017 period (and they have), these volumes could change. If partnerships and associated funding make additional treatment possible, volumes will change. Changes are also likely depending on project locations, site-specific conditions, and appropriate silvicultural prescriptions. Volumes are also dependent on having site-specific, project-level environmental analyses completed.

For all alternatives except alternative 1, it is assumed that acres treated within the wildland-urban interface are distributed among vegetation types in diversity to the amount of area within the wildland-urban interface that each type occupies. Alternative 1 assumes the distribution of wildland-urban interface treatment acres remains as it was between 2007 and 2017.

Projected Harvest Levels

The projected timber sale quantity (PTSQ) is the volume of timber projected to be sold over a specified time period. Projected wood sale quantity (PWSQ) is the projected timber sale quantity *plus* the volume of other wood products projected to be sold in association with timber sales and other types of harvesting activities in woodland ERUs. Projected harvest levels **do not** include volume removed under personal use permits for fuelwood or other forest products. Under all alternatives, the volume of personal use wood products is assumed to be relatively constant over time. While the volume may vary in the future, that variation will be based on the number of permits purchased by the public, not on decisions made by the Gila National Forest. The supply of volume to support personal use permits is expected to exceed demand under any reasonably foreseeable scenario.

Both PTSQ and PWSQ are calculated based on state-and-transition modeling outputs and regionally developed coefficients that related acres treated to volume outputs by ERU, pre-treatment vegetation conditions and thinning treatments. More details related to these calculations can be found in appendix F. The discussion related to assumptions, limitations, and sources of variability from the projected values described in the previous section are also relevant here.

Climate Adaptation and Impacts

Forest industries support the Resistance-Resilience-Transition adaptation spectrum for ecosystems and watersheds. Over the life of the plan, forest industries are assumed to benefit from implementation of the plan and subsequent adaptation actions. The forest will continue to provide socioeconomic contributions over the life of the plan. As climate change progresses, this may change. These impacts are considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Changed Circumstances

Most of the stand-replacement fire within the 2022 Black Fire occurred in congressionally designated areas and outside areas that may be suitable for timber production. The Black Fire did not create a new or different the need for change in the forest plan or create a need to revisit the timber suitability analysis or the environmental analysis for Timber, Forest, and Botanical Products.

Effects Common to All Alternatives

The availability of forest products for ceremonial and traditional tribal use will continue and does not change between alternatives. This sustains the tribes' and pueblos' traditional, cultural, and spiritual uses of the forest that have spanned centuries. All alternatives provide the opportunities for the public to collect fuelwood and other forest and botanical products under permit, which sustains ways of life and family traditions, and contributes to the economic stability of the rural communities surrounding the forest. Forest product collection also connects people to the land, which cultivates a sense of stewardship.

The volume or other quantity of these products provided under permit is projected to remain relatively stable but may vary in the future based on the permits purchased by the public, not by management decision; supply is expected to exceed demand under any reasonably foreseeable scenario. Additional forest products such as fuelwood and posts, poles and stays, will also be available as by-product of restoration and adaptation treatments under all alternatives, with effects like forest products collection provided through permits as previously described.

All alternatives have a sustained yield limit of 583 million board feet (MMBF) or 130 million cubic feet (MMCF) and provide for some level of timber and other harvesting activities that contributes revenue and job opportunities to local and regional communities. All include mechanical treatments for forest restoration or adaptation, and fuels reduction, which may produce commercial timber, small-diameter timber, fuelwood, or other biomass as by-products. Reducing tree densities can reduce competition between trees, leading to enhanced vigor and growth in the remaining trees and potentially leading to higher quality timber in the future. Uneven-aged forest management, including group selection and free thinning, is a feature of all alternatives that is not only ecologically sound, but helps make 30-year cutting cycles sustainable in the arid and semi-arid Southwest where even thinning-enhanced growth rates are slow[33.]

Thinning can also reduce the risk for product loss due to high-severity wildfire and epidemic levels of insects and disease. Thinning can lead to positive or negative changes in site moisture characteristics. Changes in site moisture characteristics have implications for product loss through drought stress and mortality. In the short term, thinning can mitigate water stress (Clark et al. 2016; Bradford and Bell 2017; among others). However, with enhanced growth rates, water demand in the residual trees and understory vegetation increases, as do evaporative losses, which may increase vulnerability to drought over the long term (Brauman et al. 2007; Clark et al. 2016; Moreno et al. 2016). The success of any given thinning intensity to reduce moisture stress will likely differ based on local site, soil, and stand conditions (Meyer et al. 2007 in North et al. 2009).

A suitable land base for timber has the potential to create jobs, support existing and new timber-related industries, generate revenue, and support a way of life valued by local communities. This potential is proportionate to the amount of suitable area and the market value of the products it contains. In terms of timber harvest as a thinning activity, a suitability determination of not suited for timber production does

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[33] There are some instances where even-aged management is appropriate and necessary. These instances include sanitation harvest for forest health. Even-aged cutting methods are necessary to address forest health agents such as mistletoe and beetle infestations, or for special objectives such as aspen or spruce-fir regeneration.

not necessarily preclude timber harvest for other reasons. Timber harvest remains a tool to move toward desired conditions unless the area is not suited for timber production based on legislation that prohibits timber harvest. Where not prohibited by law, thinning activities in areas not suited for timber production may provide products to people but cannot be relied upon on a routine basis to support local and regional markets and contribute financially to area residents.

Inventoried roadless areas are not suited for timber production, based on desired conditions, under all alternatives. The desired conditions for these areas are the same across all alternatives in compliance with the requirements of the regulation that established them. While timber could legally be removed from these areas, regular cycles of timber harvest require road infrastructure, which is inconsistent with the intent of the clause in the Roadless Rule that allows for roads to be used to harvest timber under specified exceptional circumstances. Aerial operations on a regulated, periodic basis are not economically feasible, nor are they likely to benefit local economies, as those technologies are not currently available locally and would require a substantial investment by local operators. For these reasons, approximately 184,929 acres of inventoried roadless areas or approximately 6 percent of the Gila National Forest are removed from suitability under all alternatives without a measurable decrease in the ability of the forest to contribute to jobs and revenue to local economies.

Proposed research natural areas are determined to be not suited for timber production based on the desired conditions, nor is the harvest of other forest and botanical products consistent with research natural area status. While the alternatives vary in their proposals for research natural areas, none contain lands that would be suited for timber production were they not proposed. This is predominantly because they do not contain forested vegetation (see Appendix H: Research Natural Area Evaluation Process). There is also no substantial effect to the availability of other products given the vegetation communities they contain and the small number of acres involved.

All alternatives establish soil and slope-based standards to support maintenance of desired conditions for soil and watershed. These standards contain caveats to accommodate any site-specific tradeoffs that might exist between mechanical vegetation treatments, potential damage associated with high-severity wildfire, and wildland-urban interface values. If harvest is necessary to protect watershed or wildland-urban interface values, it is allowable. However, regular cycles of timber harvest are not. This removes approximately 72,918 acres from suitability, or approximately 2 percent of the Gila National Forest, which includes 22,925 acres of highly erodible Datil soils on slopes greater than 15 percent and 49,993 acres that either occur on erosional landforms or have little to no soil development on slopes greater than 25 percent. Soils with little to no development have low natural stability and are less resilient. Furthermore, some of these soils are not capable of producing a significant herbaceous response, due to natural soil properties, which leaves their stability entirely reliant on conifer canopy cover, basal area, coarse woody debris, and needle litter. Removing these acres from suitability does not substantially reduce the forest’s ability to contribute jobs and revenue to local economies, but it does reduce the reliability of contributions that these acres may provide as compared to the suitable timber base.

Similarly, another 54,259 acres, or approximately 2 percent of the Gila National Forest with slopes over 40 percent are removed from suitability under plan standards to support maintenance of desired conditions for soil and watershed. This slope threshold represents the limitations of conventional, ground-based equipment. Specialized ground-based equipment or aerial operations would be required to harvest these acres, both of which substantially increase the cost per acre[34] and would reduce the number of acres that could be harvested given fiscal limitations. No local operators have this equipment, and much less of the

[34] Recent cost estimates obtained for a project on the Kaibab National Forest are approximately $3,000 per acre (Natharius, pers. comm. 2019) as opposed to the roughly $350 to $700 per acre cost the Gila National Forest has paid in recent years for conventional equipment.

revenue generated by such harvest would benefit local economies. While harvesting on these slopes is not prohibited by plan standards, it is not economically feasible to do so on a routine basis. Furthermore, if operators from outside the local communities were brought in to do this work, the economic benefit to the local economy would be reduced. Lastly, 2,561 acres, or approximately 0.1 percent of the Gila National Forest, were removed from suitability because they represent pockets of suitable timber less than 10 acres in size within larger areas that were determined not to be suited. These acres were removed because it is not economically realistic and may not be operationally feasible to manage them for timber production. Therefore, this does not substantially reduce the forest's ability to contribute jobs and revenue to local economies.

Differences among alternatives arise in terms of the number of acres suited for timber production, number of acres treated, types of products, and projected harvest volumes. These differences are tied to the ecosystem types that treatments would focus on under a given alternative, methods used to accomplish treatments, and the amount of land that would be recommended to Congress to be considered for wilderness designation.

Wildland fire would continue to occur under all alternatives, although its role as a management tool varies between alternatives. Both prescribed and naturally ignited fire can be restoration or fuels management tools when used alone, or in conjunction with mechanical treatments. Scientific research suggests that neither mechanical treatments nor prescribed fire used alone produce a significant effect on nutrient availability. However, when used in combination, the effects are generally both significant and positive (Sánchez Meador et al. 2017 among others). Higher nutrient availability can enhance growth rates. On the other hand, there is literature indicating the significance of fire effects on nutrient cycling, and whether those effects are positive or negative, is dependent on soil heating thresholds (DeBano 1990; Busse et al. 2014). While it might be that these thresholds are not reached under most prescribed burning conditions, it does happen and can result in enhanced or reduced nutrient availability for a relatively short period of time (Busse et al. 2014). These thresholds are more often reached in wildfire scenarios, where unfavorable weather and fuel conditions support stand-replacement fire. Mixed and high severity (whether because of prescribed or naturally ignited) wildfire can lower product values as fire-damaged timber generally has lower market value. While the potential for salvage sales exists under all alternatives, lower product values results a smaller socioeconomic contribution. On lands suited for timber production, stand-replacement fire can also substantially lengthen the time between harvest cycles as it may take well over 30 years for stands to reestablish such that a socioeconomic contribution may be made.

Effects Common to Alternatives 1, 2, 3, and 4

The area suitable for timber production can be viewed as an indicator of potential opportunity for the Gila National Forest to provide reliable contributions to local and regional revenue and job opportunities if market forces and industry capacity were not factors. In terms of the area suitable for timber production, alternatives 1, 2, 3, and 4 are not substantially different with roughly one-tenth of a percent separating them (table 44, and figure 35 through figure 38). Therefore, there is not a substantial difference between these alternatives in terms of potential opportunity for timber production to contribute to jobs and revenue in local communities, stimulate markets, or support industry innovations even though alternatives 2, 3, and 4 recommend approximately 110,402, 130,012, and 72,901 acres, respectively, to Congress for wilderness designation. Recommended wilderness is the sole variable driving differences between alternatives 1, 2, 3, and 4. Alternative 5's suitability determination is displayed and discussed under the alternative 5 heading because there is a substantial difference in the acres recommended to Congress for wilderness designation between alternative 5 and alternatives 1 through 4.

Table 44. Comparison of timber production suitability classifications under alternatives 1, 2, 3, and 4

Land Classification Category	Alternative 1 (acres)	Alternative 2 (acres)	Alternative 3 (acres)	Alternative 4 (acres)
A. Total area within the administrative boundary of the Gila National Forest	3,392,112*	3,392,112*	3,392,112*	3,392,112*
Lands within the administrative boundary that are not National Forest System lands (private property or other ownership)	119,972	119,972	119,972	119,972
B. Lands not suited for timber production due to legal or technical reasons (B1+B2+B3+B4)	2,589,050	2,589,050	2,589,050	2,589,050
B1. Lands not suited for timber production because it is prohibited. †	822,995	822,995	822,995	822,995
B2. Lands not suited for timber production because the technology to harvest timber without causing irreversible damage is not available.	0	0	0	0
B3. Lands not suited for timber production because there is no reasonable assurance of adequate restocking within 5 years of final regeneration harvest. ¥	338,694	338,694	338,694	338,694
B4. Lands not suited for timber production because they are not forested. £	1,427,361	1,427,361	1,427,361	1,427,361
C. Lands that *may* be suited for timber production (A–B)	683,090	683,090	683,090	
D. Total lands suited for timber production because timber production is compatible with the desired conditions and objectives established by the plan (C – E)	354,246	352,922	351,028	354,205
E. Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the plan (C – D) ¤	328,845	330,168	332,062	328,885
F. Total lands not suited for timber production (B+E)	2,917,895	2,919,218	2,921,112	2,917,935

*Acreages of National Forest System lands may vary slightly over time due to factors such as resurvey, improved mapping technology and updates to corporate geospatial information systems (GIS) data.

†This includes existing congressionally designated wilderness areas (792,584 acres) and wilderness study areas (27,660 acres), eligible wild and scenic river segments with a preliminary classification of wild (approximately 71,715 acres), existing designated research natural areas (393 acres). In some cases, there is overlap between these kinds of areas. For example, many eligible wild and scenic river segments occur within existing designated wilderness. See also Appendix F. Timber Production Suitability, Estimated Vegetation Practices and Projected Harvest Levels Methodology.

¥This includes ecotones, or transition areas between woodland and forest types. On these moisture limited sites, ponderosa pine establishment and survival under the current climatic regime is episodic and site indices are low. Site indices are a measure of site productivity based on tree height, diameter and age. See also Appendix F. Timber Production Suitability, Estimated Vegetation Practices and Projected Harvest Levels Methodology.

£This includes woodland, grassland, shrubland and riparian ecological response units. See also appendix F. Timber Production Suitability, Estimated Vegetation Practices and Projected Harvest Levels Methodology.

¤This includes the acres previously identified and discussed under the effects common to all alternatives as being removed for soil and watershed desired conditions and vegetation objectives, as well as those acres of recommended wilderness included in the alternative. There may be overlap between areas removed due to incompatibility with desired conditions and objectives and recommended wilderness areas depending on the soils and slopes contained in each recommended area.

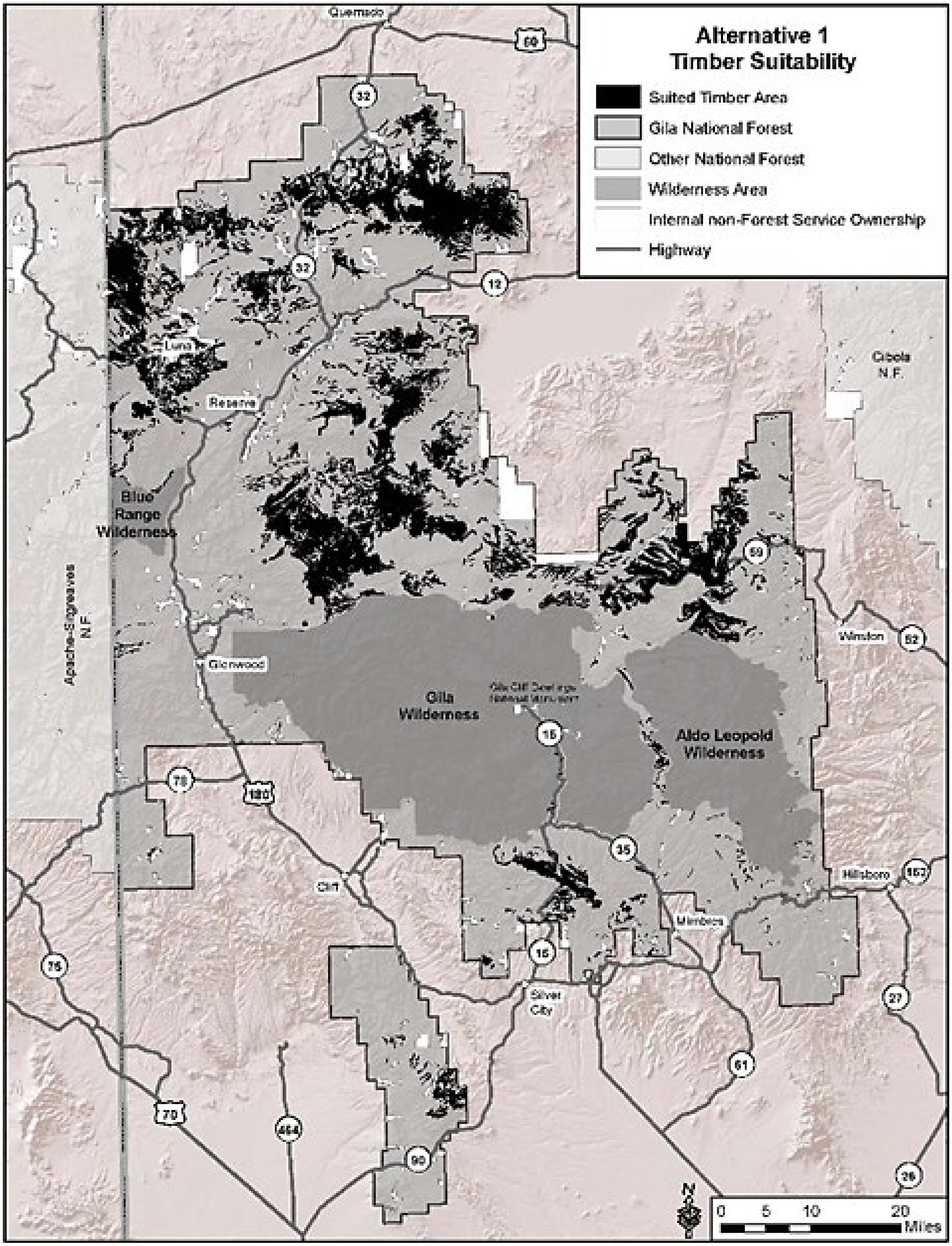

Figure 35. Suitable timber base under alternative 1

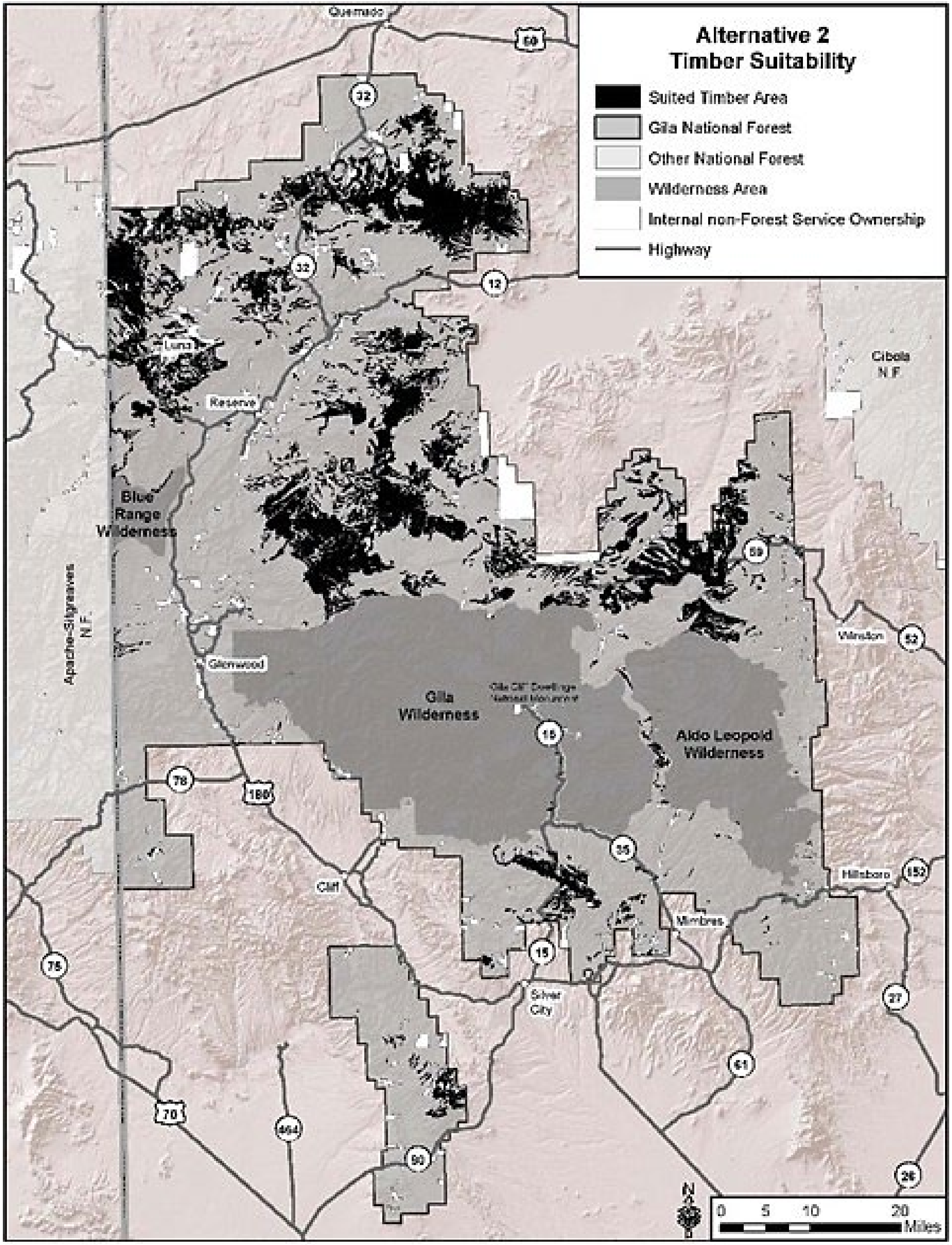

Figure 36. Suitable timber base under alternative 2

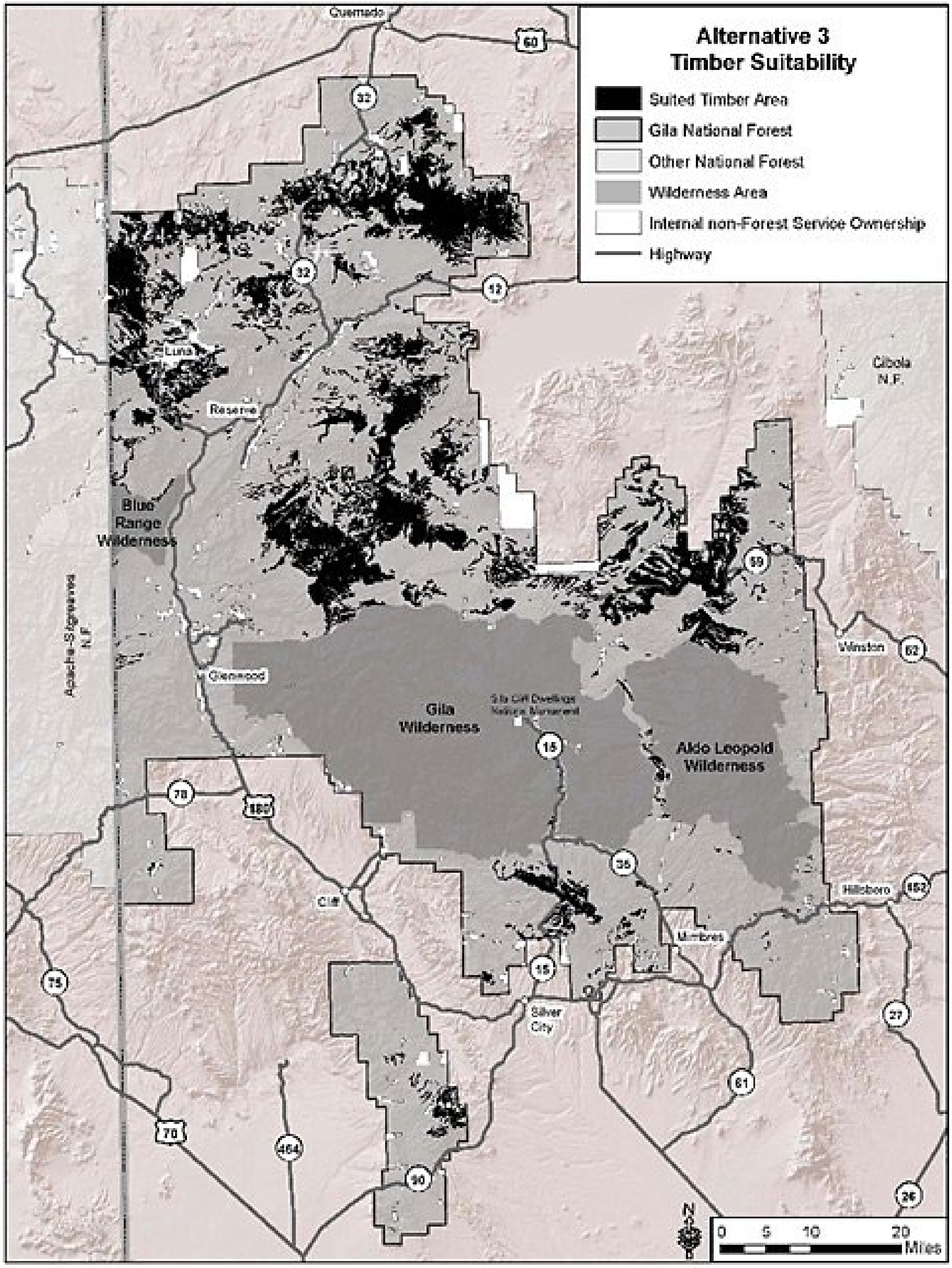

Figure 37. Suitable timber base under alternative 3

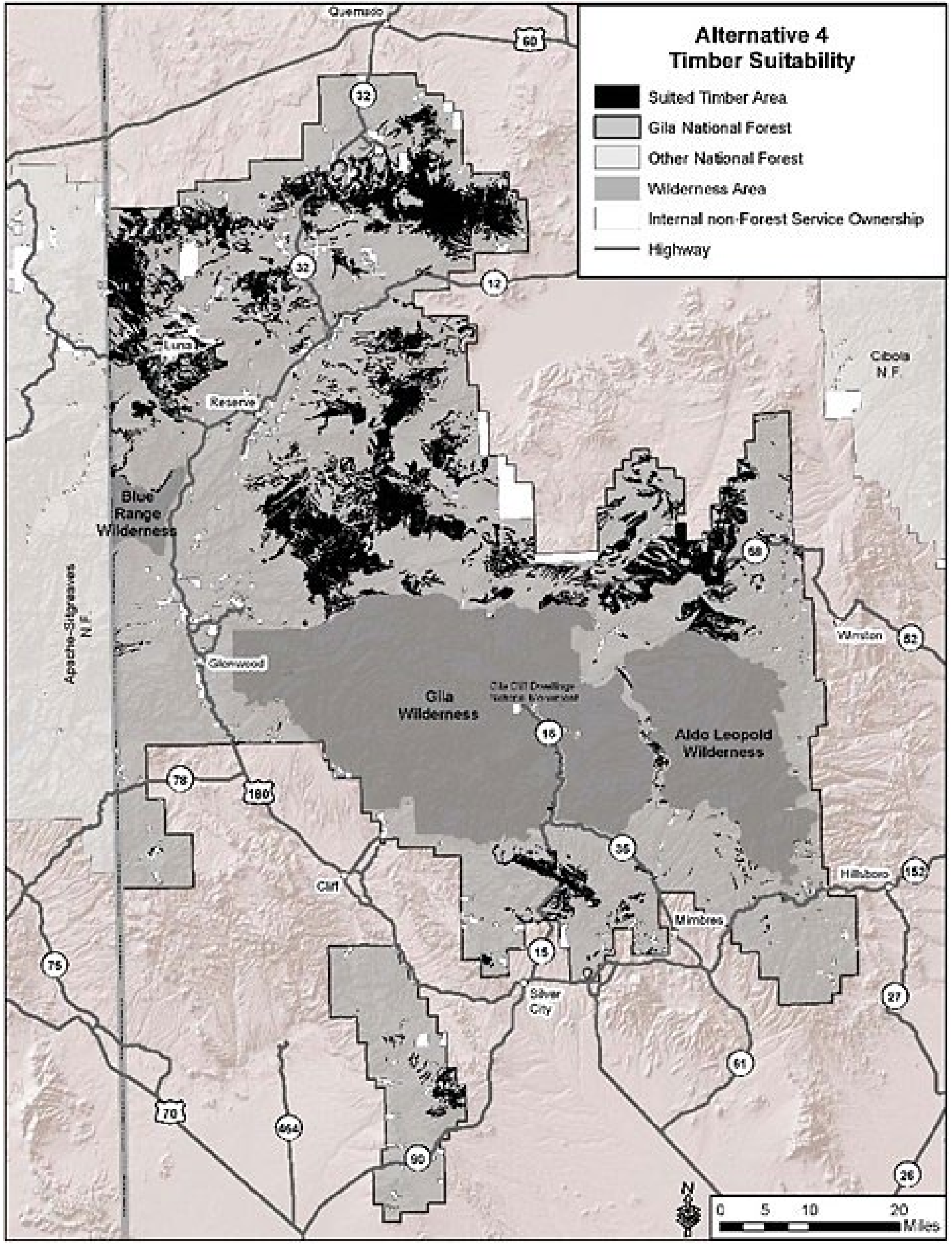

Figure 38. Suitable timber base under alternative 4

On the other hand, there are substantial differences in terms of how this opportunity is leveraged among these alternatives. These differences are related to the desired conditions for each vegetation type, the estimated vegetation practices and projected harvest levels proposed under each alternative. and are discussed in alternative-specific sections that follow.

Effects of Alternative 1

Under the no-action alternative, most vegetation types receive some acres of mechanical treatment that typically result in forest products being made available to local business and individuals, which has contributed jobs and revenue to local economies. In the timber types, Ponderosa Pine Forest has been the primary focus, followed by Ponderosa Pine-Evergreen Oak and Mixed Conifer-Frequent Fire. Treatments in Mixed Conifer with Aspen have been relatively incidental, occurring when relatively small areas are present within a larger project area. Table 45 provides the estimated vegetation management practices for timber types under alternative 1.

Table 45. Estimated forestwide vegetation management practices in timber vegetation types under alternative 1 (shown in annual average acres per decade)

Forest Cover Types/ Vegetation Management Practices	1st Decade	2nd Decade
Ponderosa Pine Treatments		
Regeneration (Even-aged harvest)	539	831
Thinning (Even-aged Intermediate harvest)	3,155	3,100
Selection (Uneven-aged harvest)	12,620	12,399
Wet Mixed Conifer Treatments		
Regeneration (Even-aged harvest)	19	36
Thinning (Even-aged Intermediate harvest)	64	60
Selection (Uneven-aged harvest)	254	239
Dry Mixed Conifer Treatments		
Regeneration (Even-aged harvest)	0	117
Thinning (Even-aged Intermediate harvest)	121	102
Selection (Uneven-aged harvest)	486	408
Total Treatments		
Regeneration (Even-aged harvest)	557	968
Thinning (Even-aged Intermediate harvest)	3,340	3,262
Selection (Uneven-aged harvest)	13,360	13,046

On average, approximately 17,275 acres of harvesting activities in timber vegetation types, both within and outside the wildland-urban interface, are projected to occur each decade with a strong emphasis on ponderosa pine types. Harvesting activities are also planned in woodlands and encroached grasslands with an additional average of 11,996 acres in woodland vegetation types and roughly 8,317 acres in encroached grasslands each decade. Treatments in woodlands and grassland systems provide additional wood products, including fuelwood, and may ease access into these areas for the collection of special forest products like pinyon nuts.

Considering 354,246 acres of suitable timber under alternative 1 (table 44), a substantial portion of the potential socioeconomic contribution remains untapped in terms of timber production. Table 46 contains the PTSQ and PWSQ associated with treatments in timber and woodland vegetation types. The table does not include wood that might be associated with grassland restoration because those systems are not being managed for a sustainable supply of wood products. Values are rounded to the nearest whole number or decimal place where a whole number would be reported as zero.

Table 46. Projected volume associated with estimated vegetation practices under alternative 1

Sustained Yield Limit (SYL)	**583 MMBF, 130 MMCF per decade**					
Timber Products	First Decade			Second Decade		
	MMCF	MMBF	Tons	MMCF	MMBF	Tons
	Volumes other than salvage or sanitation that meet timber product utilization standards					
Lands suitable for timber production						
A1. Sawtimber (industrial softwoods, 9"+)	6	29	92,589	8	39	118,932
A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	1		19,047	2		22,775
Lands not suitable for timber production						
B1. Sawtimber (9"+)	0.3	2	4,873	0.4	2	6,260
B2. Other Products (5-9")	0.1		1,002	0.1		1,199
C. **Projected Timber Sale Quantity (PTSQ)** (A1+A2+B1+B2)	8	30	117,511	10	41	149,165
Other Estimated Wood Products	Fuelwood, biomass, and other volumes that do not meet timber product utilization standards					
	MMCF		Tons	MMCF		Tons
D1. Non-industrial softwood fuelwood (5"+)	1		0.2	1		0.3
D2. Hardwood fuelwood (5"+)	0.5		0.2	1		0.2
D3. Aspen (5"+)	0.1		0.03	0.1		0.03
E. **Projected Wood Sale Quantity (PWSQ)** (C+D1+D2+D3)	9		117,512	12		149,166

The total decadal volumes projected to be produced under alternative 1 are very similar to the decadal average the forest has produced in the past (2005 and 2018), but the distribution of that volume between product types differs. The projected volume for the first decade under alternative 1 includes 6 MMCF of sawtimber, but the forest has only produced an average of 3.7 MMCF per decade. Several things may explain these differences, including site-specific conditions and appropriate silvicultural prescriptions. Projected volumes are based on regional averages, which may introduce error in the calculations where those averages do not reflect the actual volumes in a specific stand. In recent years, the forest has offered timber sales and on occasion, received no bids. Whether this reflects lack of interest, market conditions, industry capacity, or some combination of these factors is somewhat speculative. Nevertheless, it has reduced the volume the Gila National Forest has been able to produce. Assuming all sales offered are sold, this alternative would continue to support existing timber and timber-related industries and may support a modest amount of growth in some markets.

Under alternative 1, harvesting activities and low severity prescribed fire are frequently used in conjunction and naturally ignited wildfires are managed for resource benefit based on proximity of wildland-urban interface values, and weather and fuel conditions. In general, only 4 percent of natural ignitions have been managed for resource benefit. The rest have been suppressed (see Upland Vegetation, Fire Ecology and Fuels). Given existing conditions, this does little to reduce the risk of damaging stand-replacement fires that can reduce the quantity and quality of timber, forest, and botanical products and the socioeconomic contributions that would be provided under this alternative.

Furthermore, when stand-replacement fire occurs within the suitable timber base, several harvest cycles could be missed before the area can produce the same quantity and quality of merchantable material again.

Effects of Alternative 2

Like alternative 1, most vegetation types would receive some amount of mechanical treatments. However, the distribution of acres treated differs from alternative 1. Table 47 provides the estimated vegetation management practices for timber types under alternative 2. It includes acres within and outside the wildland-urban interface. Alternative 2 maintains an emphasis on timber with approximately 16,463 acres of harvest in timber vegetation types, 9,940 acres of harvest in woodlands, and 7,861 acres in encroached grasslands on an average decadal basis. Total acres of projected harvest are less than alternative 1 due to an increased investment in prescribed fire. This reflects tradeoffs made under this alternative between the cost per acre to move vegetation toward desired conditions and the socioeconomic benefit associated with forest products.

Table 47. Estimated forestwide vegetation management practices in timber vegetation types under alternative 2 (shown in annual average acres per decade)

Forest Cover Types/ Vegetation Management Practices	1st Decade	2nd Decade
Ponderosa Pine Treatments		
Regeneration* (Even-aged harvest)	579	327
Thinning (Even-aged Intermediate harvest)	1,676	1,726
Selection (Uneven-aged harvest)	6,702	6,905
Wet Mixed Conifer Treatments		
Regeneration* (Even-aged harvest)	24	66
Thinning (Even-aged Intermediate harvest)	66	57
Selection (Uneven-aged harvest)	263	230
Dry Mixed Conifer Treatments		
Regeneration* (Even-aged harvest)	529	593
Thinning (Even-aged Intermediate harvest)	1,325	1,312
Selection (Uneven-aged harvest)	5,298	5,247
Total Treatments		
Regeneration* (Even-aged harvest)	1,133	986
Thinning (Even-aged Intermediate harvest)	3,067	3,095
Selection (Uneven-aged harvest)	12,263	12,382

Within the timber types, ponderosa pine types received fewer acres of treatment in favor of an increased emphasis on mixed conifer, which has received less attention under current management. This shift in emphasis reflects concerns about existing conditions in cooler, moister vegetation types, fire management and predicted climate change impacts. Within the ponderosa pine types, Ponderosa Pine Forest retains priority over Ponderosa Pine-Evergreen Oak. While treatment acres are reduced for both pine types, planned harvesting activities in Ponderosa Pine-Evergreen Oak would be substantially reduced from alternative 1 due to the post-treatment evergreen oak response that has been observed. A post-treatment increase in both evergreen oak and juniper species in every ERU where they are a component has been observed frequently, but the response in terms of stems per acre and canopy cover has become particularly problematic in Ponderosa Pine-Evergreen Oak and is of substantial concern in the wildland-urban interface. The increased density of these species alters forest composition and structure, the potential for future timber harvest, and fire behavior. These species have the competitive advantage in the warmer, drier post-treatment environment and may interfere with the establishment and growth of timber species. They also serve as ladder fuels, which may result in a shift from a frequent, low-severity fire regime to a more variable, mixed-severity fire regime. This issue has been discussed in detail in the Upland Vegetation, Fire Ecology and Fuels section of this document. The objectives under alternative 2 have sufficient flexibility that harvest could be increased over projected levels should more successful methods and the funds to do so become available.

Like alternative 1, this alternative leaves much of the potential socioeconomic benefit associated with the amount of land suitable for timber production untapped, with only about 5 percent of the 352,922 acres suited for timber production being harvested each decade. Table 48 contains the PTSQ and PWSQ associated with treatments in timber and woodland vegetation types. The table does not include wood that might be associated with grassland restoration because those systems are not being managed for a sustainable supply of wood products. Values are rounded to the nearest whole number or decimal place where a whole number would be reported as zero.

Table 48. Projected volume associated with estimated vegetation practices under alternative 2

Sustained Yield Limit (SYL)	**583 MMBF, 130 MMCF per decade**					
Timber Products	First Decade			Second Decade		
	MMCF	MMBF	Tons	MMCF	MMBF	Tons
	Volumes other than salvage or sanitation that meet timber product utilization standards					
Lands suitable for timber production						
A1. Sawtimber (industrial softwoods, 9"+)	8	35	115,153	5	24	78,972
A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	3		22,497	1		15,093
Lands not suitable for timber production						
B1. Sawtimber (9"+)	0.4	2	6,061	0.3	1	4,156
B2. Other Products (5-9")	0.1		1,184	0.1		794
C. **Projected Timber Sale Quantity (PTSQ)** (A1+A2+B1+B2)	11	37	144,894	7	25	99,016
Other Estimated Wood Products	Fuelwood, biomass, and other volumes that do not meet timber product utilization standards					
	MMCF		Tons	MMCF		Tons
D1. Non-industrial softwood fuelwood(5"+)	1		0.3	1		0.2
D2. Hardwood fuelwood (5"+)	0.4		0.2	0.2		0.1
D3. Aspen (5"+)	1		0.1	0.3		0.1
E. **Projected Wood Sale Quantity (PWSQ)** (C+D1+D2+D3)	13		144,895	8		99,016

Despite these differences, on the decadal average, alternative 2 is not substantially different from alternative 1 in terms of projected volume. Assuming all sales offered are sold, this alternative would also continue to support existing timber and timber-related industries and may provide for a modest amount of growth in some markets.

Also, like alternative 1, alternative 2 uses harvesting activities, and prescribed and naturally ignited wildfire. However, alternative 2 places a slightly higher emphasis on prescribed fire to move more acres toward desired conditions. It also takes on more risk by allowing more mixed-severity fire to occur on the landscape and by managing more natural ignitions. This increases both the potential beneficial and detrimental effects to timber, forest, and botanical products associated with fire identified as common to all alternatives.

This could mean an increase in the number of treated acres on which the vigor and growth of residual trees are demonstrated, providing higher value products to local industries over the long term, but could be accompanied by salvage sales and lower value products over the short term. However, this alternative does more to reduce the risk of large, contiguous extents of high-severity wildfire, which protects product value and socioeconomic contributions the forest can make over the long term.

Effects of Alternative 3

Dissimilar to alternatives 1 and 2, this alternative focuses exclusively on woodland and grassland vegetation types based on stakeholder concerns about the lack of progress being observed in these systems. As a result, the only timber production potential that is tapped into is in the wildland-urban interface, where mechanical treatments may produce timber in diversity to how much of the wildland-urban interface occurs within timber vegetation types. The potential is essentially the same, it just isn't used outside the wildland-urban interface. Table 49 provides the estimated vegetation management practices for vegetation types under alternative 3.

Table 49. Estimated forestwide vegetation management practices in timber vegetation types under alternative 3 (shown in annual average acres per decade)

Forest Cover Types/ Vegetation Management Practices	1st Decade	2nd Decade
Ponderosa Pine Treatments		
Regeneration* (Even-aged harvest)	72	0
Thinning (Even-aged Intermediate harvest)	313	328
Selection (Uneven-aged harvest)	1,253	1,340
Wet mixed conifer/spruce-fir Treatments		
Regeneration* (Even-aged harvest)	0	18
Thinning (Even-aged Intermediate harvest)	11	7
Selection (Uneven-aged harvest)	42	29
Dry mixed conifer Treatments		
Regeneration* (Even-aged harvest)	0	0
Thinning (Even-aged Intermediate harvest)	55	55
Selection (Uneven-aged harvest)	222	222
Total Treatments		
Regeneration* (Even-aged harvest)	72	18
Thinning (Even-aged Intermediate harvest)	379	390
Selection (Uneven-aged harvest)	1,517	1,591

On average, 1,968 acres of harvesting activities in timber types are projected to occur in the wildland-urban interface along with 33,940 acres of woodland treatments and 15,900 acres of grassland restoration. The total acres of treatments increase significantly as opposed to alternatives 1 and 2 because there is significantly less investment being made in the use of prescribed fire, which frees up additional funds for mechanical treatments. Table 50 contains the PTSQ and PWSQ associated with treatments in timber and woodland vegetation types. The table does not include wood that might be associated with grassland restoration because those systems are not being managed for a sustainable supply of wood products. Values are rounded to the nearest whole number or decimal place where a whole number would be reported as zero.

Table 50. Projected volume associated with estimated vegetation practices under alternative 3

Sustained Yield Limit (SYL)	**583 MMBF, 130 MMCF per decade**					
Timber Products	First Decade			Second Decade		
	MMCF	MMBF	Tons	MMCF	MMBF	Tons
	Volumes other than salvage or sanitation that meet timber product utilization standards					
Lands suitable for timber production						
A1. Sawtimber (industrial softwoods, 9”+)	1	6	20,121	0.8	4	12,650
A2. Other Products (industrial softwood, 5-9” - roundwood, commonly pulpwood, mostly in the form of fuelwood)	0.2		3,391	0.2		2,397
Lands not suitable for timber production						
B1. Sawtimber (9"+)	0.1	0.3	178	0.04	0.2	666
B2. Other Products (5-9")	2		1,978	0.01		126
C. **Projected Timber Sale Quantity (PTSQ)** (A1+A2+B1+B2)	2	7	25,669	1	4	15,839
Other Estimated Wood Products	Fuelwood, biomass, and other volumes that do not meet timber product utilization standards					
	MMCF		Tons	MMCF		Tons
D1. Non-industrial softwood fuelwood (5"+)	15		4	4		1
D2. Hardwood fuelwood (5"+)	1		0.5	1		0.4
D3. Aspen (5"+)	0.03		0.01	0.04		0.01
E. **Projected Wood Sale Quantity (PWSQ)** (C+D1+D2+D3)	18		25,673	6		15,840

There are substantial declines in sawtimber volume projected under this alternative. On the other hand, the volume of fuelwood and other wood products are projected to substantially increase. This alternative has the potential to put the local timber industry out of business, which would result in a loss of revenue and job opportunities. While the local timber industry could theoretically be replaced by a new business model capable of using the products made available under this alternative, such as a biomass energy-generation plant or bio-char production, such businesses are not currently operating within economically feasible haul distances. Start-up costs could be prohibitive for most residents and businesses within the life of the revised plan without grant funding or some other kind of subsidy or incentive. It is unlikely that any market or industry growth that could take advantage of these products would be able to compensate for the loss of the timber industry.

While wildland fire remains a tool under alternative 3, the decreased emphasis on its use means fewer acres are treated overall and the risk to forest products is not substantially lessened by the harvesting activities projected under this alternative. This makes the likelihood of large extents of stand-replacement wildfire and the associated detrimental effects to forest products identified as common to all alternatives, greater than alternative 1 or 2. There are also implications for future timber management options beyond this planning cycle, given the emphasis on treating woodlands and grasslands; stand-replacement fire will more likely occur in both suited and unsuited timber that does not receive thinning treatments.

Effects of Alternative 4

In contrast to alternative 3, alternative 4 focuses exclusively on timber vegetation types based on stakeholder interests and concerns about the local timber industry. Woodland and grasslands are only harvested in the wildland-urban interface. Table 51 displays the estimated vegetation management practices for timber types.

Table 51. Estimated forestwide vegetation management practices in timber vegetation types under alternative 4 (shown in annual average acres per decade)

Forest Cover Types/ Vegetation Management Practices	1st Decade	2nd Decade
Ponderosa Pine Treatments		
Regeneration* (Even-aged harvest)	3,138	2,499
Thinning (Even-aged Intermediate harvest)	7,546	7,674
Selection (Uneven-aged harvest)	30,184	30,695
Wet Mixed Conifer Treatments		
Regeneration* (Even-aged harvest)	28	40
Thinning (Even-aged Intermediate harvest)	65	63
Selection (Uneven-aged harvest)	260	250
Dry Mixed Conifer Treatments		
Regeneration* (Even-aged harvest)	1,385	1,396
Thinning (Even-aged Intermediate harvest)	2,278	2,276
Selection (Uneven-aged harvest)	9,114	9,106
Total Treatments		
Regeneration* (Even-aged harvest)	4,552	3,935
Thinning (Even-aged Intermediate harvest)	9,889	10,013
Selection (Uneven-aged harvest)	39,558	40,051

On average, 53,998 acres of harvest per decade are projected for timber vegetation types under alternative 4, with 1,940 acres of woodland harvest and 462 acres of grassland restoration. As with alternative 3, less investment in prescribed fire allows more acres of mechanical harvest to occur. In terms of volume, sawtimber volumes are expected to increase 6-fold and the total volume of wood products is projected to quadruple over what is projected under alternative 1. Table 52 contains the PTSQ and PWSQ associated with treatments in timber and woodland vegetation types. The table does not include wood that might be associated with grassland restoration because those systems are not being managed for a sustainable supply of wood products. Values are rounded to the nearest whole number or decimal place where a whole number would be reported as zero.

Under this alternative, the forest's ability to sustain existing timber and timber-related industries and contribute to economic growth is substantially greater than the other alternatives, but projected volumes still do not approach the sustained yield limit. As previously mentioned, the forest has offered timber sales in the recent past and on occasion, received no bids. Perhaps this alternative could inspire greater confidence in the reliable availability of products and invigorate local industry. However, given current markets and industry capacity, this level of harvest within the analysis timeframe may not be realistically achievable.

Table 52. Projected volume associated with estimated vegetation practices under alternative 4

Sustained Yield Limit (SYL)	**583 MMBF, 130 MMCF per decade**					
Timber Products	First Decade			Second Decade		
	MMCF	MMBF	Tons	MMCF	MMBF	Tons
	Volumes other than salvage or sanitation that meet timber product utilization standards					
Lands suitable for timber production						
A1. Sawtimber (industrial softwoods, 9”+)	28	128	420,205	28	130	414,731
A2. Other Products (industrial softwood, 5-9” - roundwood, commonly pulpwood, mostly in the form of fuelwood)	6		86,443	5		77,582
Lands not suitable for timber production						
B1. Sawtimber (9"+)	1	7	22,116	1	7	21,828
B2. Other Products (5-9")	0		4,550	0		4,083
C. **Projected Timber Sale Quantity (PTSQ)** (A1+A2+B1+B2)	36	134	533,314	35	137	518,224
Other Estimated Wood Products	Fuelwood, biomass, and other volumes that do not meet timber product utilization standards					
	MMCF		Tons	MMCF		Tons
D1. Non-industrial softwood fuelwood (5"+)	2		0.6	2		0.6
D2. Hardwood fuelwood (5"+)	2		0.9	2		0.8
D3. Aspen (5"+)	1		0.3	1		0.2
E. **Projected Wood Sale Quantity (PWSQ)** (C+D1+D2+D3)	41		533,316	40		518,226

As in alternative 3, more acres of mechanical harvesting are possible due to a decreased emphasis on prescribed fire. However, the effects are different with the emphasis being placed on timber vegetation types. In the timber types, existing conditions are either maintained or improved over alternative 1 and the risk of product or value loss resulting from high-severity fire in these types is reduced and more acres of timber may experience enhanced growth rates. On the other hand, research suggests that mechanical treatments alone favor the dominance of woody species in the understory that may compete with the establishment and growth of higher value timber species (in the sense of Goodwin et al. 2018) and serve as ladder fuels that can increase the likelihood of stand-replacement fire. Over time, this could reduce the forest’s potential to produce timber and provide socioeconomic contributions.

The trend in woodland and grassland conditions under this alternative is projected as stable to declining. However, risk posed to forest products in woodlands and encroached grasslands by stand-replacement fire represents a smaller potential economic loss because the value of fuelwood and the other products that come from woodlands and encroached grasslands are less likely to be affected than sawtimber.

Overall, the risk of stand-replacement fire is reduced as compared to alternatives 1 and 3, as more area on the forest moves to open-canopy conditions. However, alternative 4 does less to reduce this risk than alternative 2, because it treats fewer overall acres because of limiting the use of naturally ignited wildfire.

Effects of Alternative 5

This alternative substantially reduces the potential socioeconomic benefit that a suitable timber base can provide. Although this alternative recommends 745,286 acres of land to Congress for wilderness designation, the primary reason for the reduced potential is because this alternative restricts regular harvesting activities outside of the wildland-urban interface in favor of using fire as the primary restoration tool. Only 29,998 acres of suitable timberland occur within the wildland-urban interface as displayed in table 53 and figure 39. Table 54 displays the estimated vegetation management practices for timber types.

Table 53. Timber production suitability classifications for alternative 5

Land Classification Category	Acres
A. Total area within the administrative boundary of the Gila National Forest	3,392,112*
Lands within the administrative boundary that are not National Forest System lands (private property or other ownership)	119,972
B. Lands not suited for timber production due to legal or technical reasons	2,589,050
B1. Lands not suited for timber production because it is prohibited.†	822,995
B2. Lands not suited for timber production because the technology to harvest timber without causing irreversible damage is not available.	0
B3. Lands not suited for timber production because there is no reasonable assurance of adequate restocking within 5 years of final regeneration harvest.¥	338,694
B4. Lands not suited for timber production because they are not forested.£	1,427,361
C. Lands that *may* be suited for timber production (A–B)	683,090
D. Total lands suited for timber production because timber production is compatible with the desired conditions and objectives established by the plan (C-E)	29,998
E. Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the plan¤ (C-D)	653,092
F. Total lands not suited for timber production (B+E)	3,242,142

*Acreages of National Forest System lands may vary slightly over time due to factors such as resurvey, improved mapping technology and updates to corporate geospatial information systems (GIS) data.

†This includes existing congressionally designated wilderness areas (792,584 acres) and wilderness study areas (27,660 acres), eligible Wild and Scenic River segments with a preliminary classification of Wild (approximately 71,715 acres), and existing designated research natural areas (393 acres). In some cases, there is overlap between these kinds of areas. For example, many eligible Wild and Scenic River segments occur within existing designated wilderness. See also Appendix F. Timber Production Suitability, Estimated Vegetation Practices and Projected Harvest Levels Methodology.

¥This includes ecotones, or transition areas between woodland and forest types. On these moisture limited sites, ponderosa pine establishment and survival under the current climatic regime is episodic and site indices are low. Site indices are a measure of site productivity based on tree height, diameter, and age. See also Appendix F. Timber Production Suitability, Estimated Vegetation Practices and Projected Harvest Levels Methodology.

£This includes woodland, grassland, shrubland and riparian Ecological Response Units. See also Appendix F. Timber Production Suitability, Estimated Vegetation Practices and Projected Harvest Levels Methodology.

¤This includes the acres previously identified and discussed under the effects common to all alternatives as being removed for soil and watershed desired conditions and vegetation objectives, as well as those acres of recommended wilderness included in the alternative. There may be overlap between areas removed due to incompatibility with desired conditions and objectives and recommended wilderness areas depending on the soils and slopes contained in each recommended area.

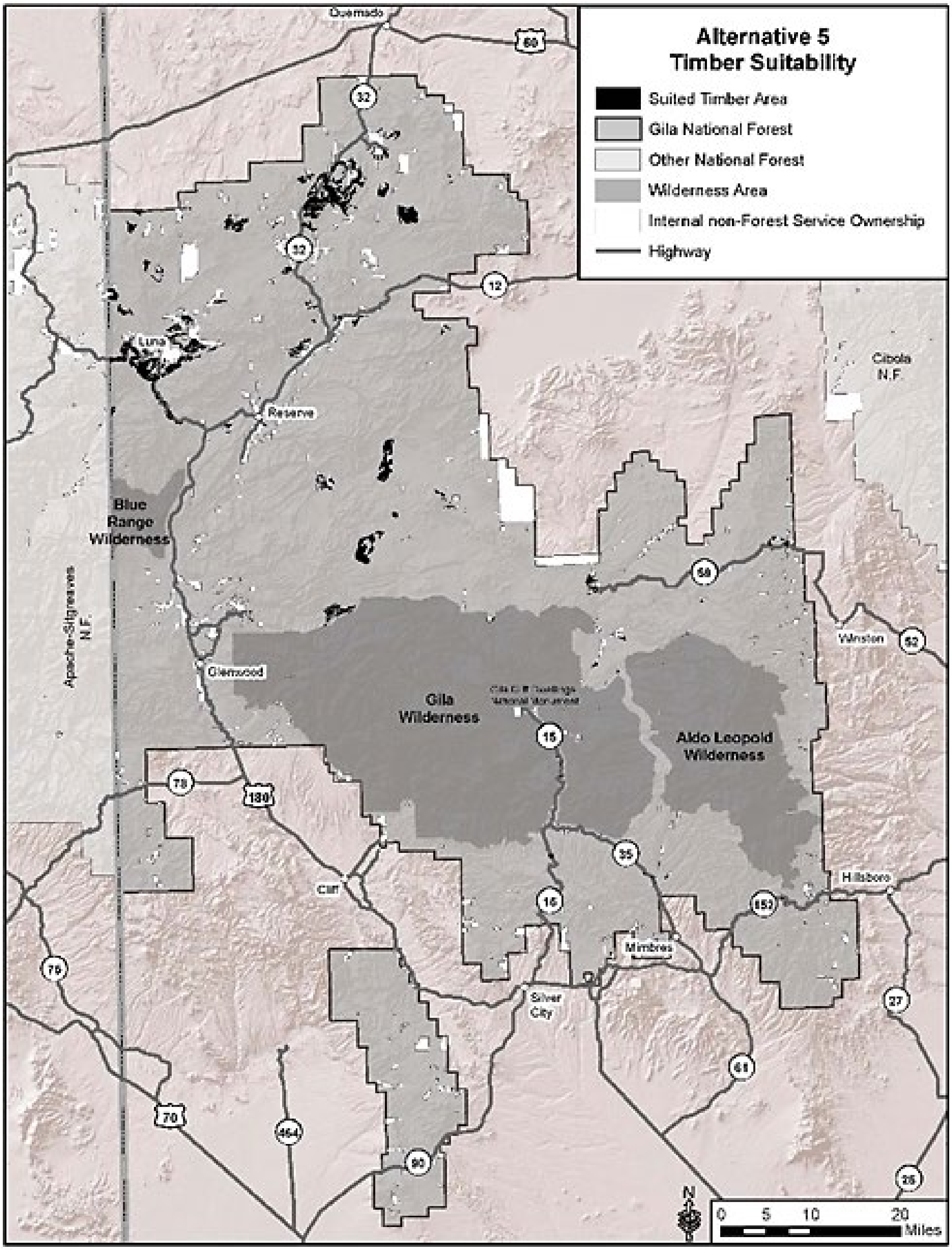

Figure 39. Suitable timber base under alternative 5

Table 54. Estimated forestwide vegetation management practices in timber vegetation types under alternative 5 (shown in annual average acres per decade)

Forest Cover Types/ Vegetation Management Practices	1st Decade	2nd Decade
Ponderosa Pine Treatments		
Regeneration* (Even-aged harvest)	296	386
Thinning (Even-aged Intermediate harvest)	1,141	1,123
Selection (Uneven-aged harvest)	4,562	4,490
Wet Mixed Conifer Treatments		
Regeneration* (Even-aged harvest)	6	9
Thinning (Even-aged Intermediate harvest)	38	37
Selection (Uneven-aged harvest)	151	149
Dry mixed conifer Treatments		
Regeneration* (Even-aged harvest)	74	0
Thinning (Even-aged Intermediate harvest)	191	206
Selection (Uneven-aged harvest)	763	822
Total Treatments		
Regeneration* (Even-aged harvest)	376	395
Thinning (Even-aged Intermediate harvest)	1,370	1,366
Selection (Uneven-aged harvest)	5,476	5,461

On average, 7,222 acres of harvesting activities in timber types, 7,106 acres in woodland, and 168 acres of grassland restoration would provide forest products. This represents roughly a 42 percent reduction in acres harvested mechanically as compared to alternative 1. Table 55 shows the PTSQ and PWSQ associated with these treatments in timber and woodland vegetation types. The table does not include wood that might be associated with grassland restoration, because those systems are not being managed for a sustainable supply of wood products. Values are rounded to the nearest whole number or decimal place where a whole number would be reported as zero.

While not completely forfeiting the socioeconomic benefit forest products can provide, alternative 5 is projected to result in volume decreases that would be detrimental to the local timber and timber-related industries, reducing the forest's contribution to revenues and job opportunities. Reduced revenue and job opportunities associated with wood products could lead to a local economic downturn, particularly Catron County's environmental justice communities where the small mills are a major place of employment (see Environmental Justice and Equity section toward the end of chapter 3).

Table 55. Projected volume associated with estimated vegetation practices under alternative 5

Sustained Yield Limit (SYL)	**583 MMBF, 130 MMCF per decade**					
Timber Products	First Decade			Second Decade		
	MMCF	MMBF	Tons	MMCF	MMBF	Tons
	Volumes other than salvage or sanitation that meet timber product utilization standards					
Lands suitable for timber production						
A1. Sawtimber (industrial softwoods, 9”+)	2	9	28,084	1	7	20,319
A2. Other Products (industrial softwood, 5-9” - roundwood, commonly pulpwood, mostly in the form of fuelwood)	0.3		5,041	0.2		3,025
Lands not suitable for timber production						
B1. Sawtimber (9"+)	2	9	28,084	1	7	20,319
B2. Other Products (5-9")	0.3		5,041	0.2		3,025
C. **Projected Timber Sale Quantity (PTSQ)** (A1+A2+B1+B2)	4	18	66,250	3	14	46,690
Other Estimated Wood Products	Fuelwood, biomass, and other volumes that do not meet timber product utilization standards					
	MMCF		Tons	MMCF		Tons
D1. Non-industrial softwood fuelwood (5"+)	4		1	3		0.8
D2. Hardwood fuelwood (5"+)	0.5		0.2	0.3		0.1
D3. Aspen (5"+)	0.1		0.03	0.05		0.01
E. **Projected Wood Sale Quantity (PWSQ)** (C+D1+D2+D3)	9		66,251	6		46,691

Cumulative Effects

In addition to the timber, forest, and botanical products harvested from the Gila National Forest, harvesting activities that support restoration or fuels objectives are also occurring on private lands near or adjacent to the Gila National Forest through cooperative efforts between state forestry and private landowners. Products are also available on the nearby Apache-Sitgreaves and Coronado National Forests, and on lands managed by the Bureau of Land Management. However, access and haul distances continue to be limiting factors for the timber industry. Products being made available within the Gila National Forest are the dominant socioeconomic driver for the local timber and wood-related industry, and the primary source of fuelwood that many residents depend on to heat their homes.

Partnerships with other federal and state agencies, local governments, private landowners, and non-governmental organizations have contributed to accomplishing restoration goals, thereby contributing to the forest product industry. These partnerships are anticipated to increase in importance in the future and new opportunities may emerge. For example, over the last couple of years, there has been increased interest in commercial fuelwood harvesting. While this type of activity has not been common and there is not enough information to suggest a trend, if the interest continues, more acres could be treated, and more products could be made available. Similarly, the creation or expansion of timber-related industry, especially one that could use small-diameter wood (such as biomass energy and biochar), would help the forest management to further reduce overstocked conditions and support a forest products program that sustains social, economic, and ecological systems.

Under the Forest Service's shared stewardship initiative, all national forests will strive to work more closely with state forestry to align goals, set priorities and combine mutual skills and assets to achieve cross-jurisdictional outcomes desired by all (USDA FS 2018). This initiative is driven by recent wildfire activity across the nation and current and predicted climate-driven trends in wildfire activity. New Mexico State Forestry has already identified the state's priority areas based on risks posed by wildfire and climate (NM EMNRD Forestry Division 2020). The Gila National Forest contains areas ranging from medium to high priority for the state (NM EMNRD Forestry Division 2020), so there is already a good measure of alignment and potential for future collaborative efforts.

The 2018 Farm Bill gave the Forest Service and the Bureau of Land Management permanent authority for Good Neighbor and expands authority to all states and Puerto Rico to enter into cooperative agreements or contracts to allow the states to perform watershed restoration and forest management services on National Forest System land. The Gila National Forest was the first national forest in the state of New Mexico to use the Good Neighbor Authority. More use of the Good Neighbor Authority in the southwestern part of the state would be beneficial for accomplishing needed watershed restoration and forest management, as well as encouraging collaborative partnerships. Several projects are ready to be implemented.

Even with collaboration and partnerships, resources are not without limits and competition can be strong. Congress has recently provided historic amounts of funding to address the wildfire crisis, which will likely benefit the wood product industry nationwide. Millions of dollars have been dedicated to priority landscapes in Arizona and New Mexico alone, including two regional priority, high-risk landscapes on the Gila National Forest. However, many scientific predictions of widespread, climate driven tree mortality. Widespread regeneration failure has also been predicted. These events could alter the type, quality and amount of available timber, forest, and botanical products over the long term. While these predictions may or may not be realized within the life of the plan, the actions taken within the life of the plan will likely influence how climate change affects the Gila National Forest, the sustainability of the forest products it currently has to offer, and their associated socioeconomic benefits.

Livestock Grazing

Affected Environment

Livestock grazing is a traditional use of the forest that precedes establishment of the national forests and grasslands. Livestock grazing is important to the cultural identity of local communities and to socioeconomic sustainability. This use has changed dramatically over the last 70 years. Prior to 1930, substantially more livestock were permitted to graze in the Gila National Forest than today, and there were many more ranchers with permits, in part because allotments were smaller, so more permits were available. The amount of permitted livestock use and number of allotments were reduced to bring grazing in-line with the capacity of the landscape to support it over the long term.

The Spanish introduced livestock grazing in the Southwest in the late 16th century, which included cattle, horses, goats, and sheep. Pueblos and Spanish-American villages practiced year-round grazing in the tradition of open range for several hundred years. By the early 1800s, Spanish-Americans had developed large cattle herds in New Mexico. After 1870, the cattle industry expanded. It is estimated that on New Mexico rangelands there were 158,000 cattle in 1870, and 1,065,000 in 1886. Range conditions deteriorated and following the drought of 1886, thousands of cattle starved. This drought, range deterioration, and competition for grazing lands brought about the fencing of private rangelands. Open-range grazing ended on all but federal lands (Baker et al. 1988 IN USDA FS 2017a).

A 1905 U.S. Geological Survey report included a description of range conditions across the Gila National Forest. Near the T Bar Grasslands, the report documents the grazing of sheep had produced "a barren desert, not a blade of grass to be seen and even the roots being entirely destroyed." Conditions were similar, "but not so bad" over much of the forest. The area around the East Fork Gila River and the Black Mountains was an exception, which Rixon described as having "a fine growth of grass" (Rixon 1905).

Based on decadal averages, from 1910 to 1960, livestock grazing in the Gila National Forest was reduced by 64 percent. Sheep and goat numbers began to decline and no longer grazed the forest after the 1970s, although most of these animals were taken off long before. As part of the elk reintroduction effort in the 1950s, the New Mexico Department of Game and Fish (NMDGF) acquired the Heart Bar Ranch and the permit for the Glen Allotment, which encompassed the vast majority of the Gila Wilderness. This portion of the Gila Wilderness has been unallotted since, with no permitted or authorized livestock. The Glen Allotment is likely no longer economically viable due to the financial investment that would be required to get range infrastructure into a functional condition.

The Wilderness Act of 1964 directs that livestock grazing should continue where it occurred before designation. Congressional grazing guidelines [House Committee on Interior and Insular Affairs Reports (95-620 and 95-1821)] provide that grazing shall not be curtailed or phased out simply because the area is or has been designated as wilderness. Adjustments to permitted livestock grazing in wilderness should consider legal mandates, range condition, and protection of range resource deterioration.

Today, livestock grazing activities in the Gila National Forest support 612 jobs and contribute $11.4 million in labor income on an average annual basis (see Social and Economic Conditions). While the economic benefit may seem small to some, it is essential to the families it supports. So much so that many work other jobs outside the ranch as a means of supplementing their income and maintaining the viability of their operation. As of 2018, the Gila National Forest contained 129 allotments. One hundred sixteen of these allotments are active with current permits, 10 are active but currently vacant, and 3 have been closed. Livestock use on vacant allotments may be authorized to a current permit holder in good standing on a temporary basis. For example, grazing could be authorized on a vacant allotment before or after a prescribed fire, or during and after a wildfire. Grazing can be reauthorized on vacant allotments at any time with an allotment-specific environmental analysis.

Permitted and authorized use between the years of 2012 and 2018 are shown in the following graph using animal unit months as units of measure. While records extend beyond this time frame, the 2012 to 2018 period of record was chosen because of shortcomings in the agency's database that require more processing to get accurate values out of older data. An animal unit month (AUM) is the quantity of forage required by one mature cow and her calf for one month, or the equivalent in sheep or horses. Permitted use is the upper limit generally allowed by the allotment's National Environmental Policy Act decision. Authorized use may be less than or temporarily slightly more than permitted use, depending on annual variability in forage and water availability.[35]

[35] This allowable temporary increase is usually limited to no more than 10 animals.

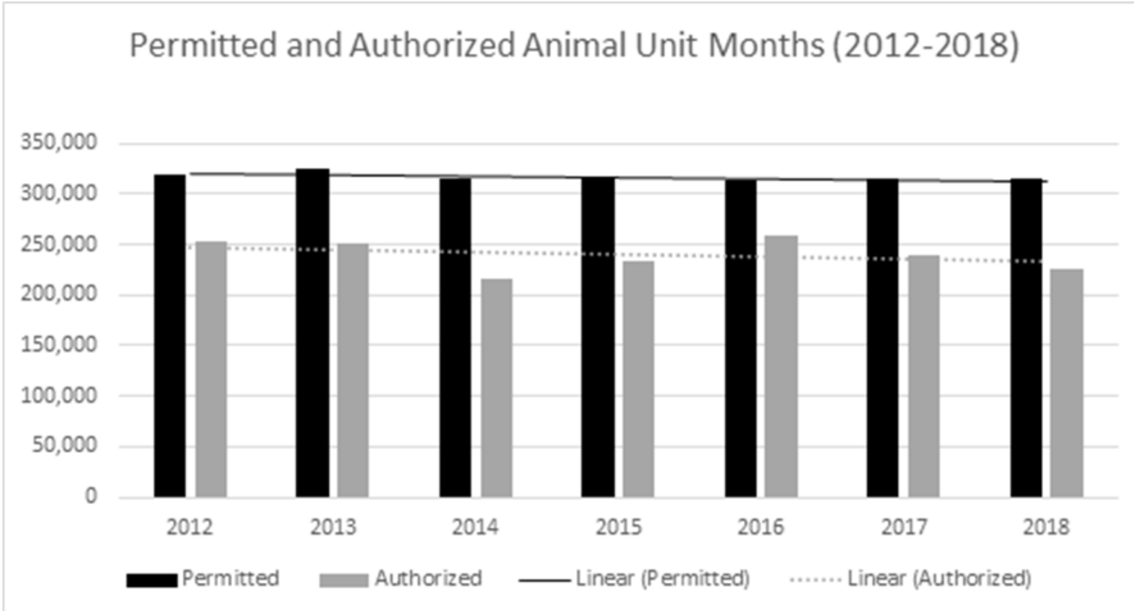

Figure 40. Current trends in permitted and authorized use in the Gila National Forest, including the portion of the Apache National Forest administered by the Gila National Forest

Even though there is no longer a substantial downward trend in permitted use (figure 40), the Gila National Forest range program and its permittees continue to face change. Maintaining range infrastructure is an expense borne primarily by the permittee—and it is expensive. Fire-damaged infrastructure has become a major challenge for some, but not all permittees. This is a challenge not just for the permittee and the range program, but also for the social acceptance of restoring the natural role of fire to the landscape in communities that depend on ranching.

Pasture rotations are an important adaptive management tool that builds flexibility into grazing systems. In some areas on the northern portion of the forest, seasonal use of forage by elk can become significant in localized areas during certain periods of the year. Competition for forage between livestock and elk is an ongoing concern for livestock producers within the plan area (USDA FS 2017a). Recent annual end of growing season utilization monitoring in these areas indicates that elk or livestock are not exceeding utilization standards. Conflicts with other wildlife, notably the Mexican gray wolf and riparian-dependent and aquatic species, have also created range management challenges. Livestock and wildlife conflicts have resulted in several legal actions since the 1986 plan decision was signed. All have been partially or wholly related to non-compliance with permit requirements or consultation agreements with the Fish and Wildlife Service. Regardless of circumstances or outcomes, legal actions can be costly in terms of financial resources and the broader social acceptance of ranching ways of life.

Drought has always been a factor, and is likely to increase in frequency, severity, and duration. Some have concluded that this kind of change in the Southwest could be a benefit to livestock producers, as forest and woodland vegetation are expected to decline and grassland and shrubland vegetation are expected to increase (McDowell et al. 2015; Parks et al. 2018a; among others). However, others have concluded that especially in the Southwest, livestock production will be negatively impacted due to increased diseases and heat stress, decreased water availability, lower nutritional content in some forage species and lower overall productivity (Rojas-Downing et al. 2017). Although uncertainty remains about these predictions and their socioeconomic impacts (Hand et al. 2018 and Borchers et al. 2021), livestock grazing in the forest will continue under an adaptive management framework and retain its cultural and socioeconomic importance to local communities for the foreseeable future.

Allotment management and the adaptive management framework is guided by a document called an Allotment Management Plan, which is developed through a site-specific National Environmental Policy Act decision-making process. Grazing permits incorporate the Allotment Management Plan and may also include additional allotment-specific terms. Both the issuance of the permit and the development or amendment of an Allotment Management Plan that becomes part of the permit is considered an administrative action the implements the National Environmental Policy Act decision (FSH 2209.13, chapter 90, section 94). Permanent grazing management modifications are authorized through the term grazing permit, consistent with the National Environmental Policy Act decision.

Each year, the district ranger sends each permittee Annual Operating Instructions to implement the Allotment Management Plan and permit. Annual operating instructions allow for temporary adjustments while implementing the terms and conditions of a term grazing permit. Annual operating instructions do not constitute a permit modification and are not an appealable decision (36 CFR 214.4). Allotment grazing management modifications may be made through the Allotment Management Plan, term grazing permits, and Annual Operating Instructions, all of which are done at the site-specific level and outside the scope of a forest plan.

The adaptive management framework recognizes that knowledge about natural systems can be uncertain, and that future management will need to have flexibility to respond to changing conditions. Adaptive management practices are based on clearly identified desired conditions and monitoring to determine if those practices are producing movement toward or achievement of those desired conditions; and, if not, to facilitate management changes that will promote movement toward, and achievement of desired conditions. Adaptive management decisions are a large driver of the observed fluctuations in authorized use (figure 40).

When implemented as designed, adaptive range management can provide for cultural, social, and economic benefits while supporting natural processes, biodiversity, soil and watershed function, and wildlife habitat. Range and other resource conditions have improved over the last 20 years under the adaptive management framework; however, more forage production remains a desired condition. While there is certainly an inverse relationship between understory herbaceous cover and degree of overstory canopy closure, higher densities of woody vegetation are not the sole reason forage productivity remains below desired levels. Soil properties and functional status, temperature and precipitation patterns, herbivory and fire all interact to influence the outcomes of plant competition and the relative dominance of either woody or herbaceous species. Unfortunately, woody vegetation densities have increased across the forest because of these interactions and many rangelands need restoration (USDA FS 2017a).

Environmental Consequences

The following discussion of environmental consequences addresses the effects of the alternatives on livestock grazing as a use of the forest. It does not discuss the effects of livestock grazing on natural resources or other resource uses. Those discussions are housed under their respective topic headings.

Analysis Methodology

This analysis includes the following general assumptions:

- Adaptive management includes appropriate site-specific, allotment scaled monitoring.
- The Congressional Grazing Guidelines for Wilderness are applied. These guidelines include direction to consider, on a case-by-case basis, allowing occasional motorized access where

practical alternatives do not exist for the purposes of maintaining or constructing range infrastructure where livestock grazing is a pre-existing use prior to wilderness designation.

The degree to which each of the alternatives provides for movement toward the desired conditions for a sustainable grazing program and socioeconomic contributions to local communities is measured by projected changes in range condition, animal unit months, and management flexibility.

Range Condition

Range condition is an assessment of rangeland health. Range condition assessments compare existing soil and vegetative condition as it relates to the ecological potential of the site, and its value for livestock grazing. When a site is healthy, it is more productive and resilient to disturbances such as drought and fire. There are several methodologies to assess soil and vegetative conditions. In the past, the Parker 3-step methodology was the standard, which includes an assessment of groundcover and plant community composition, density, and vigor. A condition category and observed or apparent trend was then subjectively assessed for both vegetation and soil stability. While new protocols that better consider soil quality and ecological health have been developed and are being adopted, a few of the Parker 3-step concepts are useful for this environmental analysis.

Woody species below a certain size are considered undesirable “invaders” by the Parker 3-step method, and their presence affects both condition and trend determinations. Because the state-and-transition models that were used to analyze vegetation condition and trend for plan alternatives are only able to capture changes in woody vegetation, not herbaceous vegetation, this is the only component of range condition that can be analyzed quantitatively. The models, including important assumptions and limitations are discussed in the Upland Vegetation, Fire Ecology and Fuels analysis with additional information about how Gila National Forest staff developed model inputs provided in Appendix B: State-and-Transition Modeling Process. Soil functions and conditions are analyzed qualitatively and supported by the analysis under the Soil and Watershed Resources heading in this chapter of the environmental impact statement.

Forage Availability

Estimations of any changes in animal unit months (AUMs) that could occur because of implementing each alternative is a required input for the socioeconomic model and analysis under the Social and Economic Conditions heading in this chapter. It is used as an indicator of forage availability here. Any actual changes in AUMs would be evaluated and determined at the allotment level within a project-level National Environmental Policy Act decision-making process.

The estimated percent change in AUMs was calculated, based on the vegetation models described previously, using the estimated percent reduction in canopy cover across the forest at the end of the first decade. Spruce-Fir Forest, Mixed Conifer with Aspen, and Mountain Mahogany Mixed Shrubland were not included in the calculations. The first two vegetation types contribute in a relatively small way to livestock grazing. The shrubland is important to livestock grazing, but the dynamics are different. Browse availability is a matter of both total woody cover and shrub height. The way vegetation conditions are described in this model includes all height classes in each canopy cover class, which does not facilitate a quantitative estimation of potential changes in AUMs.

Estimation of the percent reduction in canopy cover required a series of calculations and assumptions. In the vegetation models, canopy cover is open or closed. Open canopy conditions are classified as being 0 to 29.9 percent canopy cover. Closed canopy is described in two classes, 30 to 59.9 percent and 60 percent or greater. The most common closed-canopy cover class in the forest is 30 to 59.9 percent. It is assumed that forage production under open canopies is not limited by woody species, but forage production is limited by woody species under closed-canopy conditions.

Increases in forage production between existing and post-treatment conditions vary greatly, depending on a variety of factors including natural soil productivity, temperature, and precipitation patterns, tree canopy density, height and architecture, and grass species traits—to name a few. This necessitates additional assumptions to develop the estimate:

- On average, half of the area beneath tree canopy cover at the beginning of the model run is occupied by grass plants.
- The difference between the mid-point of each canopy class approximates the average change in canopy cover when an area moves between open and closed canopy states.
- The 10-year time step is sufficient to account for the lag time between the reduction in woody canopy cover and the establishment of grass plants.
- It is possible that no change in forage availability could result from reductions in tree canopy cover because of factors such as patterns of precipitation and temperature, differences in soil productivity potential, and wildlife populations and patterns of use. Any increase or decrease in AUMs that are projected in this analysis could be offset by a series of dry or wet years, or changes in any other of the variables mentioned.
- A conservative range of values provides a more realistic estimation, due to the factors in the previous bullet. Zero (no change) bounds the range.

Management Flexibility

Management flexibility is necessary for adaptive management to work. The degree to which each alternative affects management flexibility is analyzed qualitatively. It considers range infrastructure condition, modes of access and travel, and the use of mechanized equipment.

Range infrastructure includes fences, cattle guards, water tanks, troughs and pipelines, corrals, and other holding facilities. When infrastructure is in good condition, the full suite of adaptive management strategies is possible. When infrastructure is not in good condition, the success of some strategies may be reduced or may be impossible to implement. Modes of access and travel, and the use of mechanized equipment can influence the level of socioeconomic contributions to the local economy. Recent cost estimates obtained by the forest provide basis for understanding the economic costs of fencing both outside and within areas that cannot be accessed or cleared by mechanized means. With mechanized access and other equipment, a mile of fencing can be reasonably expected to cost $17,477. Without mechanized access and other equipment, the cost should be expected to increase to $29,410.

Climate Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the Resistance-Resilience-Transition adaptation spectrum. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Changed Circumstances

The 2022 Black Fire did not affect the needs to change the forest plan, the alternatives, or the analysis for natural resources upon which livestock grazing relies (see Changed Circumstances subsections for Upland Vegetation, Fire Ecology, and Fuels; Soil and Watershed Resources; and Riparian and Aquatic Ecosystems). It did substantially impact the range infrastructure on several allotments, reducing management flexibility until repairs or replacements can be made. However, those substantial impacts do not affect the needs to change the forest plan, the alternatives, or any part of this analysis. Some affected permittees are piloting virtual fencing, in collaboration with a team led by New Mexico State University Extension Services, which is applicable to the cumulative effects analysis; additional detail can be found in that analysis.

Effects Common to All Alternatives

All alternatives would continue to provide forage for domestic livestock and opportunities for ranching lifestyles consistent with the desired conditions for other resources and resource uses, the agency's multiple-use sustained-yield mandate and other applicable laws and regulations. Maintaining consistency with the desired conditions for other resources and resource uses could include periodic adjustments in grazing intensity, season or duration of use, and type of grazing system. It could also potentially include other management practices such as changing pasture rotations, reconfiguring pasture divisions or investments in water developments. These adjustments would be made at the allotment-level, but they are likely under all alternatives.

This may not be convenient and may even have short-term economic costs. These short-term costs could include temporary reductions in economic contributions because of running fewer numbers or higher expenditures for range infrastructure. However, as several grazing permittees have commented during the plan revision process, taking care of the land and its resources is in the producer's long-term best interest (USDA FS 2016a). Movement toward, achievement, and maintenance of the desired conditions for ecosystems and watersheds sustains livelihoods and sustains a long-term economic benefit to local economies. Ecosystems and watersheds in good condition produce more forage, which increases the potential socioeconomic contributions the land can provide. Furthermore, when drought and other disturbances temporarily reduce forage production, the magnitude and duration of those reductions are smaller and shorter. Less fluctuation in forage ability creates greater economic stability for local communities.

All alternatives include direction to maintain or improve range condition and manage for forage quality. Given this, grazing management in all alternatives would balance use with the capacity of the land to support it using an adaptive management approach to deal with fluctuations in available forage and water. Most of the procedural mechanisms and requirements for adjusting grazing management to balance use with capacity and make progress toward the plan desired conditions are found in the Forest Service Handbooks and Manuals. As a result, the plan does not reiterate the existing guidance for managing livestock grazing or permit administration. Improved range condition would increase the productivity and resiliency of the land, and opportunities for economic gains. Conversely, declines in range condition would reduce the productivity and resiliency of the land, and thereby, the opportunities for economic gain.

In terms of access and travel, allotment management will continue to be influenced by travel management and existing designations such as research natural areas, wilderness study areas, and congressionally designated wilderness under all alternatives. All alternatives are consistent with the Travel Management Rule. Under any of the alternatives, permittees would be required to follow stipulations in their permit regarding cross-country motorized travel and use of administrative roads to access their allotment and infrastructure. Existing designated areas will continue to pose limitations on modes of access and the use of mechanized equipment for infrastructure maintenance, consistent with the legislation or policy direction that establishes those designations.

All alternatives include the Gila River designated Research Natural Area (402 acres), the congressionally designated Hell Hole and Lower San Francisco Wilderness Study Areas (18,860 and 8,800 acres, respectively), and the congressionally designated Blue Range, Gila, and Aldo Leopold Wildernesses (29,099 acres, 559,688 acres, and 203,797 acres, respectively). Livestock grazing is generally not consistent with the management of research natural areas and is specifically inconsistent with the establishment of the Gila River Research Natural Area. Given that this removes only 402 acres from livestock grazing and does not pose any limitation on access to the surrounding rangelands, there is no reduction in the ability of the forest to contribute grazing-related socioeconomic benefits, nor are there decreases in flexibility. Similarly, despite the differences between the alternatives in terms of proposals for additional research natural areas, none would pose limitations on access to surrounding rangelands and the number of acres are small. There is no substantial difference in the forest's ability to contribute to local economies because of any of these proposals (see appendix H).

Livestock grazing is consistent with direction for managing existing congressionally designated wilderness study areas and wilderness areas, but there are limitations imposed on modes of access and the use of motorized equipment, which can add time, labor, and cost. Public motorized access and use of mechanized equipment is prohibited in these areas. However, in designated wilderness, Congress established guidelines for grazing permittees to obtain permission for occasional use of motorized equipment, on a case-by-case basis, where motorized access for range management was permitted prior to designation. District rangers or forest supervisors may authorize such use in the grazing permit for the maintenance, reconstruction, or construction of range infrastructure necessary for effective management based on a rule of practical necessity and reasonableness. Such use must also not have a "significant adverse impact" on the natural environment. Following these guidelines may mitigate some, but certainly not all the added time, labor, and cost associated with managing livestock grazing in designated wilderness. Time, labor and cost do not necessarily correlate to the level of socioeconomic contribution but can affect how those benefits are distributed within the local economy.

All alternatives contain some level of mechanical harvesting, prescribed fire, and the use of natural ignitions under conditions that are likely to support movement toward, attainment, and maintenance of desired conditions. While any increase in available forage could be a long-term economic benefit to producers, it may come at a short-term cost or inconvenience. Adjustments to grazing management may be needed to realize increased forage production after treatment as grass plants need time to establish, and sometimes to recover (Drewa and Havstad 2001). Differences in projected changes in forage production vary among the alternatives due to the vegetation types targeted, number of acres treated, and preferred methods of treatment.

The Gila National Forest is a frequent-fire landscape. Naturally ignited wildfire would continue to occur under all alternatives. Any wildfire would consume forage and has the potential to damage or destroy range infrastructure. Erosional events and altered patterns of water flow can result from high-severity fire, which may lead to stock ponds filling up with sediment or being breached, and reduced water availability for livestock. All these things can reduce or redistribute the socioeconomic benefits that livestock grazing in the forest provides. Differences among alternatives are associated with the extent to which vegetation treatments are likely to promote low-intensity surface fires and reduce the risk of high-intensity fire.

In relation to water-related range infrastructure and management flexibility, riparian areas that are moving toward or in proper functioning condition would sustain livestock grazing as a use of the forest under all alternatives. Riparian areas in this condition are better able to provide benefits to people, as discussed in the riparian and aquatic ecosystems analysis. What management actions are necessary to accomplish this would be determined by site-specific circumstances in collaboration with the permittee. Working together on range and riparian issues is the most effective approach.

There is no objective for riparian exclosures under any alternative. Exclosures can be one of several effective management strategies to help move degraded riparian areas toward proper functioning condition, but they are not necessary in every case. When and where exclosures are determined appropriate, collaborating with the permittee to develop design features that also support movement toward desired conditions for livestock grazing, such as alternative watering points, fulfills integrated multiple-use management objectives. Any additional economic costs that may be placed on a permittee associated with construction and maintenance of riparian exclosures, and the degree to which the agency can absorb some of those costs, would continue to be dependent on the circumstances of each individual situation. Therefore, how this may affect socioeconomic contributions to local economies cannot be predicted.

All alternatives provide a measure of flexibility to support the full Resistance-Resilience-Transition adaptation spectrum. The adaptive management framework provided by the plan allows for incremental adjustments to be made in response to climate-driven changes and maintain or move toward desired conditions (Resistance). Supplements specifically designed to enhance or maintain livestock productivity during drought are allowable under all alternatives, provided they are not potential sources of noxious weed introduction. Switching to more efficient or resilient breeds of cattle and diversifying the breeds of cattle within a single operation would be allowable under all alternatives. Adopting new husbandry practices and upgrading or reconfiguring water systems are also supported by the alternatives if they are consistent with moving toward desired conditions. All these things are Resilience-Transition adaptation strategies (Salman et al. 2019) that could be part of addressing vulnerability and risks to sustainability.

Effects Common to All Action Alternatives

All action alternatives contain requirements for livestock water developments to include wildlife access and escape considerations, either as a standard or a guideline. Whether a standard or a guideline, this is required, and the language is general enough in both cases that there is no actual difference in the flexibility permitted. How that consideration is best provided can be designed at the project level. Providing for wildlife escape can reduce inconvenience and maintenance costs associated with water being fouled by wildlife that can't get out and drown. All action alternatives include a standard or guideline requiring new or reconstructed fencing to be wildlife friendly in their design or modification. Like providing for wildlife escape, this would reduce wildlife entanglements in fences, which would reduce fence maintenance costs.

All action alternatives provide stronger support to the prevention, control, containment, and eradication of invasive and noxious weeds than alternative 1 (Non-native Invasive Species objectives and supporting management approaches). While invasive and noxious weeds are not known to occur in the Gila National Forest to a great extent, invasive and noxious weeds have led to substantial reductions in rangeland productivity in other national forests, grasslands, and rangelands under other public or private ownerships across the West (Duncan et al. 2004). Climate change is expected to favor non-native species and the proactive approach in the action alternatives would provide stronger support of the Resistance end of the climate adaptation spectrum than alternative 1.

Effects Common to Alternatives 2, 3, and 4

Related to management flexibility, these alternatives recommend acres to Congress for wilderness designation. These areas are identified in Appendix H: Documentation of the Wilderness Process. If designation were to happen in the future, the flexibility that all alternatives would provide in terms of motorized access and travel and the use of mechanized equipment in recommended wilderness would be reduced. However, most of these areas are currently accessed, traveled, and maintained by non-mechanized means and are unlikely to become a priority for mechanical harvesting treatments due to steep and rugged terrain (see also Upland Vegetation, Fire Ecology and Fuels). Certainly, individual permittees could incur some increased operation and maintenance costs because of the prohibition on mechanized equipment;[36] however, the nature of the process used to arrive at these recommendations was such that those increased costs would not occur to the extent that it could be reasonably expected to reduce the viability of any one operation, or substantially reduce the contribution to local economies that livestock grazing on the forest generates. Specifically, the criteria for recommended wilderness under these alternatives examined water sources, range fence, and other range developments that require frequent maintenance or access by motorized mean and adjusted boundaries to allow exclusion of these management concerns (Appendix H: Documentation of the Wilderness Process). The socioeconomic contributions provided through livestock grazing would not be substantially different from alternative 1.

Effects Common to Alternatives 2 and 5

Both alternatives 2 and 5 include fire as a treatment method, with a stronger emphasis on prescribed and naturally ignited wildfire than alternative 1. Restoring fire to the landscape would provide opportunities to improve forage production, and address tree densities and encroachment. More acres can be treated overall with fire treatment methods under these alternatives but can also lead to range infrastructure damage and costs to the affected permittees. There are many unknowns in how the tradeoffs between improved range condition, potential increases in forage production, and infrastructure damage might play out economically, both for the permittee and for the local economy. There is a management approach within the revised forest plan that when range infrastructure is damaged as a direct result of any suppression action from wildland fire, the incident management team and forest personnel identify qualifying needs for immediate repair or reconstruction and prepare a plan. If approved, the plan is implemented under the fire's funding mechanism. Applying this management approach improves relationships, builds support for restoring fire to the landscape, and helps maintain the forest's ability to support existing multiple uses.

Effects Common to Alternatives 3 and 4

In accordance with the regulatory framework and Forest Service policy direction, permits that are waived back to the agency without a preferred applicant, or allotments that otherwise become vacant, the district ranger determines the sufficiency of the existing National Environmental Policy Act analysis and decision, as well as U.S. Fish and Wildlife Service consultation requirements. If the district ranger finds the analysis and decision are sufficient, and consultation requirements are met, the ranger has the authority to reissue a new permit through the grant process. The ranger could also authorize the use of a vacant allotment by an existing permit holder in good standing, provided the requirements established through consultation are met. If the district ranger finds conditions warrant a new environmental analysis, decision and consultation, the allotment would remain vacant and unstocked until the new analysis, decision and consultation were completed. The future management of the allotment would be determined through this decision-making process.

This is the process that would be followed under all alternatives, but the management approach that would be taken under alternatives 3 and 4 would be to reissue the permit as soon as possible or stock the vacant allotment to the maximum extent possible as soon as possible. This management approach could maintain or increase the socioeconomic benefits provided by livestock grazing opportunities proportional to the capability and capacity of the allotment, including the condition of its infrastructure and the range. On the other hand, fully stocking every allotment to the maximum extent possible could result in loss of flexibility during drought years, before or after fire, or under other circumstances which result in some or all a permitted allotment becoming temporarily unusable. If there were no legal places for displaced livestock to graze in the forest, the permittee may have to

[36] With mechanized access and other equipment, a mile of fencing can be reasonably expected to cost $17,477. Without it, the cost should be expected to increase to $29,410 based on 2017 estimates.

find another lease somewhere else (e.g., private property, state, or Bureau of Land Management), which would involve additional financial burdens, hauling of stock and feed, and social anxiety due to economic insecurity.

This approach to stocking vacant allotments also represents a Resistance adaptation strategy for livestock production, which may not be adequate to adapt to future climate. It fails to adequately support the Resilience-Transition end of the adaptation spectrum, address vulnerability (Borchers et al. 2021), and does not address the risks to the sustainability of livestock grazing as a use of the forest (USDA FS 2017a).

Effects of Alternative 1

The assessment report found trends in range condition were generally stable to upward under current management based on recent allotment-level environmental analyses. However, the assessment report also found tree densities continuing to increase in all the vegetation types important to livestock grazing, which is part of the range condition evaluation of plant community composition. The assessment concluded that the increase in tree densities posed a risk the sustainability of forage production (USDA FS 2017a). The stable to upward trend in the groundcover and herbaceous plant community composition, density, and vigor components of range condition are assumed to continue under this alternative. However, given the number of acres that could be treated under this alternative, tree densities are projected to continue increasing, leading to a decline in range condition due to woody invaders.

A corresponding decline in forage production (8 percent) would reduce the forest's ability to contribute to the local economy. Favorable weather conditions could mitigate a decline and unfavorable weather conditions could exacerbate it. The risk of infrastructure damage due to undesirable wildfire effects is likely to increase as more of the forest moves toward more closed-canopy conditions. No additional areas are recommended to Congress for wilderness designation under this alternative, so there are no associated effects. There are also no specific provisions for the use of vacant allotments. The status and use of vacant allotments has been and would continue to be determined on a case-by-case basis within the existing regulatory and policy framework and interested applicants. This makes the availability of those allotments to provide for flexibility during times of drought, fire, or wildlife conflict a matter of happenstance. This is a reactive approach to climate change, rather than a proactive, anticipatory approach. It does nothing to promote economic stability or address the risks to sustainability (USDA FS 2017a) given projected long-term trends in drought cycles and wildfire seasons.

Effects of Alternative 2

Alternative 2 uses both mechanical harvesting and fire as treatment methods, with a stronger emphasis on prescribed and naturally ignited wildfire than alternative 1. Due to this increased emphasis, more total acres could be treated. This alternative also allows for slightly more mixed-severity fire, which is more effective in reducing tree densities than low-severity fire. Subsequently, a decrease in closed-canopy conditions is projected. Forage production is expected to improve slightly as compared to alternative 1 with a maximum projected increase of 2 percent. Favorable weather conditions would support the projected increase and may augment it, while unfavorable conditions could offset any increase in forage production.

The reduction in closed-canopy conditions would also reduce the risk of infrastructure damage due to high-severity wildfire. However, with an increased emphasis on fire as a management tool and more mixed-severity acres there is a greater likelihood of infrastructure damage. This would result in decreased flexibility and increased costs for the affected permittees, but the cascading effects on the local economies may be positive, negative, or neutral. For example, If the resources acquired and labor needed to repair range infrastructure is locally sourced, the socioeconomic contribution would be redistributed rather than lost. Given the current difficulties associated with repairing and reconstructing fire-damaged range infrastructure, some permittees are piloting the use of virtual fencing, which may prove to be the first Resilience-Transition adaptation option to be adopted by local industry. This is discussed further in the cumulative effects subsection.

Alternative 2 also adds a measure of flexibility as contains a guideline and supporting management approach that would create a small system of strategically located swing allotments to serve as forage reserves for use by current permit holders during drought years, before or after fire, and under other circumstances, which might render a portion or all a permitted allotment unusable. The management approach would include the agency becoming responsible for infrastructure maintenance. While this may slightly reduce the overall socioeconomic contribution the forest can provide through livestock grazing, it is the only alternative that would address the risk to sustainability by adopting a proactive Resilience-Transition approach to climate adaptation.

Effects of Alternatives 3 and 4

Alternatives 3 and 4 would limit the use of prescribed fire to free up more funds to invest in mechanical harvesting treatments. Naturally ignited wildfires are used to move toward desired conditions for natural resources at a level similar level to alternative 1. Due to the emphasis on mechanical treatments, fewer acres can be treated overall. Mechanical harvesting typically has much higher cost per acre than prescribed fire.

While the vegetation types where work would be focused on differ between these two alternatives are different, the effects on range condition and forage production would be similar. Forage production is expected to improve slightly as compared to alternative 1 with a maximum projected increase of 1 percent. Favorable weather conditions would support the projected increase and may augment it, while unfavorable conditions could offset any increase in forage production. The predicted increase in forage production is less than alternative 2 because fewer acres are treated overall. Grasslands and historically open-canopy woodlands are not the only vegetation types that support livestock grazing.

There would be a slight reduction in the likelihood that infrastructure damage because of prescribed fire given that less prescribed fire would be used. However, the likelihood of damage associated with undesirable wildfire would remain like what it is currently, and the likelihood associated with wildfire managed for resource benefit would be the same as alternative 1.

Effects of Alternative 5

This alternative would also restrict mechanical harvesting to the wildland-urban interface and emphasize the use of fire. Like alternative 2, it allows for more mixed-severity fire on the landscape and as a result, more of the forest moves to an open-canopy condition. Range condition and forage production are projected to improve, with a potential maximum increase of 4 percent, weather permitting. Infrastructure damage would be more likely under this alternative than any other, and it would be more likely to reduce management flexibility than alternative 2. However, like alternative 2, there are a lot of unknowns in how the tradeoffs between improved range condition, potential increases in forage production, and infrastructure damage might play out in terms of socioeconomic contributions, both for the permittee and the local economy.

This alternative also includes approximately 745,073 acres recommended to Congress for wilderness designation. These areas are identified in Appendix H: Documentation of the Wilderness Process. Area boundaries were not adjusted for livestock operation considerations in this alternative. If Congress were to designate the areas recommended under this alternative, reductions in management flexibility and increases in operational and maintenance costs could reduce the level of socioeconomic contributions generated by livestock grazing within the forest. This is because the recommendations associated with alternative 5 include lands where permittees are currently using mechanized modes of access, mechanized tools for infrastructure maintenance, or both. However, plan direction for recommended wilderness would allow those mechanized activities to continue until Congress decides to act. If designated, livestock grazing would continue and the congressional grazing guidelines would apply, but there would likely be times and places where mechanized tools and modes of access were not allowed.

Similar to alternatives 1, 3, and 4, alternative 5 would approach the management of vacant allotments in compliance with the existing regulatory and policy framework but the management approach would favor leaving vacant allotments unstocked until a new environmental analysis and decision-making process determined future management and uses. This management approach would not support adaptive management as well as alternative 1 or specifically address the risks to the sustainability of livestock grazing as a use of the forest as does alternative 2.

Cumulative Effects

Lands adjacent to the Gila National Forest include the Apache-Sitgreaves National Forests in Arizona, private ownerships, and those lands under the jurisdiction of local or state government, and the Bureau of Land Management. The Gila Cliff Dwellings National Monument, under the jurisdiction of the National Park Service, is also adjacent to the forest. Most, but not all these lands support livestock grazing. The average rancher does not own enough private land to graze livestock on a year-round basis. Typically, ranchers require a private, state, Bureau of Land Management, or Forest Service grazing lease or permit to maintain a viable operation, and many ranchers have more than one. The ability to graze these lands sustains the economic viability of this traditional land use.

An apparent social trend, and perhaps a cultural shift being observed that may influence livestock grazing on lands under any jurisdiction is the decline in the use of horses and mules for access and travel. More and more producers are opting for all-terrain, off-highway, or utility vehicles for access and travel. While there are certainly exceptions to this trend, if it continues, remote allotments that contain substantial area in designated wilderness or inventoried roadless areas could become less attractive. As a result, there could be a reduction in the economic contributions the livestock industry provides to local economies.

Elk are abundant and management of their populations are and will remain under the jurisdiction of their respective state's departments of game and fish. They are important game species that generate a significant amount of revenue. Elk and livestock would continue to compete for forage and water resources for the foreseeable future. Similarly, wolves and other predators would continue to prey on livestock when they have the need and opportunity. Livestock-wildlife conflicts and the economic costs they impose would likely remain a reality despite interagency efforts to identify and mitigate such conflicts. Potentially, conflicts could worsen because of increased competition for already limited water resources as climate change progresses.

Vegetation treatments that reduce the densities of woody vegetation are occurring and would continue to occur on lands of all ownerships. Whether intended for ecosystem and watershed function, fire protection, forage production enhancement, or climate adaptation, these activities can potentially increase forage availability to support livestock grazing and protect investments in range infrastructure. Forage and water availability are still limiting factors, particularly during times of drought, and may become more limiting in the future as climate change progresses. This could potentially result in more land area being required to support the same number of animals, regardless of how the land is managed. This would reduce the quantity and quality of sustainable social, cultural, and economic benefits provided by livestock grazing.

While adaptive management is a long-standing approach to livestock production and systems are always changing in response to market forces, these changes have rarely been made with the long-term impacts of climate change in mind. In highly vulnerable ecological and socioeconomic settings, the consideration of long-term climate trajectories will be critical to selecting climate-smart management approaches, food security and social equity (Salman et al. 2019). There are many promising adaptation options, including feed optimization and breed development, selection, and diversity (Salman et al. 2019).

Experiments with Criollo cattle are taking place all over the arid and semi-arid western United States as part of the Long-Term Agroecosystem Research network. Criollo cattle are a more desert-adapted breed originating from northern Africa. Spaniards brought these cattle to Mexico in the late 1500s. They have survived with little human intervention, and they remain prized by the indigenous Tarahumara people. Studies on the Jornada Experimental Range in southern New Mexico, which began in the mid to late 2000s, will continue to clarify the opportunities these cattle could play in adapting local and regional livestock production systems for future climate. Despite this work, much more is needed in terms of genetic and breed diversity to fully understand all the options, their feasibility, and likelihood of success in various livestock production settings and systems.

Producers, both individually and collectively, will be highly influential partners in adapting these food production systems to future climate. Their willingness to seek information, adapt and adopt new and emerging practices, and transform their systems to align with future climate will impact regional, national, and global food security; social equity; and climate mitigation co-benefits (Salman et al. 2019). In partnership with permittees, there will be many opportunities to implement collaborative solutions on public lands.

One such partnership opportunity was catalyzed by the 2022 Black Fire, which damaged or destroyed range fences on 11 allotments. Two of the impacted permittees are collaborating with a New Mexico State University Extension team that includes representatives from Sierra County and the New Mexico Department of Agriculture's Southwest Border Protection and Emergency Preparedness Center and have adopted virtual fencing. This is a relatively new technology that allows producers to control livestock distribution without physical fences. Livestock are fitted with collars that communicate with GPS (global positioning systems) and reception towers to set up a virtual fence determined by the land manager. When the livestock approach the limits of the virtual fence, the collar emits a series of loud beeps. If they continue, the animals receive a benign shock. The virtual fencing has been a success thus far, and another permittee will be adopting the approach in 2024. This Resilience-Transition climate adaptation strategy provides co-benefits for both livestock grazing as a land use, wildlife habitat connectivity (see Wildlife, Fish, and Plants cumulative effects) and community relationships.

Tribal Relationships and Co-Stewardship

Affected Environment

The Gila National Forest manages a great diversity of landscapes and areas critical for the continuation of traditional cultural lifeways, wide arrays of natural and ecological resources, and those held sacred by the first peoples of this area. The Pueblos of Acoma, Isleta, Laguna, Zuni, and Ysleta Del Sur; the Navajo Nation; the Hopi Tribe; Comanche Nation; Yavapai-Apache Nation; and the San Carlos, Ft. Sill, Mescalero, and the White Mountain Apache Tribes recognize the lands managed by the Gila National Forest as part of their aboriginal or traditional homes and use areas. Each tribal nation has their own history, traditions, relationships to the land and to other tribal nations, and relationships with the Federal Government.

The nation-to-nation relationship between the Forest Service and individual federally recognized tribal nations is a sovereign nation-to-sovereign nation relationship that predates the United States Constitution. These relationships are codified in the U.S. Constitutional Articles, treaties, and numerous acts and Executive orders. Together, these authorities direct the agency to consult with all affected federally recognized tribes and pueblos in any action that has the potential to affect the tribe or pueblo, and to manage, make decisions, and administer forest management activities and in a manner that takes into consideration those potential impacts to tribes and pueblos. This includes a decision-making process that respects and seeks to integrate into management practices traditional American Indian beliefs, cultural practices, and Indigenous Knowledges. This is achieved through consultation, engagement, and co-stewardship between those individual federally recognized tribal governments and the Forest Service.

The Gila National Forest maintains a nation-to-nation relationship with the federally recognized tribal and pueblo governments mentioned above, and routinely consults on policy development, proposed plans, projects, programs, and forest activities that have a potential to affect tribal interests or natural and cultural resources important to the tribes and pueblos.

Specific places and properties valued and utilized by the tribes and pueblos have been identified on every district of the Gila National Forest; however, the areas of tribal and pueblo interest are not limited to these specific locations. Some of these properties can possess traditional, cultural, or religious significance. Specific locations of traditional or religious significance are often held in confidence (Freedom of Information Act exempt) to protect these important areas and resources. Traditional cultural properties are managed and protected as eligible for the National Register of Historic Places under the National Historic Preservation Act. It is important that traditional practitioners maintain continued access to traditional cultural properties, sacred sites, and areas of spiritual significance and are afforded privacy to conduct ceremonies as requested.

Tribal ways of life can be impacted by changes in land ownership and development of private land that affects their access to ancestral lands, degradation of forest and watershed health, technological developments that interfere with traditional ceremonies, and recreational use of their ancestral lands. Climate change is also affecting the environment and influencing tribal ways of life. Tribal nations are conducting vulnerability assessments, developing adaptation plans, and establishing priorities for implementing those plans.

With the heightened emphasis on co-stewardship with the tribes, the Gila National Forest can consult, collaborate, and integrate tribal Indigenous Knowledges of the management practices of their ancestral landscape and ecosystems. Co-stewardship values and integrates all voices and knowledges into all aspects of lands management, as well as the maintenance of cultural, environments, resource-based climate adaptation planning and implementation. Co-stewardship offers a path forward that can integrate the Indigenous Knowledges and practices that have allowed Native peoples to survive climatic change over millennia. Co-stewardship that values and integrates all voices and knowledges is key to successful climate adaptation.

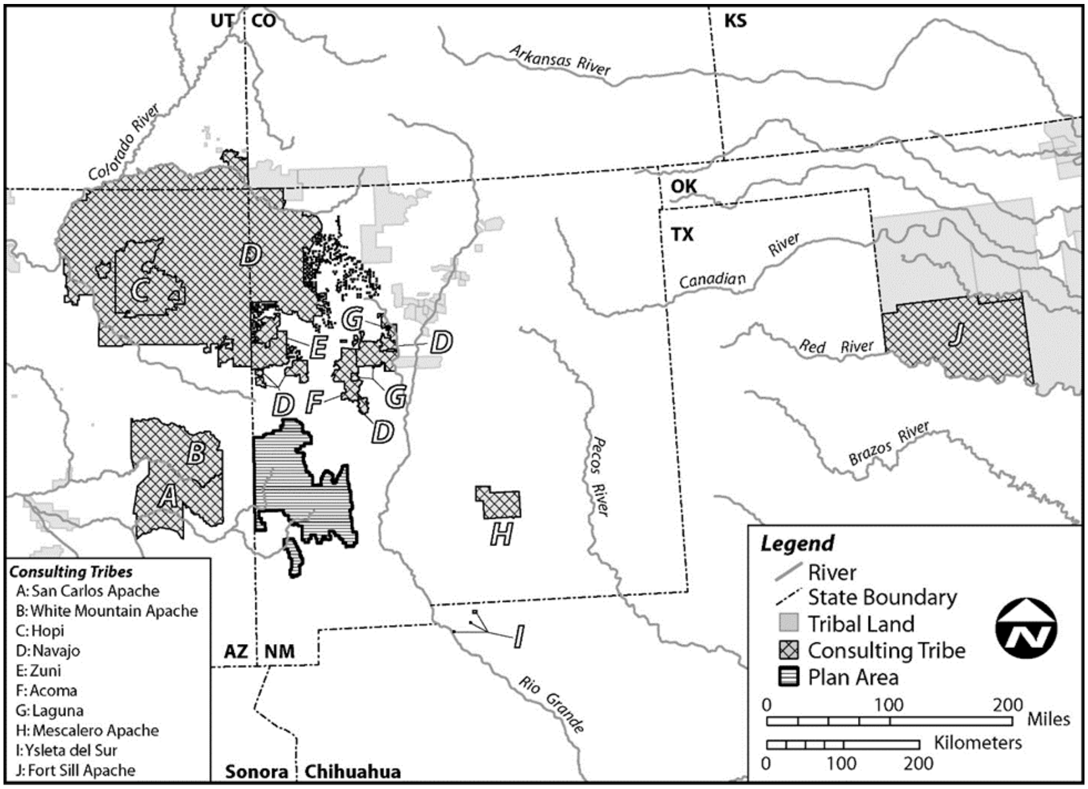

Figure 41. Location of the Gila National Forest in relationship to consulting tribes

Environmental Consequences

Analysis Methodology

Probable management activities related to alternatives are used to evaluate or predict short- and long-term effects to the tribes and pueblos with ancestral ties to the Gila National Forest. With integration of Indigenous Knowledges into the planning and implementation of management practices, the forest and tribe(s) play a more collaborative and significant role in supporting the cultural, social, religious, and economic values of federally recognized tribes and pueblos.

The co-stewardship model, working within the laws, regulations, and policy direction for the National Forest System lands is a collaborative process, allowing for the integration of traditional knowledges and practices with current research and public needs. This decision-making process opens the opportunity for new and alternative practices for public lands health and viability based in both old and new practices.

Effects Common to All Alternatives

As discussed above, as per the constitutional and legal authorities the Gila National Forest maintains active and vibrant nation-to-nation consultation with tribes and pueblos as well as on-going collaboration and coordination between Gila National Forest staff and Tribal staff on specific projects and programs of identified interest by those tribes and pueblos. Consequently, all alternatives would have the same effects on tribal relations: the process of consultation on all levels would continue regarding tribal and pueblo all areas of management, resources, and access at the level of the specific tribe or pueblo's interest. Maintaining and developing nation-to-nation relationships with tribes and pueblos helps inform management of the forest lands, resources, and products; maintains open, honest, and respectful lines of communication; and continues to build and maintain trust.

All alternatives support the 2014 travel management decision (2014a), which addressed tribal and pueblo concerns about their ability to access locations in the forest and the impacts of too much motorized use. All alternatives require the continued nation-to-nation consultation on any activities, management decisions, and policies that could impact the tribes and pueblos.

As such all alternatives will continue to address these issues throughout the life of the final environmental impact statement. Specific issues identified in recent consultation include the following:

- Formal co-stewardship agreements.
- Water, riparian corridors, and the native species that depend on them are important to tribal ways of life and connection. The tribes and pueblos expressed support for maintaining, improving, and protecting rivers and their watersheds.
- Plants used for subsistence, religious, medicinal, and other cultural purposes are important to tribal ways of life. Many of these important species fall in two categories: species that favor areas disturbed by fire and other activities and species that favor riparian areas. While individual plant species respond differently to specific types of disturbance, through consultation, the tribes and pueblos expressed support for the use of fire as a disturbance source to encourage the availability, abundance, and sustainability of disturbance species.
- Wildfire managed for resource benefit and prescribed fire would be the most immediately productive for encouraging disturbance species. In areas subject to mechanical treatment, the availability of disturbance species would be anticipated to decline during, and immediately following, treatment, depending upon the volume of woody debris left on the landscape. However, mechanical treatment followed by prescribed burning would increase the availability and abundance of disturbance species after implementation was completed. However, both fire and mechanical treatments can also have negative effects on tribal spiritual and cultural sites.
- Mechanical treatments impact cultural resources by compacting the ground and by disturbing the distribution, arrangement, or properties of artifacts within the site, leading to loss of site integrity. Mechanical treatment also involves the construction of more temporary roads and mechanical treatment projects have more opportunity for public intrusion to collect fuelwood. Mechanized activities that increase noise have the potential to adversely affect solitude and privacy of tribal practices.
- The cultural resources that have tribal value in the Gila National Forest have persisted through many fire cycles over time and prescribed and lightning-caused fires. Generally, low-intensity fires have not adversely impacted pre-contact era sites that are not fire sensitive or composed of combustible material, and the forest would generally be managing for low to mixed fire severity. The effects from mixed-severity fires depend on the site type and the temperature and duration of heat on the ground surface. High-intensity fire could result in adverse impacts including pre-contact era rock structures crumbling from exposure to very high temperatures; ceramic material re-firing; obsidian artifacts melting; site features undergoing accelerated erosion because of loss of vegetative ground cover, water-repellant soils, or both; cultural features and structures being displaced or damaged by killed trees falling and uprooting the ground surface; creation of burned stump holes that result in erosion; and the increased potential for theft because of vegetation removal from the ground surface. Prescribed fire reduces the threat to structures, sites, and areas in the acres treated. Increased acreage of prescribed fires during optimal conditions can allow for fire that will not burn as intensely

when fire weather conditions are not favorable, and sites can be identified prior to implementation and protected (Buenger 2003). Wildland fire managed for resource benefit reduces the threat from high-intensity fire for known structures, sites, and areas. However, unknown, or unrecorded heritage resources could be impacted by managed wildland fire.

- Tribal access could be affected in the short term during mechanical treatment and fire management activities, with temporary closures of areas for health and safety. These activities could result in a short-term decrease in the availability of plant species and other materials for traditional uses in the acres treated until implementation is complete. The availability of plant species that favor disturbance would increase in these areas once treatment activities are complete. And any temporary roads used to support those activities would be restored to natural conditions after use. Restoring these temporary roads to natural conditions would result in a decrease in visitation, helping to restore conditions that support privacy and confidentiality for traditional or cultural practices.
- Impacts created by the presence of towers, or any other highly visible, human-made objects obstruct the line of sight from the physical location of the ceremony to a given location at a distance. These visible impacts represent an intrusion to the traditional experience and impair practitioners' ability to properly conduct prescribed cultural practices and provide for individual and cultural well-being. Visual and physical intrusions can alter, damage, or destroy the attributes of the place that are necessary for the traditional religious use or cultural purposes. The continued permitting and development of electronic facilities and mines on the forest, particularly on or near the higher mountains, affects the meditative atmosphere, quietness, and privacy necessary for traditional cultural activities. The additional vehicular traffic associated with the use, maintenance, or expansion of these types of facilities can also intrude and interfere with traditional and religious practices. Located away from urban areas, hunting, backpacking, and camping represent important activities that are enjoyed by locals and bring visitors into the area. Improved recreation opportunities and experiences could result in increased access and visitation. Increased public visitation could result in more people accidentally intruding upon important cultural or sacred sites, and increased vandalism While increased access is a positive in many ways for communities, the increase in visitation by people from outside tribal communities has the potential to disrupt the settings and privacy of traditional practices.

Effects of Alternative 1

The 1986 forest plan recognized that adjustment of landownership is needed to support resource management goals. It identified of 9,580 acres of National Forest System lands that could be exchanged to provide for community expansion as the need arose. It is very prescriptive in prioritizing parcels for landownership adjustment and does not consider cultural resources. Adherence to this list could narrow opportunities to work with tribal and pueblo governments in addressing their expansion and access needs. In addition, some areas identified for acquisition by the existing forest plan are likely no longer relevant given completed land adjustments or changing priorities. Many access opportunities have been lost across private lands due to historic landownership patterns; changing private ownership conditions; and a lack of established, legally defensible access routes through private lands. Alternative 1 does not account for the current increasing residential development adjacent to the forest resulting in restricted public access across private property to National Forest System lands and forest products for traditional uses.

Land adjustments have the potential to affect the use and characteristics of cultural resources adversely or positively. Conveying cultural resources that are eligible or listed on the National Register out of federal ownership would be an adverse effect. Once the lands are transferred out of federal ownership, the tribes would not be guaranteed the same rights of access and use of the traditional cultural properties or area for traditional purposes. Federal laws, Executive orders, regulations, and Forest Service policy regarding American Indian rights and interests would no longer apply. Land adjustments may also potentially have a positive effect on cultural resources where newly acquired private lands would come under protection of federal laws and management. Acquired private lands, including traditional cultural properties that were previously inaccessible to tribes, would be accessible for traditional proposes.

Herbicide use on some native plant species would be allowable under alternative 1. Herbicide use is a highly regulated activity and any project-level proposal for its use would be subject to a separate National Environmental Policy Act process, consultation with the tribes and pueblos, and with the U.S. Fish and Wildlife Service.

Alternative 1 does not include any recommendations for additional wilderness designations. While not the purpose of wilderness, it may provide some protection for cultural and sacred sites as a secondary benefit. Recommendations for additional wilderness designations can also increase the exposure of cultural and sacred sites to climate change impacts. For example, areas that are likely to experience high-intensity fire because tree densities are too high increase the likelihood that fire-sensitive sites could be damaged or lost for lack of ability to conduct thinning treatments. Recommendations for wilderness designation could also make accessing cultural or sacred sites more difficult for tribal members who may not be able to easily walk to those sites if motorized access was allowable prior to recommendation.

Alternative 1 does not specifically discuss or promote climate change adaptation or climate resiliency; however, it does provide a measure of support as discussed in the ecological sections of this environmental impact statement. Overall, it doesn’t provide the flexibility or degree of support needed to adapt to climate change. Because of this, the quality and availability of forest products for traditional native uses may decline and the natural resources that comprise sacred places and settings, and traditional cultural properties, may degrade because of climate-induced changes.

Effects Common to All Action Alternatives

All action alternatives explicitly recognize the value of the forest to pueblos, tribal nations, and their peoples. The action alternatives incorporate the critical nature of integrating Indigenous Knowledges, data sovereignty, management of traditional cultural properties, and co-stewardship. This provides stronger support and valuation of nation-to-nation relationships, shared interests, and effective collaboration. All action alternatives elevate the importance of providing tribal and pueblo access, privacy, confidentiality, protection of traditional resources of importance, and access to these to sustain the traditional lifeways of federally recognized tribes.

Access to locations and materials for traditional purposes is addressed in plan components, with a desired condition for forest resources that are important for cultural and traditional needs, subsistence, and economic support to be available and sustainable for use by tribal and pueblo communities. Management activities and permitted uses would maintain or make progress toward the desired conditions for ecosystems and habitats, soil and watershed resources, water quality, riparian and aquatic ecosystems and wildlife, fish, and plant species. Moving riparian vegetation toward desired conditions would enhance the availability of plants that are collected by Native Americans for traditional uses.

All action alternatives specifically discuss and provide direction for climate change adaptation and climate resiliency, but the degree to which climate change adaptation and climate resiliency are supported varies amongst the action alternatives. All would sustain tribal uses, but the quality and availability of forest products for tribal uses would still be expected to change depending on the vulnerability of the plant communities and species providing those products. This is because of the different emphasis placed on restoration and adaptation of forested, woodland, shrubland and grassland ecosystems in each alternative.

All action alternatives identify criteria in a management approach for land acquisitions or exchanges without listing specific areas. This would provide the flexibility to make determinations based on the current needs of the management, local communities, and tribes. The criteria for land adjustments now include considerations for cultural resources. Lands desirable for acquisition would now include lands needed to protect significant historical or cultural resources when these resources are threatened or when management may be enhanced by public ownership. Federal land conveyances could include parcels that do not have significant recreational, cultural, or ecological value, and the transfer does not impact public access or resource management objectives. These land adjustment considerations help ensure long-term tribal access to ancestral lands.

In all action alternatives, there is a plan guideline stating reconstruction and rehabilitation of existing roads should be emphasized over new road construction. Existing roads identified for reconstruction or rehabilitation would consider those roads that provide access to properties of traditional importance, sacred areas, and traditional use areas. All action alternatives contain an objective for decommissioning at least 50 miles of closed roads every 10 years until the need is met. A complementary management approach suggests that one of the priority factors for decommissioning roads include those roads having adverse impacts to cultural resources. Decommissioning motorized travel routes reduces the risk of ground disturbance and unauthorized collection and vandalism at structures, sites, and areas near those motorized routes, although this could also hamper tribal members' ability to access areas of interest. Roads that would be decommissioned would require a site-specific National Environmental Policy Act process, a public process, and consultation with the tribes. Another guideline states that special-use authorizations for roads, linear utilities, communications sites, and other facilities or installations should be consolidated and co-located whenever possible, which will help minimize impacts to cultural and visual resources.

There is a continued emphasis on dispersed recreation in all the action alternatives. While visitation is not expected to increase because of implementing any alternative (see Sustainable Recreation Analysis Methodology) it may very well increase over time based on external factors such as number of hunting and fishing licenses or permits issued by the State of New Mexico (see Social and Economic Conditions Analysis Methodology). All action alternatives include recommendations for additional wilderness designation and have desired recreation opportunity spectrum classifications that would increase primitive settings by 11 to 31 percent over alternative 1. This may result in more area where tribal practitioners can find solitude and privacy and more area where traditional cultural properties and sacred sites might be protected from mechanized management activities, but potentially more vulnerable to climate change impacts.

All action alternatives would support on-going consultation, co-stewardship, incorporate Indigenous Knowledges, respect data sovereignty, and expand opportunities for shared learning.

Effects Common to Alternatives 1, 2, 3, and 4

In terms of area suitable for timber production that could provide forest products for tribal use, these alternatives are not substantially different, with roughly one-tenth of a percent separating them (see Effects Common to Alternatives 1, 2, 3, and 4 in the Timber, Forest, and Botanical Products section of this environmental impact statement).

Effects of Alternative 2

Alternative 2 aims to restore a variety of grasslands, open woodlands, and forests using a combination of naturally ignited wildfire, prescribed fire, and mechanical methods to maintain or move toward desired conditions. This blend represents the strongest support for the full spectrum of climate change adaptation options, the long-term productivity of traditionally used forest resources, and availability of those resources across the landscape.

This alternative identifies new areas on the forest to recommend for wilderness designation and increases the amount of primitive recreation opportunity spectrum settings by 12 percent over alternative 1. There are no known areas within the recommended wilderness for this alternative that would create a conflict with tribal interests and values.

Effects Common to Alternatives 2 and 5

Alternatives 2 and 5 allow flexibility in the occurrences of both land acquisitions (purchases) and land conveyances (sale, exchange, or donation). Land acquisitions of private property are expected to continue to be easier to implement than land conveyances based on the authorities currently available, which could lead to the area administered by the Gila National Forest growing slightly over the life of the plan. Newly acquired private lands would come under protection of federal laws and management, and acquired private lands, including traditional cultural properties that were previously inaccessible to tribes, would be accessible for traditional proposes.

Effects Common to Alternatives 2, 3, and 4

Herbicide use would be allowed under alternatives 2, 3, and 4 to treat nonnative invasive plant species, and under some circumstances, to help reduce overabundant native species. These alternatives would provide baseline constraints on herbicide use, like prohibiting aerial application methods, and other standards and guidelines designed to avoid or mitigate unintended, adverse environmental impacts. Herbicide use is a highly regulated activity and any proposal for its use would be subject to nation-to-nation consultation and a separate, project-level National Environmental Policy Act process. Under regulatory requirements and plan direction, herbicide use would be allowable to complement other vegetation treatments designed to restore or maintain the vegetation community composition and fuel structures necessary to support natural fire regimes. Only resprouting native species such as alligator juniper and evergreen oaks would be targeted, but not in all places and cases. The intent would not be to eradicate these species, only to bring their abundance within what supports low to mixed-severity fire. This would also impact the places, types and abundance of forest products provided by alligator juniper and evergreen oak species, keeping them more in-line with what was believed to have occurred historically.

Effects Common to Alternatives 3 and 4

Alternatives 3 and 4 stipulate that land acquisitions (purchases) would be balanced over time with land conveyances (sale, exchange, or donation) so that no-net loss of private property in a county occurred. Since it is easier for land acquisitions to occur than land conveyances, based on the authorities currently available, it likely that this will limit the amount of future land acquisitions (although purchased easements could provide access in some cases). As a result, lands of other ownership with important cultural resources could be developed instead of acquired and tribal access to important sites may be hindered.

Effects of Alternative 3

Alternative 3 places more emphasis on mechanically thinning grassland and open woodland vegetation communities to maintain or move toward desired conditions for those vegetation types.

These efforts are intended to improve understory vegetation that provides forage for wildlife and domestic livestock grazing, which contributes to local and regional economic sustainability. The use of fire would be limited. The emphasis on mechanical thinning treatments may generate more wood products that may be available to tribal members and limits the total number of acres impacted by management activities because mechanical treatments are typically more expensive than using fire. However, those acres would likely experience higher intensity disturbance due to the use of mechanized equipment. This alternative would be less effective at reducing the risk of large, contiguous areas of high-intensity fire than alternative 2 and provides weaker support for climate change adaptation and climate resiliency than alternative 2 because it would not reduce high intensity fire risk across much of the forest. The varying effects of mechanical treatments and fire are described in the Effects Common to All Alternatives subsection above.

This alternative identifies new areas on the forest to recommend for wilderness designation and increases the amount of primitive recreation opportunity spectrum settings by 13 percent over alternative 1. Wilderness recommendations are avoided in areas identified as needing restoration in grassland and open woodland vegetation and providing access to traditional recreational, cultural, and historical uses of the forest. There are no known areas within the recommended wilderness for this alternative that would create a conflict with tribal interests and values.

Effects of Alternative 4

Alternative 4 places more emphasis on mechanically treating forested and timberland vegetation to maintain or move toward desired conditions. These efforts would prioritize restoring forested vegetation that could also produce forest products, which contributes to local and regional economic sustainability. The use of fire would be limited. This alternative focuses on timber production and would offer more wood products, which could be available to tribal members. Like alternative 3, this limits the total number of acres impacted by management activities because mechanical treatments are typically more expensive than using fire. However, those acres would likely experience higher intensity disturbance due to the use of mechanized equipment. This alternative would be less effective at reducing the risk of large, contiguous areas of high-intensity fire than alternative 2 and provides weaker support for climate change adaptation and climate resiliency than alternative 2 for the same reason as alternative 3. The varying effects of mechanical treatments and fire are described in the Effects Common to All Alternatives subsection above.

This alternative identifies new areas on the forest to recommend for wilderness designation and increases the amount of primitive recreation opportunity spectrum settings by 11 percent over alternative 1. Wilderness recommendations are avoided in areas identified as needing restoration in forested vegetation or being suitable for timber production and providing access to traditional recreational, cultural, and historical uses of the forest. There are no known areas within the recommended wilderness for this alternative that would create a conflict with tribal interests and values.

Effects of Alternative 5

Alternative 5 places more emphasis on use of wildland fire as a restoration tool to maintain or move toward desired conditions for a combination of grassland and open-canopy woodlands, and forest types. Mechanical treatments would be largely limited to the wildland-urban interface. This alternative leads to more acres of disturbance overall, but the intensity of those disturbances is generally less than mechanical treatments. There is also a greater risk that such aggressive use of fire could increase the likelihood of undesirable fire effects as well as beneficial effects. The varying effects of mechanical treatments and fire are described in the Effects Common to All Alternatives subsection above.

Riparian areas containing perennial streams or native trout populations, or Mexican spotted owl would have an increased buffer from new construction or realignment of roads. This may or may not reduce detrimental effects of the transportation system on riparian and aquatic resources to a greater degree than the other action alternatives for those qualifying areas (see Riparian and Aquatic Ecosystems analysis Effects of Alternative 5). Alternative 5 also prohibits the use of herbicide on native species. This would provide more protection for tribal values than the other alternatives, but hinder management's ability to move toward the plan's desired conditions for vegetation communities and the wildland-urban interface.

This alternative identifies new areas on the forest to recommend for wilderness designation and increases the amount of primitive recreation opportunity spectrum settings by 31 percent over alternative 1. This alternative includes one recommended wilderness area that has been identified as a potential impediment to tribal access.

Cumulative Effects

Tribal relations in this country have been shaped by the history of interactions between the Federal Government and tribes. Other national forests solicited the tribes regarding their concerns and interests in forest management and they received specific comments about concerns over increased development, impacts to resources from off-road travel, the environmental and cultural impacts of mining, and protection of agave.

Tribal access and use of the lands and resources now managed by the Gila National Forest, as well as the general landscape, have been altered over time due to several factors. The primary factor is the change in land ownership and jurisdiction. Historically, resources on the land were more widely available to tribes, and they had nearly unfettered access to these lands for hunting, acquiring construction material, gathering firewood, and collecting resources for food, medicine, and ceremony. There were often well-established travel routes between communities, and prescribed routes to specific locations of tribal importance. As the Spanish, Mexicans, and later the Americans moved into the area, recognition of land ownership became increasingly important. Access to and use of resources continued to change with the establishment of the national forest in the early 20th century, and the gradual progression of environmental policy, resulting in the passage of federal laws and regulations, and greater federal oversight. In some cases, access to culturally significant locations has been severely restricted or eliminated altogether in places where land has gone into private ownership.

The process of preparing for and travelling to an area to conduct traditional and cultural activities is often as significant as the activity itself. The construction of fences, installation of gates, and checkerboard land-ownership patterns have contributed to complicating the ability to do resource collection and to visit areas of traditional cultural and religious significance. Land ownership can affect how Native Americans approach areas that are important to them, and conflicts have been known to arise with landowners or with Forest Service personnel who are unfamiliar with tribal rights on National Forest System lands. Ownership and development of private land has led to a greater reliance on national forests. Instead, they will opt, where they can, to obtain these resources on their own lands, or will travel to National Forest System lands that are closer to their reservations. When tribal and pueblo members do go to important places on national forests, their methods of travel and their activities often must be adjusted for factors such as road development, fences, gates, mixed land ownership, and other permitted or recreational uses of forests.

Tribal and pueblo members are concerned about the cumulative degradation of open spaces and the modification of cultural landscapes. Places of historical, traditional, and cultural significance to the tribes, whether they are identified as traditional cultural properties or not, and traditional forest product collection areas are located across these landscapes. Many of these traditional use areas are located on nontribal lands including state, federal, and private lands. As with cultural resource sites, many of which are considered ancestral homes of tribal members, losses of traditional use areas and places of traditional importance has been high on developed private lands.

There are inholdings of private land within the forest. In some cases, these properties contain strategic and culturally significant features such as springs. Most of these lands have not been subdivided. However, development of subdivisions within or adjacent to the forest can create concerns for a variety of reasons including: changes to the visual characteristics of the landscape, construction of new transmission lines and other utilities in the forest, concerns for wildlife, introduction of new species, degradation of watershed condition, increased fire risk, and when residents who live immediately adjacent to the national forest and wilderness areas establish informal trail systems for their personal use.

Evidence of past mineral exploration is still evident today on the forest and surrounding areas, and the Forest Service and other state agencies are working on reclamation of abandoned mines as funds are available. In the aftermath of the 2015 Gold King Mine wastewater spill originating in Colorado, and subsequent response of the Navajo Nation and other tribes in the region, there could be heightened tribal interest in the successful remediation of mines, expansion of mining activities and mineral exploration.

Current and future mining activities could also impact lands and waters important to tribal ways of life and ability to achieve desired conditions in some locations. Mining is not a currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. Mining activities are subject to valid existing rights and the decision whether to allow mining is outside the authority of the plan. Because of this, the Forest Service Southwestern Region intends to use a strategy to work toward jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b).

Indeed, there is likely to be much more tribal involvement on environmental issues of all types as co-stewardship is implemented. Some of the actions highlighted at the 2022 White House Tribal Nations Summit include over 20 new signed co-stewardship agreements between tribal nations and the Forest Service and Department of the Interior, implementation of the Forest Service Tribal Relations Action Plan, and numerous provisions for incorporating Indigenous Knowledges and supporting and enhancing tribal climate resiliency efforts. Many more co-stewardship agreements are already in process and are likely to become a standard operating procedure for working together. Co-stewardship can provide many benefits, particularly for addressing climate change-related management issues. Tribal managers bring Indigenous Knowledges and a commitment to place that is not cultivated in federal public land management professionals. Many tribal managers also bring advanced university education, decades of technical experience, or both, and can leverage resources not otherwise available. Capacity to accomplish climate adaptation actions is likely to be substantially increased through co-stewardship.

Cultural Resources and Archeology

Affected Environment

The Gila National Forest contains archaeological resources that demonstrate human occupation and use for approximately the past 12,000 years. The occupation and use of the forest by Native Americans with Pueblo and Athabaskan ethnic affiliation and groups ancestral to these ethnic affiliations has occurred the entire time. Occupation and use of the forest by Euro-Americans and other peoples from the Old World occurred over the past 400 years. The plan area has been under the management of the United States Department of Agriculture, Forest Service beginning in A.D. 1906, or for a little more than 100 years. Native American, Hispanic, and Anglo-American traditional communities continue to use the forest for economic, social, and religious purposes.

Management of culture and history is an important part of federal land management policy and practice. The recreational, educational, cultural, and scientific values of the archaeological sites on the forest are a recreational and scientific benefit that the forest can provide to the public. Preservation of these cultural heritage resources helps to give a sense of connection to modern people with those that have come before them through archaeological sites, historic properties, and sacred sites, among others. It is this resource that ties together the historic human use of the landscape and practices employed on it today. It tells the story of the changes in the environment and how humans benefited, impacted, or were otherwise affected by their utilization of the landscape and varying environmental conditions through time.

Of the 3.3 million acres encompassed by the Gila National Forest, approximately 400,000 or roughly 12 percent, have been inventoried to current standards. Inventory endeavors have recorded over 6,160 archaeological sites in the plan area. Of the total number of sites, eight have been formally listed in the National Register of Historic Places (or National Register).[37] Approximately 33 percent of all cultural resources in the Gila National Forest have been recommended as being eligible for inclusion in the National Register of Historic Places, and 7 percent of all resources have been recommended as being not eligible for inclusion in the National Register. The eligibility of the remaining 59 percent of known cultural resources for inclusion in the National Register of Historic Places is currently undetermined.[38]

Analyses from the assessment report (USDA FS 2017a) demonstrate that the vast majority of these resources are located in areas below 8,000 feet in elevation; on gently sloping landforms with less than a 10 degree gradient; in either pinyon juniper woodland or ponderosa pine forest biotic provinces (that is Ponderosa Pine Forest, Juniper Grass Woodland, and Pinyon Juniper Grass Woodland ecological response units in order of prevalence); within 200 meters of a stream; in areas modeled to be non-productive from a modern agricultural perspective; and on landforms classified as mountain tops/high ridges, canyon/deeply incised streams, U-shaped valleys, and/or local ridges/hills in valleys. The high proportion of inventoried archaeological sites in the Ponderosa Pine Forest is

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[37] Cultural and historic resources can be divided into two, related categories: archaeological resources; and characteristics of historic and cultural importance to traditional communities. Historic properties are defined under Section 110 of the National Historic Preservation Act [16 U.S.C. 470(a)(1)(A) and (B)] and NPS Bulletin 15 (National Register of Historic Places Staff 2002) as objects, structures, buildings, and sites, and districts of the four aforementioned property types, that are listed or eligible for listing to the National Register of Historic Places, based on their importance to local, regional, or national history. Thus, the term "historic properties" represents a specific designation for archaeological resources that are eligible for listing in the National Register.

[38] The treatment of "undetermined' resources as if they are eligible for inclusion in the National Register is a general practice for all projects in the plan area.

due, in part, to more projects targeting this vegetation community for thinning and fuels reduction activities.

Many cultural resource sites in the Gila National Forest have been negatively affected by past and ongoing activities. Cultural resources have been lost or damaged by past land management activities, including those dating from before national forest designation, from vandalism and visitor use, and because of natural events like erosion and lightning-caused fire (USDA FS 2017a). Many activities were initiated prior to implementation of the National Historic Preservation Act of 1966, as amended. Data on current conditions and trends for archaeological resources can be examined from the recording and monitoring of cultural resources over the past 50 years. Overall, erosion caused by flowing water is the most prevalent impact observed at archaeological sites. Water erosion has been noted as impacting deposits at nearly one-third of all resources visited. Vandalism, a category that includes looting, the defacement of standing structures and other features like rock art, arson, and the collection of surface remains such as pottery sherds, arrow and spear points, and bottles was noted during roughly 16 percent of site visits.

Cultural resources are nonrenewable, with few exceptions. Once the resource has been disturbed, damaged, moved, altered, or removed, nothing can recover the information that could have been gained through analysis, or replace the opportunity for individuals to understand and experience the site. Adverse effects have decreased over time because today, significant sites are typically identified during project planning, allowing for projects to be designed to avoid and mitigate potential effects before implementing an action.

Climate change is expected to amplify the disturbances that affect cultural resources. Persistent drought driven by higher temperatures is expected to increase wildfire activity. Increased wildfire can lead to more erosion and flooding, depending on fire effects to vegetation and soils. Fewer, but more extreme precipitation events can also lead to more erosion and flooding, either independent of high-severity fire or in conjunction with it. Erosion and flooding have the most potential to affect the condition of cultural resources. Cultural resources occur in and on soils. When soil movement increases, the context of cultural resources deteriorates.

Environmental Consequences

Methodology and Analysis

This section provides an assessment of the potential impacts each alternative could have to cultural resources and archaeology in the forest. Most land and resource management activities have potential to affect cultural resources, but individual actions are evaluated through project-level National Environmental Policy Act processes and the project-level Section 106 Consultation required by the National Historic Preservation Act. Because of the mitigation or avoidance measures that are developed and implemented through these project-level processes, adverse effects from planned undertakings are rare. At the forest planning level, the greatest threats to cultural and historic resources are those activities not initiated by agency actions such as erosion, looting, vandalism, naturally ignited wildfire, and recreational activities outside developed recreation areas. Looting and vandalism are implementation and enforcement issues and are not relevant to this analysis (see Assumptions Common to All Analyses).

Therefore, the potential differences between alternatives arise from: plan objectives for vegetation communities and how well they address the risk of large extents of high-intensity wildfire; plan direction for dispersed recreation and plan direction for roads management.

The assessment of potential effects to cultural resources and archaeology incorporated the following assumptions:

- The distribution of cultural resources inventory varies across vegetation communities;
- The number of sites within vegetation communities is representative only of sites that have been recorded within them during cultural resources inventory;
- Low inventory percentages in vegetation communities may not represent the actual potential for sites; and
- Appropriate mitigation and avoidance measures continue to be identified through project-level National Environmental Policy Act and Section 106 Consultation processes.

Climate Change Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

At a forest plan level, the environmental consequences associated with all the alternatives are similar regarding potential effects to cultural resources and archeology because the alternatives provide a programmatic framework that guides site-specific actions, but do not mandate, authorize, fund, or carry out any project or activity.

All alternatives have plan components for the use of some amount of mechanical treatments, prescribed and naturally ignited fire to treat vegetative ecosystems in the forest to move toward desired conditions for vegetation community composition, structure, function and process. These treatments also aim to reduce the risk of large extents of high intensity fire by reducing fuels, and restoring the fuel characteristics that support natural fire regimes. While these treatments have numerous effects on vegetation and the ecosystems in which they occur (see Vegetation and Fire sections), they would also have effects on cultural resources.

Mechanical treatments of vegetation adjacent to historic structures and sites susceptible to fire would also reduce their potential damage and loss from wildland and prescribed fire thereby preserving these types of sites for future public enjoyment, education, and research.

Vegetation treatments involving fire have the potential to expose cultural resources to heat and erosion, leading to degradation, and structural damage or loss; however, the cultural resources in the Gila National Forest have persisted through many fire cycles over time, and are generally not highly damaged by low-severity fire that moves quickly across the landscape. Conversely, even lower severity fires can damage cultural resources by altering their chemical or physical properties, such as charring exterior surfaces or promoting faster decomposition rates. In some cases, lower severity fires can completely consume plant fibers, hair, or textiles ruining the important historical data they once held.

High-intensity fire can be devastating to cultural resources, especially for perishable and fire-sensitive items such as wood, fabric, basketry, hides, leather, and plant residues or seeds. Extreme temperatures may destroy or alter the physical characteristics of artifacts, which significantly alters informational context. These temperatures can also affect the potential for dating features in a historical context by altering their physical and chemical composition. For example, extreme temperatures during high intensity fires can rearrange radiometric iron in hearths or deposit newer carbon that can interferes with the potential for carbon isotopes used for dating materials. Furthermore, high intensity fire damages vegetation and ground cover, contributes to soil hydrophobicity, and thereby increasing water runoff and erosion that can move cultural materials from their origin. High-intensity fire can also increase the incidence of other disturbances like fire-killed trees falling onto cultural materials.

Prescribed fire reduces the threat to structures, sites, and areas in the acres treated. Increased acreage of prescribed fires during optimal conditions can allow for fire that will not burn as hot as wildland fires and sites can be identified prior to implementation and protected (Buenger 2003). Wildland fire managed for resource benefit reduces the threat from high-intensity wildland fire for known structures, sites, and areas. However, unknown or unrecorded heritage resources could also be negatively impacted. Until more inventory is completed, the impact to these resources is not fully known.

The Wildland Fire Decision Support System process can be used to manage the potential threat to known fire-sensitive structures, sites, and areas where there is a known high site density from wildland fire managed for resource benefit. This knowledge would direct the response so the impact to sites could be reduced (Ryan et al. 2006). Finally, management actions associated with wildfire suppression can lead to effects to cultural resources including the construction of fire line through sites, burning of perishable materials resulting from suppression ignition, and other effects associated with the suppression of wildfire. Fire suppression and burned area emergency response activities, such as dozer line construction, road improvements, watershed protection, and noxious weed treatment, could adversely affect structures, sites, and areas as an indirect effect of wildland fire. Not all effects from fire suppression can be mitigated through the emergency management process (36 CFR 800.12), as immediate protection of life and property take precedence over resource protection.

There are wide variations in the acres treated and the combination of mechanical thinning treatments, prescribed fire and naturally-ignited fire that may be used within the range of alternatives; however, in most cases, the net potential for adverse effects to cultural resources is expected to be similar because both known and presently unknown sites within any given treatment area could be affected in similar ways by project activities. For example, if there is more prescribed burning and less mechanical treatment in one alternative, and vice versa in another, they would have the same basic potential effects to cultural resources because all sites within the entire prescribed burn and mechanical treatment areas could potentially be directly affected by vehicles, personnel, or other equipment associated with either kind of activity. The development and use of temporary roads in support of these activities could have negative effects to cultural resources. Damage caused by vehicles may include displacement and/or damage to artifacts, and loss of soils and vegetation, causing increased erosion. Increased access by temporary roads into the forest could also increase visitation to newly opened areas and have greater potential to adversely affect cultural resources. Most of these impacts would be avoided or mitigated.

Appropriate cultural resource inventory and development of appropriate avoidance measures, mitigation measures, or both, would be identified at the project level. In addition, tribal members, the public, and the State Historic Preservation Office would have the opportunity to review and comment during the planning phase.

Even in remote areas, visitors to the forest have the potential to negatively affect cultural resources. Dispersed recreation can be associated with impacts from ground disturbance, erosion, unauthorized collecting, and vandalism caused by motorized and non-motorized recreation. Alternatively, recreationists may observe and report impacts on resources in remote areas and assist forest staff in monitoring and protecting resources. None of the alternatives make changes to the 2014 travel management plan and will not change effects to cultural and historic resources from dispersed motorized recreation (USDA FS 2014a and b). Resources at greatest risk from ground disturbance, vandalism and unauthorized collecting are generally within a few hundred meters of motorized travel routes.

Again, differences between alternatives are expected to be small because most management of cultural resources and archeology is already decided by law, regulation, and policy. Also, all share the same desired conditions for cultural resources and archaeology, and management would be directed toward achieving those desired conditions. All alternatives make progress toward desired conditions for vegetation communities; however, there are a few notable differences between alternatives as discussed in the subsections that follow. All alternatives provide some degree of support for the full Resistance-Resilience-Transition climate change adaptation spectrum, whether the alternative specifically provides the context for it, or not. All alternatives also provide the flexibility to identify any necessary site-specific adaptation actions for cultural resources during project development; however, the degree to which those opportunities are likely to manifest before a damaging event takes place may differ between alternatives as discussed in the subsections that follow.

Effects Common to All Action Alternatives

The primary intent of roads management associated with the action alternatives is to have a manageable system for public and administrative access. All action alternatives contain an objective for road decommissioning at least 50 miles of closed roads every 10 years until the need is met. A complementary management approach includes cultural resources as one of the priority factors for identifying which closed roads to decommission. Decommissioning reduces the risk of ground disturbance, unauthorized collection, and vandalism at structures, sites, and areas near those closed roads.

Forest leadership and staff regularly engage volunteers and partners to help address both research and management concerns. Research projects in the forest involve universities, museums, Passport in Time volunteers, and other volunteers. Many of these projects address management concerns, such as erosion. A dedicated group of New Mexico SiteWatch volunteers serve as site stewards, monitoring changing site conditions and alerting forest staff to significant changes in condition. These volunteers and partnerships provide a valuable service and represent a meaningful and lasting way for the public to contribute to and learn about our cultural resources. All action alternatives include management approaches related to cultural heritage resources and archeology that would leverage volunteers and partners to continue to improve management and protection.

Effects of Alternative 1

Under alternative 1 there would be no change to the process of managing cultural and historic resources in the Gila National Forest. The 1986 plan provides specific direction regarding management of cultural resources, including cultural resource inventory, site protection, enhancement and interpretation, and research with the intent to protect and avoid resource management activities that have potential to disturb and degrade cultural resources. Site protection, restoration, and maintenance would reduce the potential for adverse effects on historic properties from weathering, erosion, ongoing use or natural processes. Most of these elements are required by various laws, regulations, policies, and agreements, particularly the cultural resource protection compliance process specified by Section 106 of the National Historic Preservation Act. In 1987, a plan amendment in response to the Save the Jemez/State of New Mexico lawsuit added plan direction related to cultural resource preservation and integrity, interactions with the State Historic Preservation Office, and public interest and education.

The no-action alternative does not include direction regarding issues and mandates for cultural resource preservation and management that have arisen since the amendment in 1987. It also does not address management of collected artifacts and cultural items, nor the need to have them catalogued and curated in accordance with current standards. Specifically, the plan predates the passage of the Native American Graves Protection and Repatriation Act and the 1992 amendment to the National Historic Preservation Act, the latter of which called attention to procedures for the identification of traditional cultural properties. While the 1986 plan is devoid of direction regarding compliance with many recent laws and regulations that protect cultural resources, Gila National Forest archaeologists are cognizant of the latest regulations and ensure that their requirements are followed. Many of the objectives for cultural resource management in the 1986 forest plan have been accomplished, have become standard operating procedures, or are now irrelevant. The no-action alternative does not provide direction on managing resources in response to climate change.

Alternative 1's approach to vegetation management maintains desired conditions or moves toward desired conditions for fire severity, patch size or both in most vegetation communities; however, in most cases the area under closed tree canopy conditions and fuel loading generally increase (see Upland Vegetation, Fire Ecology and Fuels) because fire is being used as more of a maintenance tool rather than a restoration tool. The management tradeoff here is that alternative 1 does little to reduce the existing risk and distribution of high-severity fire, which would affect cultural resources and archaeology. Many sites would remain at risk from increased erosion associated with high-intensity fires and other post-fire impacts resulting in the degradation or loss of site integrity and site data. Because alternative 1 does not target enough acres to move toward desired conditions for the vegetation community attributes that most affect cultural resources, cultural resources management is likely to remain reactive in a reactive stance to climate change impacts rather than a proactive stance.

Effects Common to Alternatives 3 and 4

Alternatives 3 and 4 limit the number of acres that can be treated with prescribed fire; instead, emphasizing mechanical treatments that provide products to people. While this approach would move some vegetation communities toward some desired conditions, it would not treat enough acres to move toward desired conditions for the vegetation community attributes that most affect cultural resources. Like alternative 1, alternatives 3 and 4 would still see an increase in the likelihood of high-severity fire across more acres than would experience a risk reduction. There would be more opportunities to identify and implement site-specific climate adaptation measures in areas treated mechanically, simply because more survey would be focused in these areas. However, from a forestwide perspective, cultural resources management would likely remain in a more reactive stance to climate change impacts than a proactive stance. Alternative 1 does not recommend additional areas to Congress for wilderness designation.

Effects of Alternative 2

Alternative 2 objectives would target a range of vegetation types using any combination of naturally ignited wildfire, prescribed fire, and mechanical thinning treatments to maintain or move toward desired conditions across the forest. Alternative 2 proposes treating between 32,845 and 1,997,413 acres over each 10-year period. The use of naturally ignited fire to accomplish vegetative objectives also requires some level of compliance with legal mandates; however, there is some increased risk to cultural resources and archaeology through increased fire on the landscape. While project activities under this alternative could pose risks to cultural resources as described in the Effects Common to All Alternatives, it is more likely that site degradation, loss of site integrity, and loss of site data could be reduced because avoidance and mitigation measures would be identified and designed during project planning across more of the forest than alternatives 1, 3, and 4. It also moves more vegetation communities toward desired conditions for the attributes that most affect cultural resources, reducing the risk of large, high-intensity wildfires. This provides more opportunities for cultural resource management to move toward a more proactive stance in addressing climate change impacts, although a reactive stance remains likely in the immediate future.

Alternative 2 also includes recommendations to Congress for more areas to be designated as wilderness. Under alternative 2, the recommended areas are generally coincident with inventoried roadless areas and areas where terrain naturally constrains modes of access and mechanical treatments, and road infrastructure is essentially non-existent. Because of this, implementation of alternative 2 would not substantially reduce that area potentially exposed to the effects of mechanical vegetation treatments over alternative 1.

Effects of Alternative 3

Alternative 3 includes mechanical treatment of at least 57,800 acres over each 10-year period in grasslands and historically open canopy woodlands to maintain or move toward desired conditions. It has no objective pertaining to Ponderosa Pine Forest or other forested vegetation communities. Recall that Ponderosa Pine Forest has the highest frequency of identified cultural resources in the forest. This means that for alternative 3, large extents of high-intensity wildfire are more likely to occur in forested vegetation communities, including Ponderosa Pine Forest and provides the fewest opportunities to identify and implement climate adaptation measures for cultural resources in forested vegetation communities. Cultural resources withing grasslands and historically open canopy woodlands are more likely to be identified and provided appropriate avoidance, mitigation, and climate change adaptation measures.

Alternative 3 also includes recommendations to Congress for more areas to be designated as wilderness. Under alternative 3, the recommended areas are generally coincident with inventoried roadless areas and areas where terrain naturally constrains modes of access and mechanical treatments, and road infrastructure is essentially non-existent. Because of this, implementation of alternative 3 would not substantially reduce that area potentially exposed to the effects of mechanical vegetation treatments over alternative 1.

Effects of Alternative 4

Alternative 4 includes mechanical treatment of forested vegetation communities on at least 52,030 acres over each 10-year period. Recall that the Ponderosa Pine Forest has the highest frequency of known cultural resources and would be one of the main vegetation communities targeted for treatment, like alternative 1 but at much higher intensity and with limited prescribed fire.

This means that for alternative 4, large extents of high-intensity wildfire are more likely to occur in woodland and grasslands that have become encroached upon by trees and shrubs. Alternative 4 would provide the fewest opportunities to identify and implement climate adaptation measures for cultural resources in woodlands and encroached grassland communities. Cultural resources within forested vegetation communities like Ponderosa Pine Forest are more likely to be identified and provided appropriate avoidance, mitigation, and climate change adaptation measures.

Alternative 4 also includes recommendations to Congress for more areas to be designated as wilderness. Under alternative 4, the recommended areas are generally coincident with inventoried roadless areas and areas where terrain naturally constrains modes of access and mechanical treatments, and road infrastructure is essentially non-existent. Because of this, implementation of alternative 4 would not substantially reduce that area potentially exposed to the effects of mechanical vegetation treatments over alternative 1.

Effects of Alternative 5

Alternative 5 objectives would target a range of vegetation types using naturally ignited and prescribed fire to move toward desired conditions. Mechanical thinning treatments would generally be restricted to the wildland-urban interface. Alternative 5 proposes treating between 157,500 and 1,899,700 acres over each 10-year period. The use of naturally ignited fire to accomplish vegetative objectives requires some level of compliance with legal mandates; however, there is some increased risk to cultural resources and archaeology through increased fire on the landscape. While project activities under this alternative would still pose risks to cultural resources as described in the Effects Common to All Alternatives, there would be less risk of mechanical impacts to cultural resources. Risk of mechanical disturbance would not be eliminated, as fire management activities would still involve some motor vehicle disturbance; however, for projects involving prescribed fire, site degradation, loss of site integrity, and loss of site data could be reduced because avoidance and mitigation measures would be identified and designed during project planning. Alternative 5 moves more vegetation communities toward desired conditions for the attributes that most affect cultural resources, by accepting more risk now, when fuel and weather conditions are favorable, rather than deferring it for large, high-intensity wildfire events. Cultural resources management would be likely to remain in a reactive position because the risks associated with managing that much more naturally ignited fire on the landscape, the emergency management process that is in place for natural ignitions (36 CFR 800.12), and the money, staffing, and workload that would be involved to bring cultural resource management up to the pace of vegetation and fuels management.

Cumulative Effects

The landscape surrounding the Gila National Forest is managed by multiple entities including other national forests, the Bureau of Land Management, National Park Service, other federal agencies, the states of New Mexico and Arizona, local governments, and private landowners. When projects are funded by federal money, those projects must follow the requirement of the National Historic Preservation Act. Federal money may fund projects on federal land, tribal lands, or on State, county, or private lands through grants. In all these situations, the National Historic Preservation Act protects, interprets, and minimizes impact to cultural resources and maintains information that has the potential to provide new or significant data related to a specific culture, time, or artifact type. Activities that occur on private land or local government jurisdictions funded by non-federal money may not follow such strict guidelines and may therefore, cause the loss or dislocation of cultural resources.

Loss of cultural and archaeological resources has happened in the past and will continue to happen in the future. As time progresses, there may be fewer cultural and archaeological resources available to future generations to learn about past human lifeways, changes in human behavior through time, and to interpret the past for the public. On federal lands and projects funded with federal money, the loss would be limited to cultural resources not meeting qualifying criteria for protection, such as an isolated artifact; or those cultural resources for which the potential for effect would be considered very low. In other situations, impacts may be more detrimental to the archeological record and cultural interpretation. In surveyed areas, recording and archiving basic information about each cultural resource for future reference serves to partially mitigate any potential effects to cultural resources. Also, the design criteria, mitigation, and monitoring measures related to cultural resources for any potentially federally funded project serves to protect them and avoid potential negative effects to cultural resources deemed to be significant, such as historic properties. The ecologic and hydrologic changes predicted to accompany climate change also pose the increased threat to cultural resources from high-intensity wildfire and erosion. Climate-altered fire regimes, extreme weather and flooding events could lead to more erosion in the uplands and in drainages. These events have the potential to destroy or damage cultural resources over large areas. Cultural resource vulnerability assessments and related analysis contribute to the development of climate change adaptation options that reduce the risk of negative impacts (Clark et al. 2022). Such a vulnerability analysis is in the discussion stage for national forests in Arizona and New Mexico.

Several interpreted resources adjacent to the Gila National Forest will continue to provide information on the history of occupation of the area's inhabitants and contribute socioeconomic contributions to local and regional economies through cultural tourism. These include the Fort Bayard National Historic Landmark, the Mogollon Mining district, the Gila Cliff Dwellings National Monument, the West Fork ruin near the Gila Cliff Dwellings, several sites along the Trail of the Mountain Spirits, the Santa Rita Mines, and the Geronimo Trail at Kingston. Archaeological sites are a major attraction for cultural tourism. Indeed, from 2008 through 2011, roughly 37,000 people on average visited the Gila Cliff Dwellings National Monument per year (Mitchell et al. 2014). Visitors to this and other interpreted cultural resources in New Mexico generated roughly $137 million for state and local governments, with the Gila Cliff Dwellings generating roughly $17 million alone (Thomas et al. 2015). Interpreted archaeological sites also afford an opportunity to educate children and the public at large about resources that are important to the traditional history of Native Americans, to the military history of the nation, and to the history of the nation's westward expansion.

Current and future mining activities could also impact cultural and historic resources and ability to achieve desired conditions in some locations. Mining is not currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants.

Mining activities are subject to valid existing rights and the decision whether to allow mining is outside the authority of the plan. Because of this, the Forest Service Southwestern Region intends to use a strategy to work toward jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b).

Sustainable Recreation

Affected Environment

The 3.3-million-acre Gila National Forest offers a wide variety of dispersed and developed recreational opportunities including camping, picnicking, hiking, rock climbing, mountain biking, horseback riding, paddling and floating, wildlife and scenic viewing, hunting, and fishing. Its varying elevation and climatic ones allow year-round visitation. Elevations range from roughly 4,000 feet in the lowlands of the Big Burro Mountains to over 10,000 feet among the peaks of the Mogollon and Black Range mountains.

The Gila National Forest remains one of the largest, most remote, uniquely contiguous, and least developed national forests in the southwestern United States. The forest provides a rustic recreation experience with many opportunities for solitude and a range of motorized and non-motorized backcountry recreation opportunities. Twenty-four percent of the forest's land mass consists of congressionally designated wilderness, including the Gila Wilderness, the world's first designated wilderness area.

Boasting some of the darkest nights in the Southwest, the Gila National Forest offers many visitors the chance to view and admire the natural night sky, a glittering dome peppered with stars, planets, and passing meteors. Much of the forest lies within the darkest category on the Clear Sky Chart light pollution map,[39] and on the Bortle scale rates it within in the range of excellent to typical truly dark sky.[40] The Cosmic Campground on the Glenwood Ranger District has gained recognition as an International Dark Sky Sanctuary by the International Dark Sky Association. This is the first International Dark Sky Sanctuary located on National Forest System lands. International Dark Sky Sanctuaries are lands possessing an exceptional or distinguished quality of starry nights. The Cosmic Campground offers a 360-degree, unobstructed view of the night sky, and often hosts "star parties" in cooperation with the partner group Friends of the Cosmic Campground. Gila National Forest is an international destination for its wilderness areas and dark skies.

Local residents have a long-term and deep connection with the forest as it contributes to quality of life and economic opportunities. Outdoor recreation contributes to the physical, mental, and spiritual health of individuals, bonds between family and friends, and contributes to tourism and the economies of the local communities. State and local governments recognize the area's ecotourism potential and have recently increased marketing to promote that potential. Growing populations in Albuquerque, Las Cruces, El Paso, and Tucson have led to more people seeking the diverse recreation opportunities the forest offers. There are well-developed transportation links from these major population centers; however, the forest is still relatively removed, distance-wise. While on an upward trend, visitation is still relatively light with about half of the annual visits being from residents (USDA FS 2016a).

In recent decades, the forest has experienced several large wildfires that drastically changed the landscape in parts of the forest. These large wildfires have directly affected scenic character, recreation access, facilities, opportunities, and experiences, and continue to have impacts long after fire is out.

Dispersed Recreation

Dispersed recreation is the most popular form of recreation on the Gila National Forest, including but not limited to camping, hiking, mountain biking, e-biking, horseback riding, scenic and wildlife viewing, hunting, paddling or floating the forest's major rivers, geocaching, cave exploration, and driving for pleasure. Non-motorized trail use is the most popular recreational activity year-round, and hiking is the most popular activity (USDA FS 2016a). Dispersed camping, primarily along National Forest System roads and near water sources, is also a very popular activity enjoyed by small and large groups. Use trends tend to follow the population centers around the forest. Higher rates of use occur near small towns and villages where people can go for a quick outing without venturing far. Trails around these communities are popular for quick hikes over shorter distances. Conflicts between different user groups are also more common in these areas of higher use.

With trail use supporting the most popular activities, the trail system and its maintenance have not kept up with user demand or expectations. To illustrate this point, user-created hiking and mountain biking trails in the most popular day-use areas near Silver City have expanded markedly over the last

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[39] The Clear Sky Chart light pollution map can be viewed at https://www.cleardarksky.com/maps/lp/large_light_pollution_map.html.
[40] The Bortle Dark-Sky Scale is a numeric scale that rates the visibility interference cause by light pollution with a rating of one being the highest quality dark sky and a rating of one reflecting the highest degree of light pollution and poorest dark sky conditions.

several years, most noticeably in areas around Fort Bayard, Gomez Peak, and Little Walnut areas. This indicates demand is greater than the opportunities provided.

Equestrian use (horseback riding and backcountry stock packing) are also popular forms of non-motorized recreation in the forest. This type of use primarily occurs within wilderness and less-developed forest areas adjacent to communities. Backcountry horseback riders visiting wilderness areas use vehicles and stock trailers to access trailheads and areas throughout the forest. It is common for some of these users to pull stock trailers for 3 to 5 hours to reach a trailhead. Many of these backcountry trips are multi-day in duration and involve the use of both pack and saddle stock. Day-use equestrians are more likely to make use of forest trails located immediately adjacent to local communities.

The Gila National Forest has an extensive trail system. Some trails predate the establishment of the national forest. Some are not located or designed to minimize maintenance needs, erosion or sedimentation, and are often located on steep grades that require numerous drainage structures. Trail maintenance lags far behind the need and has become the largest issue facing the recreation program in the last decade. Many trails have been impacted by large wildfires and conditions vary greatly throughout the forest. Popular trails such as the Continental Divide National Scenic Trail receive annual maintenance, while other trails receive little or no maintenance for many years. Often, because of limited funding and the necessity to prioritize maintenance, more popular trails or those necessary for administering the forest are in the best condition. System trails that are the least used often have the greatest deferred maintenance issues. Trails that are rarely used or located in fire-affected areas have in some cases deteriorated to the point that they are difficult to locate and travel. Many trails are missing signs and existing signs may be illegible due to weathering. Major disturbances such as high-severity wildfires and flooding have resulted in an accelerated rate at which trails are experiencing damage across the forest.

The implementation of the Travel Management Rule (36 CFR parts 212, 251, 261, and 295), eliminated motorized cross-country travel in the Gila National Forest. The public can no longer drive off the designated roads system to recreate across most of the forest. However, the 2014 travel management decision designated 300-foot corridors along many miles of open roads where people can get off the road to camp (USDA FS 2014a and b). Open road and motorized trail maintenance is a continuing issue on the forest and many forest roads have been and continue to be impacted by wildfire and post-fire effects. With decreasing budgets, only a small number of roads and motorized trail receive maintenance in any given year. This can degrade the motorized experience, but also impact natural resources through soil erosion and sedimentation. Some forest recreationists, local businesses, and elected officials would like to grow the motorized tourism-based industry, including use of the Gila National Forest for those activities.

Opportunities to hunt, fish, or just be in nature is a very important form of dispersed recreation. Hunting, fishing, and wildlife viewing in the Gila National Forest contribute socioeconomic benefits through employment opportunities, support of small businesses, and federal receipts shared with local governments (see Social and Economic Conditions for more information). In 2013, New Mexico Department of Game and Fish commissioned a study of fishing, hunting, and other wildlife-associated activities to estimate county-level and state-wide economic contributions (Southwick Associates 2014). The study found 248,334 New Mexico residents and nonresidents fished, hunted, or participated in other wildlife-associated activities in New Mexico in 2013. Of these participants, 24 percent, or almost 60,000 participants, fished, hunted, or viewed wildlife in the four counties encompassing the Gila National Forest and spent almost $47 million (Southwick Associates 2014).

Fishing and other water-based recreation opportunities are relatively rare in the arid and semi-arid southwestern United States. The Gila National Forest provides water-based recreation opportunities associated with over 950 miles of perennial streams and rivers, and three small reservoirs—Quemado Lake, Lake Roberts, and Snow Lake. These reservoirs support fisheries managed by the New Mexico Department of Game and Fish. Some of the common sport fish found in these waters include rainbow and brown trout, large and small mouth bass, as well as channel and flathead catfish. Quemado Lake is one of two lakes in New Mexico that have a population of tiger muskie, which draws anglers from across the region. Recreation facilities at these three reservoirs has steadily improved, including new boat ramps at Lake Roberts and Quemado Lake.

Many native fish are also found in the forest’s perennial streams, some of which are federally listed under the Endangered Species Act. The Gila National Forest, U.S. Fish and Wildlife Service, and the New Mexico Department of Game and Fish continue to work together to restore native fisheries and fish species (see Wildlife, Fish, and Plants for more information). Some of these fisheries now contain fishable populations of the threatened Gila trout, which is another significant draw for anglers.

Although not the most popular activities, individuals and groups engage in rock climbing and spelunking (cave exploration) in the forest. The poor rock quality at many otherwise suitable locations is a limiting factor for climbers and there are higher quality opportunities on other jurisdictions nearby. There are some established routes within the forest, including Cherry Creek in the Piños Altos Mountains, Purgatory Chasm in the Mimbres area, Chloride Canyon in the northeastern portion of the Black Range Mountains, and Saddle Rock in the northeastern area of the Burro Mountains. Similarly, few areas provide opportunities for cave exploration and the primary locations are within the Black Range Ranger District.

Developed Recreation

The Gila National Forest has many developed campgrounds, day-use picnic sites, and trailheads, an observation site, and an interpretive visitor center near the Gila Cliff Dwellings National Monument. These areas typically experience greater use during the summer and fall seasons and on holidays. Some are during the winter months. The condition and use of developed recreation facilities on the Gila National Forest vary greatly and are dependent on several factors including location, access, and the opportunities and amenities provided by that facility. There are also three target shooting ranges operated under special-use permits held by Catron and Grant Counties.

Many of Gila National Forest’s developed recreation facilities are currently in good condition, but others are in declining condition due to the growing backlog of deferred maintenance, age of infrastructure, cost of maintenance or replacement, and vandalism (such as graffiti, litter, physical damage to facilities, etc.). Developed recreation facilities that are not maintained to a minimum acceptable condition can be a threat to public safety. This can lead management to limit the services provided at some facilities, impose seasonal closures at more locations and longer durations, or close sites permanently to reduce maintenance needs and reduce threats to public safety; in turn, this is a threat to the recreation opportunities the forest can provide.

Many of the forest’s developed recreation sites are located within floodplains, which increases the risk of flooding-related damage and loss of life. Sites located in floodplains can also be a water quality concern. Several developed recreation sites are currently closed due to damage from recent wildland fires, flood risk, or both. Seasonal closure or restrictions during the monsoon season have been instated at other sites.

Recreation Special Uses

All occupancy, use, and improvements on National Forest System lands that are not directly related to timber harvesting, grazing, or mining are referred to as special uses. Special-use authorizations are permits, leases, or easements establishing a partnership between the Forest Service and private businesses and individuals to provide services, activities, and facilities to the public. These permits, leases, and easements are legal instruments whose terms and conditions are fully enforceable, support the Forest Service mission, and meet the needs of the public. Authorizations may be short term, such as for recreation events or noncommercial group uses, or longer term such as ski areas and communication sites like cell towers. Special-use authorizations are divided into two categories: recreation and non-recreation. Non-recreation special uses are described and analyzed in the Lands section of this environmental impact statement.

Under various laws and regulations set by Congress, the Forest Service collects land use fees for special-use authorizations. While most land use fees are returned to the United States Treasury, some fees are retained by the forest. Certain recreation special-use authorizations, such as outfitter-guides and recreation events, generate revenue for the forest, which is directed to improve visitor services and address upgrades or deferred maintenance of recreation facilities.

Currently. the Gila National Forest administers recreation residence permits, a marina permit, target range permits, a visitor center and museum permit, permits for onetime events such as church gatherings, weddings, family reunions, field schools, and school-related field trips.

Recreation Issues and Trends

The recreation program on the Gila National Forest plays a key role in the social stability, environmental integrity, and economic vitality of surrounding communities. A sustainable recreation program is integral in protecting the natural, cultural, and scenic environment for present and future generations to enjoy. Several factors relating to societal, lifestyle, and demographic trends can affect recreation program participation. Populations and demographics will change over time. New trends and demands will emerge from those changes.

Many visitors tend to use the Gila National Forest for multiple types of recreation purposes in a single visit. For example, a visitor to the forest for big game hunting is also likely to camp either in a dispersed site or in a developed campground, use system roads and trails, view scenery and wildlife, and drive an off-highway vehicle or use pack or saddle stock. A visitor enjoying a scenic drive viewing wildlife may also picnic, day hike, or visit an interpretative area.

The Gila National Forest is large and provides many opportunities for recreationists to find less crowded areas. Since most visitors to the Gila National Forest enjoy multiple recreation uses within a single visit and are typically seeking solitude, conflicts between different user groups are minimal. Additionally, different user groups may use the same locations, but at different times of year. Most user conflicts that occur are limited to developed recreation sites and popular areas near communities and are more likely during weekends and holidays when there is increased visitation. However, there is an upward trend in conflicts between users on the trail system near Silver City.

Trail etiquette includes a right-of-way hierarchy where bikers and hikers yield to equestrians, and bikers yield to hikers. Signage informing trail users of this etiquette is often installed where a variety of uses occurs and use levels are higher. However, many users remain unaware of or are unwilling to abide by the rules of etiquette, which can contribute to user conflicts and adversely affect recreation experiences. Examples include horses being spooked by dog walkers, and mountain bikers passing hikers at high speeds, creating a perception of unsafe conditions and sometimes leading to accidents.

Off-highway vehicle use has increased in popularity on public lands throughout the country, including the Gila National Forest. This led to the 2005 Travel Management Rule, which has been completed for the entire forest and implementation should reduce motorized travel off the designated system of open roads. In a 2006 survey of values, attitudes, and beliefs, participants indicated concern about conflicts between motorized and non-motorized uses. They also expressed a belief that many users simply lacked information about forest rules and regulations (USDA FS 2006a). Commenters on the forest plan revision continue to express these views and concerns about enforcement. Others have expressed concern about a lack of opportunities for motorcyclists and would like to see some non-motorized trails reclassified for use only by motorcycles. Mountain biking is another recreational activity that has steadily increased in popularity. There are a variety of opportunities on the Gila National Forest, but there is potential for conflict with other trail users. Some hikers have expressed a concern about mountain biking trails created by users in popular areas.

There is growing popularity of adventure races and similar events such as boot camps, mud events, and endurance races held under a special-use permit. These events are generally limited to system trails outside of designated wilderness. Other recreation activities that may contribute to the demand for recreation within the Gila National Forest plan area include the growing interest in zip lines, use of drones, and geo- or eco-tourism. If managed appropriately, conflict can be minimized, and these activities could provide additional socioeconomic contributions to the area without undesirable impacts.

There is an upward trend in seasonal closures of some developed recreation sites due to budget and staffing constraints, the post-fire environment, or both. These sites are often within floodplains, which poses both public safety and natural resource concerns. Forest leadership and staff are striving to balance visitors' desires for developed recreation sites near water while providing for public safety. Seasonal closures not only limit the available recreation opportunities but can result in lower visitation rates overall and increases in vandalism.

Vandalism includes graffiti to structures within sites, destruction of government property, theft and damage to signs, littering, and cutting of vegetation within the developed recreation sites. Gila National Forest leadership and staff have been promoting the use of building materials that are more durable and resistant to environmental factors and vandalism. These materials tend to be more expensive and using them can limit the number of sites that can be upgraded each year.

President Bush signed the Federal Lands Recreation Enhancement Act into law in 2004. It permits federal public land management agencies to establish, modify, and charge and collect modest recreation fees at developed sites that meet specific criteria. Most of the revenue generated from fee areas is kept where it is generated and supplements the budgets Congress allocates to maintain and enhance recreation opportunities and amenities at developed sites. However, the revenue that is generated by the fee areas is not sufficient to address all deferred maintenance needs.

Compared to adjacent national forests, the Gila National Forest has very few sites that charge fees. Many campgrounds and developed recreation sites are provided at no cost to the visitor. While this provides visitors of all economic backgrounds opportunities to use developed sites, it limits the resources available to maintain and enhance the amenities provided. The Southwestern Region of the Forest Service is still working through the public process and analysis for a recreation fee program. Some of the sites being considered for the fee program on the Gila National Forest may require improvements before instating a fee. For example, a cabin rental program on the Gila National Forest would require improvements to those sites.

Until recently, recreation budgets and staffing had been on the decline while demand for services and level of use continued to increase. These factors made it increasingly difficult to maintain and operate the existing recreation and trails program infrastructure or align recreation facilities with the capacity or use for which they were originally designed. Forest leadership and staff were no longer able to depend solely on the funding allotted by Congress to provide a recreation program that even began to meet the demand. Program management became about uniting diverse interests to focus scarce resources on sustaining and expanding the benefits of outdoor recreation. Partners and volunteers became imperative to keeping the recreation program afloat, especially the trails component of the program.

It was in this atmosphere that the Gila National Forest and all other national forests in the Southwestern Region of the Forest Service, were tasked with developing a Sustainable Recreation Strategy Action Plan. These plans were to implement the Southwestern Region's Sustainable Recreation Strategy, which tiered off the Forest Service's agency-wide Framework for Sustainable Recreation. The action plan was intended to be built collaboratively with diverse communities and partners and reviewed and updated every five years. Because of staffing, budget, and workload when the first action plan was developed, Gila National Forest leadership and staff did not invest in a public process or provide clear information, readily accessible to the public at large about the action plan. This led to several years of misunderstanding and mistrust among highly valued partners, volunteers, and the public at large, specifically as it concerns a sustainable trail system.

More recently, the economic environment has changed drastically with passage of the Great American Outdoors Act and other legislation. The social and relational landscape is also changing. Partners and volunteers will forever be integral to recreation program management and the hard work to improve relationships after the experiences of the first Sustainable Recreation Strategy Action Plan is ongoing. The Gila National Forest's recreation and trails programs have weathered lean years. Now it must adapt and overcome obstacles to make the most of a few years of plenty, including an update to the Sustainable Recreation Strategy Action Plan, and emerge and face an uncertain future.

Uncertainty is not limited to budgets and staffing, for both the Gila National Forest and its partner organizations. Climate change has brought additional uncertainty, amplified familiar challenges, and may introduce new challenges to the recreation and trails programs. Climate change is predicted to increase the recreation demand on many national forests as people seek relief from the heat of lower lying populated areas and increase the incidence of heat-induced illnesses such as dehydration and heat stroke, while bringing with it more high-intensity wildfire, extreme flooding events, and less predictable water availability for all forest uses.

Environmental Consequences

Analysis Methodology

Recreation Opportunity Spectrum

Forest Service personnel use the recreation opportunity spectrum as a framework to identify, describe, plan, and manage a range of recreation opportunities that can be experienced in diverse settings. A recreation opportunity is the ability to participate in a specific recreation activity in a particular recreation setting. The social, managerial, and physical attributes of a place, when combined, provide a distinct set of recreation opportunities. Recreation opportunities include non-motorized, motorized, developed, and dispersed recreation. Opportunities vary along the spectrum from a very high probability of solitude, self-reliance, challenge, and risk to very social opportunities where self-reliance, challenge, and risk are relatively unimportant to the experience.

An important aspect of the recreation opportunity spectrum is to ensure the Gila National Forest is providing a diversity of recreation settings and opportunities that respond to public desires and expectations to the degree practicable. The assessment phase of revision identified a need to re-inventory recreational opportunities by recreation opportunity spectrum class and make future adjustments as necessary (USDA FS Gila National Forest 2017a and b). As part of the plan revision process, existing and desired recreation opportunity spectrum classes were updated (USDA FS

2016c). Appendix B in the revised plan contains a map of desired recreation opportunity spectrum classes. The six classes are described below:

1. **Primitive** areas are characterized by essentially unmodified natural environment of fairly large size (generally, 5,000 acres in size or larger) and usually located at least 3 miles from any open road. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free from evidence of human-induced restrictions and controls. Motorized use and mechanized equipment within the area are not permitted. Note that congressionally designated wilderness areas are often associated with a primitive type of recreation opportunity, but the primitive recreation opportunity class is not synonymous with designated wilderness.
2. **Semi-Primitive Non-Motorized** areas are characterized by a predominantly natural or natural-appearing environment of moderate-to-large size. They are managed to achieve a sense of remoteness, although semi-primitive non-motorized areas can be as small as 2,500 acres and generally are only a half-mile or greater from any open road. Interaction between users is low, but there is often evidence of other users. The areas are managed in such a way that minimum on-site controls and restrictions may be present but are subtle.
3. **Semi-Primitive Motorized** areas are characterized by a predominantly natural or natural-appearing environment of moderate-to-large size. Concentration of users is low, but there is often evidence of other users. The areas are managed in such a way that minimum on-site controls and restrictions may be present but are subtle. Motorized use is permitted. Semi-primitive motorized areas generally either buffer semi primitive non-motorized areas or stand alone as tracts of 1,500 acres or larger with a lower road density (less than 1.5 miles of road per 1,000 acres).
4. **Roaded Natural** areas are characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of people. Such evidence usually harmonizes with the natural environment. Conventional motorized access is accommodated. Roaded natural areas are located within 0.5 mile of a road and usually provide higher levels of development such as campgrounds, picnic areas, and river access points. Interaction between users may be low to moderate, but with evidence of other users prevalent. Resource modification and utilization practices are evident but harmonize with the natural environment. Conventional motorized use is provided for in construction standards and design of facilities.
5. **Rural** areas are characterized by substantially modified natural environment. Resource modification and utilization practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of people are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by large numbers of people. Facilities are often provided for special activities, such as amphitheaters, group pavilions, group fire rings and cooking units, and so forth. Moderate densities are provided far away from developed sites. Facilities for intensified motorized use and parking are available.
6. **Urban** areas are characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Renewable resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of people on-site are predominant. Large numbers of users can be expected, both on-site and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site.

This analysis uses the updated existing recreation opportunity spectrum settings and compares them to the desired recreation opportunity spectrum settings that would be expected to accompany each alternative. This comparison reflects the relative balance between motorized and non-motorized recreation settings that can be anticipated under each alternative. All alternatives provide for a variety of motorized and nonmotorized recreation settings and opportunities.

Existing and desired recreation opportunity spectrum classes across the forest were assigned in the 1986 forest plan, and a spatial depiction or map of these settings was started, but never completed. However, these existing and desired conditions were not developed using the same recreation opportunity spectrum class descriptions as defined above (USDA FS 2013). The existing and desired conditions defined in the 1986 planning process are not directly comparable to those defined during this planning cycle. This analysis assumes:

- Visitors want experiences that vary from primitive to highly developed, but the Forest Service cannot accommodate all preferences in all parts of the national forest;
- Motorized vehicle use will continue to be designated and managed in accordance with the Travel Management Rule, 36 CFR parts 212, 251, 261, and 295;
- Desired recreation opportunity spectrum settings result from the National Environmental Policy Act process, including public engagement and interdisciplinary discussions. The amount of vegetation manipulation can have a large impact on recreation opportunity spectrum settings and is an objective way to look at whether management is moving toward or achieving the desired recreation opportunity spectrum;
- The recreation opportunity spectrum frameworks will be applied in project-level planning for all Gila National Forest activities;
- Visitor use information specific to each ranger district is not available. National visitor use monitoring information is collected for the entire Gila National Forest. Site-specific and recreation-opportunity-spectrum-related use data is not available;
- Forest plan decisions do not substantially affect visitation rates in the Gila National Forest; however, new or altered management direction may influence the type of opportunities that are available to the public;
- The level of development on adjacent lands under other jurisdictions and ownerships may affect the quality of the night sky. Forest plan decisions do not affect the night sky;
- Future sustainable recreation planning, including development of a trails strategy, will be an iterative, transparent, and collaborative process under all alternatives; and
- Procedures for the review and response times for special-use applications and requests are now set by policy and regulations outside the forest plan and will apply regardless of the alternative selected.

Climate Change Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

All alternatives would allow for some amount of prescribed fire, naturally ignited wildfire, and mechanical thinning treatments to complete plan objectives and move toward desired conditions for ecosystems and watersheds. Thinning and burning have the potential to alter recreation opportunity spectrum classes from those that are predominantly natural appearing (that is primitive, semi-primitive non-motorized, semi-primitive motorized, and roaded natural) to those with more modified environments (that is rural and urban). However, thinning and burning could be consistent with managing for predominantly natural-appearing environments even though they would be visually evident over the short term. Prescribed thinning treatments would be designed to maintain or achieve desired recreation opportunity spectrum classes over the long term under all alternatives. In addition, if thinning and burning treatments do not occur in some areas, large, continuous extents of high-intensity wildfire could have effects that occur over larger areas, last longer, and are inconsistent with managing for predominantly natural-appearing recreation opportunity spectrum classes. Any deviation from the desired recreation opportunity spectrum settings resulting from thinning and burning treatments would be minor and temporary compared to the long-lasting effects of high-intensity wildfire. The degree to which each alternative supports maintenance or achievement of desired recreation opportunity spectrum settings over the long term varies based on how well each supports movement toward desired conditions for vegetation communities and reduces the risk of high-intensity wildfire.

Reducing tree density would change the quality of recreation opportunities and experiences. Less densely vegetated conditions benefit dispersed camping, picnicking, some types of hunting, wildflower and wildlife viewing, and travel by foot, horseback, bicycles, or motorized vehicles (Englin et al. 2001; Venn and Calkin 2011). More open conditions would be less appealing to some campers who may avoid dispersed sites with less vegetative screening. On the other hand, more open areas would be more visually appealing to others and may aid in accessing camping sites for those pulling large trailers or driving recreational vehicles. Some recreationists would avoid treated areas with views of freshly cut stumps, piles of vegetation, and blackened and burned vegetation. Loss of screening vegetation and shade along trails or at dispersed camping sites could also negatively impact recreation users.

All alternatives provide standards and guidelines to mitigate short-term impacts to recreation access and facilities from thinning and burning activities. However, recreation access may be negatively impacted by the type, amount, frequency, and duration of vegetation treatments, which vary by alternative.

All alternatives provide objectives to improve the forest's trail system and management approaches for valuing the contributions of partners and volunteers, improving those relationships and thereby the collective ability to manage for a sustainable trail system. Changes to the forest's motorized transportation system would only result from updates to the travel management decision during project-level planning under all alternatives; therefore, none of the alternatives would directly affect motorized access. However, all alternatives include objectives for decommissioning closed roads, and standards and guidelines for road maintenance, realignment, and new construction. Together, these plan components would improve, maintain, or improve both access and habitat, increasing the quality of opportunities for wildlife watchers, fishers, and hunters to participate in those activities.

Permitted livestock grazing would continue under all alternatives, overlap with many recreation settings and opportunities, and impact visitors' experiences. Some recreating visitors may be uneasy or displeased by the presence and visible evidence of cattle. Others may appreciate or enjoy their presence. There may be conflicts between uses when animals are blocking passage, behave aggressively, or present a collision hazard. There may also be additional maintenance and repairs to recreation infrastructure in some locations associated with livestock.

Recreation special-use authorizations such as outfitter and guide permits would continue to be issued within the capacity of the forest to support those special uses. A draft of a recent use-capacity analysis for outfitter and guides indicates the Gila National Forest is well within capacity and there may be some room for growth. Use-capacity studies would re-occur periodically under all alternatives. With upward trends in the demand for special-use authorizations for adventure races and similar, recurring events. During these events, other forest visitors could be denied access to the area and be forced to find a recreation opportunity elsewhere, negatively impacting some visitors' experiences. Large group events like adventure races can also impact natural resources and the recreation setting. Special-use authorizations would contain mitigation measures as appropriate.

Effects of Alternative 1

Under alternative 1, the existing 1986 plan direction would remain in effect. Gila National Forest personnel would continue to use the recreation opportunity spectrum conditions outlined in the 1986 forest plan (as summarized in USDA FS 2013) and displayed in table 56.

Approximately 41 percent of the Gila National Forest would remain in the non-motorized class settings, although there would be a decrease in the number of acres being managed for primitive opportunities and increase in the number of acres being managed for semi-primitive non-motorized opportunities. Approximately 59 percent of the forest would remain in motorized recreation opportunity spectrum settings. These settings would provide opportunities for visitors to see and enjoy a variety of experiences on the national forest; however, with most designated wilderness not being assigned to a primitive recreation opportunity setting, the plan may be more difficult to understand and lead to confusion regarding management expectation. There is no recommended wilderness in this alternative.

Table 56. Recreation opportunity spectrum settings under alternative 1

Recreation Opportunity Spectrum Setting	1986 Forest Plan Existing Condition (acres)	Percent of Gila National Forest	1986 Forest Plan Desired Condition (acres)	Percent of Gila National Forest
Primitive	526, 611	16	326, 363	10
Semi-primitive (non-motorized)	787, 063	24	1,023,684	31
Semi-primitive motorized	240,940	7	194,169	6
Roaded natural	1,768,071	53	1,771,995	53
Rural	5,083	<1	7,647	<1
Urban	not applicable	not applicable	not applicable	not applicable

Recreation managers would continue to face challenges to provide a sustainable recreation program that remains responsive to trends in visitor use when referencing a document created in the 1980s. Trends in visitor use have changed dramatically over time and the issues, opportunities, and expectations are different. Not providing the recreation opportunities and experiences that are sought after by the public could limit the socioeconomic contributions outdoor recreation provides to local communities and businesses.

The 1986 forest plan contains direction and other content that supports public education and seeks to minimize conflicts between uses. Plan content aimed at reducing conflicts between user groups requires those uses to be separated in time or location. Potential solutions for separating recreation uses could involve single-use trails or trails managed for single use on certain days. Managing trails for single uses that vary by day of the week would require an intensive public awareness and education effort and could cause more user conflicts and lower the quality of recreation experiences. Lower quality experiences could result from recreationists not following the rules, and from the restrictions themselves, which would create barriers for some visitors to enjoy the places they have enjoyed in the past and are connected to. Solutions to the satisfaction of all users are rare and can require extensive management resources where they may be possible. Creating more trails would require more infrastructure, such as trailheads and signage, that would require maintenance and could have impacts on other aspects of the environment.

Alternative 1 does not recognize the substantial and essential contributions of volunteers and partners and the importance of strengthening and expanding those relationships to include trail maintenance and other aspects of the recreation program. Alternative 1 does not establish a requirement for closure orders to adopt a forestwide length-of-stay limit. Plan components are not necessary to establish length-of-stay limits and under alternative 1, forest leadership would continue to re-issue closure orders consistent with those of other national forests in the Forest Service Southwestern Region to manage recreation and protect resources.

Alternative 1's approach to vegetation management would continue to impact recreation access, infrastructure, and visitor experiences because of planned activities and unplanned wildfire events. Area closures during mechanical thinning treatments and prescribed fire would temporarily preclude or impede access to dispersed recreation sites, developed recreation facilities, and trails. Area closures during wildfire events would also be temporary restrictions on recreation access but may be of longer duration than those closure orders issued for mechanical thinning and prescribed fire. In general, planned activities may temporarily degrade some visitor experiences over the short term and improve them over the long term as they would be designed to move toward desired conditions. Wildfires occurring under unfavorable and extreme fire weather and fuel conditions would have a more pronounced and long-lasting effect on visitor experiences and may be both positive and negative depending on individual perspective and relationship to the landscape.

Alternative 1 does not do enough to reduce the risk of large extents of high-intensity wildfire and recreation opportunities and experiences would continue to be impacted by reduced or lost trail access due to standing snags, downed logs, post-fire flooding, debris flows, hillslope failures, and other mass movements. The frequency and extent of these conditions may be greater given climate change is expected to continue amplifying drought cycles, fire weather, and extreme precipitation events. Alternative 1 does not discuss climate change adaptation or provide direction that supports adaptation broadly, or specific to recreation.

In general, continued implementation of the 1986 plan would provide direction on suitable places for special-use permits and a goal for special uses meeting the needs of communities and the public. It would encourage working to approve uses that meet the needs of expanding communities, while minimizing impacts to other resource values. However, administration of recreation special uses has seen changes in policy since 1986.

Effects Common to Alternatives 1, 3, and 4

Alternatives 1, 3, and 4 do not provide a forestwide, default length-of-stay for closure orders intended to manage recreation and protect resources. While providing a plan component that establishes a default length-of-stay can add support for closure orders, it is not necessary. Forest leadership has the authority to issue those orders and has been issuing those orders without plan direction to do so for many years. Under these alternatives, Gila National Forest leadership will continue to issue closure orders establishing a length-of-stay limit of 14 cumulative days within a 30-day period, consistent with other national forests in the Southwestern Region of the Forest Service, reserving the right to make prudent exceptions as circumstances warrant.

Effects Common to All Action Alternatives

All action alternatives recognize the importance of maintaining and improving recreation opportunities and the socioeconomic contributions those opportunities provide local and regional economies. All action alternatives provide desired conditions, objectives, standards, guidelines, and supporting management approaches for maintaining, developing, and improving recreation opportunities that are important for the visiting public and appropriate within the recreation opportunity spectrum. All action alternatives would adopt management approaches focused on partnership, volunteer, and community involvement that would move toward a diversity of high-quality recreation opportunities and experiences for visitors, with the intent of better contributing to the social and economic vibrancy of local communities and businesses.

All action alternatives would adopt desired recreation opportunity spectrum classes, to which management would maintain or work toward achieving. All action alternatives contain other desired conditions, objectives, standards, and guidelines to assist management in moving toward a sustainable recreation program with sufficient flexibility to adapt to current and future demands for recreation. The recognition of volunteer, partner, and community involvement under these alternatives would increase capacity for education, trail maintenance, and other aspects of the recreation program. Ultimately, this involvement could be one way to overcome the challenges of addressing user conflicts.

All action alternatives include desired conditions, standards, guidelines, and management approaches for caves, cliffs, and rocky features. Activities such as cave exploring and rock climbing have grown in popularity since the 1986 plan was signed. The new plan direction would enhance the safety, availability, and enjoyment of visitors seeking these and other recreation experiences in the same general vicinity.

All action alternatives include some areas that would be recommended to Congress for wilderness designation. Under all action alternatives, there would be no changes in motorized access associated with any of the action alternatives as motorized roads and trails were excluded from consideration during the wilderness inventory. There would be impacts on non-motorized, mechanized recreation access and opportunities such as mountain biking, which varies between the alternatives. There would be no changes to non-motorized, non-mechanized recreation opportunities such as hiking, horseback riding, backpacking, fishing, and hunting related to wilderness recommendations, but there may be indirect effects to recreation access for these types of activities. This is addressed by plan direction for recommended wilderness which is discussed in the Wilderness section of this environmental impact statement.

Plan direction related to special uses is updated in alternatives 2, 3, 4, and 5 to maintain alignment with policy direction, as it is subject to change over time. Desired conditions, standards, and guidelines in the revised forest plan would better balance consideration of special-use requests with impacts to natural and cultural resources, wilderness character, and other forest resources.

All action alternatives provide direction and management approaches that specifically support climate change adaptation for recreation and the landscape that provides those opportunities.

Effects Common to Alternatives 2 and 5

Alternatives 2 and 5 establish a forestwide length-of-stay limit to be used as the default for forest closure orders issued to manage recreation, protect resources, or both. This limit would be the same as it has been in recent years, which is 14 cumulative days within a 30-day period, consistent with other national forests in the Southwestern Region of the Forest Service, reserving the right to make prudent exceptions as circumstances warrant. While not necessary to issue a length-of-stay order, doing so in plan direction adds a level of consistency, transparency, and flexibility for the forest supervisor or district ranger to authorize reasonable exceptions to that limit, like exceptions to group size limits.

Effects of Alternative 2

The recreation opportunity spectrum settings that would apply under alternative 2 are displayed in table 57. The values depicting existing recreation opportunity spectrum settings are different than those displayed for alternative 1 due to the differences in how the class settings were defined in the 1986 plan, land ownership survey, and land adjustments that have been conducted between the time the 1986 plan was developed, and better mapping tools and technologies.

Table 57. Recreation opportunity spectrum settings under alternative 2

Recreation Opportunity Spectrum Setting	1986 Forest Plan Existing Condition (acres)	Percent of Gila National Forest	Desired Conditions (acres)	Percent of Gila National Forest
Primitive	522,749	16	909,427	28
Semi-primitive (non-motorized)	1,429,193	44	1,048,615	32
Semi-primitive motorized	798,130	24	795,571	24
Roaded natural	517,059	16	513,518	16
Rural	5,010	<1	5,010	<1
Urban	not applicable	not applicable	not applicable	not applicable

Alternative 2 would move 60 percent of the forest toward non-motorized recreation opportunities, with 28 percent in the primitive setting and 32 percent in the semi-primitive non-motorized setting. The area where a primitive setting is desired includes congressionally designated wilderness and recommended wilderness, which would reduce confusion and align expectations with a wilderness experience. Forty percent of the forest would be managed for motorized recreation opportunities, with 24 percent being backcountry, semi-primitive motorized experiences, and 16 percent roaded natural. Overall, these desired conditions would still provide for a balance of motorized and non-motorized recreation experiences but is a more accurate depiction of the opportunities the Gila National Forest can provide than alternative 1.

The recommendations for wilderness under alternative 2, in conjunction with the plan direction provided for recommended wilderness under all action alternatives would prohibit mountain biking on 97 miles of trails where it is currently allowed, including 6 miles of the Continental Divide National Scenic Trail. These trails are not known to experience frequent or heavy mountain biking use, but the wilderness recommendation may still affect use patterns by increasing use of the 335 miles of trail where mountain biking would still be allowed.

Like alternative 1's approach to vegetation management, alternative 2 would continue to impact recreation access, infrastructure and visitor experiences because of planned activities and unplanned wildfire events. Unlike alternative 1, alternative 2 would reduce the risk of large extents of high-intensity wildfire, but recreation opportunities and experiences would continue to be impacted by reduced or lost trail access due to post-fire conditions.

Effects of Alternative 3

The recreation opportunity spectrum settings that would apply under alternative 3 are displayed in table 58. The values depicting existing recreation opportunity spectrum settings are different than those displayed for alternative 1 due to the differences in how the class settings were defined in the 1986 plan, land ownership survey and land adjustments that have been conducted between the time the 1986 plan was developed, and better mapping tools and technologies.

Alternative 3 is essentially the same as alternative 2 in terms of providing for a balance of motorized and non-motorized opportunities that are aligned with what the Gila National Forest can offer. The minor differences between alternatives 2 and 3 in terms of recreation opportunities are related to the types of areas recommended to Congress for wilderness designation.

Table 58. Recreation opportunity spectrum settings under alternative 3

Recreation Opportunity Spectrum Setting	1986 Forest Plan Existing Condition (acres)	Percent of Gila National Forest	Desired Conditions (acres)	Percent of Gila National Forest
Primitive	522, 749	16	937,257	29
Semi-primitive (non-motorized)	1,429,193	44	1,025,310	32
Semi-primitive motorized	798,130	24	791,796	24
Roaded natural	517,059	16	512,768	16
Rural	5,010	<1	5,010	<1
Urban	not applicable	not applicable	not applicable	not applicable

The recommendations for wilderness under alternative 3, in conjunction with the plan direction provided for recommended wilderness under all action alternatives would prohibit mountain biking on 60 miles of trails where it is currently allowed. These trails are not known to experience frequent or heavy mountain biking use, but the wilderness recommendation may still affect use patterns by increasing use of the 372 miles of trail where mountain biking would still be allowed.

Like the approach to vegetation management in alternatives 1 and 2, alternative 3 would continue to impact recreation access, infrastructure, and visitor experiences because of planned activities and unplanned wildfire events. Like alternative 2, alternative 3 would reduce the risk of large extents of high-intensity wildfire, but only in historically open canopy woodlands and tree and shrub encroached grasslands because those are the only vegetation types targeted under alternative 3. Forested vegetation communities would likely see increased likelihoods of large, high-intensity fire events as tree densities would continue to increase. Still, recreation opportunities and experiences are likely to continue to be impacted by reduced or lost trail access due to post-fire conditions in all vegetation communities.

Effects of Alternative 4

The recreation opportunity spectrum settings that would apply under alternative 4 are displayed in table 59. The values depicting existing recreation opportunity spectrum settings are different than those displayed for alternative 1 due to the differences in how the class settings were defined in the 1986 plan, land ownership survey and land adjustments that have been conducted between the time the 1986 plan was developed, and better mapping tools and technologies.

Table 59. Recreation opportunity spectrum settings under alternative 4

Recreation Opportunity Spectrum Setting	1986 Forest Plan Existing Condition (acres)	Percent of Gila National Forest	Desired Condition (acres)	Percent of Gila National Forest
Primitive	522, 749	16	888,186	27
Semi-primitive (non-motorized)	1,429,193	44	1,073,410	33
Semi-primitive motorized	798,130	24	789,829	24
Roaded natural	517,059	16	515,818	16
Rural	5,010	<1	4,898	<1
Urban	not applicable	not applicable	not applicable	not applicable

Alternative 4 is essentially the same as alternatives 2 and 3 in terms of providing for a balance of motorized and non-motorized opportunities that are aligned with what the Gila National Forest can offer. The minor differences between alternative 4 and alternatives 2 and 3 in terms of recreation opportunities are related to the types of areas recommended to Congress for wilderness designation.

The recommendations for wilderness under alternative 4, in conjunction with the plan direction provided for recommended wilderness under all action alternatives would prohibit mountain biking on 15 miles of trails where it is currently allowed. These trails are not known to experience frequent or heavy mountain biking use, but the wilderness recommendation may still affect use patterns by increasing use of the 417 miles of trail where mountain biking would still be allowed.

Like the approach to vegetation management in alternatives 1, 2, and 3, alternative 4 would continue to impact recreation access, infrastructure, and visitor experiences because of planned activities and unplanned wildfire events. Like alternative 2, alternative 4 would reduce the risk of large extents of high-intensity wildfire, but only in forested areas that produce timber products, because those are vegetation types targeted under alternative 4. Woodland vegetation communities and tree and shrub encroached grasslands would likely see increased likelihoods of large, high-intensity fire events as tree densities would continue to increase. Still, recreation opportunities and experiences are likely to continue to be impacted by reduced or lost trail access due to post-fire conditions in all vegetation communities.

Effects of Alternative 5

The recreation opportunity spectrum settings that would apply under alternative 5 are displayed in table 60. The values depicting existing recreation opportunity spectrum settings are different than those displayed for alternative 1 due to the differences in how the class settings were defined in the 1986 plan, land ownership survey and land adjustments that have been conducted between the time the 1986 plan was developed, and better mapping tools and technologies.

Table 60. Recreation opportunity spectrum settings under alternative 5

Recreation Opportunity Spectrum Setting	1986 Forest Plan Existing Condition (acres)	Percent of Gila National Forest	Desired Conditions (acres)	Percent of Gila National Forest
Primitive	522, 749	16	1,538,391	47
Semi-primitive (non-motorized)	1,429,193	44	545,918	17
Semi-primitive motorized	798,130	24	715,572	22
Roaded natural	517,059	16	467,648	14
Rural	5,010	<1	4,611	<1
Urban	not applicable	not applicable	not applicable	not applicable

Alternative 5 would move 64 percent of the forest toward non-motorized recreation opportunity settings, or 4 percent more area than alternatives 2, 3, and 4. Forty-seven percent would be managed toward primitive settings, as opposed to the 27 to 29 percent managed toward primitive settings in alternatives 2, 3, and 4. This reflects the difference in areas recommended to Congress for wilderness designation. Thirty-three percent would be managed toward motorized recreation opportunity settings. While this still provides a balance of motorized and non-motorized recreation opportunity settings that reflects what the Gila National Forest can provide, the quality of the non-motorized opportunities may be less under alternative 5 because of a closer proximity to open roads in some of the areas recommended to Congress for wilderness designation.

The recommendations for wilderness under alternative 4, in conjunction with the plan direction provided for recommended wilderness under all action alternatives would prohibit mountain biking on 207 miles of trails where it is currently allowed, including 56 miles of the Continental Divide National Scenic Trail. These wilderness recommendations would affect use patterns by increasing use of the 225 miles of trail where mountain biking would still be allowed, potentially increasing the frequency of conflicts between uses.

Like all the other alternatives, alternative 5 would continue to impact recreation access, infrastructure, and visitor experiences because of prescribed fire activities and unplanned wildfire events. Like alternative 2, alternative 5 would reduce the risk of large extents of high-intensity wildfire, but to accomplish that, alternative 5 would lead to more fire on the ground for longer periods of time. Recreation access and opportunities would be reduced over all the other alternatives and visitors may experience reduced satisfaction with the opportunities they are able to access. Recreation opportunities and experiences would likely continue to be impacted by reduced or lost trail access due to post-fire conditions in all vegetation communities.

Cumulative Effects

Many recreation opportunities are available adjacent to and near the Gila National Forest. The Gila Cliff Dwellings National Monument, administered by the National Park Service, is located at the terminus of New Mexico Highway 15 near the community of Gila Hot Springs and the gateway to the Gila Wilderness. This small national monument draws significant cultural tourism to the area and increases visitation. The Apache-Sitgreaves National Forest is nearly contiguous to the Gila National Forest along the Arizona and New Mexico state line. The Cibola National Forest administers relatively small mountain ranges just to the northeast of the Gila National Forest, and the Coronado National Forest administers land just to the southwest; although, neither of these forests are contiguous to the Gila National Forest. The different opportunities provided by the national forests complement one another and draw some visitors for different reasons.

Several New Mexico State Parks in the area surrounding the Gila National Forest offer hiking and camping. Two nearby state parks are associated with two of the largest reservoirs in New Mexico (Elephant Butte Lake and Caballo Lake). Both reservoirs offer a variety of water-related recreation opportunities as well as camping and hiking. Two other state-managed lakes in the area are popular fishing destinations—Bill Evans Lake and Bear Canyon Lake. City of Rocks State Park offers camping, picnicking, and hiking. Several Bureau of Land Management developed recreation sites in the region also offer hiking, camping, visitor center activities, and other opportunities. Additionally, many adjacent Bureau of Land Management and New Mexico state lands allow both hunting and dispersed camping, although there may be more use restrictions on state-owned lands. There are several national wildlife refuges administered by the U.S. Fish and Wildlife Service located within the broader area, including the Bosque Del Apache, Sevilleta, and San Andres National Wildlife Refuges. These refuges all provide excellent opportunities for wildlife viewing, including large bird migrations.

The recreation opportunities provided by these jurisdictions are different and complementary to those offered by National Forest System lands in the area. Overall, diversity and quality of recreation opportunities are likely to remain high and elevate the outdoor recreation identity and economy of the region.

Management actions on lands adjacent to the Gila National Forest may contribute some of the same opportunities and experiences. The New Mexico Statewide Comprehensive Outdoor Recreation Plan (NM EMNRD 2021) identifies goals for managing recreation through a commitment to stewardship, preservation of natural beauty, and conservation of resources. Several agencies that participated and provided leadership to the development of the Statewide Comprehensive Outdoor Recreation Plan have outlined objectives for obtaining this goal across the state. Wherever the goals and objectives of these plans align with those of the Gila National Forest, coordinated efforts could result in improved recreational opportunities within the forest without negative effects. The Gila National Forest and adjacent lands may be able to contribute more to growing local and regional outdoor recreation economies.

Through maintaining and strengthening relationships and coordination, the State of New Mexico and Gila National Forest would sustain partnerships with other government agencies, local communities, and chambers of commerce. Including these partners will help develop a shared vision for the needs and desires of the recreation public, open new opportunities, and improve performance. A local collaborative with an emphasis on building the outdoor recreation economy is already working with Gila National Forest leadership and staff to attract visitation and provide socioeconomic benefits to the communities within and adjacent to the forest. New Mexico True, the Silver City Chamber of Commerce, and Western New Mexico University also actively market the outdoor recreation qualities of the Gila National Forest. The COVID-19 pandemic has ushered in a new normal in tourism and outdoor recreation. More people are choosing outdoor recreation opportunities, and many are still not traveling as far from home (Pröbstl-Haider et al. 2023), which may or may not exert long-term influences on visitation rates, outdoor recreation marketing strategies, and the target audiences.

As climate change progresses, these partnerships will become increasingly important to help adapt recreation opportunities to those climate changes. The impacts of climate change, including more frequent and severe heat waves, precipitation events, and fire incidents are expected to increase impacts to visitor health and safely, water-based recreation, and recreation facilities and infrastructure, especially in floodplains along streams and rivers. Human-caused wildfires will also become more likely as fire seasons are predicted to become fire years, until fuel becomes limiting. Fire restrictions and even closures may become more commonplace during more of the year. Closures for wildfire management and hazardous post-fire conditions will also become more commonplace and increase visitation to those areas in the region that remain open to visitation. This could negatively impact visitor experiences and satisfaction.

Shorter cool and cold weather recreation opportunities are likely, as are longer periods of warm weather opportunities. A longer warm season may be a draw for some visitors, potentially creating a need to extend seasonal staff and services, which would increase operation and maintenance costs. On the other hand, warm to hot weather with less reliable availability of water in streams and springs may reduce the number of visitors and the diversity of recreation activities they engage in. Some areas in the Southwest are already difficult to traverse on extended backpacking or stock packing adventures due to lack of water. Many visitors that participate in these kinds of activities may find it increasingly difficult to carry the amount of water they need to make the trip. This reduced availability of water will likely concentrate visitor use where water exists.

Managing recreation opportunities to address the impacts of expected conditions and accounting for and communicating the risks to human well-being are adaptation strategies that will become increasingly important. As the climate changes, working together across jurisdictions to promote and manage a diverse range of high-quality recreation opportunities will produce the best outcomes for the outdoor recreation economies of Arizona and New Mexico and the quality of life for residents.

The sights and sounds of military training flights and recent proposals for expanding those training flights have created local controversy because of impacts to the wilderness and other resources the Gila National Forest provides. While this has been settled for the time being, with the Department of Defense choosing another alternative, it is something that very well may come up again in the future. What happens in air space is completely outside Forest Service jurisdiction, but it is certainly a concern for the management of the forest, its wilderness areas, and the quality of the recreation opportunities those wilderness areas provide.

Scenic Resources

Affected Environment

Scenery provides the backdrop and the setting for the entire forest, defines its character, and contributes substantially to the connections people have to the land and the experiences they have. It includes ecological features and human elements, varying with such things as vegetation, water features, landform and geology, cultural features, and the built environment. The scenic characteristics of the forest contribute to a sense of place and attract both visitors and new residents in the four-county area (USDA FS 2006a). Natural-appearing scenery contributes to high-quality recreation opportunities.

Gila National Forest’s scenery is dominated by vast, rugged mountain ranges, rolling foothills, broad plains, and mesa tops. These landscape features harbor a range of vegetation communities from high-elevation mixed conifer forests and meadows to semi-desert grasslands. Wide and narrow ribbons of green riparian corridors dissect the landscape, flowing through deep, rocky canyons and meandering across broad valley bottoms. Depending on where you are, you may find expansive, layered, and richly textured views reaching as far as Mexico, the Pinaleño Mountains in Arizona, or across the Rio Grande river valley. In other places, dense tree canopies offer fleeting glimpses across canyons. The landscape tells a long and storied history of fire in its natural role as an agent of change and renewal, and the exclusion of it.

Forest Service leadership and staff recognize the importance of scenery and currently manage the scenic resource through the scenery management system. This system is structured to emphasize “natural appearing” scenery but recognized scenery more broadly as the visible expression of dynamic ecosystems functioning within places that have unique aesthetic and social values. The scenery management system recognizes that in addition to naturally occurring features, positive scenery attributes associated with social, cultural, historical, and spiritual values, including human presence and the built environment, can also be valued elements of scenery.

As part of the plan revision process, Forest Service staff completed a scenery management system inventory to update and replace the visual quality objectives and visual management system that were part of the 1986 forest plan. The scenery management system applies to every acre of the Gila National Forest and every management activity including but not limited to timber harvesting, road building, stream, range and wildlife improvements, special-use developments, utility line construction, recreation developments, and fuels management.

Environmental Consequences

Analysis Methodology

The probable management activities related to the alternatives are used to evaluate or predict long- and short-term effects to scenery in the Gila National Forest in relation to scenic integrity. Scenic integrity is classified into five categories from very high to low. Very high scenic integrity means that the scenery appears natural or unaltered. High scenic integrity also means the scenery appears natural or unaltered, but visual disturbances are present; however, they remain unnoticed because they repeat the form, line, color, texture, pattern, and scale of the valued scenery. Moderate integrity means the scenery contains minor noticeable disturbances that are visually subordinate to the valued scenery because they repeat the form, line, color, texture, pattern, and scale of the valued scenery. Low integrity means the scenery appears altered and visual disturbances are co-dominant with the valued scenery and may provide a point of focal contrast. Disturbances may reflect or introduce valued scenery attributes from outside the landscape being viewed. Very low integrity means the scenery is heavily altered, disturbances are visually dominant over the valued scenery, and those disturbances may only slightly reflect valued scenery attributes within or beyond the viewed landscape.

To make comparisons between alternatives, this analysis uses:

- The amount and location of recommended wilderness management area;
- The areas proposed for research natural area status;
- The areas proposed as botanical areas;
- The amount and type of vegetation management activities expected to occur;
- Plan direction related to livestock infrastructure;
- Transportation and access objectives related to roads and trails;
- Invasive species objectives related to treatments;
- Recreation objectives; and
- Plan components related to scenery.

This analysis assumes:

- Most noticeable changes to scenic conditions across the landscape occur through natural processes such as fire, flooding, or insect and disease outbreaks. These natural disturbances have shaped and will continue to shape the scenic qualities of the landscape.

- Movement toward desired conditions for vegetation communities and other ecological aspects of the environment improves scenery over the long term.
- All projects will be designed to move toward and achieve desired conditions for scenic resources over the long term. Mitigation measures for short-term impacts to scenic resources will be incorporated as appropriate.

Because of the laws and regulations that govern mining, it is mostly outside the scope of forest plans. This analysis treats the potential for mining impacts on scenic integrity as a cumulative effect.

Climate Change Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

Each alternative provides for scenery management, although alternative 1's visual management system has been replaced by the scenery management system in the action alternatives. There is potential for management activities and natural disturbance regimes to impact scenic integrity under all alternatives. Management activities affect scenic resources by altering the appearance of the landscape and include both short-term and long-term effects. What constitutes short- and long-term would be defined in the project-level analysis based on the potential effects of the activities proposed. Short-term effects are usually noticeable after project completion and contrast with surrounding landscape. These impacts are generally short-term as project activities begin to move the landscape toward the desired scenic character. Effects that move the landscape toward desired scenic character are often realized over a long period, or cumulatively, and lead to the lasting sustainability of valued scenery attributes. Project mitigation or design would consider scenic resources under all alternatives, and the landscape would move toward desired conditions.

There is potential to temporarily impact the existing landscape and scenic integrity from mechanical treatments, fuelwood collection, prescribed fire, roads, and recreation infrastructure. All the alternatives use mechanical treatments or prescribed fire, or both as management tools. Scenery would be affected in the short term following each of these activities, but in the long term it would improve.

Mechanical treatments that target areas likely to experience large extents of high-intensity wildfire would change the short-term scenic character where the activity occurs. Short-term effects include unnatural-appearing slash piles, stumps, bare soil, and scars on remaining vegetation. Depending on the intensity of the treatment, it can result in a forest that looks moderately altered in the short term. Long-term effects can be beneficial to scenic character. Mechanical treatments typically shift densely forested lands to a more open forested mosaic, providing increased visual access and making scenic attributes more resilient to large-scale, high-intensity disturbances. Often, variety, texture, and color are enhanced, along with improved wildlife habitat, vegetation, and watershed condition.

Activities from prescribed fire create short-term effects to scenic character in the form of burned, blackened vegetation and charred ground surface that many consider less attractive but are not necessarily indicative of human alteration. Grasses and other vegetation typically re-sprout quickly, depending on the time of year the area was burned and moisture conditions during the growing season. Control lines built to manage the fire may be evident along low maintenance roads and detract from natural appearance. In the long term, prescribed burning usually increases the diversity of texture, color, vegetation size classes and distribution across the landscape. In the short and long term, prescribed burning often creates the appearance of more uniform ground cover, which is a preferred scenic setting in some landscapes.

Wildfire management can create similar impacts on the landscape as prescribed fire when weather and fuel conditions are favorable. When weather and fuel conditions are not favorable, large, high-intensity wildfires remain likely under all alternatives, at least in the immediate future. Suppression efforts that involve fire retardant would discolor the landscape and appear unnatural over the short term.

Treatment for invasive species would occur under all alternatives. Treatments can include mechanical or chemical treatments, which can leave unsightly dying plants or bare spots on the landscape. Typically, treatment areas would not be large in scope, but may occur in or near high-use areas or areas of high scenic value. When done appropriately, these activities may create a short-term visual impact, but provide opportunity for new and more visually appealing vegetation that adds ecological value as well as visual value.

Decommissioning closed forest roads to prevent unauthorized, motorized travel can appear unnatural on the landscape. Decommissioning can involve berms and trenches that appear like raw piles of earth or can be extreme as moving large mounds of earth and knocking over trees and other vegetation along the closed road. This activity can be unsightly in the short term, but within a few years, it is generally beneficial to scenery resources.

Recreation activities, both developed and dispersed, would continue under all alternatives. Developments for recreation activities are evident, such as road, trails, and campground and trailhead facilities, and they are appropriate for the recreation opportunity spectrum setting (generally rural and roaded natural). The recreation opportunity spectrum incorporates the naturalness of scenery as one of the defining variables of the setting classification. When facilities are designed to blend in with the surrounding landscape, they have minimal effects to scenery. Additional, recreation facilities that conform to the cultural landscape are also appropriate in high scenic integrity areas as they are in rural or roaded natural settings. The location of facilities affects the surrounding setting because they raise the level of concern by becoming viewing platforms for visitors.

Under all alternatives, scenic resources may be influenced by permitted livestock grazing on the landscape. In most instances, visible disturbances would only be visible in the immediate vicinity and would not affect larger viewsheds. Range infrastructure may affect larger viewsheds with the visible presence of windmills, stock tanks, fences, and other grazing management infrastructure. These improvements are typically small, isolated, and often do not substantially impact scenic character or integrity. They may even contribute to scenic character in some settings. Many forest visitors are accustomed to the presence of these structures and consider them part of the traditional western landscape, contributing to a sense of place and cultural identity.

Utility corridors would continue to be managed under all alternatives. The establishment and maintenance of utilities rights-of-way corridors on forest lands create varying extents of long-term modifications to the landscape. Powerline corridors maintain vegetation at a minimum height within the utility corridor to ensure reliable electrical service and human safety. These maintained utility corridors have the effect of degrading the scenic qualities of the viewshed. However, some negative effects to scenic values may be mitigated by best management practices. Whether long- or short-term, degradation effects to scenic resources caused by the visibility and the unnatural appearance of cleared and maintained utility corridors on the landscape are likely to be most evident when they occur on hillsides and ridgelines or other areas where they are highly visible as contrasts to the surrounding natural landscape over a large area and from great distances.

Under all alternatives, eligible Wild and Scenic River segments and their corridors would be managed to preserve or enhance their free-flowing condition and outstandingly remarkable values. This would generally provide co-benefits for scenic resources, especially where scenery is identified as an outstandingly remarkable value. Although the areas proposed as research natural areas differ between alternatives, there is no substantial effect on scenic resources as these areas are small. The largest area being considered is approximately 1,500 acres within existing designated wilderness. The other three areas are a few hundred acres each in size. Appendix I contains more information on these areas.

Effects of Alternative 1

Alternative 1 provides direction for visual quality using the visual management system, which the Forest Service no longer uses. Continued management under alternative 1 would not allow for management that incorporates current scenery management objectives or incorporates ecosystem management concepts into scenery management. This would make it difficult to design and implement projects that improve scenic resource condition. Visual quality objectives also do not recognize or reflect changes in visitor use patterns, views from trails, current public opinion, or the cultural value of some human-made features. Therefore, visual quality objectives do not provide adequate guidance for maintaining, improving, or enhancing scenic integrity.

Alternative 1 recommends no new areas to Congress for wilderness designation. Recommended wilderness areas would typically have minimal human alteration over the long term and would maintain very high to high scenic integrity.

Effects Common to Alternatives 2 through 5

Alternatives 2 through 5 include new recommendations to Congress for wilderness designation and include plan direction to maintain or enhance the wilderness characteristics of these areas until Congress designates or releases these areas to other uses. Recommended wilderness areas would typically have minimal human impacts over the long term and would maintain high to very high scenic integrity for recreational visitors.

Effects Common to Alternatives 2 and 5

Alternatives 2 and 5 would establish botanical areas based on proposals developed from the New Mexico Rare Plant Conservation Strategy (and Important Plant Areas identified within the strategy). Alternative 5 would establish three areas totaling 150,590 acres. Alternative 2 would establish three areas totaling 68,171 acres. While the difference in acreage is substantial, the difference in management between the botanical areas and the general forest is not. Plan components include avoidance and mitigation measures, but do not prohibit or put substantial restrictions on the management activities that affect scenic resources and were discussed in the Effects Common to All Alternatives section.

Effects of Alternative 2

The scenic integrity objectives that would apply under alternative 2 are displayed in table 61.

Table 61. Scenic integrity objectives for alternative 2

Scenic Integrity Level	Existing Condition (acres)	Percent of Gila National Forest	Desired Condition (acres)	Percent of Gila National Forest
Very High	1,454,455	44	924,146	28
High	1,190,976	36	1,083,864	33
Moderate	604,370	18	1,247,911	38
Low	16,034	1	16,219	1
Very Low	6,305	<1	0	0
Unacceptable	0	0	0	0

Existing scenic integrity exceeds desired. Alternative 2 would meet and likely continue to exceed desired conditions for scenic integrity over the long term; however, there would be short-term effects resulting from future project activities implementing the plan. Alternative 2's approach to vegetation management emphasizes a combination of naturally ignited wildfire, prescribed fire, and mechanical treatments, which would have the effects discussed as common to all alternatives. Alternative 2 is expected to perform better than alternative 1 in terms of reducing the risk of large extents of high-intensity wildfire and would, therefore, promote long-term scenic integrity better than alternative 1.

Alternative 2 identifies 13 separate areas totaling 110,402 acres to recommend to Congress for wilderness designation. While the management that accompanies this recommendation would help protect scenic character over the long term, these areas already sustain high and very high scenic integrity under current management. This conclusion is inferred by the higher percentage of the forest that currently have high and very high scenic integrity, and the substantial acreage that could move to moderate scenic integrity and still meet desired conditions (table 61).

Effects of Alternative 3

The scenic integrity objectives that would apply under alternative 3 are displayed in table 62.

Table 62. Scenic integrity objectives for alternative 3

Scenic Integrity Level	Existing Condition (acres)	Percent of Gila National Forest	Desired Condition (acres)	Percent of Gila National Forest
Very High	1,454,455	44	950,809	29
High	1,190,976	36	1,059,248	32
Moderate	604,370	18	1,245,863	38
Low	16,034	1	16,219	1
Very Low	6,305	<1	0	0
Unacceptable	0	0	0	0

Existing scenic integrity exceeds desired. Alternative 3 would meet and likely continue to exceed desired conditions for scenic integrity over the long term; however, there would be short-term effects resulting from future project activities implementing the plan. Alternative 3's approach to vegetation management emphasizes mechanical treatments and makes limited use of prescribed fire as compared to alternative 1. The effects associated with mechanical treatments and prescribed fire have been discussed as common to all alternatives. Alternative 3 would reduce the risk of large extents of high-intensity wildfire in historically open canopy woodlands and encroached grasslands to some degree by reducing tree densities. It would not do as well in the forested vegetation communities, which would not be targeted for treatment. Based on this, alternative 3 would not promote long-term scenic integrity as well as alternative 1 or 2.

Alternative 3 identifies 26 separate areas totaling 130,012 acres to recommend to Congress for wilderness designation. While the management that accompanies this recommendation would help protect scenic character over the long term, these areas already sustain high and very high scenic integrity under current management. This conclusion is inferred by the higher percentage of the forest that currently has high and very high scenic integrity, and the substantial acreage that could move to moderate scenic integrity and still meet desired conditions (table 62). Based on the percentage of area with high and very high desired scenic integrity objectives, alternative 3 is not substantially different than alternative 2 in terms of desired outcomes for scenic resources.

Effects of Alternative 4

The scenic integrity objectives that would apply under alternative 4 are displayed in table 63.

Table 63. Scenic integrity objectives for alternative 4

Scenic Integrity Level	Existing Condition (acres)	Percent of Gila National Forest	Desired Condition (acres)	Percent of Gila National Forest
Very High	1,454,455	44	887,218	27
High	1,190,976	36	1,124,061	34
Moderate	604,370	18	1,244,726	38
Low	16,034	1	16,135	1
Very Low	6,305	<1	0	0
Unacceptable	0	0	0	0

Existing scenic integrity exceeds desired. Alternative 4 would meet and likely continue to exceed desired conditions for scenic integrity over the long term; however, there would be short-term effects resulting from future project activities implementing the plan. Alternative 4's approach to vegetation management emphasizes mechanical treatments and makes limited use of prescribed fire as compared to alternative 1. The effects associated with mechanical treatments and prescribed fire have been discussed as common to all alternatives. Alternative 4 would reduce the risk of large extents of high-intensity wildfire in forested vegetation communities to some degree by reducing tree densities. It would not do as well in woodland and encroached grassland vegetation communities, which would not be targeted for treatment. Based on this, alternative 4 would not and promote long-term scenic integrity as well as alternatives 1 or 2.

Alternative 4 identifies 17 separate areas totaling 72,901 acres to recommend to Congress for wilderness designation. While the management that accompanies this recommendation would help protect scenic character over the long term, these areas already sustain high and very high scenic integrity under current management. This conclusion is inferred by the higher percentage of the forest that currently has high and very high scenic integrity, and the substantial acreage that could move to moderate scenic integrity and still meet desired conditions (table 63). Based on the percentage of area with high and very high desired scenic integrity objectives, alternative 4 is not substantially different than alternative 2 in terms of desired outcomes for scenic resources.

Effects of Alternative 5

The scenic integrity objectives that would apply under alternative 5 are displayed in table 64.

Alternative 5's desired conditions for scenic integrity would shift more of the landscape from high to very high scenic integrity. Existing conditions still generally exceed desired, as a substantial amount of area could move from high to moderate scenic integrity and still meet desired conditions. Alternative 4's approach to vegetation management emphasizes prescribed and naturally ignited wildfire and makes limited use of mechanical treatments as compared to alternative 1. The effects associated with mechanical treatments and prescribed fire have been discussed as common to all alternatives. Alternative 5 would reduce the risk of large extents of high-intensity wildfire across vegetation types by reducing both live and dead fuels. Alternative 5 would accomplish this by relying heavily on naturally ignited wildfire, assuming favorable weather and fuel conditions would support movement toward desired conditions. Based on this, alternative 5 could promote long-term scenic integrity as well or better than alternative 2 by taking on more risk. The tradeoff is a higher risk of failure and degraded scenic integrity.

Table 64. Scenic integrity objectives for alternative 5

Scenic Integrity Level	Existing Condition (acres)	Percent of Gila National Forest	Desired Condition (acres)	Percent of Gila National Forest
Very High	1,454,455	44	1,539,134	47
High	1,190,976	36	646,072	20
Moderate	604,370	18	1,071,952	33
Low	16,034	1	14,982	<1
Very Low	6,305	<1	0	0
Unacceptable	0	0	0	0

Alternative 5 identifies 58 separate areas totaling 745,286 acres to recommend to Congress for wilderness designation. While the management that accompanies this recommendation would help protect scenic character over the long term, most of these areas already sustain high and very high scenic integrity under current management. This conclusion is inferred by the higher percentage of the forest that currently has high and very high scenic integrity, and the substantial acreage that could move to moderate scenic integrity and still meet desired conditions (table 64). Based on the percentage of area with high and very high desired scenic integrity objectives, Alternative 4 is not substantially different than alternative 2 in terms of desired outcomes for scenic resources.

Cumulative Effects

The Gila National Forest offers spectacular scenic opportunities that contribute diversity to the other remarkable scenery and viewing opportunities throughout the region. Loss of quality scenery and viewing opportunities within or surrounding the forest would have a negative impact upon the quality of the experiences enjoyed by both visitors and residents of local communities.

Landowners or managers who do not manage for scenery may have noticeable differences in levels of development across boundaries that could impact scenic quality in areas such as scenic byways. For example, the State of New Mexico manages State Trust Lands to optimize economic benefit for the trust beneficiaries, which include schools, universities, and hospitals. While these lands permit public access, they are not managed like federal public lands. As these lands are managed, leased, or auctioned, scenic resources may or may not be considered. Since most private lands and other ownerships do not have regulations for scenic resource management, the effects of ongoing developments adjacent to National Forest System lands can sometimes have negative effects on scenic resources across the continuous landscape. Forest visitors often view scenery as a single landscape with little discernment between land ownerships or jurisdictions.

Areas to the south of the forest around Silver City, Tyrone, Santa Clara, Bayard, and Hurley, have long been mined for gold, silver, and more recently, copper. There are three large open-pit copper mines operated by Freeport-McMoRan Inc. with parts of two of them (Tyrone and Cobre) directly adjacent to the forest boundary. These mines are highly visible and affect the scenic qualities of much of the area. There has been recent expanded mining activity near Hanover Mountain at the Cobre Mine and Little Rock Mine at the Tyrone Mine. Renewable energy sources require large amounts of copper. With the emphasis on growing green energy, the demand for copper is expected to go up and remain higher than supply. It is likely that the area will see expansion of these mines and possibly additional development. Freeport McMorRan Inc. has been doing reclamation work on parts of Cobre and Little Rock operations. This reclamation work has focused on regrading, covering, and seeding mining areas such as tailing and waste rock piles that were no longer being used, which may mitigate some effects to scenic resources, but certainly not all.

While not immediately adjacent to the forest boundary, the Copper Flat mine in Sierra County is currently working through the permitting process with the responsible state agencies and the Bureau of Land Management. There is also a proponent seeking to undertake mining in the historic mining district around Mogollon, New Mexico. Mogollon is a historic mining town nestled between Gila National Forest inventoried roadless areas and the congressionally designated Gila Wilderness. Most of the active coal mines found in New Mexico are in the northern half of the state, primarily in the San Juan and Raton basins, and do not affect scenic resources in the greater Gila area.

Abandoned mine lands include known abandoned mines and/or mining-related hazards in need of reclamation or restoration. An abandoned and inactive mine land inventory conducted in the Gila National Forest in December 1998 identified 353 mine sites, some of which were located on private land. While these lands can have some negative impacts on scenic resources, in some cases, they can add historical context and scenic interest.

The Gila National Forest is an important source of salable minerals resources compared to the amount available on private, state, tribal, and other federal lands in the area. Efforts are underway to foster partnerships with local county governments through the opening of new gravel and aggregate sources on the forest to be used for road maintenance purposes, including roads recently conveyed by the Forest Service to local governments. However, the effects of salable mineral materials activities would be relatively limited because this material is for road maintenance activities and not new road construction. Development and expansion of gravel pits and associated roads have effects to scenic resources.

Renewable energy installations such as windmills or large areas of solar panel development may affect scenic resources. An increasing number of solar and wind facilities have been built in southwestern New Mexico along existing transportation and power transmission line alignments. Much of the future energy development would likely occur on the periphery of the forest or outside the forest boundary where development would be less costly. There are several of these installations surrounding the Gila including a relatively recently approved wind energy installation to the northeast of the forest on lands managed by the Bureau of Land Management and both wind and solar installations to the south of the forest in Luna County. Additional wind-generation developments are in planning phases, such as the Great Divide in southern Grant County. Several large utility companies operate in the area. As electrical infrastructure ages and electrical suppliers consider alternative energy sources such as wind and solar, there may be more transmission and distribution infrastructure that could impact and degrade scenic integrity.

Natural resources and their contributions to scenic character and integrity are vulnerable to the impacts of climate change. Climate change is amplifying disturbance regimes and contributing to longer and more severe fire seasons. Where large-scale high-intensity disturbances such as wildfire, insect infestations, disease outbreaks, and flood events substantially alter large tracts of land, scenic integrity could be degraded, and the scenic character of the landscape could transition to a new baseline.

Mining activities could also impact the Gila National Forest's scenic resources and ability to achieve desired conditions in some locations. Mining is not a currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. Mining expansion or new mining activity could impact scenic resources in the Gila National Forest.

Mining activities are subject to valid existing rights and the decision whether to allow mining is outside the authority of the plan. Because of this, the Forest Service Southwestern Region intends to use a strategy to work toward jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups, and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b).

Roads

Affected Environment

People from all over travel to and through the relatively remote Gila National Forest. Most start off on federal, state, or county roads, and eventually make their way onto connecting National Forest System roads. Once in the forest, users may choose to continue their journey on higher standard roads or transition to lower standard roads, where high clearance and four-wheel-drive vehicles are recommended. Several different agencies are responsible for keeping these roads open and safe for all users. Many of these roads serve as primary access for communities in and around the forest.

The Forest Service uses a road maintenance management system to prioritize, plan, budget, schedule, and maintain National Forest System roads. Every system road is assigned road management objectives, (not to be confused with forest plan objectives), which then help determine its maintenance level. The Forest Service uses the road management objectives to describe the level of service provided by a specific road. Several factors are considered when assigning maintenance levels including user safety, traffic volume, traffic speeds, road investment, user comfort and convenience, and funding levels. When roads are scheduled for maintenance, the maintenance performed should meet the maintenance criteria for the road's assigned maintenance level. Maintenance levels range from 1 to 5. A maintenance level 2 road provides the lowest level of service, and a maintenance level 5 is associated with roads providing the highest level of service. A road intended to move more traffic at a higher rate of speed would be assigned a higher maintenance level than a road maintained for high-clearance vehicles at lower speeds.

Maintenance level 1 roads are closed to all vehicular traffic but may require basic custodial maintenance to prevent damage to adjacent resources or to preserve the road for future resource management needs. Roads assigned to maintenance levels 2 through 5 may provide year-round or intermittent access. Maintenance level 2 roads, which are managed for high-clearance vehicles, account for the majority of the open road miles in the forest's transportation system. These roads typically do not receive a lot of traffic, but they provide motorized access to more acres of forest than all the maintenance level 3, 4, and 5 roads combined. No provision is made for user comfort, user convenience, and speed of travel. On the other hand, level 3 through 5 roads are passable to prudent drivers in passenger cars. Users can reasonably drive with expectations of predictable road conditions and can expect warning signs and traffic control devices when hazards are present.

Maintenance occurs year-round. Roads on the north end of the forest in the Quemado and Reserve Ranger Districts are typically scheduled for maintenance during the warmer months to avoid the adverse conditions like frozen roadbeds and snow that are typical in winter months. During winter months, maintenance is performed on roads in the southern portions of the forest where temperatures are typically milder, and conditions are more conducive. Flash floods from isolated thunderstorms, persistent monsoon rains, downed trees from the past winter or spring winds, and potholed pavement from freeze-thaw cycles are some of the maintenance challenges through the year. Emerging trends are the impacts of larger and more severe fires, and the subsequent monsoon rains that follow, leading to increased flooding, plugged culverts, gully erosion of cut and fill slopes, and roadway washouts.

Funding levels for road maintenance have significantly declined over the years. From 2011 to 2015, funding levels for road maintenance in the Gila National Forest saw an average reduction of 11 percent per year. In 2015, the forest's road maintenance budget was $738,400. Since then, the annual road maintenance budget has stabilized. The forest is completing basic custodial maintenance such as grading the road surface, maintaining ditch lines, select sign replacement, and minor brushing of roadside vegetation on approximately 300 miles, or roughly 9 percent of the total open road miles on an annual basis; approximately 75 percent of miles maintained are maintenance level 3, 4, and 5 roads. The remaining 25 percent are maintenance level 2 roads. Approximately 80 percent of maintained miles are the same every year. The forest staff has worked with local county agencies to clarify jurisdictional issues associated with roads passing through the Gila National Forest. The result was a transfer of nearly 400 miles of National Forest System roads to Catron and Grant Counties.

Most roads that receive maintenance are not maintained fully. That is, not all deficiencies are corrected and not all drainage features are functioning properly. The annual maintenance needs are displayed in table 65. When comparing maintenance need to the 2015 road maintenance budget ($738,400) a large discrepancy is evident. Budgets are a substantial factor preventing forest staff from fully maintaining the road system. Recent and temporary boosts in funding for infrastructure maintenance on federal lands may provide help reduce the backlog, but regular road maintenance budgets are not forecasted to increase and providing basic custodial maintenance to the entire road system will continue to be a challenge.

Table 65. Annual road maintenance needs by maintenance level

Maintenance Level	Miles	Annual Estimated Maintenance Needs $ per mile*	Total
2	2,932	$350	$1,026,200
3	251	$8,282	$2,078,782
4	129	$10,294	$1,327,926
5	22	$6,597	$145,134
Total	**3,334**	**--**	**$4,578,042**

*Annual costs per mile from "Identifying a Financially Sustainable Road System Spreadsheet Tool" (USDA FS 2006b)

The result of the forest's inability to perform full maintenance is a maintenance backlog known as deferred maintenance. Examples of deferred maintenance include replacing culverts, cattle guards, surfacing, and signs based on their life cycle or only when needed, and removing all roadside vegetation encroaching into the roadway or only that which is limiting sight distances. An estimate of the current deferred maintenance for system roads in the Gila National Forest is $272,265,429.

The Gila National Forest manages 12 road bridges as part of its transportation system. All but three of the forest's bridges have been in service for 50 years or more. The forest recently replaced two bridges, rehabilitated a third, and has designs in place to replace another five structures when funding becomes available. Of the remaining four bridges, two are rated in "good" condition or better and the other two are rated to be in "fair" condition. None of the remaining four bridges is currently subject to load restrictions. All 12 bridges are inspected every 2 years. Inspectors document all observed deficiencies and create a list of work items that are prioritized and corrected as funding permits. The funding source for minor bridge repair and maintenance is the same as funds available for road maintenance. Funds for major work items, rehabilitation and bridge replacements are typically competed for at a regional level.

To address the concern about unmanaged off-highway vehicle use, the Forest Service published final travel management regulations for use of motor vehicles on November 9, 2005. The Travel Management Rule (USDA FS 2005) requires that each national forest and grassland identify the motorized road and trail system, including the class of vehicle and time of year use is permitted. The Gila National Forest's travel management decision was released in June 2014. The decision was implemented when the motor vehicle use maps for the Quemado, Reserve, Wilderness and Black Ranger Districts were published in July 2016, and the Silver City and Glenwood Ranger Districts in January 2017. Designated roads, trails, and areas open for motor vehicle use are identified in these motor vehicle use maps. Consistent with the rule, motor vehicle use off designated roads, trails, and areas identified on a motor vehicle use map is prohibited without written authorization. The Gila National Forest's motor vehicle use maps currently identify just over 3,300 miles of roads designated for public motorized use (table 66). Approximately 88 percent are maintenance level 2. The remaining designated roads are maintenance level 3, 4, or 5 and are managed for passenger car use.

Roads not selected as part of the designated public system can be used administratively or by written authorization (329 miles), be stored (908 miles) for future use, or closed and decommissioned. The future needs of these stored roads will be evaluated during future project planning. More information on travel management decision and implementation can be found at Travel Management Decision and Implementation .

Table 66. Miles (and percentage) of Gila National Forest roads by maintenance level (ML)

ML2	ML3	ML4	ML5	Total
2,932 (88%)	251 (8%)	129 (4%)	22 (<1%)	3,334 (100%)

Environmental Consequences

Analysis Methodology

Probable management activities related to the alternatives are used to evaluate or predict short- and long-term effects to roads in the Gila National Forest. To make broad comparisons between alternatives, this programmatic analysis uses:

- Objectives for road decommissioning;

- The amount of vegetation that would be treated based on the objectives identified for each alternative; and
- Standards and guidelines related to best management practices, wildlife species movement and connectivity, riparian areas, stream crossings, and emphasis on the existing road system.

This analysis also includes several assumptions about roads over the life of the plan:

- None of the alternatives has specific objectives, during the life of the plan, to construct new permanent motorized roads. Proposals for any new road development and the associated environmental effects will be considered through project-level planning.
- The level of forest visitation across all alternatives is anticipated to remain relatively constant.
- New motorized routes will not be constructed in designated wilderness areas, inventoried roadless areas, and other areas with prohibitions on new motorized route construction.
- Closed roads no longer needed for current or future use will be decommissioned by such methods as re-contouring, ripping, and seeding, as appropriate, and will be analyzed on a project-level basis.
- Any changes to motor vehicle use maps would be made under a separate decision.
- Funding levels for road maintenance is expected to be relatively constant.

Climate Change Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

All alternatives keep the same road system. This road system influences the forest's ability to contribute to the social, cultural, and economic conditions within the forest and the broader landscape. The transportation system is integral to providing Forest Service personnel access to perform resource management activities that contribute to the health of forest ecosystems, and to supporting the many uses and opportunities enjoyed by the public. Roads allow access to gather firewood, hunt, fish, hike, and recreate. Local businesses and communities benefit from visitors who want to use the forest because they can safely access and experience the forest. Gaining access to the forest through roads is important for residents to continue their traditional uses, which are integral in maintaining the social and cultural fabric of many forest communities.

All alternatives seek to provide safe, reasonable access for public travel, recreation uses, traditional and cultural uses, and land management and resource protection activities, as well as contributing to the social and economic sustainability of local communities. All alternatives strive for a forest road system that is well planned, managed, and maintained, so as not to harm ecological integrity or cultural resources and allow for continued enjoyment and use of the forest by many user groups. Through project-level environmental planning and analysis, unneeded roads are closed to motor vehicle use and naturalized to reduce impacts to ecological resources, especially watersheds, wildlife and fish habitat, and soil erosion. Construction of new roads is minimized in riparian areas.

Roads across the forest are important for access and fire management, and facilitate multiple uses, but can have potential negative ecological impacts. Infrastructure contributes to ecological sustainability when it is properly designed, integrated within the landscape, and well maintained. However, the Gila National Forest struggles to keep pace with the maintenance of its transportation system, given current road maintenance funding levels. Damage to the forest transportation system caused by fires and ensuing floods results in expenses above the annual road maintenance budget, thereby, reducing the amount of money available for standard road maintenance. Limited funding and workforce capacity to properly maintain all roads is one of the biggest challenges to providing quality public access.

Roads can affect natural sediment and hydrologic regimes by altering stream flow, sediment loading, sediment transport and deposition, channel morphology, channel stability, substrate composition, stream temperatures, water quality, and riparian conditions in a watershed (USDA FS 2000). They also provide a vector for the spread of invasive and noxious species and contribute to habitat fragmentation. Large increases in the amount of sediment delivered to the stream channel can greatly impair or even eliminate fish and aquatic invertebrate habitat and alter the structure and width of stream banks and adjacent riparian zone. The amount of sediment can affect channel shape, sinuosity, and relative balance between pools and riffles. Indirect effects of increased sediment loads may include increased stream temperatures and decreased inter-gravel dissolved oxygen (USDA FS 2000). Best management practices are identified during project planning to prevent or mitigate potential adverse impacts to environmental quality.

The roads and trails indicator from the watershed condition classification describes the likelihood of altered hydrologic and sediment regimes in terms of road density, maintenance, and proximity to water attributes. Ratings of functioning properly indicate the hydrologic and sediment regimes are largely intact. Functioning at risk and impaired function ratings indicate moderate and higher likelihoods of alteration of hydrologic and sediment regimes. Between 64 and 67 percent of subwatersheds are functioning properly with respect to road density and proximity to water, while only approximately 12 percent are considered functioning properly with respect to maintenance. Roads near water have some of the highest maintenance requirements, and the most immediate effects on riparian vegetation, channel shape and function, and sediment and hydrologic regimes.

After implementation of the travel management decision resulting in motorized travel being restricted to a designated transportation system, impacts to riparian ecosystems and watershed condition are expected to decline (USDA FS 2014b). Although, this implementation process (including education, outreach, and enforcement) will take time. As future projects include decommissioning of closed, unneeded system roads and unauthorized roads, impacts will be further reduced. These projects would be identified during implementation of any of the alternatives, but the action alternatives include objectives for decommissioning unneeded roads. Road maintenance will also continue under all alternatives as funding allows.

Effects of Alternative 1

Under alternative 1, management of the transportation system would continue under management area-specific goals, objectives, standards, and guidelines in the 1986 forest plan (as amended). The 1986 forest plan provides plan language to maintain the transportation system to support resource goals and assure user safety. The 1986 forest plan is quite prescriptive in road activities including miles constructed, reconstructed, and closed (determined by management area). Some areas identified for road activities by the existing forest plan could be no longer relevant, given completed work or changing priorities, which would not be an efficient use of limited maintenance funds. Some areas may not be considered important for road maintenance under the 1986 forest plan even though there could be current maintenance needs impacting important resources like water quality and riparian areas. Alternative 1 does not consider or discuss the vulnerability of the transportation system to climate change or how management might approach climate change adaptation. This would result in a purely reactionary approach to address climate impacts after they occur.

Effects Common to All Action Alternatives

All action alternatives contain an objective for road decommissioning at least 50 miles each 10-year period following plan approval, until the need is met. A complementary management approach suggests the priority factors for decommissioning roads include redundant routes, cause severe erosion, located near waterbodies, or have adverse impacts to water quality, at-risk species, or cultural resources, or those within inventoried roadless areas that negatively affect roadless character. Roads that would be decommissioned would require a site-specific environmental analysis, public process, and decision. The management approach describing road decommissioning further encourages projects to consider incorporating road decommissioning into project activities where there are closed roads meeting these priority factors. Applying these criteria during project-planning over the long term would result in fewer high-risk, low-value roads, enhance wildlife habitat connectivity, and reduce noise disturbance, sedimentation, and vandalism and theft at archaeological sites, while leaving a manageable system for public and administrative access.

Temporary roads, created to accomplish vegetation restoration and adaptation activities, would be expected as part of all action alternatives. Alternatives 3 and 4 emphasize mechanical thinning treatments as the preferred restoration method, while alternative 5 limits mechanical treatments or thinning treatments to the wildland-urban interface. During treatment, forest roads would likely experience higher traffic volumes and a greater variety of vehicles, including heavy equipment. This would create a need for more frequent road maintenance and possibly road improvements to accommodate this increased activity safely. Other short and long term effects include increased traffic conflicts with other users, changes to surface water flow paths and quantities, the loss of vegetation, soil disturbance and compaction, wildlife displacement and habitat fragmentation, decreased air quality due to dust and vehicle emissions, increased noise, increased risk of human-caused fires, and decrease in recreational opportunities due to temporary closures. These temporary roads would be restored to natural vegetative conditions following the cessation of work. The increased use of fire through prescribed burns and managing naturally ignited fires in alternatives 2 and 5 would result in more areas where roads are closed for public safety from fire and smoke. Road closures for fire management would temporarily potentially affect access for firewood, hunting, and other uses. Alternative 2 would also include mechanical thinning treatments, which would have impacts similar to those described for alternatives 3 and 4.

There is a plan standard that road construction and maintenance will incorporate best management practices to minimize impacts to water quality. The Soil and Water Quality sections of the plan contain a list of publications intended as a resource to interdisciplinary team members during project planning to be able to consider the most applicable and effective best management practices. The list is not comprehensive but provides a starting place to begin to explore options. These best management practices include structural and non-structural protection measures to address potential detrimental changes in water temperatures, blockages of water courses, deposits of sediment in streams, streambanks, shorelines, lakes, wetlands, and other bodies of water that are likely to affect water conditions seriously and adversely.

There is a guideline that construction and maintenance of roads and trails should accommodate appropriate terrestrial and aquatic wildlife species movement and habitat connectivity. A complementary management approach suggests working with the New Mexico Department of Game and Fish and New Mexico Department of Transportation to identify any wildlife habitat needs, potential barriers to wildlife movement, and explore ways to mitigate these issues. This collaborative effort encourages sharing information and targeting site-specific wildlife connectivity issues during project planning or even regular maintenance. Another guideline in the riparian section states that new or redesigned stream crossings, such as bridges and culverts should be wide enough to at least pass the bankfull width unimpeded and incorporate aquatic organism passage design where appropriate. The riparian section guideline would make the new or redesigned stream crossings more sustainable to routine floods and decrease aquatic habitat fragmentation where appropriate. Although these considerations may result in more upfront expenses, there could be less need for later maintenance or retrofitting.

There is a guideline that construction of new roads should be minimized in riparian areas, and another guideline in the riparian management section states that new construction or realignment of roads and motorized routes, recreation sites or other infrastructure should not be located within the 100-year floodplain, or within a minimum buffer distance of a riparian management zone. While the minimum buffer distance varies between alternatives, the differences in effects would be to those resources; more analysis on this guideline can be found in the Riparian and Aquatic Ecosystems and Wildlife, Fish and Plants sections in this chapter. A complementary management approach suggests relocating roads away from floodplains, perennial stream channels, and riparian areas when opportunities and funding allow. Over time, this plan direction would reduce resource concerns regarding water quality, hydrologic function, fluvial geomorphology, and riparian and aquatic habitat condition, and reduce costs associated with reoccurring maintenance, which are higher in floodplain settings.

There is a guideline that reconstruction and rehabilitation of existing roads should be emphasized over new road construction. This plan component would decrease the effects associated with new road construction such as changes to surface water flow paths and quantities, loss of vegetation, soil disturbance and compaction, and wildlife displacement and habitat fragmentation. Although there might be a loss of potential access to new areas if the emphasis is on existing roads and the access already provided. Emphasis on existing roads over new road construction would also help moderate the deferred maintenance backlog by minimizing additions to the transportation system, which the forest already struggles to maintain.

Through management approaches, all action alternatives encourage working with local and county governments, New Mexico Department of Transportation, and the Federal Highway Administration on the planning, design, construction, and maintenance of highway corridors, which helps ensure contiguous road systems across multiple ownerships. Another management approach encourages stakeholders to provide specific feedback on the road system to assist with travel management implementation and look for opportunities to resolve issues. These management approaches encourage stakeholder collaboration in the iterative and ongoing process of transportation system management. By working with partners and other stakeholders, the forest would be better able to maintain roads and provide better access for forest visitors.

While these alternatives have varying amounts of recommended wilderness, none of the recommended areas contain open roads, which means those wilderness recommendations would have no effect on motorized access and the open road system. New road construction, even temporary routes, would not be authorized in recommended wilderness areas, but this would not have a substantial limiting effect on forest access because most of these areas are within inventoried roadless areas that already have restrictions on road construction.

All action alternatives have a desired condition to move toward a climate-resilient transportation network. This desired condition would help transition management to a more proactive approach for the transportation system. Implementation of a climate-resilient transportation network would have upfront costs but would support movement toward the other desired conditions in the Roads section of the plan and likely reduce maintenance and reconstruction costs over the long term. While management would be directed toward achieving a climate-resilient transportation system, it will take time with anticipated budget allocations. Gila National Forest leadership, staff, and people who care about access to the forest should anticipate needs to respond to impacts over the life of the plan.

Cumulative Effects

State and local government agencies with road management authority can be expected to continue to maintain their existing road network across the forest. Some changes such as widening, resurfacing, and bridge replacements are probable but are dependent on budgets and funding allocations. There is a continued likelihood of jurisdiction of National Forest System roads being passed to other public road agencies where those agencies are agreeable. In doing so, forest managers would continue to better align the road system with the available maintenance budget. Grant, Sierra, and Catron Counties have approved ordinances allowing off-highway vehicles to operate on roads owned and controlled by those counties, which may increase the use of those vehicles in certain parts of the forest because there may be more connectivity of legal access. This increased use may be limited to areas close to communities with limited impacts in more remote areas of the forest.

Change in ownership of private lands can result in continued requests for road access across National Forest System lands. Depending on the circumstances, these may be requests for forest or private road special-use authorization. Depending on the terms and conditions written into any new authorizations, opportunities for access to National Forest System lands may be created.

There is a trend of private ranches being subdivided, and portions being converted to other uses including residential development. This development can often occur near the forest boundary, as it is a desirable amenity for a piece of private property to be near or adjacent to the national forest. As communities grow and infill occurs, undeveloped lands and their open space values are converted to residential or commercial uses. In addition, the subdivision of private parcels increases demands for access to the forest. Communities that have not planned for additional infrastructure needs would likely request acquisition of National Forest System lands for infrastructure. This may also trigger the need to acquire rights-of-way in places where informal public access is lost to development.

Climate change is projected to increase the frequency, severity, and duration of droughts, and while the region is expected to get drier, it is likely to see larger, more destructive flooding events. The variability in weather patterns may produce heavy precipitation in brief periods of time that can wash out roads and plug or blow out culverts. Increased tree mortality due to drought, insects and disease, and fire could lead to more hazard trees along roadways and waterways. More instances of wildfires may also create more wear and tear on roads from fire response. These effects may increase the maintenance needs upon already strained budgets across jurisdictions. While road infrastructure damage is being repaired, routes may be temporarily closed, causing reduced access and inconvenience to the public and disrupted access for Forest Service personnel for management activities. These effects may also lead to the development of adaptive strategies such as retrofitting, relocating, or upgrading road infrastructure. However, working together to determine the most vulnerable infrastructure with the highest cost of failure and proactively identifying and implementing climate adaptation options could improve outcomes for health and safety; ingress, egress and other access considerations; the resistance and resilience of the transportation system, and reduce maintenance costs over the long run. Processes to assess the vulnerability of transportation infrastructure are available to support this (USDA FS 2018c).

Facilities

Affected Environment

The Gila National Forest manages a variety of facilities for a variety of purposes to enable the Forest Service to fulfill its mission. These include administrative facilities like offices, warehouses, employee housing, range, and fire facilities; recreation facilities like visitor centers, campground and picnic ground restrooms, storage buildings; and associated water and wastewater treatment systems.

Much of the planning for forest facilities is guided by Facilities Master Plan, which is updated and revised regularly. The Gila National Forest maintains a total of 264 non-recreation administrative buildings including all range facilities, which include range cabins and barns that are maintained by the permittee. Each structure receives a facility condition assessment by qualified personnel every five years. The inspections result in the documentation of all required maintenance needs. The result of comparing the required maintenance to the generated replacement value for each asset is a facility condition index. The facility condition index correlates to a facility condition rating of good, fair, or poor (table 67). A good condition rating is considered a site that is fully functional and poses little to no safety concerns to the public and agency personnel. With a good condition rating, there is room for improvements to the sites, but overall function of the site is acceptable. A rating of poor typically indicates the need for major repairs, replacement, or decommissioning of the facility.

Table 67. Administrative buildings in the Gila National Forest, with their facility condition ratings

Ranger District	Number of Structures	Good	Fair	Poor
Supervisor’s Office	50	24	7	19
Black Range	43	15	3	25
Quemado	43	22	5	16
Glenwood	35	14	3	18
Wilderness	35	16	2	17
Reserve	43	19	6	18
Silver City	15	8	1	6
Total	**264**	**118**	**27**	**119**

Many of the facilities identified as being in poor condition are older buildings and many of those are range cabins and barns, which are to be maintained by the permittee. The facilities budget for maintaining these buildings has not increased in recent years, leading to the significant deferred maintenance backlog. The deferred maintenance of administrative facilities in the Gila National Forest, excluding the leased property, is valued at over $7.3 million. With a limited budget to address all facility needs, prioritization of investment in maintenance occurs according to the following goals: (1) address existing or potential health and safety hazards, which may include demolition; (2) emergency repairs to restore serviceability of the building; (3) repair to existing building and utility system to prevent further damage and deterioration; (4) maintenance of facilities to the objective service level; and (5) improvements to reduce maintenance and operation costs. Priority is given to more important facilities.

The Gila National Forest has 33 developed campgrounds, which includes 2 group campgrounds. All campgrounds have vault toilets and seven provide drinking water. The forest also manages a horse camp with water for stock and corrals. There are 9 interpretive sites, 5 observation or scenic vista areas, 6 picnic sites, 5 boating facilities, and 98 developed trailheads, all with some type of development. Eleven sites have horse corrals, and there are a total of 10 pavilions across 5 different sites.

Most recreation facilities are in good condition (table 68). A couple of sites are currently closed due to damage from wildland fires, flooding, or both. Other sites have some sort of seasonal closure or restrictions due to time of year and threat of flooding. There has been a significant amount of rehabilitation work at several recreation facilities affected by large wildland fires. Rehabilitation efforts have resulted in improved conditions, compared to the previous ratings before the fire impacts.

Table 68. Recreation buildings in the Gila National Forest, with their facility condition ratings

Ranger District	Number of Structures	Good	Fair	Poor
Supervisor's Office	0	0	0	0
Black Range	7	6	1	0
Quemado	26	16	6	4
Glenwood	16	14	0	2
Wilderness	54	28	5	21
Reserve	16	12	2	2
Silver City	25	20	5	0
Total	144	96	19	29

The Gila National Forest has 15 drinking water systems—7 systems serve recreational facilities and 8 serve administrative sites. Many of the drinking water systems were developed or improved during the 1990s and early 2000s, and currently range from good to poor condition. However, each drinking water system still must meet water quality and system operation standards according to its classification type. The administrative sites include the Grant County Airport and the Kingston, Beaverhead, Luna, Glenwood, Wilderness, Negrito, and Fort Bayard administrative sites. The three remaining administrative sites at Quemado, Reserve, and Silver City, are served by municipal water systems. Recreation sites include Quemado Lake, Catwalk, Lake Roberts, Gila Visitor's Center, Willow Creek, Snow Lake, and Little Walnut. Due to shrinking budgets, current plans for the water systems are to correct and maintain these systems to a good condition rating and discourage installation of any new water systems. Testing and sampling of water systems are up to date and in compliance and will continue until systems are properly decommissioned.

The Gila National Forest manages one lagoon wastewater system near the Gila Cliff Dwellings National Monument, which receives all sewage pumped from nearby vault toilets, recreational vehicle dumps, and multiple leach field or septic-type wastewater systems. The Gila National Forest also ties into four municipal septic systems. There are 104 vault toilets and 18 pit toilets in the forest.

Most of the vault toilets in the forest were installed in the 1970s and 1980s but have been replaced by newer vault model toilets in the last 20 years as part of campground reconstruction projects. Vault toilets are an all-inclusive system, which contains both the building and the belowground vault for wastewater. Currently, 73 vault toilets are in good condition, 14 are fair, and 17 are in poor condition. The approximate replacement value for one vault toilet is $40,000. Replacement of the 17 poor condition units would cost around $680,000. Over time, forest managers will seek to replace the 17 older and poorly rated vault toilets with new model vault toilets or equivalent. The deferred maintenance of septic and wastewater systems in the Gila National Forest currently is estimated at $300,000. Once a septic tank or leach field system fails, it must be entirely replaced. Since wastewater is an important health and safety issue, funding for future administrative wastewater projects would be a priority.

The Gila National Forest has three large earthen dams forming lakes located within the plan area. The Snow Lake Reservoir and Quemado Lake Reservoir are located entirely on National Forest System land and the Lake Roberts Reservoir has some of the backwaters located on National Forest System land; however, none of the dams are owned or maintained by the forest. The New Mexico Game and Fish Department maintains the three dams mentioned, and current inspection reports show that while there are some operation and maintenance issues, the dams are in “satisfactory” condition. The three lakes are managed under a special-use permit.

Four airstrips located in the forest receive semi-regular maintenance. These airstrips are located at Beaverhead, Negrito, MeOwn, and Jewett Mesa. These airstrips provide access for emergency services, fire management operations, burned area emergency response actions, and other administrative activities of the Forest Service. These airstrips are also considered open for public use and receive occasional recreational use. Two other airstrips in Glenwood and Reserve, New Mexico, are in the Gila National Forest, but are under special-use permit to Catron County. All the airstrips located in the forest are considered “primitive” according to the Airstrip Classification matrix (USDA FS 2012b), except Reserve, which is developed. Pilots are reminded that it is their responsibility to check Federal Aviation Administration Notices to Airmen (NOTAMS), the Aeronautical Information Manual, Federal Aviation Administration flight service stations, and current airstrip conditions from the airstrip manager before conducting any flight operations.

In addition, the Gila National Forest has various range infrastructure including fences, corrals, cattle guards, and assorted types of water developments including springs, wells, windmills, solar pumps, pipelines, water storage tanks, and water troughs. Range infrastructure such as water developments also benefit different species of wildlife. Many of these improvements related to livestock management were constructed years ago, are not serving current allotment management practices, and are in states of disrepair. Often, new permittees inherit these through the waiver of permits and are faced with heavy and costly workload to repair or possibly remove improvements. Through the process of range analysis, improvements are inventoried to assess condition and efficacy. Improvements no longer needed are then scheduled for removal as time and funding will allow. New improvements or those that are still necessary for livestock management are constructed or maintained through a cost share partnership between the Forest Service and the livestock grazing permittees as part of their grazing permit. Vacant allotments on the forest pose a challenge to maintenance of infrastructure as many improvements such as fences, corrals, or water developments have been abandoned since removal of the livestock. Those improvements such as water developments that continue to benefit wildlife are prioritized and maintained as funding allows. Any new range infrastructure proposed for livestock, wildlife, or both is coordinated through the district rangers, range staff, and permittees, and then taken through the proper environmental analysis for decision and implementation.

Other wildlife infrastructure includes trick tanks and drinkers for wildlife, fish barriers, fishing piers, floating docks, boat ramps, fish habitat enhancement structures, and fish cleaning stations the Forest Service maintains. The fish barriers are located throughout the forest and require little to no maintenance. Additional fish barriers may be considered pending recommendations and consultation between the Forest Service and the New Mexico Department of Game and Fish. All other fishing type infrastructure is also typically a joint effort as coordinated between the Forest Service and the New Mexico Department of Game and Fish.

Environmental Consequences

Analysis Methodology

Probable management activities related to the alternatives are used to evaluate or predict short- and long-term effects to facilities infrastructure. To make broad comparisons between alternatives, this programmatic analysis uses:

- Guideline for sustainable design and emerging technology
- Guideline for facility repurposing or decommissioning if no longer utilized as intended
- Guideline for adaptive reuse of historic properties while respecting and maintaining historic design
- Management approach using facilities master plan, sustainable recreation plan, recreation site analysis, and other long-term planning documentation

Climate Change Adaptation and Impacts

Plan content is analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

Most of the management direction affecting administrative facilities, recreation facilities, dams, and water and wastewater systems would not change under any alternative. The facility master plan would be reviewed and updated annually as necessary to reflect management needs. Facilities generally provide an environment free from recognized hazards for people, while avoiding or minimizing negative impacts to natural and cultural resources. Potable water systems, where provided, serve the public or administrative needs while complying with current standards. The recreation facilities provide cultural ecosystem services through recreation opportunities, scenic vistas, and enjoyment with nature.

The maintenance requirements across the portfolio of assets are increasing, with much of the preventative maintenance that should happen cyclically, becoming deferred. The accumulation of deferred maintenance leads to deterioration of performance, increased costs to repair, and a decrease in asset value. A lack of preventive maintenance increases the risk of major unplanned repairs or replacements.

Effects of Alternative 1

Under alternative 1, management of facilities infrastructure would continue under the facilities and developed recreation management area goals, objectives, standards, and guidelines in the 1986 forest plan (as amended). Alternative 1 provides plan direction to maintain facilities in safe and operable conditions but does not put an emphasis on sustainable facilities management that manages facilities to standard and considers repurposing or closing facilities that are no longer used as intended or are no longer required to meet Forest Service or user needs. Under current and projected funding levels, the forest cannot adequately maintain all its facilities; this alternative does not provide management direction that would improve this condition. If this trend continues, it is likely that some of the infrastructure will deteriorate beyond repair, which will force decisions on consolidation and possibly relocation. Further degradation of facility condition with potential increased risks to human health and safety, or even inconsistent or haphazard repurposing or decommissioning of facilities across the forest, may also impact historical resources and create lost opportunities for adaptive reuses. This alternative does not encourage incorporation of emerging technologies and sustainable concepts into facility design, maintenance, and renovation so benefits from energy and water conservation may not be realized.

Unplanned closure of administrative facilities because of unsafe structures could result in a loss of services to local communities. Community members would have to travel farther to go to a district office for permits or to address issues with local staff. Communities may feel they are less appreciated or receive less support from the Forest Service. Negative economic and social contributions would result from having to hastily close recreation sites, because funds are inadequate to provide appropriate maintenance to keep sites safe for human use. Closures would reduce or limit opportunities to access and gain enjoyment of recreational resources and experiences. Damage or the failure of key recreation infrastructure, especially wastewater systems, could pollute water sources and could affect the drinking water of communities or water used for agricultural purposes.

Effects Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 include desired conditions for scenic integrity, discourage construction in hazardous or environmentally sensitive areas, and encourage incorporation of emerging technologies and sustainable concepts into facility design, maintenance, and renovation. These measures would improve energy efficiency, conserve water and other natural resources, improve functionality, and ensure consistency with the scenic character of the Gila National Forest. Techniques such as use of ENERGY STAR® appliances, xeriscaping, and rain harvesting are to be used for new technology energy savings, while selecting of colors for buildings and fences may be used to blend with the surrounding environment.

As the workforce and mission services continue to evolve, existing infrastructure may become obsolete from the originally designed purpose and will require the forest to look at adaptive reuses, multi-uses, and other ways to address accumulating deferred maintenance. Adaptive reuse of historic properties would be pursued when appropriate; maintenance and renovations would respect and maintain historic design, so no important historic features are lost. Facilities no longer used as intended would be repurposed to accommodate a new use or be decommissioned to minimize maintenance backlog and infrastructure deterioration, and to protect public safety and health.

The action alternatives discuss consulting the facilities master plan, sustainable recreation plan, recreation site analysis, and other long-term planning documentation to understand how specific infrastructure would be maintained, modified, or removed from service in alignment with broader guidance in the revised plan. By reducing the maintenance backlog and investing in facilities infrastructure that is necessary to meet the Forest Service mission, a higher level of maintenance could be maintained for the remaining facilities given current and projected funding, which would increase the longevity, safety, and functionality of those facilities.

Recreation infrastructure such as campgrounds and toilet facilities allow for recreation opportunities, that contribute to local economies. The action alternatives discuss recreational aviation activities and access to airstrips and encourage volunteers and partners to assist with the maintenance of backcountry airstrips where appropriate. This could lead to increased maintenance activity at these airstrips, improving their condition and fostering increased recreational aviation activities.

All action alternatives also discuss a process that could be used to determine which facilities were most vulnerable to climate change with the highest costs of failure to inform project-level climate adaptation strategies, like the way the action alternatives support climate change adaptation for the transportation system (see Roads section). Still, forest leadership, staff and people who use and care about facilities managed by the Gila National Forest or its permittees should anticipate needs to respond to impacts. Because of the size of the backlog, it would be difficult to shift to an entirely proactive approach.

Cumulative Effects

The Gila National Forest is not the only agency that likely is dealing with insufficient maintenance funding and degrading infrastructure, but recreation facilities are where the cumulative effects are most substantial. The National Park Service, Apache-Sitgreaves National Forests, Bureau of Land Management, New Mexico and Arizona State Parks, and New Mexico and Arizona's departments of game and fish have developed recreation sites in the broader area. A common trend observed among visitors to the Southwest is that when visiting their planned destination, they discover other recreation opportunities on multiple jurisdictions. Working together to improve the outdoor recreation economy, as discussed in the Sustainable Recreation Cumulative Effect section, could involve efforts to obtain funding for recreation infrastructure maintenance and improvement projects that would benefit everyone. This could also lead to conversations about decommissioning certain infrastructure that is redundant to nearby areas or sites that receive few visitors to invest resources where the demand is higher.

In response to budgets, there may also be a transfer of management between agencies, or some facilities will continue to close. For example, the Forest Service used to maintain a roadside rest stop area near Quemado, New Mexico, because the highway passes through the forest; however, this is a service more appropriately provided by the highway department as it did not serve the Forest Service's goals, mission, and objectives very well. That rest stop was closed. Similarly, the Gila National Forest has maintained facilities that support the Gila Cliff Dwellings National Monument, but in response to reduced funding and staff, the Forest Service may seek to transfer maintenance responsibility to the National Park Service so that funding and staff time can be redirected to facilities that more directly support the Gila National Forest.

Climate change is projected to increase the frequency, severity, and duration of droughts, and while the region is expected to get drier, it is likely to see larger, more destructive flooding events. The cumulative effects discussion about climate change impacts on the forest's transportation system is also relevant here, as facilities are accessed by the road system. Further, since people tend to gather and spend time at facilities, there may be greater risks to health and safety at facilities in drainage bottoms or other vulnerable landscape positions. Some facilities, such as range cabins and barns, may be lost to wildfire as fire seasons become longer and more intense. These effects may also lead to the development of adaptive strategies such as limiting the times the facilities are open or relocating facilities. Managing facilities to address the impacts of expected conditions and accounting for and communicating the risks to human well-being are adaptation strategies that will become increasingly important.

Lands

Affected Environment

The Gila National Forest is composed of land proclaimed as Forest Reserve land by numerous presidential proclamations, Executive orders and laws through the years, along with lands that have been acquired from private or other governmental owners. The Gila National Forest is one of the largest national forests, occupying approximately 3.3 million acres. Federal ownership within the forest is mainly consolidated as a large whole unit with the exceptions of some communities and other large and small tracts of private land located within the forest's administrative boundary. The

Gila National Forest also administers the portion of the Apache National Forest[41] that is in New Mexico (figure 42), as well as designated federal lands owned by the Veteran's Administration that are part of Fort Bayard.[42] The forest shares boundaries with other federal, state, and private lands such as the Gila Cliff Dwellings National Monument, administered by the National Park Service, and the Bureau of Land Management.

The Gila National Forest is in the southwestern corner of New Mexico within the counties of Catron, Grant, Hidalgo, and Sierra. Table 69 displays land ownership within these counties (Headwaters Economics 2015). Most of the Gila National Forest's area resides in Catron and Grant Counties. The forest comprises approximately 46 percent of Catron County and 34 percent of Grant County. With the combination of other federal, state, and tribal lands, only 26 percent of Catron and 39 percent of Grant County is privately owned. The amount of the Gila National Forest within Sierra County (13 percent) and Hidalgo County (0.4 percent) is less significant, although only 25 percent and 42 percent is privately owned in these counties, respectively, due to significant holdings by other federal and state agencies.

Table 69. Land ownership (percentage) in the counties that include the Gila National Forest

	Catron County	Grant County	Hidalgo County	Sierra County	County Region	United States
Private Lands	25.5	38.6	42.1	25.3	31.3	58.7
Conservation Easement	0.1	0.0	0.8	0.0	0.2	0.6
Federal Lands	62.7	47.4	41.6	63.2	55.6	28.8
Forest Service	49.5	33.9	3.5	13.9	29.5	8.4
Gila	45.9	33.9	0.4	13.2	27.4	<0.01
Cibola	3.6	0.0	0.0	0.7	1.5	<0.01
Coronado	0.0	0.0	3.1	0.0	0.6	<0.01
BLM	13.2	13.4	38.1	28.8	21.4	11.1
National Park Service	0.0	0.0	0.0	0.0	0.0	3.4
Military	0.0	0.1	0.0	19.3	4.4	1.1
Other Federal	0.0	0.0	0.0	1.3	0.3	4.7
State Lands	11.5	14.0	16.3	11.4	12.9	8.4
State Trust Lands	11.5	14.0	16.3	10.5	12.7	1.9
Other State	0.0	0.1	0.0	0.9	0.2	6.6
Tribal Lands	0.3	0.0	0.0	0.0	0.1	4.0
City, County, Other	0.0	0.0	0.0	0.0	0.0	0.2

[41] The Gila National Forest combined with the New Mexico portion of the Apache National Forest are managed as one national forest. The use of "Apache National Forest" is only referred to when it is necessary to describe its location within a legal manner.
[42] The land has remained in the control of the Department of Agriculture with the exception of some sales to the State of New Mexico and adjacent community of Santa Clara.

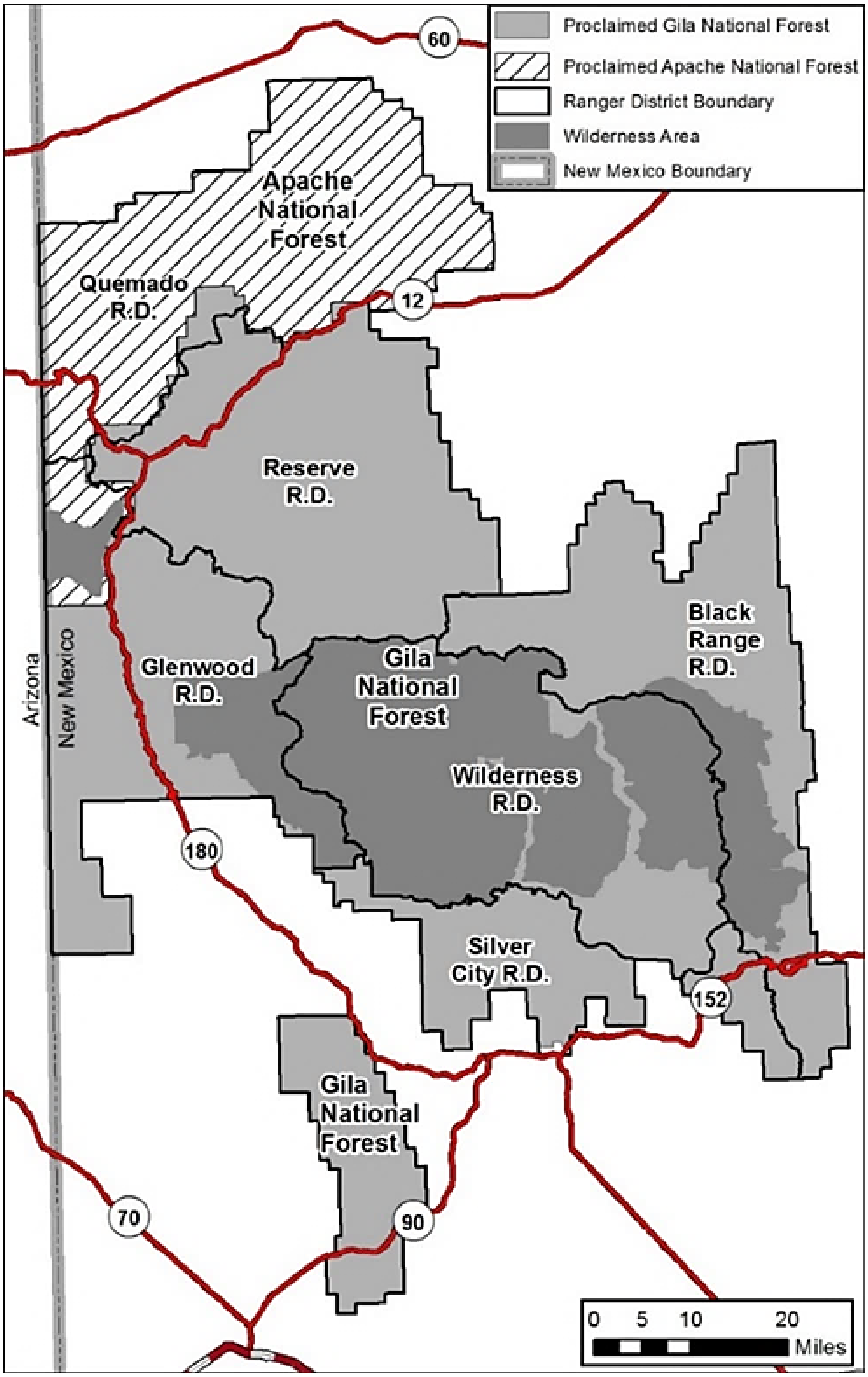


Figure 42. Proclaimed Gila and Apache National Forests that are administered by the Gila National Forest along with the current district boundaries

Counties containing federal lands have historically received a percentage of the revenues generated by the sale or use of natural resources on these lands. A steep decline in federal timber sales in national forests during the 1990s significantly decreased revenues received by counties from the Forest Service. Federal land payments are payments made by the Federal Government to state and local governments to compensate for non-taxable federal land within their borders. In the area of influence, the Forest Service makes contributions through both appropriations and revenue sharing via various programs, such as the appropriated Payment in Lieu of Taxes (PILT), and revenue sharing programs, such as the Secure Rural Schools program.

PILT are federal payments to local governments that help offset losses in property taxes due to nontaxable federal lands within their boundaries. PILT payments help local governments fund operations, such as emergency services and road maintenance. Payments are made annually for tax-exempt federal lands administered by the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, Forest Service, and for federal water projects and some military installations. Payments to counties are based on population, receipt sharing payments, and the amount of federal land within a county.

Boundary problems in the Gila National Forest have generally resulted from the remoteness, terrain, and associated accessibility of the forest area. All original survey work for township and range lines ceased in the early 1900s. Very few of the corners from the original surveys were able to be located. Lack of well-established boundary corners and markers adjacent to and within the forest during the homestead period has resulted in boundary line disputes as new surveys with better technology are completed. Independent resurvey authority is used today by the Bureau of Land Management and by Forest Service surveyors to fix problem areas.

Many of the corners that define the Gila National Forest boundaries need to be established or re-established. Some of these corners are missing due to substandard original surveys that have yet to be addressed by the forest, while others are missing due to natural and human forces. In addition to the backlog of land boundaries to be defined, none of the administrative boundaries such as wilderness area boundaries have been surveyed and posted by a licensed Forest Service surveyor on the ground. Most of these administrative boundaries have been signed and posted by Forest Service employees who are not surveyors or under the direction of a surveyor, therefore, these posted lines should be considered unofficial and for maintenance purposes only. These boundary issues have resulted in title claims and encroachments.

Land use describes the activities to which the land is devoted. For private lands, land use is typically described as being residential, commercial, industrial, or agricultural. On National Forest System lands, several land uses typically occur simultaneously and include permitted uses such as grazing and recreation. Currently, 2.6 million acres of the 3.3 million acres of the Gila National Forest are managed for livestock grazing. Other uses such as mining and timber harvesting occur on smaller scales while hunting and recreation uses are widespread. The Forest Service mission, and the Gila National Forest's goals and objectives are to continue to provide for public use and enjoyment without harming the integrity of the land or its resources.

Special uses are those primarily conducted by a single individual, a small group of people, a corporation, a university, or another government agency that has a particular need to occupy and use a portion of the forest without harming the integrity of the land base. These uses are authorized on a temporary or term basis. Some authorizations may be issued to a corporation for a use that may directly benefit the public, such as a powerline. The issued authorization has terms and conditions to help ensure that the use stays within the guidelines of laws, regulations, and policies governing management of National Forest System lands.

For a special-use permit to be issued, a review process is conducted including an environmental review to ensure that the proposed special use meets laws, regulations, and policies, and protects resource integrity. Providing adequate biological assessments and evaluations, cultural resource clearances and engineering assessments and designs for permits involving ground-disturbing activities are the responsibility of the special-use applicant. Cost recovery fees are required[43] for work conducted by the Forest Service for review and analysis of a special-use application and resource reports. These fees are for the cost of forest workers and specialists who are needed to study and evaluate the special-use proposals. An assessment of the amount of time to accomplish the task is determined and assessed to the proponent of the project.

Special-use authorizations are written permits, term permits, leases, or easements that authorize use or occupancy of National Forest System lands and specify the terms and conditions under which the use or occupancy may occur. The Forest Service divides the management of special uses into two categories: recreation special uses and non-recreation (lands) special uses. The Gila National Forest has issued hundreds of special-use permits related to lands. These authorizations include irrigation ditches, weather instrument locations, communication sites, access roads, electric transmission and distribution utilities, and scientific research among many others.

The direct and indirect value and influence of National Forest System lands for delivering goods and services are critically important to the public at local, regional, national, and even international levels. Utility corridors accommodate high-pressure natural gas pipelines for industrial, commercial, and domestic purposes; high-powered transmission lines provide for interstate transfer of electricity; as well as distribution lines for power delivery to local homes and businesses. Communication sites accommodate rapidly evolving wireless technology, while at the same time providing critical radio communication for safety and security needs.

There are currently 18 designated communication sites located in the forest that are compatible for low power administrative, government, and/or commercial electronic communication use. No sites are currently identified in the forest as suitable for high power commercial communication installations, which are typically high-power radio and television broadcasters. Communication site plans are being developed by forest staff for sites with the most users. These plans facilitate the administration of the area, and once an analysis of the type of use within the area has been conducted, updates and new uses are easier to get approved.

While there are thousands of miles of roads in the Gila National Forest, there are some access issues, primarily associated with private inholdings in the forest. Parcels of private land along major travel ways and water corridors can make access to desirable areas of the forest sometimes difficult to obtain. The Gila National Forest lacks right-of-way across some private lands and may not have a feasible alternative to accommodate a new route around the private land due to topography, current land designations, funding, or a combination of these factors. Forest leadership and staff look to acquire easements or permits across private land for public access where possible.

For most of the history of the Forest Service, modes of access to areas of the forest were mainly a product of the need, desirability, terrain, and cost of construction. Roads were initiated by use across the land, usually in a route that was the closest distance from point to point in good terrain. Sometimes these routes crossed over other parcels of private land to get to the destination. At the time, there usually was not a problem with a particular road crossing other parcels of private land without a document of authorization, easement, or right-of-way. This is no longer the case. It is now commonplace for owners of private property to restrict public travel across their parcel of ownership.

[43] Some special uses are exempt from cost recovery.

Because of this change, the Forest Service is behind in acquiring legal easements for many roads and trails, which are currently routed across parcels of private land. This issue is especially prevalent on the Black Range Ranger District.

Historically, many landowners have been willing to provide access to public hunters and recreationists across their private lands. Personal relationships were established, and respect for private property was demonstrated. Unfortunately, this traditional access has diminished as changing patterns of landownership have eroded the personal relationships between landowners, hunters, and recreationists. Landowners now often perceive recreationists as trespassers who are disrespectful of their private property rights, or sometimes lack an understanding of simple courtesies like closing gates and not scaring livestock. Many access opportunities have been lost across private lands due to historic landownership patterns, changing private ownership conditions, and a lack of established, legally defensible access across private lands. Inadequate access to public lands impacts a wide range of outdoor recreation activities, including hunting, hiking, camping, viewing scenery and wildlife, horseback riding, fishing, wilderness area use, and mountain biking. People want to use their public lands and are becoming sensitive to restrictions on that ability.

Reasonable access to private land is a right granted by the Alaska National Interest Lands Conservation Act (ANILCA 1980), which applies to other states besides Alaska. However, this right only applies to private land surrounded by National Forest System land. The way access is provided to a private inholding is a discretionary management decision and is based upon the individual case circumstances.

Environmental Consequences

Analysis Methodology

Probable management activities related to the alternatives are used to evaluate or predict short- and long-term effects to management of Gila National Forest lands including land adjustments, boundary management and encroachment issues, and lands special uses. To make broad comparisons between alternatives, this programmatic analysis uses:

- Annual survey and boundary posting objectives
- Methods available for land adjustments between alternatives
- Management approaches for land adjustments
- Management areas related to utility corridors

This analysis also includes several assumptions about the lands and lands special-use programs over the life of the plan:

- The Forest Service has the personnel and funding capacity to screen, process, and manage special uses and land adjustments.
- Community and public needs for services will continue.
- The population of New Mexico will continue to grow and be dependent on electricity. Consumers will continue to demand reliable electricity. The economy will fluctuate over time and influence the rate of utility corridor development.
- The emphasis of the lands program will remain on consolidating the forest’s land base for easier management—not shrinking or transferring the federal estate to private parties or other jurisdictions.

- It continues to be easier for land acquisitions to occur than land conveyances.
- The Payment in Lieu of Taxes program continues in its current form.
- Climate change adaptation options for and impacts specific to the lands program are not substantial.

Effects Common to All Alternatives

Since the forest was created, there have been numerous land transactions, which have added and subtracted portions of the land area, via land exchanges, purchases, donations, and sales. Parcels of private land have been acquired by the forest in the past by donation, purchase from willing sellers, and in exchange for another parcel of land. These opportunities will still occur to some degree in the future. Acquisition of some private parcels, can be helpful in achieving a desired forest landownership pattern that enhances public access, supports resource management goals, addresses fragmentation, and reduces future management costs. For example, acquisitions of specific properties may expand access opportunities for the public in areas of the national forest which may have been extremely difficult to reach in the past. Acquisition of certain private inholdings may assist in recovery efforts of threatened and endangered species. Conversely, the sale or disposal of forest land can assist communities in moving toward community objectives such as area for expansion or other municipal purposes.

With approximately 69 percent of the area owned by federal and state governments, the four-county area including Catron, Grant, Hidalgo, and Sierra Counties often lacks private land within and adjacent to existing communities for expansion and sustainability. Because so little of the area is in private ownership, land ownership has a strong influence on social, economic, and ecological conditions. The tax base in these counties is very limited, due to the lack of private land that can be developed and a relatively small, static population. At the same time, the counties are often responsible for providing services to their residents over large geographic areas, which strains their resources. Any changes, particularly acquisition of private land by public land management agencies, could appear to influence the counties' revenue. However, Payments in Lieu of Taxes (PILT) could offset some of these losses. PILT is a compensation paid to state and local governments to compensate for non-taxable federal land within their borders. Although some entities would like to see the formula for compensation adjusted, this formula is not under the jurisdiction of the forest plan. Dependency on these transfers exposes local services to changes in federal policy and spending decisions.

This area's unique land ownership pattern also acts as a draw for hundreds of thousands of visitors to the Gila National Forest each year. Visitors generate tourism and recreation-related jobs and provide tax revenue for local governments. Expanding recreational uses both within and near the forest has the potential of affecting adjacent private lands via trespass or resource damage.

Effects of Alternative 1

Alternative 1 allows for land ownership adjustments as needed to support resource management goals. Acquisition of lands through purchase are limited to lands within classified wilderness, benefiting threatened and endangered species, and high value recreation lands. The 1986 forest plan is quite prescriptive in prioritizing parcels for landownership adjustment even listing exact parcels desirable for acquisition, which complicates negotiations and property valuation. Adherence to this list could narrow opportunities to work with local communities in addressing their expansion needs and public access to federal land. In addition, some areas identified for acquisition by the existing forest plan are likely no longer relevant given completed land adjustments or changing priorities. Some important resources may not be considered important for acquisition under these criteria even though it may be highly valued for certain resources, like riparian corridors or water resources. As a result, these important resources associated with these non-federal lands may not be considered for a land adjustment case and could be lost to private development under alternative 1 as they would not be consistent with criteria for acquisition.

Effects Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 would identify criteria for acquisitions or exchanges without listing specific areas in the plan. This would allow the forest to be flexible and to make determinations based on the current needs of both the forest and of local communities. There would also be management emphasis to work with local communities to understand their community expansion needs, conserve open space and water, and retain access to National Forest System lands. Meeting the needs of local communities for increased forest access would reduce use conflicts and enhance satisfaction in public ownership of National Forest System lands. Having a continuous land base has ecological benefits, such as providing quality wildlife habitat and connectivity, protections for at-risk species, and maintaining natural-appearing landscapes.

Parcels identified for disposal and exchange are typically those that have become difficult to manage because surrounding ownership conditions have changed, or the lands no longer represent forest characteristics or qualities. These are often former administrative sites, isolated tracts, or scattered parcels, and rarely impact access for public use or administration. The disposal or exchange of these sites would help allocate resources to other areas of the forest that were more useful or productive. The action alternatives would also encourage cooperation with counties or local communities to identify lands to be included or excluded from consideration of future land exchanges. For instance, the forest has sold land to enable community development such as the Glenwood Elementary School and Fort Bayard Veterans Administration Hospital.

There would be continued efforts to consolidate land ownership within the forest boundary and establish new rights-of-way, where needed, to benefit both private landowners and federal land management. The purchase of small, isolated inholdings within the forest would simplify management activities and streamline public access. The need to acquire rights-of-way for road and trail access is reduced with a consolidated land pattern. For instance, the forest recently acquired a small private property parcel that crossed National Forest System road 141 without an established right-of-way that could have blocked recreational and commercial access to a large portion of the forest.

Concern about being involved early in land adjustments and continued support for community needs is addressed in all the action alternatives. As a result, local governments, congressional representatives, all parties affected (for example, permittee in the case of a potential loss of acreage), and adjacent landowners are informed about land adjustment proposals, leases, and easements, and their justification early enough to be able to provide meaningful feedback on the proposal. This increases trust in the Forest Service’s lands program and results in greater potential for successful implementation of land adjustment cases.

The action alternatives provide direction to maintain the forest’s boundary by annual survey and posting of the property boundary and would provide specific targets for encroachment or trespass case resolution. Annual survey and boundary posting objectives would be based on available staffing and funding. Carrying out the objectives would lessen boundary location errors by both Forest Service employees and private parties, which would also reduce encroachment or trespass cases.

The action alternatives also establish utility management areas. The utilities management area includes special-use authorizations for linear corridors that provide for those private uses of National Forest System lands that are necessary to serve a local, regional, or national public benefit such as reliable electric, natural gas, water, and communication networks. A special-use permit or easement authorizes uses and corridor width within the utilities management area. Each utility corridor is encouraged to be developed and used to its greatest potential to reduce the need to develop additional corridors. Using existing utility corridors helps avoid additional negative impacts including habitat fragmentation; cultural resource impacts; altered vegetation, which can lead to soil and water cycle disruption, soil compaction and erosion, and degraded water quality; noise; and risk of uncharacteristic fire.

Effects Common to Alternatives 2 and 5

Alternatives 2 and 5 allow the flexibility to use the suite of relevant authorities to acquire or convey land to other ownership, but when it comes to purchasing land are not talking about imminent domain, only purchasing from willing sellers. Federal funding for purchasing land has always been extremely limited and highly competitive. From 1996 to 2019, the Gila National Forest acquired 3,557 acres. During that same time, the forest conveyed approximately 684 acres. Based on the authorities available, it is easier for land acquisitions to occur than land conveyances (see more details on this in the next section). With regional consolidation of the lands program and the permanent reauthorization of the Land and Water Conservation Fund, these patterns are expected to continue under these alternatives, which leads to the forest growing slightly over the plan implementation period. This would shift slightly the amount of private property to National Forest System land, and therefore, some of the property that was previously generating tax revenue for counties, often at the lower agricultural rate, would be now included in the PILT formula to compensate counties for this now non-taxable federal land within their borders.

Effects Common to Alternatives 3 and 4

Alternatives 3 and 4 stipulate that land purchases would be balanced over time with land conveyances so that no net loss of private property in a county occurred. This would keep the amount of private property and Gila National Forest acres relatively constant and maintain tax revenue from private property taxes and PILT funds would continue to compensate counties for non-taxable federal land within their borders. The authority to sell National Forest System lands has very limiting requirements, so land exchanges and Small Tracts Act cases would be the primary conveyance methods. Land exchanges are becoming more infrequent as the transaction costs continue to rise, and which the proponent is often responsible for, and the time a transaction to be completed can be many years. Since it is easier to purchase land rather than convey it to other ownership based on the authorities currently available, it is likely that this will limit future land purchases. As a result, non-federal lands with important resources could be developed instead of acquired by the Gila National Forest. This development of non-federal land could cause new utility corridors, cause new or maintain existing access restrictions, impact recreation experiences and forest resources like wildlife habitat and scenery. If the Gila National Forest is limited in its ability to acquire land, willing sellers may have to look elsewhere for interested buyers, which may limit their options for buyers and increase the length of time to sell their property.

Cumulative Effects

While the state of New Mexico's population has grown steadily over the last few decades and is expected to continue growing, the populations of Catron, Grant, Hidalgo, and Sierra Counties is expected to hold relatively constant for the next two decades (UNM-BBER 2014). Where there is in-migration of new arrivals, they tend to be retirees from the baby boomer generation attracted by environmental amenities, such as scenery and recreation opportunities, and lower costs of living (UNM-BBER 2007). There is a trend of private ranches being subdivided, and portions being converted to other uses including residential development. These private ranches when intact contribute to local economic diversity, scenery, local culture, and community vitality. This residential development can often occur near the forest boundary because being near the forest is a desirable amenity, often reflected in the real estate listing and sale price. This conversion to residential development can also have implications for forest management, including growth of the wildland-urban interface, the spread of invasive plants to the Gila National Forest, the loss of access to public lands for recreation, the loss of wildlife habitat and wildlife movement corridors that cross private-public land boundaries, and the potential for conflict among user groups (Headwaters Economics 2015).

It is now common to have many homes, second homes, and vacation homes bordering public lands in the western United States. Because wildfire is a natural disturbance on western public forests, these homes are especially vulnerable to the risk of wildfire. Prolonged drought over the past 15 years has increased the risk of more severe and intense wildfire. Catron, Grant, Hidalgo, and Sierra Counties each have county wildfire protection plans, which seek to manage residential growth in wildland-urban interface areas, promote partnership and collaboration, and identify and prioritize hazardous fuels reduction areas. Six percent (1,726) of the homes found within the four-county area are in wildland-urban interface areas. In recent years, the Gila National Forest has planned and implemented many projects that specifically decrease the risk of wildfires within these areas. As more people live or work in the wildland-urban interface, fire management becomes more complex and the costs to reduce fire risk, manage wildfires, and protect human lives and homes have risen sharply in recent decades (Stein et al. 2013).

As private properties, especially inholdings change from rural or undeveloped land to subdivisions or higher density uses, encroachment into National Forest System lands becomes more frequent, resulting in resource impacts and land survey needs. As communities grow and infill occurs, undeveloped lands and their open space values are converted to residential or commercial uses. This growth would likely result in continued pressures to maintain National Forest System lands for their open space values. This may also trigger the need to acquire right-of-way in places where informal public access is lost to development. In addition, the subdivision of private parcels increases demands for utilities and access to the forest such as access roads, communication and power lines, and water conveyance structures for irrigation or domestic water uses. Communities that have not planned for additional infrastructure needs would likely request acquisition or use of National Forest System lands for infrastructure.

Cumulatively, continued development along the forest boundary tends to move the Gila National Forest away from desired conditions of natural open space adjacent to communities. As further development occurs, residential encroachments into the national forest are expected to occur more frequently and degrade wildland character and other resource values. Working with other governmental partners on ordinances and plans could reduce potential impacts to forest resources.

Local community leaders and members recognize the open space and recreational values the forest provides. Still, there will likely continue to be tradeoffs of resource values in the forest because of expanding communities and their needs. There will also likely continue to be tension between the desires to retain forest lands near communities and the need to provide land for infrastructure that serves the expansion of those communities. Local collaboration expectations with communities and their desire for open space may result in localized exchanges. There have been discussions on how to create a connector trail from Western New Mexico University in Silver City to the Continental Divide National Scenic Trail in the Gila National Forest. The Town of Silver City Trails and Open Spaces Plan (2002) includes a goal and action items to develop an area-wide trail system providing connectivity between neighborhoods, commute destinations, and open spaces including the Gila National Forest.

Minerals

Affected Environment

The Forest Service recognizes mineral and energy resources are fundamental to the nation's well-being and, through national policy, encourages the exploration and development of these resources on lands it is authorized to manage. The agency's role in managing mineral and energy resources is to provide reasonable protection of surface resources while allowing use of the land for operations authorized by U.S. laws. The Forest Service itself generally does not initiate exploration or development of mineral or energy resources. Rather, proposals for access to, exploration for, and development of mineral or energy resources are driven by external parties and market forces.

There are four types of mineral and energy resources in the Gila National Forest:

1. **Locatable:** Locatable minerals are those that may be "located" with a mining claim under the General Mining Law of 1872 (Act of May 10, 1872 (17. Stat. 92; 30 U.S.C. 28)), as amended. Locatable minerals include the hardrock minerals mined and processed for metals (for example: gold, silver, copper, zinc, tin, and some types of non-metallic minerals), and rare earth elements, plus some "uncommon variety minerals." The Mining Law of 1872 grants U.S. citizens the right to prospect and explore for minerals on lands open to mineral entry. The right of reasonable access for exploration and development of locatable mineral is guaranteed. The Forest Service can require reasonable protection of surface resources and compliance with other federal laws (such as the Clean Water Act, Clean Air Act, Endangered Species Act, and Archaeological Resources Protection Act), but cannot deny a request to explore and develop the minerals on National Forest System lands.
2. **Salable**: Also known as mineral materials, salable minerals include common variety mineral materials such as petrified wood, common varieties of sand, rock, stone, cinders, gravel, pumice, clay, most building stone, and other similar materials. These minerals are mostly used as building, landscaping, and construction materials. The Forest Service has the authority to dispose of, or allow for public use and sale, these materials on public lands through a variety of discretionary methods.
3. **Leasable**: According to the Mineral Leasing Act of 1920, as amended, leasable minerals include coal, phosphate, potassium, oil, oil shale, gas, and sodium resources that occur on public domain lands. The Mineral Leasing Act was amended to include minerals associated with lands acquired by the United States and, by the Geothermal Steam Act of 1970, to include geothermal resources. These minerals are typically disposed of through leases issued by the Bureau of Land Management after the Forest Service provides the appropriate stipulations. Development can only occur after site-specific National Environmental Policy Act analysis for each proposed development. Leasing decisions are not part of this forest plan revision.
4. **Renewable energy**: Includes wind energy, solar arrays, hydroelectric dams, and biomass utilization. The Forest Service has the authority to permit construction of renewable energy facilities and infrastructure under special-use permits.

Locatable minerals

The Gila National Forest contains mineral resources, with metallic ores concentrated in the mountainous portions of the region often because of interactions between hot groundwater and rock during volcanic activity (North and McLemore 2005). Past mining for metallic minerals has primarily produced gold, silver, copper, lead, manganese, zinc, iron, and tin. Historically, the concentrations of metallic ores found throughout in the area helped lead to populating the region. Over one hundred years ago, the mountain regions of the forest were the focus of intense prospecting and mining. These areas often experienced major population growth and then a rapid decline once the ore prices dropped and the mining boom ended.

Mining of metallic minerals is a supply-and-demand type of market prone to significant commodity price fluctuations. The deposits of minerals within the context area of the forest are distributed in several known mining districts (figure 43). Future demand for locatable minerals will likely occur in and around these mining districts. Table 70 lists the mining districts in the context area with past production and future potential. As shown in the table, most of the districts are not presently active. Any one mineral may or may not have high enough concentrations to facilitate an active mining operation. Economic feasibility is dependent upon many different situations, including concentration of the ore body, form of the chemical nature of the ore, value of the ore, access availability, and location of a smelter or processing plant capable of processing the type of ore available.

The area of Silver City and the Mining District (comprised of Bayard, Santa Clara, and Hurley) south of the forest is rich in copper from porphyry-copper and associated contact metamorphic (or skarn deposits). There are three large open-pit copper mines operated by Freeport-McMoRan Inc. with parts of two of them (Tyrone and Cobre) directly adjacent to the forest boundary. Freeport-McMoRan Inc. is the largest employer in Grant County. However, when production is cut back due to the low prices of the metal on the world market, employment suffers due to resulting layoffs. Currently, the copper extracted from the ore bodies is being shipped all over the world with China currently being one of the main purchasers of the metal.

Table 70. Significant metal deposits in the context area, by mining district, based on past production and known resources. From McLemore (2005)

Mining District	Mine or Deposit	Year of Initial Production	Year of Last Production	Estimated Cumulative Production	Is There Future Potential	Significant Commodities
Bayard	--	1902	1969	>$60,000,000	no	gold, silver, copper, lead, zinc
Burro Mountains	Tyrone, Little Rock, Niagra	1879	present	>$2,000,000,000	yes	gold, silver, copper, lead, fluorite
Chloride	St. Cloud	1879	1988	$20,000,000	possible	silver
Chloride Flat	Boston Hill, Chloride Flat	1871	1946	$13,000,000	no	gold, manganese, iron
Fierro-Hanover	Cobre, Hanover Mountain, Continental	1889	1980	>$2,000,000,000	yes	gold, zinc, copper, iron
Georgetown		1866	1985	$3,500,000	no	silver
Hillsboro	Copper Flat, Mesa del Oro	1877	1982	$8,500,000	yes	copper, molybdenum, gold, silver
Kingston	--	1880	1957	$6,600,000	no	silver
Lordsburg	--	1870	1999	>$60,000,000	yes	gold, silver, copper, lead

Mining District	Mine or Deposit	Year of Initial Production	Year of Last Production	Estimated Cumulative Production	Is There Future Potential	Significant Commodities
Mogollon	--	1875	1969	under exploration by Summa Silver-TBD	yes	gold, silver
Piños Altos	Piños Altos	1860	1997	>$11,000,000	yes	gold, silver, copper, lead, zinc
Santa Rita	Chino	1801	present	>$2,000,000,000	yes	copper, gold, silver
Steeple Rock	Carlisle, Center, Jim Crow, Summit	1880	1993	$10,000,000	yes	gold, silver
Taylor Creek	--	1919	1969	$7,500	no	tin

There are no active uranium mines or exploration projects in the Gila National Forest. Uranium occurrences are primarily found in the White Signal, Black Hawk, Tyrone, and Telegraph mining districts in the Burro Mountains (McLemore 1983). A few mines from these mining districts produced limited uranium ore in the 1950s (McLemore 1983).

Rare earth minerals, which contain rare earth elements, are needed for cell phones, televisions, computers, iPods, video games, wind turbines, hybrid and electric cars, and solar panels. The Burro Mountains in the Silver City Ranger District encompass several mining districts with rare earth elements. These mining districts are Black Hawk, Gold Hill, Telegraph, and White Signal, (McLemore 2015). Currently, the forest has received no proposed plan of operations to mine for rare earth minerals.

A mine in the forest supplies high-quality silica rock. Most of the material is used principally as packing and riprap for drainage, transportation, and other infrastructure features for mining-related acid transport facilities. The high-silica rock is invulnerable to degradation in acidic environments because silica does not react with acids. Production figures have varied over the years but are typically around 1,500 to 2,000 short tons per year. Most of the material is used locally at the copper mines.

Abandoned mine lands include known abandoned mines and/or mining-related hazards in need of reclamation or restoration. An abandoned and inactive mine land inventory was conducted in the Gila National Forest in December 1998. This inventory identified 353 mine sites, of which, some were inaccessible, and some were located on private land.

Saleable Minerals

Deposits of common variety minerals, including sand, gravel and rock are found throughout the forest and are concentrated in the drainages. According to data collected by the Forest Service, the only saleable materials currently removed directly from the forest are crushed stone and construction sand and gravel. Between 2011 and 2013, an average of 16,305 short tons of crushed rock and 370 short tons of construction sand and gravel were removed from the forest.

Leasable Minerals

Coal, oil, natural gas, and geothermal energy are considered leasable mineral materials. There has been minimal to no development of leasable mineral materials within the forest. There is no current development, extraction, or use of this form of mineral material from the forest. Companies have conducted test drilling and seismic analysis of the subsurface for non-renewable energy resources in various locations of the forest throughout the years. There are currently no oil and gas exploration surveys or production or leases (active or pending) in the forest. There are currently no coal production or leases (active or pending) in the forest.

Areas in the Gila National Forest have been classified as low to moderately favorable for geothermal energy (DeAngelo and Williams 2010). Several hot springs are directly used for recreational purposes. The Gila National Forest has two identified known geothermal resource areas and a couple of areas identified for noncompetitive lease applications. Under the Final Environmental Statement Geothermal Leasing completed in 1978 (USDA FS 1978), these areas were identified as the Gila Hot Springs Known Geothermal Resource Area and the Lower Frisco Known Geothermal Resource Area. The final decision restricted areas available for leasing to a small area of the San Francisco Hot Springs Known Geothermal Resource Area and lands west of the community of Glenwood, New Mexico. No proposed action has been taken on this potential resource in this area.

Renewable Energy

Renewable energy resources include solar, wind, hydropower, and biomass. There is currently little renewable energy production in the forest; although, the potential for solar, wind, and biomass energy sources does exist. There is currently a small, but promising operation in Grant County that can process small amounts of biomass into biochar, mulch, compost, and heat, and is working on more industry innovations. Labor, transportation, infrastructure, finance and logistics to use these resources may be limiting factors for development.

Small-scale solar installations are currently used at numerous locations within the Gila National Forest. These installations are used to pump water for livestock, and provide power for communication sites, fire lookout towers, and campground host sites. Additional Forest Service solar installations can be expected to comply with policy (FSM 2170.3). On-site solar energy generation for these types of uses is expected grow. On-site use of windmills for pumping water is expected to continue.

There are no active or pending proposals for commercial wind energy or solar power facilities in the forest. Development of these renewable resources may be limited due to the lack of infrastructure to any current potential site locations. Electric transmission lines would have to be built to connect the sources to a power grid. To be economical, the potential areas would probably need to be located along existing power transmission line alignments. The forest is not positioned in the direct path of transcontinental or multi-state connection routes for energy and transportation so much of this development would likely occur on the periphery of the forest or outside the forest boundary. Some of this is due in part to the topography or mountain ranges in the forest.

There is no Federal Energy Regulatory Commission licensed hydroelectric power generation in the forest, but there is currently a proposal working through the process that would impact the San Francisco River.

There is one biomass plant adjacent to the Gila National Forest at the old Fort Bayard Medical Center, which consists of a commercial scale wood-chip boiler system to produce steam and heat. This 150-horsepower steam boiler was designed to annually consume 1,000 tons of wood thinned from the forest (NM EMNRD 2007). However, this system has been idle since the new Fort Bayard Medical Center replacement facility was constructed because it was unable to cost-effectively heat the new facility, compared to conventional gas systems (Ecosphere 2013).

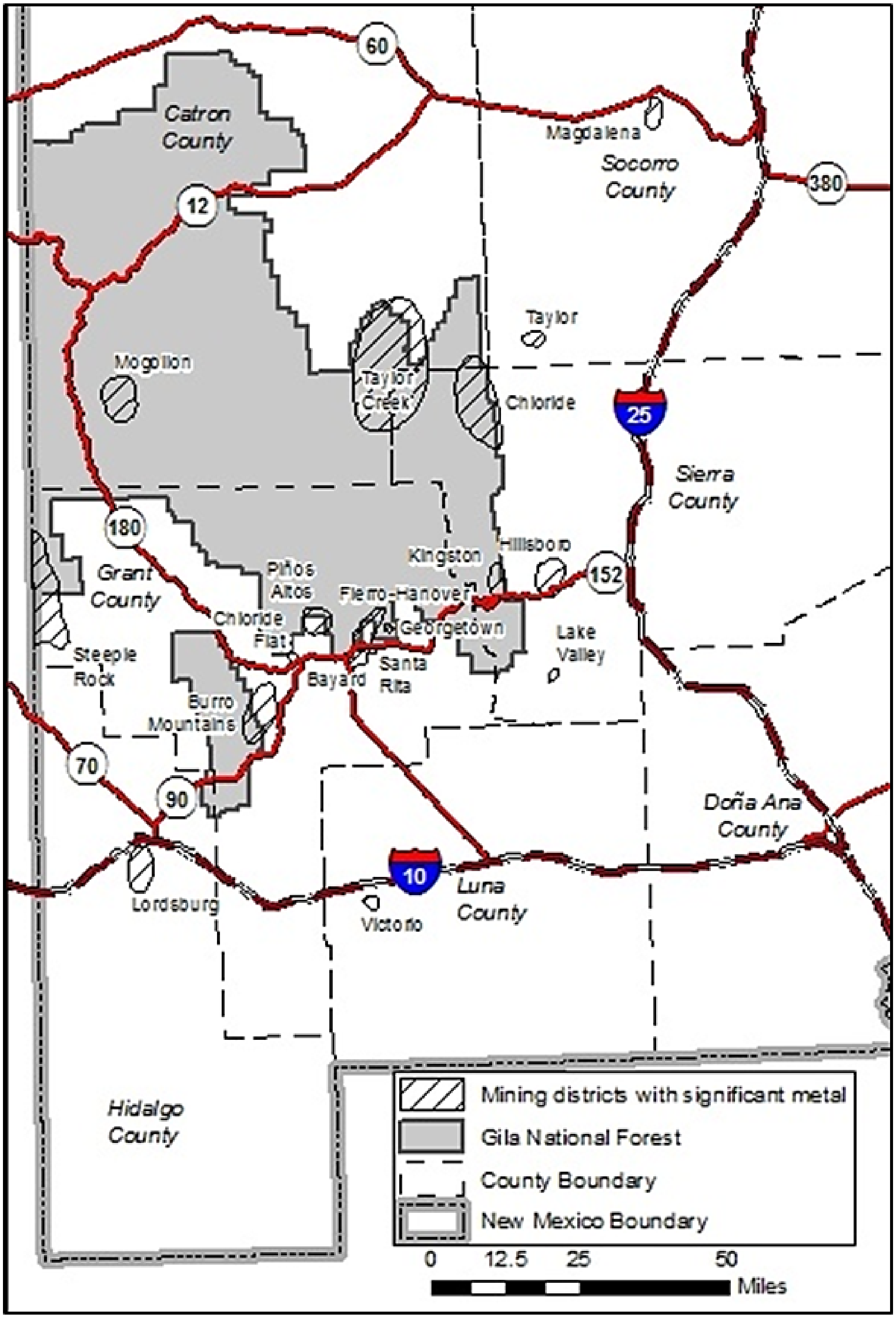


Figure 43. Mining districts in southwestern New Mexico with significant metal deposits

Environmental Consequences

Analysis Methodology

Probable management activities related to the alternatives are used to evaluate or predict short- and long-term effects to mining and minerals in the Gila National Forest. These management activities are evaluated in relation to their effects on reclamation of mining activities, new mining claims, common minerals, and energy development. To make broad comparisons between alternatives, this programmatic analysis uses:

- Mining standards and guidelines related to reclamation activities;
- Utilities management area plan direction;
- Plan direction for renewable energy; and
- Amount of recommended wilderness and eligible streams with "wild" classification including lands that could be withdrawn from mineral entry through potential designation by Congress.

None of the alternatives has specific objectives to construct new energy infrastructure or develop areas for mining or energy during the life of the plan. Proposals would be considered as they arise through project-level planning.

Effects Common to All Alternatives

Under all alternatives, decisions regarding mineral and energy activities in the Gila National Forest would largely be determined by law, regulation, and policy. Gila National Forest staff would continue to coordinate with the Mining and Minerals Division of the New Mexico Energy, Minerals, and Natural Resources Department, Mining Environmental Compliance Section of the New Mexico Environment Department, and the Bureau of Land Management on operational and closure requirements.

Under all alternatives, mineral activities would have short- and long-term environmental impacts. Short-term impacts could include increased motorized traffic, noise from equipment, temporary roads, ground disturbance during exploration activities, and construction of authorized facilities or transmission lines. Long-term impacts would arise from the operation and maintenance of the authorized facilities or transmission lines. Operation and maintenance activities may include increased human activity and noise, motorized vehicle traffic, or additional ground disturbance. Effects that could be both short- and long-term could include increased traffic conflicts with other users on National Forest System roads, changes to surface water flow paths and quantities, loss of vegetation, soil disturbance and compaction, wildlife displacement and habitat fragmentation, decreased air quality due to dust and vehicle emissions, increased noise, increased risk of human-caused fires, and decrease in recreational opportunities. Extractive mineral activities that alter the landscape would most likely encumber scenery, other uses, and ecological processes on National Forest System lands for the foreseeable future. All alternatives include standards and guidelines intended to lessen these impacts by requiring mitigation measures to protect resources, but there is very little discretionary room in the laws governing mining and most of what forest managers can do is dictated first and foremost by those laws.

Over the long term, the greater public and communities benefit from services provided by mineral activities. The potential benefits of energy and mineral production include having the raw materials necessary to sustain the quality of life we all enjoy, gravel and landscaping rock to meet the requests of the public, domestic sources of energy to increase national energy security, local employment, royalties paid on the minerals support federal and state programs, and state and county taxes are paid by operators. These benefits have the effects of providing employment opportunities to the local population, attracting a suite of labor and technical employees to the community with often higher wages than other employment sectors, and increased economic activity due to purchases of goods and services. However, communities whose economies rely solely on mining activities are sensitive to price fluctuations of those commodities.

It is the desire of the Gila National Forest to eliminate known and potential hazards relating to abandoned mine lands. The former release of contaminants into the environment from historical mining activities pre-dating environmental regulations is known as a "legacy" issue. While some mines have interesting historical and educational features, many abandoned mine lands contain minerals like arsenic, cadmium, copper, lead, mercury, and zinc which can cause human health and environmental hazards like water quality impairments, as well as other physical safety hazards (USDA FS 2012e). The Forest Service's Abandoned Mine Lands program identifies mine features posing a danger to the public, which are prioritized and identified for closure or remediation. This program is administered and funded at the national level and individual national forest and grassland managers have little to no influence in the priority setting process.

The classification as "abandoned" applies when there are no entities or individuals left operating the mining activity or who have financial ties to the mine. The significance of this classification is that for most abandoned sites there is no money from the original operators available to clean up the sites. Although occasionally a responsible party can be found to contribute funds toward cleanup, the major burden falls on the Forest Service to finance cleanup and remediation. The number of problems within the forest is vast and it will take many years and a lot of money to complete all the work that is needed. To avoid the future occurrence of abandoned mine lands, all plans of operation now incorporate a reclamation plan, which is usually accompanied by a financial bond.

Under all alternatives, the Gila National Forest would continue to have an active salable mineral materials program, and demand for these resources is expected to continue. There is no indication that the quantity of materials sold would significantly increase under currently available projections.

Congressionally designated wilderness areas are withdrawn from mineral entry, subject to valid existing rights, as part of their governing law (24 percent of the forest). Several administrative and recreation sites have also been previously withdrawn from mineral entry totaling 12,660 acres. The Gila River Research Natural Area (2,496 acres) is withdrawn from mineral entry and mineral leasing, and mineral materials and locatable minerals extraction are not allowed. These withdrawals from mineral entry protect the unique characteristics and qualities for which these areas were designated.

Eligible wild and scenic rivers with wild classifications are not withdrawn from the mining or mineral leasing laws. It is the congressional designation that enacts the withdrawal of the river corridor. Protective management requirements for eligible river areas are subject to existing laws and agency guidance until Congress acts.[44] While some of the corridors associated with eligible river segments have experienced some mining or mining exploration activity in the past, none of them have been identified as having high potential. Still, that would be something to consider in a future suitability study, not in an eligibility study or the plan's environmental impact statement.

In New Mexico's rural communities, firewood obtained from National Forest System lands is often the only source of heat for homes and is a form of very small-scale carbon neutral energy. Plan direction for forest product availability, including personal firewood permits, would continue to be

[44] Designated wild and scenic rivers with wild classifications are withdrawn from mineral entry; however, there are no designated wild and scenic rivers in the Gila National Forest at this time.

made available as discussed in the Timber, Forest, and Botanical Products section of this environmental impact statement.

Effects of Alternative 1

Alternative 1 has language that directs that management of minerals and mining comply with applicable laws and regulations and in doing so minimize impacts to other surface resources. The 1986 forest plan has standards and guidelines related to visual resources and recreation sites but does not set any standards or guidelines to better manage and reduce potential impacts to other resources. This plan direction has the effect of maintaining the assigned visual quality category with more restrictions on leasable mineral material activities.

Effects Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 contain standards and guidelines that ensure reclamation of mineral areas to mitigate resource impacts and return the land to a planned use, which is consistent with the overall land use of the area. Throughout the proposed plan, standards and guidelines in resource sections for scenery, watershed, soils, cultural resources, vegetation, and wildlife resources emphasize sustainable management and effects mitigated during projects, which would include mineral projects. This plan direction would guide mineral activity across the forest, minimizing negative environmental effects within the discretion provided by the laws governing mining, while promoting beneficial effects discussed as common to all alternatives.

The proposed plan for all action alternatives includes a standard for recommended wilderness that no structures, improvements, and developments would be constructed or provided within recommended wilderness except those improvements associated with valid existing rights. These and other standards and guidelines for recommended wilderness are intended to maintain or improve wilderness characteristics until Congress acts one way or another on the recommendation. Active mining claims would be considered valid existing rights. The Forest Service does not have the legal authority to prohibit mining activity in recommended wilderness, as its recommendation does not automatically result in a mineral withdrawal and mineral rights constitute property rights. It is the congressional designation that institutes the withdrawal. Any parts of the recommended wilderness areas that have active mining claims at the time of recommendation or designation or both could see mineral development and the associated impacts described in effects common to all alternatives. The parts of the recommended wilderness areas without active mining claims would be managed to prohibit future development and the associated impacts to wilderness characteristics.

In all action alternatives, plan direction for scenery, wildlife, riparian, archaeology, and traditional and cultural ways of life may make it complicated to determine a new route for power transmission lines within the Gila National Forest that minimize impacts to those resources. This may delay the development of commercial energy generation and the associated effects discussed as common to all alternatives.

The utilities management area includes special-use authorizations for linear corridors that provide for those private uses of National Forest System lands that are necessary to serve a local, regional or national public benefit such as reliable electric, natural gas, water, and communication networks. The utilities management area features linear areas up to approximately 1,000 feet wide (as determined by the special-use permit; local distribution lines would be less than this width) to accommodate existing utility facilities and related access for maintenance and repair, and to accommodate co-location of new utilities. There is a guideline that each utility corridor should be developed and utilized to its greatest potential to reduce the need to develop additional corridors, and where possible, existing corridors should be expanded as needed rather than creating additional corridors. This plan direction concentrates some of the energy infrastructure activities and their associated effects (see Effects

Common to All Alternatives) in existing linear paths while alleviating other areas from infrastructure development. This co-location may increase costs to the utilities since it might be a longer route along the established corridor than a more direct new route. Although there might be a point where co-location is no longer economically feasible, and a new route might be justified, which is one reason this plan direction was designed as a guideline and not a standard.

While there are no commercial solar or wind energy installations in the forest, alternatives 2, 3, 4, and 5 include direction that would apply to these renewable energy facilities should they be proposed in the future. These plan components would serve as baseline management practices to mitigate negative impacts to natural resources. All action alternatives promote wood industry innovations, which would largely be related to biomass utilization and energy production.

All action alternatives contain recommendations to Congress for wilderness designation. A recommendation would have no effect on the establishment of new or existing mining projects for locatable minerals such as copper and gold. Areas are withdrawn from mineral entry if they are established as designated wilderness by Congress. Claims for locatable minerals are processed through the Bureau of Land Management, and recommended areas would still open to mineral entry. If the areas are withdrawn as wilderness, they would be closed to new claims, but any valid existing claims would not be affected.

Cumulative Effects

The demand for minerals and energy resources is influenced by market forces such as supply and demand, as well as local industry infrastructure and connection to infrastructure at broader scales. During the plan revision process, some stakeholders expressed their opinion that the forest has not done enough to promote mineral and energy development, although they recognize that many times commodity prices, other market or regulatory forces, and deposit characteristics play larger roles than Forest Service management. The primary drivers for mineral and energy development are regional, national, and global economic factors including supply and demand, technical factors, and political decisions. These factors determine whether commercial renewable energy development is economically viable, and whether fossil fuels such as oil and natural gas remain the primary fuels for electrical generation.

The Gila National Forest and surrounding areas contain mineral resources, with past mining for metallic minerals primarily producing gold, silver, copper, lead, manganese, zinc, iron, and tin. It is expected that mining these minerals will continue to be a supply and demand type of market prone to significant commodity price fluctuations. Future demand for these locatable minerals, primarily copper, will likely occur in and around known mining districts when prices of metals increase nationally. The demand for copper is expected to rise considerably, as it is a critical component necessary to grow renewable energy systems.

Mining is an important industry in southwestern New Mexico and Arizona with established active mines immediately adjacent to the Gila National Forest boundary at the Cobre and Tyrone mines operated by Freeport McMorRan Inc. There has been recent expanded mining activity at Hanover Mountain at the Cobre Mine and Little Rock Mine at the Tyrone. While not immediately adjacent to the forest boundary, the Copper Flat mine (THEMAC Resources) in Sierra County is currently working through the permitting process with the responsible state agencies and the Bureau of Land Management. Freeport McMorRan Inc. has been reclaiming several sites in the Burro Mountain and Santa Rita mining districts. This reclamation work has focused on regrading, covering, and seeding tailing and waste rock piles that were no longer being used. These reclamation activities redirect stormwater runoff, prevent water infiltration and potential groundwater contamination, and reduce windblown tailings.

Most of New Mexico's uranium reserves, and virtually all past production, are in northwestern New Mexico (Bland and Scholle 2007). As global demand and prices have increased, there has been renewed interest from the private sector in uranium mining in New Mexico using conventional and in-situ leaching methodologies although this interest is predominantly focused in northwestern New Mexico (McLemore et al. 2013).

Rare earth elements are used to make components for motor vehicles and electronic devices, clean energy, and technologies used for aerospace and defense. According to McLemore (2015), pegmatites in New Mexico are usually too small to be currently mined for rare earth elements, but residual placers from the pegmatites could have future potential. The deposits of rare earth elements in the forest are uneconomic to mine under current conditions, but changing markets, the regulatory environment, and international political dynamics could change that. An increase in mining could occur.

The demand for the saleable materials such gravel, stone, and clay is driven by the local economy and the relative remoteness of the area where they exist. Generally, external demand for mineral materials is related to population growth as construction occurs to accommodate growth. Based on population projections, the trend for salable minerals is expected to remain level. The Gila National Forest is an important source of salable minerals resources for local counties. Efforts are underway to foster partnerships with local county governments through the opening of new gravel and aggregate sources in the forest to be used for road maintenance purposes including roads recently conveyed by the Forest Service to local governments. This would increase the effects to other resources (as discussed in the effects common to all alternatives section). However, the effects of salable mineral materials activities would be relatively limited since this material is for road maintenance activities and not new road construction.

Historically, there hasn't been much, if any, exploration or development of coal, oil, natural gas resources within or immediately surrounding the Gila National Forest. The Zuni Uplift and San Agustin Basin plays (or prospects) in Catron County have low and moderate potential, respectively, for oil and gas (URS 2003). The currently producing oil and gas basins in New Mexico are located well away from the Gila National Forest in the San Juan and Permian Basins. Limited understanding of the oil dynamics of the Zuni Uplift and San Agustin Basin represent a high level of risk to private companies under current market conditions (URS 2003). If market demands for oil or gas change substantially, more exploratory activity might occur in these areas in the future.

The nearest coal fields are in the Salt Lake and Datil Mountain Coal Fields located north of U.S. Highway 60 in Catron County and the Engle coal field east of Interstate 25 in Sierra County. Most of the active coal mines found in New Mexico are in the northern half of the state, primarily in the San Juan and Raton basins.

In 2013, New Mexico's first utility-scale geothermal power plant came online in the Animas Valley in Hidalgo County south of the forest in an area classified as being highly favorable for geothermal energy. In contrast, areas in the Gila National Forest have been classified as low to moderately favorable for geothermal energy (DeAngelo and Williams 2010). Issues limiting large-scale use of geothermal energy are water rights, limited power transmission capability, markets, federal regulatory requirements, and a lack of government incentives (Fleischmann 2006). Substantial geothermal energy development, outside the Animas Valley, is unlikely, although direct use of geothermal energy does occur on a small scale for things like facility heating (including greenhouses) and recreational hot springs.

Renewable portfolio standards, which require utilities to produce or procure a minimum amount or percentage of their electricity from renewable energy sources, exist in New Mexico and other western states, and have contributed to increased renewable energy development statewide. There was a bill passed in the 2019 state legislature that will require that New Mexico get all its energy from carbon-free sources by 2045, which could amplify interest in renewable energy. There is currently little to no renewable energy production in the forest; although, the potential for solar and wind energy sources does exist. However, the potential areas would probably need to be located along existing power transmission line alignments. Recently proposed regional transmission corridors (SunZia and Southline) designed to transport electricity to western power markets have been located outside the forest boundary, likely due to topography. Much of the future energy development would likely occur on the periphery of the forest or outside the forest boundary where development would be less costly.

An increasing number of solar and wind facilities have been built in southwestern New Mexico along existing transportation and power transmission line alignments. The Deming Solar Center opened in 2011 in Luna County to the south of the forest boundary. Similarly, the Macho Springs wind-generation facility and photovoltaic solar project was completed in 2011 and 2014 respectively, and the Luna Solar facility opened in 2017. There are several wind generation developments that are either in planning phases such as the Great Divide in southern Grant County, or with recently signed decisions such as the Borderlands Wind LLC facility near Quemado on land managed by Bureau of Land Management. Most of these renewable energy developments are somewhat removed from the forest boundary, which lessens any potential effects.

The Borderlands Wind LLC facility near Quemado will impact scenic resources within the Gila National Forest, as that installation will “be particularly evident during nighttime conditions, when lighting would extend for a substantial distance from the developed areas. Impacts...would be perceived as strongest where viewed from sensitive viewing platforms, traditional areas identified by Native American Tribes, and from wilderness and WSAs [wilderness study areas]” (USDI BLM 2019). This installation is also expected to have substantial impacts on bald and golden eagle populations and habitat, and minor impacts on Mexican gray wolf populations and habitat (USDI BLM 2019).

The future of biomass energy in the forest faces limitations. The current market demand for biomass heat is diminished due to the relatively low price of natural gas, but things may be changing. If market conditions change, the biomass systems may become economical to operate (Ecosphere 2013). There is at least one local operation that has been working on developing technologies and products that utilize the biomass generated from forest thinning projects that generate low-value, small-diameter material. There are many opportunities for game-changing industry innovations that may be pioneered locally.

There is currently no Federal Energy Regulatory Commission licensed hydroelectric power generation within or near the Gila National Forest; however, there is a proposal working its way through the regulatory process that would impact National Forest System lands along the San Francisco River south of Glenwood, New Mexico. If approved, there could be substantial affects to many natural resources.

Wilderness

Affected Environment

The resource of wilderness is a quality of natural landscapes “where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain” (Wilderness Act 1964, U.S.C. 1131–1136). Wilderness as a resource is preserved through congressional designation for the use and enjoyment of the American people. In 1964, Congress acknowledged the immediate and lasting benefits of wild places by passing landmark legislation that permanently protected some of the most natural and undisturbed places in America. The Wilderness Act established the National Wilderness Preservation System "...to secure for the American people of present and future generations the benefits of an enduring resources of wilderness" (U.S. Congress 1964). Wilderness areas provide a wide variety of opportunities for exploration, solitude, self-challenge, and primitive and unconfined recreation.

The Wilderness Act identified five qualities of wilderness character:

- **Untrammeled** – or being free from modern human control or manipulation;
- **Natural** –the natural condition of the land, its plants, wildlife, water, soil, air and ecological processes;
- **Undeveloped** – retaining primeval character and influence, and without permanent improvements or human occupation;
- **Outstanding opportunities for solitude or a primitive and unconfined type recreation**; and
- **Other features of value**, where they exist, and may be of ecological, geological, or other features of scientific, educational, scenic, or historical significance.

Designated Wilderness

Gila Wilderness

Administratively designated in 1924 at the behest of Aldo Leopold, the Gila Wilderness was the world's first wilderness. It was also one of the first to be established by Congress through the Wilderness Act of 1964. The distinction of being the world's first designated wilderness, combined with a close association to the legacy of renowned conservationist Aldo Leopold gives the Gila Wilderness prominence as a national and international destination for those seeking a primitive natural experience.

At 559,688 acres, the Gila Wilderness is New Mexico's largest. The eastern portion of the Gila Wilderness consists of high mesas, rolling hills, and deep canyons with vegetation consisting of pinyon and juniper woodland and some grassland areas. Ponderosa pines dominate the central part of the area, with sheer cliffs rising above the Gila River. The west and southwest locations feature high mountains and spruce-fir forests, principally within the Mogollon Range, with elevations up to 10,895 feet at Whitewater Baldy. The headwaters of many important rivers and creeks originate in the Gila Wilderness.

The Gila Wilderness receives the bulk of wilderness-specific recreational use that occurs in the forest, mostly during the early spring through late fall. Popular recreation activities include backpacking, day hiking, horseback riding, horse and mule packing, and big game hunting. Visitation is generally light, with minimal use conflicts, but there are occasional periods of high use at popular locations including the East, Middle, and West Forks of the Gila River near Gila Cliff Dwellings National Monument. The popularity of these areas may be attributed to their proximity to water sources and trailheads providing convenient access to the wilderness.

When water levels in the rivers are sufficient, rafting and kayaking are popular uses of the stretch of the Gila River between Grapevine Campground to Mogollon Box. The Gila Cliff Dwellings National Monument (administered by the National Park Service) is a popular destination, and many visitors to the monument also visit the wilderness. This contributes to higher visitation to the Gila Wilderness during summer months. The Continental Divide National Scenic Trail traverses the Gila Wilderness and is another substantial draw for visitors.

Permitted livestock grazing is a protected use under the 1964 Wilderness Act, where it was an established use at the time of designation. Permitted livestock grazing continues in portions of the Gila Wilderness. Significant grazing reductions occurred forestwide in the 1950s, and then again in the 1990s. In the 1950s, the New Mexico Department of Game and Fish acquired the Glenn allotment in the Gila Wilderness and the base property at Heart Bar near Gila Hotsprings to help facilitate reintroducing elk to the forest. Given the condition of the range infrastructure and a lack of base property, the Glenn allotment is no longer viable for livestock production and remains unallotted. Since the 1950s, permitted livestock numbers in the allotted portions of the Gila Wilderness have remained stable, but actual use has dipped in recent years with some allotments entering non-use status.

A variety of management activities that require a minimum requirements analysis are ongoing in the Gila Wilderness. A minimum requirements analysis is a process used to identify and understand the potential impacts of a management action on wilderness characteristics, thus allowing managers to determine which ways of approaching that action would have the least impact on wilderness character. These activities include the treatment of saltcedar along the Gila River and its tributaries. While the Gila Wilderness does not currently have a substantial problem with noxious weeds, these saltcedar treatments may be trammeling over the short term, but there are long-term positive effects to apparent naturalness. The Gila National Forest also routinely partners with the New Mexico Game and Fish Department and the U.S. Fish and Wildlife Service on a variety of habitat improvement, nonnative fish removal, and other management activities within the Gila Wilderness.

Other ongoing activities requiring minimum requirements analyses include fire management and efforts to remove feral cattle. The feral cattle issue developed many decades ago and forest leadership and staff have been working to resolve it. While there have been successes, the feral cattle issue remains ongoing. The Gila National Forest has been a leader in restoring fire's natural ecological role, especially in wilderness. However, there are times when mechanized equipment is required to perform fire management activities safely and expediently, particularly in suppression situations. An active fire history is evident in the Gila Wilderness, including the footprint of several very large fires including the 2011 Miller, 2012 Whitewater-Baldy Complex, and 2021 Johnson Fires. The Whitewater-Baldy Complex Fire was the largest fire in New Mexico history until 2022. The Gila Wilderness is the only Class I airshed within the Gila National Forest. Class I airsheds are established by the Clean Air Act and include all wilderness areas that were congressionally designated prior to the 1977 amendments to that act. Class I airsheds are subject to the highest protections for air quality. Air quality is currently very high, demonstrating minimal pollution-related impacts. For more information on air quality in wilderness areas please refer to the Air Quality section of this environmental impact statement.

Aldo Leopold Wilderness

The 203,797-acre Aldo Leopold Wilderness is New Mexico's third largest wilderness. The Aldo Leopold Wilderness encompasses the rugged and complex terrain of the Black Range Mountains, including many steep, narrow valleys thousands of feet deep. The Aldo Leopold Wilderness is widely regarded as being New Mexico's "wildest" wilderness, because combined with a respectable size and challenging terrain, it also receives relatively light use. These factors combine to provide challenging recreation experiences with excellent opportunities for solitude. Visitors often report not encountering any other visitors during their entire time in the Aldo Leopold Wilderness.

Only the narrow corridor of National Forest System Road 150 separates the Aldo Leopold from the larger Gila Wilderness, creating a wilderness complex. Prior to construction of Road 150, the area that is now the Aldo Leopold Wilderness was part of the original administratively designated Gila

Wilderness. After being separated by the road, it was administratively preserved as the Black Range Primitive Area until Congress later designated it as wilderness and re-named it for Aldo Leopold.

The ridgeline of the Continental Divide follows the crest of the Black Range Mountains, and therefore, it also features one of the most remote sections of the Continental Divide National Scenic Trail. Hiking and backpacking are the major recreational activities of visitors to the Aldo Leopold Wilderness, but scarcity of water, particularly along the crest, discourages some potential visitors.

Access points into the Aldo Leopold Wilderness are fewer and can be more challenging to reach than access points in the Gila Wilderness. Many trailheads may only be accessed by forest roads that require high clearance vehicles. Visitors must then hike several miles before entering the wilderness. Difficult access is likely a contributing factor to the lower visitation numbers in comparison with the neighboring Gila Wilderness. Most visitors to the Aldo Leopold Wilderness stay for multiple days, likely due to the investment it takes to get into the wilderness. The trail system in the Aldo Leopold Wilderness does not receive the maintenance attention that trails in the Gila Wilderness do, which may be another reason for lighter visitation.

Like the Gila Wilderness, a variety of management activities requiring minimum requirements analyses are ongoing. Most notably, native fish reintroductions to Diamond Creek, South Diamond Creek, and Animas Creek and fire management activities. The evidence of an active fire history is pronounced in the Aldo Leopold Wilderness and in the Black Range Mountains generally. Over a decade ago, an insect outbreak affecting white fir in mixed conifer stands just south of the Aldo Leopold Wilderness and New Mexico Highway 152 left many dead trees, which changed the fuel characteristics and elevated the risk of high-intensity wildfire. This area south of the Aldo Leopold Wilderness was where lightning started the 2013 Silver Fire. The Silver Fire eventually jumped the highway and burned into the Aldo Leopold Wilderness and was the second largest wildfire in New Mexico state history. More recently, the 2022 Black Fire, which started in the Gila Wilderness just west of National Forest System Road 150, burned over 70 percent of the Aldo Leopold Wilderness. The Black Fire is now the second largest wildfire in New Mexico History.

Blue Range Wilderness

The 29,099-acre Blue Range Wilderness is the smallest wilderness in the Gila National Forest and is located immediately adjacent to the nearly 200,000-acre Blue Range Primitive Area across the state line in Arizona's Apache-Sitgreaves National Forests. This wilderness is in the northeast part of the Blue Range Mountains it is named for, and halved by the Mogollon Rim, the dramatic southernmost edge of the Colorado Plateau.

Six trails traverse the Blue Range Wilderness, two of which are accessed from the primitive area on the Arizona side of the state line. All these trails are challenging to navigate, and there are very few dependable water sources available within the area. There is minimal visitation to this area, offering excellent opportunities for solitude. However, the trail and water situation steer many visitors seeking solitude away from the Blue Range Wilderness to visit other wilderness areas with more water and better, more accessible trails.

There is a permitted powerline located immediately adjacent to the wilderness boundary, affecting wilderness character where it is visible in a small part of the overall area. The Blue Range Wilderness contains semi-precious stones including agate, bytownite, chalcedony, labradorite, and hypersthene at relatively accessible locations. Some ground disturbance created by amateur rock-hounds gathering these stones is evident. There have also been occurrences of motorized intrusion at lower elevations and milder terrain located on the eastern and southern wilderness boundaries.

Wilderness Issues and Trends

Big wilderness, and wilderness management, is part of the Gila National Forest's identity and important to the distinctive roles and contributions the forest provides the American people. Wilderness management isn't without its challenges. While all three of the Gila National Forest's wilderness areas have been managed to standard for several years now, there are a few ongoing issues.

There are occasional motorized intrusions where wilderness boundaries occur in areas of gentle terrain, open vegetation, or both. Gila National Forest staff have also lacked the capacity to validate that outfitter-guides operating in the wilderness follow the terms of their permits and that those terms are sufficient to preserve wilderness character. There are the ongoing issues with feral cattle in the Gila Wilderness that were discussed previously. These animals are not managed and continue to over utilize areas around the Gila River and around water sources in nearby upland. There is the potential for a similar problem to develop in the Aldo Leopold Wilderness, although the terrain and availability of water is much more limiting.

The sights and sounds of military training flights and recent proposals for expanding those training flights have created local controversy because of impacts to the wilderness and other resources the Gila National Forest provides. While this has been settled for the time being, with the Department of Defense choosing another alternative, it is something that very well may come up again in the future. What happens in air space is completely outside Forest Service jurisdiction, but it is certainly a concern for the management of the forest, its wilderness areas, and the quality of the recreation opportunities those wilderness areas provide.

There is also a significant backlog of trail maintenance. Despite the evidence that the large fires that have occurred in the last decade were not ecological disasters (see Upland Vegetation, Fire Ecology and Fuels), the Gila National Forest is in danger of losing its trail system, especially those trails that traverse areas of the Gila and Aldo Leopold Wildernesses impacted by high-intensity fire. Wilderness visitation has been on the rise over the last few years, with the most recent National Visitor Use Monitoring report finding just over 6 percent of the total visitation to the Gila National Forest was wilderness oriented. While it seems like a small increase, it is almost a 90 percent increase from the previous 2016 monitoring report. It is also quite possible that wilderness visitation is not well captured by the National Visitor Use Monitoring protocol and that actual visitation is underrepresented in the reporting.

Forest leadership and staff have been working with non-governmental organizations to increase capacity for wilderness patrols, wilderness rehabilitation of impacted resources, and provision of wilderness education. This ongoing collaborative work supports restoration, protection, or enhancement of wilderness character.

Designated Wilderness Study Areas

Through the New Mexico Wilderness Act of 1980, Congress designated the Hell Hole and Lower San Francisco River as wilderness study areas. The act directed the Gila National Forest to determine if these areas possess wilderness characteristics, and if so, to analyze and determine their suitability as wilderness. Gila National Forest staff did this as part of the 1986 planning process and did not include a recommendation for their designation as wilderness. Until Congress chooses to act, the New Mexico Wilderness Act of 1980 requires the Gila National Forest to maintain their existing wilderness characteristics. No baseline monitoring data describing the status of wilderness characteristics in either area has been collected.

Regardless of whether these two wilderness study areas are ever found suitable or recommended to Congress for wilderness designation, or not, Gila National Forest leadership and staff are bound by the New Mexico Wilderness Act of 1980 and must manage them to preserve their wilderness characteristics until Congress either releases them to other uses or decides to designate them as wilderness. Both were reevaluated as part of this plan revision process, as described below in the Recommended Wilderness subsection of this Affected Environment description.

Hell Hole Wilderness Study Area

The 18,860-acre Hell Hole Wilderness Study Area is located south of the settlement of Mule Creek, New Mexico, and its west boundary follows the state line between Arizona and New Mexico. State Highway 78 bounds the area to the north, and a county road from Mule Creek south to the forest boundary forms the eastern boundary.

The southern portion of Hell Hole is dominated by deep, rugged canyons, rocky peaks, and steep cliffs. The northern part is primarily rolling hills. Vegetation varies with elevation and slope aspect. The presence of ponderosa pine (or Apache pine, or both) in Hell Hole is somewhat unusual, as surrounding areas are dominated by woodland, shrubland, and grassland vegetation communities. The area lends itself to a variety of primitive recreation activities. The degree of difficulty and variety of conditions found in the Hell Hole provide an adequate level of challenge regardless of user’s skills. Current recreation activities are primarily hunting and viewing scenery and wildlife. There are no developed recreation sites or system trails within the area. The present and expected future level of use of this area is low.

There are few internal roads in Hell Hole, but there are roads along the perimeter. The travel management decision (USDA FS 2014a) reduced the total number of roads and mileage of roads and prohibited cross-country travel. Traces of the undesignated routes will likely remain visible for a long time, especially those occurring on steep slopes with low revegetation potential and high soil loss rates.

Lower San Francisco Wilderness Study Area

The 8,800-acre Lower San Francisco Wilderness Study Area is located west of U.S. Highway 180 near the town of Glenwood, New Mexico, and extends to the state line between New Mexico and Arizona. The area generally follows the rim of the river gorge. The travel management decision (USDA FS 2014a) eliminated existing motorized routes along the river within the Lower San Francisco but maintained public access through Big Dry Creek, with parking and camping opportunities available near the San Francisco River. There is also non-motorized access into the area from a trail that leads down into the gorge from a developed trailhead located west of U.S. 180 south of the wilderness study area boundary.

Popular recreation activities include hiking, picnicking, fishing, and hunting. In spring or during heavy monsoon rain seasons when the river is high enough, rafting and kayaking sometimes occur. Boaters typically put in above the San Francisco Hot Springs south of Glenwood and take out of the river at Martinez Ranch in Arizona. The San Francisco River within the wilderness study area is designated as critical habitat for both the loach minnow and spikedace. The native fishery within this reach of river has been severely degraded due to the dominance of non-native aquatic species (J. Monzingo pers. comm. 2016). Saltcedar (*Tamarix* spp.) is scattered throughout the river corridor from the confluence of Whitewater Creek downstream to the Arizona border (K. Brown pers. comm).

The Tucson Electric Power powerline right-of-way is in the Lower San Francisco wilderness study area and is periodically maintained under terms and conditions of a special-use permit, which includes helicopter access, use of roads, and vegetation management, all of which may be audible or visible to the recreating public.

Recommended Wilderness

No recommended wilderness areas in the Gila National Forest have been carried forward from the previous planning cycle that concluded with the 1986 forest plan. The 1986 forest plan declined to recommend the two wilderness study areas previously discussed.

Each national forest undertaking forest plan revision under the 2012 Planning Rule is required to complete a process of identifying and evaluating lands that may be suitable for inclusion in the National Wilderness Preservation System. The forest supervisor determines whether to recommend any of the suitable lands to Congress for designation. Congress reserves the authority to designate wilderness. Forest Service Handbook 1909.12 Chapter 70 provides direction for the four-step process, which is completed as one part of the larger plan revision effort:

1. **Inventory** to identify all National Forest System lands in the plan area that may have wilderness characteristics as defined in the Wilderness Act;
2. **Evaluate** the wilderness characteristics possessed by the lands identified in the inventory step of the process;
3. **Analyze** the evaluated areas that are determined to be potentially suitable for inclusion in one or more alternatives as part of the forest plan revision National Environmental Policy Act process; and
4. **Recommend** to Congress any lands the forest supervisor determines should be included in the National Wilderness Preservation System.

In Gila National Forest's inventory—100 areas totaling 1,271,576 acres—met the criteria for being carried forward into the evaluation. During the evaluation, 63 areas totaling 827,475 acres were found to have some level of wilderness characteristics. The level of wilderness characteristics each area possessed was ranked to facilitate a basis of comparison and aid in developing the alternatives, analysis, and recommendation. Many of the areas that emerged from the inventory and evaluation steps of the process contain inventoried roadless area. Inventoried roadless areas are a designation made under the 2001 Roadless Area Final Planning Rule. More information on inventoried roadless areas is found in that section of this environmental impact statement. For a more detailed description of the overall wilderness process steps and results, please see appendix H of this environmental impact statement.

Environmental Consequences

Analysis Methodology

The effects to existing designated wilderness areas, including their existing conditions are analyzed in combination with varying levels of recommended wilderness by alternative. Most of the analysis is directed toward the effects of a suite of recommended wilderness areas under each alternative. Individual recommended areas are discussed when there are effects or considerations not covered by the analysis of the suite of recommended areas under each alternative. Analysis assumptions include:

- The management of designated wilderness is largely decided by the Wilderness Act, 36 CFR 293, and applicable Forest Service manuals and handbooks. The management direction and guidance provided by the forest plan and any individual wilderness area management plan are consistent with and complementary to law, regulation, and policy.

- Designated wilderness areas are measured against the wilderness stewardship performance elements. Recommended wilderness areas are not held to that standard.
- Wilderness stewardship performance scores continue to demonstrate designated wilderness areas are being managed to standard. Management continues to maintain or enhance wilderness character.
- Livestock management in designated wilderness continues to conform to the Congressional Grazing Guidelines (FSM 2320 – Wilderness Management 2323.22-Exhiit 01, Congressional Grazing Guidelines).
- Forest plan decisions do not substantially affect visitation rates in the Gila National Forest; however, new or altered management direction may influence the type of opportunities that are available to the public.

Analysis indicators include:

- Acres of recommended wilderness;
- Relative strength of recommended wilderness' wilderness characteristics (evaluation ranking);
- Ecological condition including vegetation communities, soil and watershed resources and wildlife habitat condition; and
- The balance of recreation opportunities (both compatible and incompatible with wilderness management).

While there is an extensive trail system in designated and recommended wilderness, those effects are not analyzed here. The forest's trail system is analyzed holistically in the Sustainable Recreation section of this environmental impact statement to reduce repetition and redundancy.

Changed Circumstances

The 2022 Black Fire impacted several areas recommended for wilderness designation under one or more alternatives. Fire-related changes could impact apparent naturalness if fire effects are outside what would be expected under the fire regimes for specific vegetation communities. Fires could also impact other features of value such as cultural sites. However, because other features of value are not required to be present for an area to be suitable, changes to these values will not impact the area's suitability for recommendation. A changed circumstances analysis was conducted for those affected recommended areas and is fully documented in appendix H.

Climate Change Adaptation and Impacts

Plan content and recommendations for wilderness are analyzed in terms of how it promotes the continuum of adaptation strategies (Resistance-Resilience-Transition) as defined at the beginning of this chapter. Climate change impacts are also considered in the cumulative effects analysis. Climate change is a cumulative impact of past, present, and reasonably foreseeable human activities across the globe, under every jurisdiction (Reid and Lisle 2008).

Effects Common to All Alternatives

Under all alternatives, there would be no change to current designated wilderness, which represents almost 25 percent of the entire forest. Designated wilderness would continue to be managed according to law, regulation, and policy to preserve and enhance wilderness character. A primitive recreation experience would be maintained. Natural ecological processes and disturbances would be the primary forces affecting composition, structure, and patterns of vegetation. Designated wilderness study areas would continue to be managed to maintain or enhance their wilderness characteristics.

Research (Wilderness Society 2004; Bowker et al 2005; Rasker et al. 2013) indicates that there are likely economic benefits to surrounding communities due to nearby areas being designated by Congress as wilderness, and that there is no evidence that it causes a loss of local employment (Duffy-Deno 1998). None of the alternatives make changes to the existing open road or motorized trail system or the non-motorized trail system.

Effects of Alternative 1

Alternative 1 specifically restricts group size in wilderness to 25 persons and 35 head of pack and saddle stock. While intended to manage visitor use and maintain opportunities for solitude, this group size limit is large enough that it could decrease opportunities for solitude in some places as indicated by Shelby and Heberlein's guidelines for appropriate group size limits (1986). Additionally, alternative 1 does not provide any flexibility for adjustment, which would require a plan amendment should there ever be valid adjustments necessary to accommodate a particular group. For example, there may occasionally be larger groups that demonstrate a high proficiency for wilderness ethics and are teaching those ethics that would be denied a special-use authorization under alternative 1's provisions. The group size limit is also intended to mitigate visitor use impacts to the other characteristics of wilderness (that is naturalness, undeveloped and untrammeled), but may be so permissive that it is not effective.

Alternative 1 would not include recommendations to Congress for any additional wilderness. In the Gila National Forest, opportunities for solitude or primitive and unconfined types of recreation are not exclusively found in designated wilderness. Those opportunities are abundant under current management, as documented in the wilderness evaluation (see appendix H of this environmental impact statement) and motorized activities are already restricted to the designated open road system, which would not change with this alternative. Wilderness use would be most concentrated under alternative 1, which may lower the ability to protect wilderness character and values such as solitude and apparent naturalness as visitation continues to increase. However, dispersal in existing wilderness areas is currently high, so any additional dispersal under the other alternatives would likely be negligible and overall opportunities for solitude would be similar. Some areas evaluated as having wilderness characteristics, but not managed as recommended wilderness, could be subject to future management that would reduce the level or quality of those characteristics. In other areas, it would be unlikely that future management would be different than current management, regardless of their wilderness status, and those characteristics would remain unchanged by management. For example, many of the areas evaluated for wilderness characteristics are inventoried roadless areas, and they are inventoried roadless areas for a reason—steep, rugged, and complex terrain makes road building and other management activities technically difficult and cost prohibitive. Opportunities for restoration or climate change adaptation would be greatest under alternative 1 because no additional limitations would be imposed on the methods or tools that could be used.

Effects Common to Alternatives 1, 3, and 4

Alternatives 1, 3, and 4 do not provide a forestwide, default length-of-stay for closure orders intended to manage recreation and protect resources. While providing a plan component that establishes a default length-of-stay can add support for closure orders, it is not necessary. Forest leadership has the authority to issue those orders and has been issuing those orders without plan direction to do so for many years. Under these alternatives, Gila National Forest leadership would continue to issue closure orders establishing a length-of-stay limit of 14 cumulative days within a 30-day period, consistent with other national forests in the Southwestern Region of the Forest Service, reserving the right to make prudent exceptions as circumstances warrant. Length-of-stay orders may benefit wilderness character and visitor experiences.

Effects Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 would include some recommendations to Congress for wilderness designation. While the suite of areas differs between alternatives, and even the areas that are common to all recommendations define area boundaries and acres differently, plan direction for their management is common to alternatives 2, 3, 4, and 5. Under the action alternatives, recommended wilderness would be managed to maintain or enhance the wilderness characteristics and their level of quality until Congress acts to designate or release them to other uses. Motorized and mechanized recreation uses would not be authorized. The use of motorized and mechanized equipment would be allowed on a case-by-case basis for trail maintenance, fire management activities and range infrastructure purposes.

By not authorizing non-conforming recreational uses, such as mountain biking, there would be less of an adjustment in use patterns and visitor expectations if Congress decides to designate. This would avoid conflict between uses should Congress decide to designate. Providing the flexibility to authorize motorized and mechanized equipment for trail maintenance, fire management activities and range infrastructure purposes may benefit the trail system, ecological and watershed restoration, and climate change adaptation, depending on the condition of the trails, ecosystems, and watersheds and what the opportunities for adaptation are in that area. Providing the flexibility to use motorized and mechanize equipment for range infrastructure purposes provides the flexibility that would be expected for livestock grazing under the congressional grazing guidelines that would apply should Congress decide to designate. The use of wheelchairs, as defined in the Americans with Disabilities Act, would be allowed in recommended wilderness.

The areas recommended for wilderness designation under alternatives 2, 3, 4, and 5 would increase the area perceived to offer wilderness-type recreation opportunities. This would potentially disperse those visitors, improving opportunities for solitude. However, the number of acres, and therefore, the actual magnitude of these effects varies by alternative. There may also be socioeconomic benefits provided by recommended wilderness, beyond what is provided by designated wilderness (see Effects Common to All Alternatives).

Designated wilderness is withdrawn from mineral entry, subject to valid existing rights, but recommended wilderness is not because it is the congressional designation through legislation that enacts the withdrawal (see also Effects Common to All Action Alternatives in the Minerals section of this chapter). The extraction of saleable mineral materials such as gravel and sand would not be allowed because it would be inconsistent with maintaining the area’s existing wilderness characteristics and it is within the discretion of Forest Service leadership to prohibit development of those types of mineral resources. It is not within the discretion of Forest Service leadership to authorize or prohibit locatable mineral extraction such as copper, silver, gold, or tin. If a claim were to be filed prior to congressional action on the recommendation, the effects of mineral exploration, extraction, or both could degrade or destroy the wilderness characteristics that exist in recommended areas.

Effects Common to Alternatives 2 and 5

Alternatives 2 and 5 establish a flexible, default group size limit of 15 persons and 25 head of pack and saddle stock in wilderness and recommended wilderness areas. This group size limit is based on a review of current conditions in the context of Shelby and Heberlein’s guidelines for appropriate group size limits (1986). Exceptions are allowed for emergency services or management activities that help to maintain wilderness character and wilderness characteristics. Examples of emergency services would include fire management and search and rescue activities. An example of an activity that helps maintain wilderness character and wilderness characteristics would be if a group of more than 15 volunteers were to pack into the wilderness to conduct wilderness character monitoring.

Exceptions would also be allowed through special-use authorizations for groups that agree to mitigation terms and demonstrate a high proficiency for wilderness ethics. Building in some flexibility to the default group size limit allows managers to preserve wilderness character, wilderness characteristics, and visitor experiences (for example, Cole and Freimund 2001), without placing further restrictions on special-use permit holders with a good track record. Permit holders that demonstrate sufficient proficiency for Leave No Trace® ethics are unlikely to see any negative effects to current business operations.

Alternatives 2 and 5 establish a forestwide length-of-stay limit to be used as the default for forest closure orders issued to manage recreation, protect resources, or both. This limit would be the same as it has been in recent years which is 14 cumulative days within a 30-day period, consistent with other national forests in the Southwestern Region of the Forest Service, reserving the right to make prudent exceptions as circumstances warrant. While not necessary to issue a length-of-stay order, doing so in plan direction adds a level of consistency, transparency, and a measure of flexibility for the forest supervisor or district ranger to authorize reasonable exceptions to that limit, like exceptions to the group size limits discussed in the previous paragraph. For example, through-hikers on the Continental Divide National Scenic Trail need more than 14 days to traverse the length of the trail on the forest. It may take a strong hiker 16 days just to cross the wilderness portion of the Continental Divide National Scenic Trail. This user group is intent on covering distance each day and generally demonstrates a proficiency for Leave No Trace® ethics. Through-hikers could be specifically excepted from the closure order with written permission. Unfortunately, the way the direction is written, it would require each individual or group of hikers to request written permission and forest leadership and staff time to consider and issue written permission. This could be a substantial workload for all involved considering the volume of through-hikers the Continental Divide National Scenic Trail attracts each year; however, length-of-stay orders may benefit wilderness character and visitor experiences by supporting management of recreational uses less focused on traveling substantial distances each day.

Effects Common to Alternatives 3 and 4

Alternatives 3 and 4 would not establish a default group size limit in wilderness, with or without the flexibility to adjust those group size limits. Instead, these alternatives would rely solely on the conditions and terms of the special-use permit to minimize impacts to wilderness character and characteristics. However, not all large group activities that may impact wilderness character require a special-use permit. Special-use permits are required when a proponent is generating income or advertising, or if non-commercial in nature, when group size is larger than 74 persons. Instead of special-use authorizations, management of non-commercial use is affected through closure orders, which would be based on the default group size limit in the plan. This approach does not serve to minimize impacts to wilderness character, wilderness characteristics, or visitor experiences as well as alternatives 1, 2, or 5.

Effects of Alternative 2

Alternative 2 recommends 13 separate areas totaling 110,402 acres (table 71) to Congress for wilderness designation. All recommended areas in this alternative are located immediately adjacent or minimally separated from existing designated wilderness area boundaries to enhance the Gila National Forest's distinctive roles and contributions to large, mostly contiguous, wilderness complexes. All have overall evaluation rankings of moderate/high, high, or outstanding. All have a low likelihood of experiencing high-intensity, stand-replacement type fire over large contiguous areas; moderate or greater likelihoods may exist in relatively small, isolated pockets, but not over 10 percent of their total area. All are compatible with the desired conditions in the Wildland-Urban Interface section of the plan.

None of these areas contain land that would substantially contribute to the suitable timber base if they were not recommended (see Timber, Forest, and Botanical Products Effects Common to Alternatives 1, 2, 3, and 4). All these areas minimize the amount of range infrastructure included in the recommendation. Most of the areas are inventoried roadless areas and feature steep, rugged, and complex terrain that make even temporary road building technically difficult and cost prohibitive. Given all these considerations, these areas are not likely to see any practical difference in their management because of recommendation and the forest would continue to provide a balance of motorized and non-motorized recreation opportunities (see Sustainable Recreation section of this environmental impact statement). See appendix H for more detailed information on how alternative 2 was developed.

Table 71. Areas recommended for wilderness designation under alternative 2

Recommended Area	Acres
B10-ALDO LEOPOLD ADDITION NORTHEAST	8,381
B11-ALDO LEOPOLD ADDITION SOUTHEAST	944
B14-ALDO LEOPOLD ADDITION CARBONATE CREEK	2,819
B1a-ALDO LEOPOLD SECO ADDITION	4,724
B1c-ALDO LEOPOLD SECO ADDITION	48
G12-GILA WHITEWATER ADDITION	1,960
G1-MINERAL CREEK	16,538
QG1-NOLAN NORTH	6,718
RG1-ASPEN MOUNTAIN	19,053
W3-ALDO LEOPOLD ADDITION WEST	1,110
W4-ALDO LEOPOLD ADDITION MCKNIGHT CANYON	11,094
WB1-TAYLOR CREEK	10,012
WSB1-RABB PARK	27,002
Alternative Total Acres	**110,402**

Because all these recommended areas are located immediately adjacent to or minimally separated from existing designated wilderness area boundaries, there would generally be positive effects to both the recommended area and the designated area. In general, the wilderness characteristics of each would be enhanced by the other, contributing to the use and enjoyment of high-quality wilderness experiences sought by the American people. There are no known valid existing mineral rights within recommended areas and there is no or low potential for future mineral development within recommended areas (see also Minerals section of this environmental impact statement).

The 2022 Black Fire impacted B1a, B1c, B10, B11, W3, and W4 Aldo Leopold Additions, WB1 Taylor Creek and WSB1 Rabb Park, although most of these areas experienced low-severity fire or did not burn (appendix H). W4-Aldo Leopold Addition McKnight Canyon was the most impacted area, with 6 percent of its area experiencing high severity and 19 percent experiencing moderate severity. Based on the vegetation types impacted and their natural fire regime, the Black Fire likely did not affect apparent naturalness in any of the recommended areas (appendix H and Upland Vegetation, Fire Ecology and Fuels section of this environmental impact statement). On the other hand, some fire management lessons were learned. W3-Aldo Leopold Addition West lies between the existing Gila and Aldo Leopold wilderness boundaries along the corridor containing Forest Road 150. It juts out from the Aldo Leopold Wilderness to the road. This road corridor has been used as a major wildfire control line, admittedly not always successfully, which points to a need to do more hazardous fuels reduction work. Recommending W3-Aldo Leopold Addition West would not be compatible with that work. W4-Aldo Leopold Addition McKnight Canyon and the northern half of WSB1-Rabb Park were covered under a project-level decision that included prescribed fire. Due to the 2013 Silver Fire and concerns about cumulative watershed effects, the prescribed fire portion of that project-level decision was dropped. The district had been working on a proposal that would have restored prescribed fire as an authorized project activity in that area when the 2022 Black Fire happened. While prescribed fire is allowed in recommended and designated wilderness, it is only allowed in designated wilderness for fire management purposes. It is not allowed for natural resource benefits.

Nolan North's boundaries, as adjusted to accommodate the alternative development and analysis criteria, have an odd shape and configuration, narrowly arching out from the Aspen Mountain recommended area. Its only attachment point to an existing wilderness being through its connection to the Aspen Mountain recommended area, which is separated from the Blue Range Wilderness by a National Forest System road.

While the purpose of wilderness is to provide an enduring resource of wilderness for the use and enjoyment of the American people, there may be secondary benefits depending on the characteristics of the area and its relationship to the rest of the landscape. For example, some wildlife species may benefit from primitive management that minimizes the types of land uses, disturbances and infrastructure that can reduce habitat quality and connectivity. If a landscape is likely to be developed or used for purposes that are not compatible with movement toward desired conditions for vegetation communities, natural disturbance processes, watersheds, and habitats, then a recommendation for wilderness might have a secondary benefit of maintaining or improving those conditions. If a landscape is not likely to be developed or set aside for purposes that would create obstacles for movement toward desired conditions for vegetation communities, disturbance processes watersheds and habitats, then a wilderness recommendation may maintain existing conditions, but it would not substantially improve or enhance conditions. Conversely, a wilderness recommendation may hamper the ability to maintain or move toward desired conditions by limiting the actions that managers may take. For example, if mechanical thinning is needed to reduce the likelihood of large, continuous extents of high-intensity, stand-replacement fire, a wilderness recommendation would negatively impact wildlife. Additionally, as climate change progresses, there may be climate change adaptation actions that are necessary to conserve biodiversity that wouldn't conform with wilderness management, and a recommendation would have negative impacts on wildlife.

There may be ways of achieving outcomes that would be consistent with the restrictions a wilderness recommendation, or designation, would impose on management, such as thinning with crosscut saws; however, it would take much longer, and less area could be treated. Further, the purpose of all management activities must be tied to maintaining or enhancing the wilderness characteristics that made it suitable for recommendation as wilderness, or fire management purposes. Managers cannot take actions in wilderness for the purpose of benefitting natural resources. Not all restoration or climate change adaptation actions will be able to tie back to maintaining or enhancing the characteristics of apparent naturalness, untrammeled, undeveloped, opportunities for solitude or primitive and unconfined recreation, or other features of value. For the most part, the current management of these 13 areas would not change substantially if they were managed as recommended wilderness, future management options could be limited by restrictions on motorized and mechanized uses.

Recall that none of the alternatives make changes to the open road and motorized trail system, or the non-motorized trail system; livestock grazing is a protected use under the Wilderness Act and would be managed under forestwide plan direction; and that the Forest Service has no jurisdiction over air space. Based on these factors and a lack of mineral potential, there is no substantial benefit to wildlife habitat or habitat connectivity because of alternative 2's recommendations for wilderness.

Effects of Alternative 3

Alternative 3 recommends 26 separate areas totaling 130,012 acres (table 71) to Congress for wilderness designation. Alternative 3 provides the same considerations for high-intensity, stand-replacement fire as alternative 2, but only for historically open canopy woodlands and grasslands. Alternative 3 does not consider those risks in forested or timbered vegetation types and may include areas of those vegetation types with moderate or greater likelihoods of high-intensity, stand-replacement type fire over large acreages. All recommended areas are compatible with the desired conditions in the Wildland-Urban Interface section of the plan.

None of these areas contain land that would substantially contribute to the suitable timber base if they were not recommended (see Timber, Forest, and Botanical Products Effects Common to Alternatives 1, 2, 3, and 4). All these areas minimize the amount of range infrastructure included in the recommendation. Most of the areas included in alternative 3 are adjacent to an existing designated wilderness, although not by design. Most of the areas are inventoried roadless areas and feature steep, rugged and complex terrain that make even temporary road building technically difficult and cost prohibitive. Given all these considerations, these areas are not likely to see any practical difference in their management because of recommendation and the forest would continue to provide a balance of motorized and non-motorized recreation opportunities (see Sustainable Recreation section of this environmental impact statement). See appendix H for more detailed information on how alternative 3 was developed.

While these areas are not likely to see any practical difference in their management because of recommendation, their contribution to positive effects on designated wilderness would sometimes be reduced as compared to alternative 2 due to the level and quality of wilderness characteristics each area possesses. The Dry Creek Addition, Gila Rain Creek Addition, all Gila Additions North Reserve, all Gila Additions Southwest and Gila Addition Northeast all have overall evaluation rankings of moderate, which reduces the ability of these areas to enhance the wilderness characteristics of adjacent designated wilderness, as compared to areas with higher evaluation rankings.

North Mogollon Mountains, Mogollon Box/Tadpole Ridge, Sawyer Peak, Gila Addition Sapillo, and Gila Addition East all have moderate/high, high or outstanding evaluation rankings and would do more to enhance wilderness characteristics of adjoining designated wilderness, like those areas recommended under alternative 2. North Mogollon Mountains also contains the only acreage of Spruce-Fir Forest that is outside of designated wilderness. Spruce-Fir Forest is very highly vulnerable to climate change (see Upland Vegetation, Fire Ecology and Fuels). If there were climate change adaptation actions that could be taken without the management restriction wilderness imposes, it would be in this area. Recommendation could impose restrictions on adaptation options should Congress decide to designate. Mogollon Box/Tadpole Ridge, Sawyer Peak, Gila Addition Sapillo, and Gila Addition East all contain relatively large, contiguous areas of forested vegetation types with moderate or greater likelihoods of high-intensity, stand-replacement fire. While it is unlikely that these areas would be targeted for vegetation treatments to address this because of their inventoried roadless area status, terrain, and the economic feasibility of treatment, it is legally and technically possible to do so with mechanized or motorized equipment. A recommendation for wilderness designation would eliminate those options if Congress were to designate. There are no known valid existing mineral rights and there is no or low potential for future mineral development within recommended areas (see also Minerals section of this environmental impact statement).

Table 72. Recommended wilderness – alternative 3

Recommended Area	Acres
B10-ALDO LEOPOLD ADDITION NORTHEAST	4,076
B11-ALDO LEOPOLD ADDITION SOUTHEAST	943
B14-ALDO LEOPOLD ADDITION CARBONATE CREEK	3,592
B1a-ALDO LEOPOLD SECO ADDITION	517
B1b-ALDO LEOPOLD SECO ADDITION	208
B1c-ALDO LEOPOLD SECO ADDITION	78
G11-GILA DRY CREEKS ADDITION	1,973
G12-GILA WHITEWATER ADDITION	3,116
G1-MINERAL CREEK	16,540
G3-GILA RAIN CREEK ADDITION	374
QG1-NOLAN NORTH	7,686
R10a-GILA ADDITION NORTH RESERVE	536
R10b-GILA ADDITION NORTH RESERVE	657
RG4-NORTH MOGOLLON MOUNTAINS	11,584
S1-MOGOLLON BOX/TADPOLE RIDGE	930
S6a-GILA ADDITION SOUTHWEST	11
S6b-GILA ADDITION SOUTHWEST	270
S6d-GILA ADDITION SOUTHWEST	248
SB1-SAWYER PEAK	21,007
SW1-GILA ADDITION SAPILLO	186
W3-ALDO LEOPOLD ADDITION WEST	1,109
W4-ALDO LEOPOLD ADDITION MCKNIGHT CANYON	11,050
WB1-TAYLOR CREEK	6,672
WB2-GILA ADDITION EAST	1,434
WB4-GILA ADDITION NORTHEAST	9,230
WSB1-RABB PARK	25,984
Alternative Total Acres	**130,012**

The discussion relative to recommended wilderness and ecological conditions under Effects of Alternative 2 are also relevant here. Alternative 3's recommendations for wilderness designation would mostly likely maintain existing conditions; would not substantially improve, or enhance vegetation communities, watershed conditions, habitat conditions, or habitat connectivity; and may reduce management options in the future.

Effects of Alternative 4

Alternative 4 recommends 17 separate areas totaling 72,901 acres (table 73) to Congress for wilderness designation. Alternative 4 provides the same considerations for high-intensity, stand-replacement fire as alternative 2, but only for forested vegetation types that provide timber products. Alternative 4 does not consider those risks in woodland or encroached grassland vegetation types and may include areas of those woodlands and encroached grasslands with moderate or greater likelihoods of high-intensity, stand-replacement type fire over large acreages. All recommended areas are compatible with the desired conditions in the Wildland-Urban Interface section of the plan.

None of these areas contain land that would substantially contribute to the suitable timber base if they were not recommended (see Timber, Forest, and Botanical Products Effects Common to Alternatives 1, 2, 3, and 4). All these areas minimize the amount of range infrastructure included in the recommendation. Most of the areas are inventoried roadless areas and feature steep, rugged and complex terrain that make even temporary road building technically difficult and cost prohibitive. Given all these considerations, these areas are not likely to see any practical difference in their management because of recommendation and the forest would continue to provide a balance of motorized and non-motorized recreation opportunities (see Sustainable Recreation section of this environmental impact statement). See appendix H for more detailed information on how alternative 4 was developed.

Table 73. Recommended wilderness – alternative 4

Recommended Area	Acres
B11-ALDO LEOPOLD ADDITION SOUTHEAST	943
B1a-ALDO LEOPOLD SECO ADDITION	4,031
B1c-ALDO LEOPOLD SECO ADDITION	40
B9-ALDO LEOPOLD ADDITION EAST	11,909
G11-GILA DRY CREEKS ADDITION	373
G3-GILA RAIN CREEK ADDITION	871
G6-LOWER SAN FRANCISCO	14,746
G8-SMOOTHING IRON MESA	3,152
R10b-GILA ADDITION NORTH RESERVE	207
S1-MOGOLLON BOX/TADPOLE RIDGE	4,856
S6a-GILA ADDITION SOUTHWEST	120
SB1-SAWYER PEAK	23,353
SW1-GILA ADDITION SAPILLO	256
W1c-GILA ADDITION LAKE ROBERTS	691
W7-GILA ADDITION EAST	642
WB2-GILA ADDITION EAST	4,437
WB6-GILA ADDITION BEAVER CREEK	2,273
Alternative Total Acres	**72,901**

While these areas are not likely to see any practical difference in their management because of recommendation, their contribution to positive effects on designated wilderness would sometimes be reduced as compared to alternative 2 due to the level and quality of wilderness characteristics each area possesses and to alternative 3 because more of the areas recommended by alternative 4 are not connected to an existing designated wilderness and stand alone.

Those areas that have evaluation rankings lower than moderate/high include Aldo Leopold Addition East (low) The Dry Creek Addition, Gila Rain Creek Addition, Gila Addition North Reserve, Gila Addition Southwest, Gila Addition Lake Roberts, Gila Addition, W7-Gila Addition East and Gila Addition Beaver Creek (all moderate). The Lower San Francisco is not adjacent to an existing designated wilderness, has an evaluation ranking of outstanding, is a designated wilderness study area, and an inventoried roadless area; however, there are concerns about being able to manage this area as wilderness given motorized intrusions at the confluence with Big Dry Creek are a recurring issue. From the confluence, off-highway vehicles illegally make their way downstream some distance into the river gorge. There are non-native invasive species issues, both riparian and aquatic, that continue to require management. There is also a pending Federal Energy Regulatory Commission proposal that would have substantial impacts on the river and the areas wilderness characteristics if it were permitted to go forward. Water resources development may be permitted, even in designated wilderness study areas or designated wilderness, if the President of the United States finds it is in the public’s best interest.

Smoothing Iron Mesa, Sawyer Peak, Gila Addition Sapillo, and WB2-Gila Addition East all have moderate/high or high evaluation rankings and relatively large, contiguous extents of moderate or greater likelihoods of high-intensity, stand-replacement type fire in woodland or encroached grassland vegetation types, if a fire were to occur.

The discussion relative to recommended wilderness and ecological conditions under Effects of Alternative 2 is also relevant here. Alternative 4’s recommendations for wilderness designation would mostly likely maintain existing conditions, would not substantially improve, or enhance vegetation communities, watershed conditions, habitat conditions, or habitat connectivity and may reduce management options in the future.

Effects of Alternative 5

Alternative 5 recommends 58 areas totaling 745,286 acres (table 74) to Congress for wilderness designation. This is inclusive of areas in a citizen’s proposal that was submitted to the planning team for consideration early in the revision process. It is does not precisely mirror the citizen’s proposal, including additional areas for recommendation because it was created through a systematic process designed to create an alternative that included the maximum number of acres with at least a moderate evaluation ranking. All recommended areas are compatible with the desired conditions in the Wildland-Urban Interface section of the plan, but no consideration was provided for areas with moderate or greater likelihoods of high-intensity, stand-replacement fire, areas that would otherwise contribute to the suitable timber base, or the presence of range infrastructure that is routinely accessed by motorized means or requires mechanized tools to maintain.

All inventoried roadless areas are included for recommendation, as are areas that are not inventoried roadless. Wilderness restrictions on mechanized and motorized equipment would potentially alter the future management of some of these areas, which could lead to higher wildfire risk. While alternative 5 still provides a balance of motorized and non-motorized recreation opportunity settings that reflects what the Gila National Forest can provide (see Sustainable Recreation section of this environmental impact statement), the quality of the non-motorized opportunities may be less under alternative 5 because of a closer proximity to open roads in the areas recommended to Congress for wilderness designation. See appendix H for more detailed information on how alternative 5 was developed.

Some recommended areas under this alternative are located adjacent to existing designated wilderness and others stand alone or as a small group, create areas that are somewhat remote from existing wilderness or other recommended areas. Alternative 5 would have a high magnitude of beneficial effects to wilderness characteristics of recommended and designated wilderness areas where evaluation rankings are higher, and a lower magnitude where evaluation rankings are lower.

Alternative 5 also includes some areas in historic mining districts with high potential for future mineral development and active mining claims (see also Minerals section of this environmental impact statement). This could create a management situation in which it was difficult to maintain existing wilderness characteristics. The discussion relative to recommended wilderness and ecological conditions under Effects of Alternative 2 are also relevant here. Alternative 5’s recommendations for wilderness designation would mostly likely maintain existing conditions, would not substantially improve, or enhance vegetation communities, watershed conditions, habitat conditions, or habitat connectivity and may reduce management options in the future.

Specifically, there may be reduced management options in North Mogollon Mountains, which contains the only acreage of Spruce-Fir Forest that is outside of designated wilderness. Spruce-Fir Forest is very highly vulnerable to climate change (see Upland Vegetation, Fire Ecology and Fuels). If there were climate change adaptation actions that could be taken without the management restriction wilderness imposes, it would be in this area. Recommendation could impose restrictions on adaptation options should Congress decide to designate.

Table 74. Recommended wilderness – alternative 5

Recommended Area	Acres	Recommended Area	Acres
B10-ALDO LEOPOLD ADDITION NORTHEAST	15,181	R1-EAGLE PEAK	31,169
B11-ALDO LEOPOLD ADDITION SOUTHEAST	1,242	R3-MORAGA CANYON	8,162
B13-WAHOO NORTH	19,737	R4-O-BAR-O MOUNTAIN	18,555
B14-ALDO LEOPOLD ADDITION CARBONATE CREEK	4,546	R9-WAGON TONGUE	11,463
B1a-ALDO LEOPOLD SECO ADDITION	5,741	RB1-EAST ELK MOUNTAIN	8,924
B1b-ALDO LEOPOLD SECO ADDITION	229	RG1-ASPEN MOUNTAIN	21,895
B1c-ALDO LEOPOLD SECO ADDITION	48	RG2-DEVILS CREEK	43,383
B5-STONE CREEK	8,383	RG4-NORTH MOGOLLON MOUNTAINS	20,398
B8-BEAVERHEAD	8,055	S10-LOWER GALLINAS CANYON	8,544
G10-BLUE RANGE SW ADDITION	3,709	S1-MOGOLLON BOX/TADPOLE RIDGE	46,437
G11-GILA DRY CREEKS ADDITION	2,827	S2-GILA MIDDLE BOX	24,523
G12-GILA WHITEWATER ADDITION	2,223	S3-BEAR MOUNTAIN	10,056
G1-MINERAL CREEK	16,848	S4-NORTH BURROS	15,556
G3-GILA RAIN CREEK ADDITION	1,095	S5-SADDLE ROCK	6,519
G5-PARK MOUNTAIN	10,737	S6a-GILA ADDITION SOUTHWEST	447
G6-LOWER SAN FRANCISCO	21,018	S6b-GILA ADDITION SOUTHWEST	4,558
G7-HELL HOLE	19,623	S6d-GILA ADDITION SOUTHWEST	1,040
G8-SMOOTHING IRON MESA	3,588	S7-BURRO PEAK	7,319
G9-BLUE RANGE SE ADDITION	2,856	S8-KNIGHT PEAK	5,294
Q11-MOTHER HUBBARD	5,689	S9-ROYAL JOHN	6,915
Q1-LARGO	14,265	SB1-SAWYER PEAK	39,150
Q2-THE HUB	34,085	SW1-GILA ADDITION SAPILLO	128
Q4-CHAVEZ LAKE	6,759	W1c-GILA ADDITION LAKE ROBERTS	393
Q6-FOX MOUNTAIN	9,704	W3-ALDO LEOPOLD ADDITION WEST	3,389
Q9-APACHE MOUNTAIN	13,942	W4-ALDO LEOPOLD ADDITION MCKNIGHT CANYON	12,458
QG1-NOLAN NORTH	7,609	W7-GILA ADDITION EAST	564
QG2-NOLAN SOUTH	4,404	WB1-TAYLOR CREEK	26,852
QR1-UPPER FRISCO BOX	36,691	WB2-GILA ADDITION EAST	3,919

Recommended Area	Acres	Recommended Area	Acres
QR2-UPPER FRISCO BOX EAST	14,252	WB4-GILA ADDITION NORTHEAST	13,862
R10a-GILA ADDITION NORTH RESERVE	536	WB6-GILA ADDITION BEAVER CREEK	4,252
R10b-GILA ADDITION NORTH RESERVE	657	WSB1-RABB PARK	42,878
		Alternative Total Acres	**745,286**

Cumulative Effects

In addition to the wilderness found within the Gila National Forest, there are other wilderness and primitive areas managed by other national forests and the Bureau of Land Management close by and throughout Arizona and New Mexico. These areas contribute to a diversity of primitive recreation opportunities and wilderness experiences available to residents and visitors.

In 1933, the Secretary of Agriculture proclaimed that the Blue Range Primitive Area, at that time located on the Apache National Forest in Arizona and New Mexico, should be managed for primitive uses to maintain the wildness of that area, and administratively designated it as a Forest Service Primitive Area. In 1971, the President of the United States forwarded a recommendation by the Forest Service for a Blue Range Wilderness in New Mexico and Arizona to Congress, who acted in 1980 on a portion of it, designating the Blue Range Wilderness in New Mexico, located on the portion of the Apache National Forest now administered by the Gila National Forest. The remaining Blue Range Primitive Area in the Apache-Sitgreaves National Forests is the last designated primitive area in the National Forest System, all others having been designated as wilderness by Congress through the Wilderness Act of 1964 and other subsequent wilderness legislation.

The Blue Range Primitive Area, along with other areas on the Apache-Sitgreaves National Forests from the 1971 recommendation to Congress, total 199,505 acres. These acres are managed under the same legal and policy framework as congressionally designated wilderness. The Gila National Forest borders the Blue Range Primitive Area along the state line for approximately 8 miles of adjoining designated Blue Range Wilderness and 7 miles of non-wilderness National Forest System lands on the New Mexico side.

During their forest plan revision effort, the Apache-Sitgreaves National Forests planning staff made an analysis assumption that three potential wilderness areas, Hells Hole, Nolan, and Mother Hubbard, "would be managed to protect their wilderness characteristics until a decision is made in the revised Gila NF land management plan as to whether or not to recommend these areas for wilderness designation" (USDA FS 2015b). These potential wilderness areas are composed of inventoried roadless areas that straddle the state line. While this analysis assumption was not part of the decision (USDA FS 2015c), Gila National Forest leadership and staff attempted to coordinate with counterparts on the Apache-Sitgreaves National Forests. The Apache-Sitgreaves National Forests' leadership decided other priority work already had the Apache-Sitgreaves National Forests' staff over their capacity and they were not interested in pursuing the discussion further. These lands would continue to be managed as inventoried roadless areas, which has been sufficient to maintain the wilderness characteristics they possess and could be considered for recommendation at a later date.

In 1976, Congress directed the Bureau of Land Management to evaluate all lands managed by the agency for wilderness characteristics. All lands found to possess such characteristics were identified as wilderness study areas. The Bureau is required by law to manage these areas for protection of their wilderness characteristics until such time as Congress decides to designate or direct they be managed for other uses. Some of these wilderness study areas are managed in the same manner as wilderness areas; however, the rules for other wilderness study areas permit activities that are generally excluded from wildernesses. For example, some wilderness study areas allow mountain bikes and off-road vehicles.

The Bureau of Land Management's 7,161-acre Apache Box Wilderness Study Area is contiguous for one mile of the southern boundary of the Hell Hole Wilderness Study Area, located on National Forest System lands managed by the Gila National Forest. The Hoverrocker Wilderness Study Area, another unit administered by the Bureau, is located west of the Hell Hole and Apache Box Wilderness Study Areas. Hoverrocker is a 22-acre area that remained after the adjacent Arizona portion was released from wilderness review in 1990, but continues to be managed as a wilderness study area in New Mexico pending congressional action. The Bureau's Continental Divide Wilderness Study Area consists of 68,671 acres, encompassing parts of Pelona Mountain and a portion of the Continental Divide National Scenic Trail. This unit adjoins non-wilderness lands the Gila National Forest manages for 2 miles. The 840-acre Gila Middle Box Area of Critical Environmental Concern, also managed by the Bureau of Land Management, is immediately adjacent to the Gila National Forest. Areas of critical environmental concern are areas "where special management attention is required...to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes" 43 U.S.C. § 1702(a).

Mining is not currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. Mining can negatively impact wilderness characteristics and wilderness character beyond those lands that are mined if the sights and sounds of mining activity can be experienced from within the recommended or designated wilderness area. These effects are not documented in the Gila National Forest because of current adjacent mining activities, but future mining expansion or new mining activities could change that. Specifically, the Mineral Creek and Gila Whitewater Addition recommended for wilderness designation as part of forest plan alternatives 2, 3, and 5 could be impacted by the proposed Summa Silver Mogollon project, as well as portions of the Gila Wilderness from which those mining activities could be viewed or heard.

The Forest Service Southwestern Region intends to use a strategy to work toward jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b). As climate change progresses, fire danger is likely to be elevated over longer periods of time and fire restrictions may be in place more of the year to reduce human-caused fires. This could negatively impact wilderness visitor experiences and satisfaction as campfires are an important component of the experience for many visitors. Increasing frequency and intensity of droughts will also reduce available water sources for wilderness visitors. There are already limited water sources in many areas away from major river corridors and the distance between those available water sources often limiting, as there is a limit to how much water can be carried. Further, as water levels decrease, the diversity and quality of water-based recreation opportunities decrease. The depth and rate of water flow can determine the quality of fishing, navigability by watercraft, and suitability for swimming or bathing in hot springs. This can concentrate use along waterways that continue to have flowing water and increase impacts to streamside resources.

Plants and animals will also be vulnerable to the consequences of higher temperatures, erratic rainfall patterns, the increasing frequency and intensity of drought and water stress, and longer and more intense wildfire seasons. These impacts will be felt everywhere, including designated wilderness, wilderness study areas and recommended wilderness areas. The mandates around managing these areas may limit climate change adaptation options and prevent managers from implementing effective strategies in a timely manner.

Demand for outdoor recreational opportunities, including wilderness recreation, is likely to increase in the future with population growth. Rising temperatures are likely to concentrate this demand in cooler, high-elevation environments. Together, these factors could increase wilderness visitation and human impacts, and detract from apparent naturalness and opportunities for solitude in more accessible wilderness locations. This could necessitate more intensive management of recreational use in the future; however, all the wilderness and similarly managed lands in the area enhance the availability and quality of primitive recreation opportunities and may serve to distribute use without more intensive management while maintaining the quality of visitor experiences, wilderness character, wilderness characteristics, and similar values.

Eligible National Wild and Scenic Rivers

Affected Environment

Congress created the National Wild and Scenic Rivers System in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) for the purpose of preserving rivers with outstanding natural, cultural, recreational, or other values in a free-flowing condition. Wild and scenic rivers are designated by Congress and to be protected for the benefit and enjoyment of present and future generations.

Wild and scenic rivers that are eligible for designation must meet the basic criteria for inclusion in the National Wild and Scenic Rivers System. Eligible rivers must be free-flowing and possess at least one value that is outstandingly remarkable on a regional or national level. Outstandingly remarkable value categories include scenic, recreation, geologic, fish and wildlife, historic, cultural, or other similar values that are unique, rare, or exemplary when compared with other similar values at a regional or national scale (FSH 1909.12; 82.73). The Wild and Scenic Rivers Act defines river classifications on a variety of elements: accessibility, developments along the shoreline, presence or absence of impoundments, and water quality. For management purposes, river segments are classified as wild, scenic, or recreational.

Wild rivers are those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and water unpolluted. Scenic rivers are those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and undeveloped, but accessible by road in some places. Recreational rivers are those rivers or sections of rivers that are readily accessible by road or railroad that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

The Gila National Forest does not manage any designated wild and scenic rivers, but it has been managing eight river segments found eligible in a 2002 study that concluded with an amendment to the 1986 forest plan. The 2002 study did not meet the legal and policy requirements of the Wild and Scenic Rivers Act or the 2012 Planning Rule and final Forest Service directives (FSH 1909.12 Chapter 80). To meet those requirements, a study that did meet these requirements was completed as part of this plan revision process, including a review of all the river segments studied in 2002. The rivers found eligible in 2002 were also found eligible by the current study, as were eight additional rivers totaling approximately 224 miles. Approximately 191 miles are classified as wild, 17 are classified as scenic, and 50 are classified as recreational.

Appendix I describes the eligibility study process in detail. A suitability study provides the basis for determining which eligible rivers should be recommended to Congress as additions to the National Wild and Scenic Rivers System. A suitability study is not required as part of the plan revision process and was not undertaken.

Certain management is legally mandated to eligible river segments until a decision is made as to the future use of the river and its adjacent lands through an act of Congress or a change in eligibility or suitability status from a future study (FSH 1909.12 section 84.3). Site-specific projects or activities within eligible river corridors may be authorized only when that project or activity protects free-flow, outstandingly remarkable values for which the river is deemed eligible, and the classification of the river. Neither eligibility nor designation by Congress affects existing water rights, or the existing jurisdiction of state and federal governments as determined by established laws. Table 75 displays the Gila National Forest's eligible river segments and preliminary classification.

Table 75. Eligible wild and scenic rivers of the Gila National Forest

River Name	Outstandingly Remarkable Values	Total Miles	Classification (# of miles)
Diamond Creek	Fish, Historic	23.80	Wild (22.12) Scenic (1.68)
Middle Box of the Gila River	Wildlife, Scenic, Recreation, Fish, Historic	8.90	Recreational (1.34) Wild (7.56)
Middle Fork Gila River	Scenic	35.54	Wild (35.54)
West Fork Gila River	Scenic, Historic	30.01	Wild (30.01)
Wilderness Run of the Gila River	Geologic, Scenic, Recreation, Historic, Wildlife	40.39	Wild (33.67) Recreational (6.72)
Holden Prong	Fish	7.27	Wild (7.27)
Iron Creek	Fish	3.53	Wild (3.53)
Las Animas Creek	Fish, Historic	7.35	Wild (2.53) Scenic (4.82)
Mineral Creek	Fish, Recreation	8.71	Wild (8.71)
Mule Creek	Geologic	4.33	Scenic (4.33)
Lower Box of the San Francisco River	Scenic, Recreation, Wildlife	17.02	Scenic (2.43) Wild (14.59)
Upper Box of the San Francisco River	Scenic, Recreation	5.70	Scenic (3.78) Wild (1.92)
South Diamond Creek	Fish	8.05	Wild (8.05)
Spruce Creek:	Fish	3.74	Wild (3.74)
Whitewater Creek	Recreation, Historic	14.73	Wild (11.79) Recreational (2.94)
Willow Creek	Recreation	4.95	Recreational (4.95)
Total Eligible River Miles:		**224.11**	

Environmental Consequences

Analysis Methodology

Eligibility does not change with alternative. This section describes the potential environmental consequences on the wild and scenic river resource that may result with the adoption of different alternatives in the revised forest plan. This qualitative analysis assumes that all alternatives would provide management consistent with the laws, regulations and policies that are established for eligible wild and scenic river segments. This analysis also assumes that if a proposed project has the potential to adversely affect the free-flow or outstandingly remarkable values of an eligible river, the suitability of that river would be studied before approving the project. Again, no suitability studies are being conducted as part of this plan revision.

Changed Circumstances

The 2022 Black Fire impacted several eligible river segments. A changed circumstances analysis that was conducted for those affected river segments is documented in appendix I. This analysis concludes no change in eligibility status is warranted at this time.

Effects Common to All Alternatives

Under all alternatives, eligible wild and scenic rivers, and their corridors, which generally consist of one-quarter mile on either side of the river, would be managed in accordance with Forest Service Handbook 1909.12, chapter 80 section 82.5. The determination of eligibility constrains the type and manner of activities that may occur in the river corridor without first conducting a suitability analysis. Three constraints would apply to activities proposed under any alternative in all eligible river corridors: (1) free-flowing river character must be maintained; (2) identified outstandingly remarkable values must be maintained or enhanced; and (3) the river classification must be maintained.

Constraints vary by river classification, with activities within eligible wild river corridors being most restricted and those within eligible recreational river corridor being least restricted. For example, the cutting of trees is not allowed in wild classification corridors unless it is necessary for human safety or to protect a cultural value at risk. Cutting of trees is acceptable in recreational corridors to meet resource objectives. Natural or planned fire is acceptable in all eligible corridors to restore natural fire regimes or to improve wildlife habitat. High-intensity wildfire would continue to be a threat to the watershed conditions that regulate water flow and, in some cases, the outstandingly remarkable values that make each segment eligible for wild and scenic status under all alternatives (see the Riparian and Aquatic Ecosystems section of this environmental impact statement for more details). Typically, wildfires occurring under extreme fire weather and fuel conditions are most damaging and have the longest duration effects to the wild and scenic river resource. Impacts from these types of fires could include temporary area and trail closures, hazard trees, more intense and frequent flood events, debris flows, increased erosion and sediment delivery, and fish kills.

Some activities or infrastructure in wild or scenic corridors may be limited, such as roads, vegetation management, and mineral development, or restricted, such as utility corridors and hydroelectric power generation. Specific limitations or restrictions would depend on the specific activity, the river's outstandingly remarkable values and classifications, and the results of a suitability determination, if required. In general, the law, regulation, and policy allow for fish barriers deemed necessary to maintain or restore native fish populations if they are designed to maintain overall patterns of flow and visually blend in with the natural environment. Permitted grazing is also acceptable in all eligible corridors, provided it is managed to maintain or enhance free-flow, water quality, outstandingly remarkable values, and the river classification. In general, current grazing management practices are consistent with these requirements because the eligibility determination was made with those practices in place. If grazing were not being managed in a way appropriate for wild and scenic river status, those river segments would not have been found eligible.

Eligible wild and scenic rivers may result in increased public interest and awareness of river resources, leading to increased visitation, satisfaction, and well-being of visitors from spending time in these special areas. Conversely, increased visitation could have some detrimental effects such as ground disturbance, increased trash or discarded items, non-native species introduction or spread, water quality impacts, and increased use conflicts. These conflicts may arise between recreationists engaged in different activities in the same place, or between recreation and non-recreation uses like permitted livestock grazing.

While not the purpose of the Wild and Scenic Rivers System, there may be secondary ecological benefits associated with eligible and designated river segments. The legally mandated management of these river segments may serve as a climate change adaptation by keeping more water in the river even as higher temperatures and more erratic rainfall patterns impact water levels and conditions of water flow.

Cumulative Effects

The intent of the Wild and Scenic Rivers Act is to counteract "the established national policy of dam and other construction," and to "preserve other selected rivers or section thereof in their free-flowing condition and to protect the water quality of such rivers and to fulfill other vital national conservation purposes" (Wild and Scenic Rivers Act 1968, section 1 (b)). The Forest Service manages more water than most adjacent land managers. In addition to the eligible wild and scenic rivers in the Gila National Forest, the Apache-Sitgreaves National Forests have three eligible river segments. These segments include a reach of the San Francisco River downstream of the Gila National Forest (USDA FS 2015b). The Gila National Forest also contains small portions of Coal Creek and Campbell Blue Creek, both of which are also administratively designated eligible wild and scenic rivers by the Apache-Sitgreaves National Forests (USDA FS 2015b).

Together, these protections of free-flowing rivers in their natural state complement the river development that has occurred in many other parts of the landscape, and thereby, fulfills the intent of the Wild and Scenic Rivers Act. Those rivers that are not designated or eligible for designation serve other purposes that are a vital part of life in the arid southwestern United States. Trends on adjacent lands under non-federal jurisdiction are subject to land use change and development. Water resources like rivers, are sensitive to land use change and development. Over time, as relatively undeveloped river corridors on non-federal lands become more developed, wild and scenic river resources may draw more attention and require more intensive management to prevent overuse and degradation.

Water is a limiting resource in the arid southwestern United States and water issues will only increase as climate change progresses. There are several interstate and international agreements and legal mandates related to the allocation of water resources that have fueled disputes over water for decades. Recently, through the Arizona Water Settlements Act, there were various proposals for the consumptive use of an additional 14,000 acre-feet of water from the Gila River, San Francisco River, their tributaries, and groundwater sources in New Mexico. While none of the proposals were approved and the funding source to administer this process and implement any selected proposals has been terminated, this and other projects like it are likely to resurface as water becomes more limiting. Future proposals could include eligible wild and scenic river segments on the Gila National Forest, which would trigger a suitability study.

The Wild and Scenic River Act expressly reserves the quantity of water necessary to protect river values, including water quality and flow-dependent outstandingly remarkable values. This reservation of water is called a federal reserved water right and is generally adjudicated in a state court (e.g., basin-wide adjudication). River designation does not supersede existing, valid water rights. The priority date is the date the river was added to the National System if designated by Congress and (IWSRCC 2018). A federal reserved water right does not result from just an eligibility determination. If rivers in the Gila National Forest were designated by Congress as Wild and Scenic Rivers, the federal reserved water right may affect future water rights. Once water rights are adjudicated, the federal reserved water right may affect future water development projects, depending upon the impacts of the new proposal on the river's flow-dependent values. River-administering agencies can work with local and state agencies to negotiate solutions that accommodate future water needs and that protect Wild and Scenic River flows and outstandingly remarkable values (IWSRCC 2018).

Rivers found eligible or suitable for the National System through federal agency planning processes are not protected by the Wild and Scenic Rivers Act from proposed hydroelectric facilities or other federally assisted water resources projects that have the potential to affect the river's free-flowing characteristics and other identified values. However, the Gila National Forest would, within its authorities, protect the values that make the river eligible or suitable for wild and scenic status.

Concurrent with the Gila National Forest plan revision and eligibility study, a citizen's proposal for wild and scenic river designation has been endorsed by New Mexico congressional representatives and legislation has been introduced to Congress several times. If rivers were to be designated by Congress, the full protections of the Wild and Scenic Rivers Act would apply. Proposed federally assisted water resources projects within the designated wild and scenic river corridor would be prohibited if they would have a "direct and adverse effect" on the values for which a river was added to the National System. For water resources projects below, above, or on a stream tributary to the designated wild and scenic river corridor, the river-administering agency evaluates non-hydroelectric project proposals under the "invade the area or unreasonably diminish" standard. The federal official proposing or permitting the project typically includes analysis (called a section 7 analysis) of what, if any, impact the proposal would have on a designated wild and scenic river in their respective environmental and/or permitting processes. The river-administering agency is responsible for conducting the section 7 analysis and making a determination under the statute (IWSRCC 2004).

Mining is not a currently a substantial activity in the forest, but it is on adjacent lands under other jurisdictions. Local copper mines adjacent to the forest are likely to expand operations as the state, nation, and the world move toward renewable energy sources to mitigate climate change. Renewable energy is copper intensive, requiring up to six times as much copper as natural gas-fired power plants. Mining removes vegetative cover and soil, alters surface and groundwater connections, lowers adjacent water tables, and can impact soil and water quality. These activities have the potential to alter surface and groundwater connections, water tables, impact soil and water quality, and potentially lead to the decline of riparian and aquatic habitat on lands beyond those that are mined. These effects are not documented in the Gila National Forest because of current adjacent mining activities, but future mining expansion or exploration activities could change that.

Several river segments that were determined eligible for Wild and Scenic status are in proximity to likely areas of mining expansion and exploration activities. Proposals for mining expansion and development that could impact eligible segments would trigger the Forest Service to conduct a suitability study, which would have an environmental impact statement and decision associated with it. However, this process could not prevent a proposed mineral project from proceeding. If the river segment was a designated Wild and Scenic River, the river corridor itself would be withdrawn from mineral entry by Congress, unless otherwise detailed in the enabling legislation. Still, mining projects outside the river corridor could negatively impact free-flow, outstandingly remarkable values, or both depending on a variety of site-specific factors. Specifically, it is possible that the eligible Mineral Creek and Whitewater Creek segments could be impacted by the Summa Silver Mogollon project.

The Forest Service Southwestern Region intends to use a strategy to work toward jointly conceived mining projects that drive ecological protection and reclamation (USDA FS 2022b). The intent is to bring diverse perspectives into the planning of mining projects, including tribes, conservation groups and communities, to promote increased understanding and decrease impacts from development and operations. Then, collaborate on restoration and reclamation outcomes funded by the mining companies at watershed scales (USDA FS 2022b).

Inventoried Roadless Areas

Affected Environment

National Forest System inventoried roadless areas were established under 36 CFR Part 294, the 2001 Roadless Area Conservation Final Rule. The rule prohibits road construction, reconstruction, and timber harvest, except under certain circumstances. These activities are limited because they have the greatest likelihood of altering and fragmenting landscapes, resulting in long-term loss of roadless area values. Some roads may be present within designated inventoried roadless areas. The rule does not prohibit travel on existing roads, or prohibit the use, maintenance, or construction of motorized trails within inventoried roadless areas.

Approximately 22 percent of the Gila National Forest (733,836 acres) is inventoried roadless area (figure 44). Individual inventoried roadless areas and their acreage are listed in table 76. Inventoried roadless area boundaries were not reconsidered during this plan revision process, and they do not differ among alternatives. Inventoried roadless areas provide primitive, semi-primitive non-motorized and in some cases, semi-primitive motorized recreation opportunities in natural-appearing landscapes with high or very high scenic integrity. Many of the Gila National Forest's inventoried roadless areas receive very light use by the public. Existing roads and trails on the boundaries of and within these areas have continued to be maintained and provide access for grazing permittees and special uses such as outfitter-guides, communication sites, and utilities rights-of-way.

Table 76. Gila National Forest inventoried roadless areas

Inventoried Roadless Area Name	Official Acres
1978 Administratively Endorsed Wilderness Proposal	4,286
Apache Mountain	17,506
Aspen Mountain	23,783
Brushy Mountain	7,199
Brushy Springs	5,735
Canyon Creek	9,824
Contiguous to Black & Aldo Leopold Wilderness	111,811
Contiguous to Blue Range Wilderness	1,980
Contiguous to Gila Wilderness and Primitive Area	79,048
Devils Creek	89,915
Dry Creek	26,719
Eagle Peak	34,016
Elk Mountain	6,550
Frisco Box	38,977
Gila Box	23,759
Hell Hole	19,553
Largo	12,730
Lower San Francisco	26,459
Meadow Creek	34,167
Mother Hubbard	5,895

Inventoried Roadless Area Name	Official Acres
Nolan	13,050
Poverty Creek	8,770
Sawyers Peak	59,743
Stone Canyon	6,801
T Bar	6,823
Taylor Creek	16,639
The Hub	7,498
Wagon Tongue	11,411
Wahoo Mountain	23,121
TOTAL Forestwide inventoried roadless area acres:	**733,836**

Environmental Consequences

Analysis Methodology

This qualitative analysis evaluates how the alternatives protect the roadless character of these areas. This analysis assumes inventoried roadless areas will continue to be managed under the direction provided by The Roadless Area Conservation Final Rule. Following existing regulation and policy, the Chief of the Forest Service reviews projects involving road construction or reconstruction and the cutting, sale, or removal of timber in inventoried roadless areas. Any such projects not reviewed by the Chief are reviewed by the regional forester.

Effects Common to All Alternatives

Under all alternatives, inventoried roadless areas would be managed in accordance with current regulation and policy to protect their roadless character and the ecosystem services such lands provide. Existing open roads would continue to be managed consistent with their maintenance level and no new permanent roads would be constructed. Temporary roads, if needed and authorized, would be returned to a more natural conditions when the authorized activities were completed. There could be temporary degradation of roadless characteristics within inventoried roadless areas because of any authorized temporary roads or when existing roads are used, but particularly when that use facilitates fire management, it may serve to enhance roadless characteristics and the ecosystem services these areas provide over the long term. Fire management activities that limit the impacts from large, high-intensity wildfires can mitigate the more severe and longer duration impacts associated with those types of fires such as hazard trees, temporary area or trail closures, more frequent and intense flood events, debris flows, increased erosion and sedimentation, and fish kills.

Inventoried roadless areas would continue to provide primitive, semi-primitive non-motorized and in some cases, semi-primitive motorized recreation opportunities in natural-appearing landscapes with high or very high scenic integrity. While the National Visitor Use Monitoring survey results indicate an upward trend in visitors seeking these kinds of opportunities, these areas are likely to see visitor impacts like those described for wilderness areas previously in this environmental impact statement. Where inventoried roadless areas overlap other designated and management areas, the most restrictive plan direction would apply.

Effects Common to All Action Alternatives

All action alternatives recommend some inventoried roadless area to Congress for wilderness designation. Where inventoried roadless areas overlap other designated and management areas, the most restrictive direction would apply. In this case, it would be the recommended wilderness direction that was the most restrictive and the effects would be like those described in the Wilderness section of this environmental impact statement.

Cumulative Effects

Other adjacent land mangers that maintain roadless areas, including wilderness, wilderness study areas, and recommended wilderness areas include other national forests, tribes, and the Bureau of Land Management. The roadless character of these areas would be maintained and enhanced through agency regulation and policy, and cumulatively, these areas each enhance the others effect on roadless characteristics and the ecosystem services these areas provide.

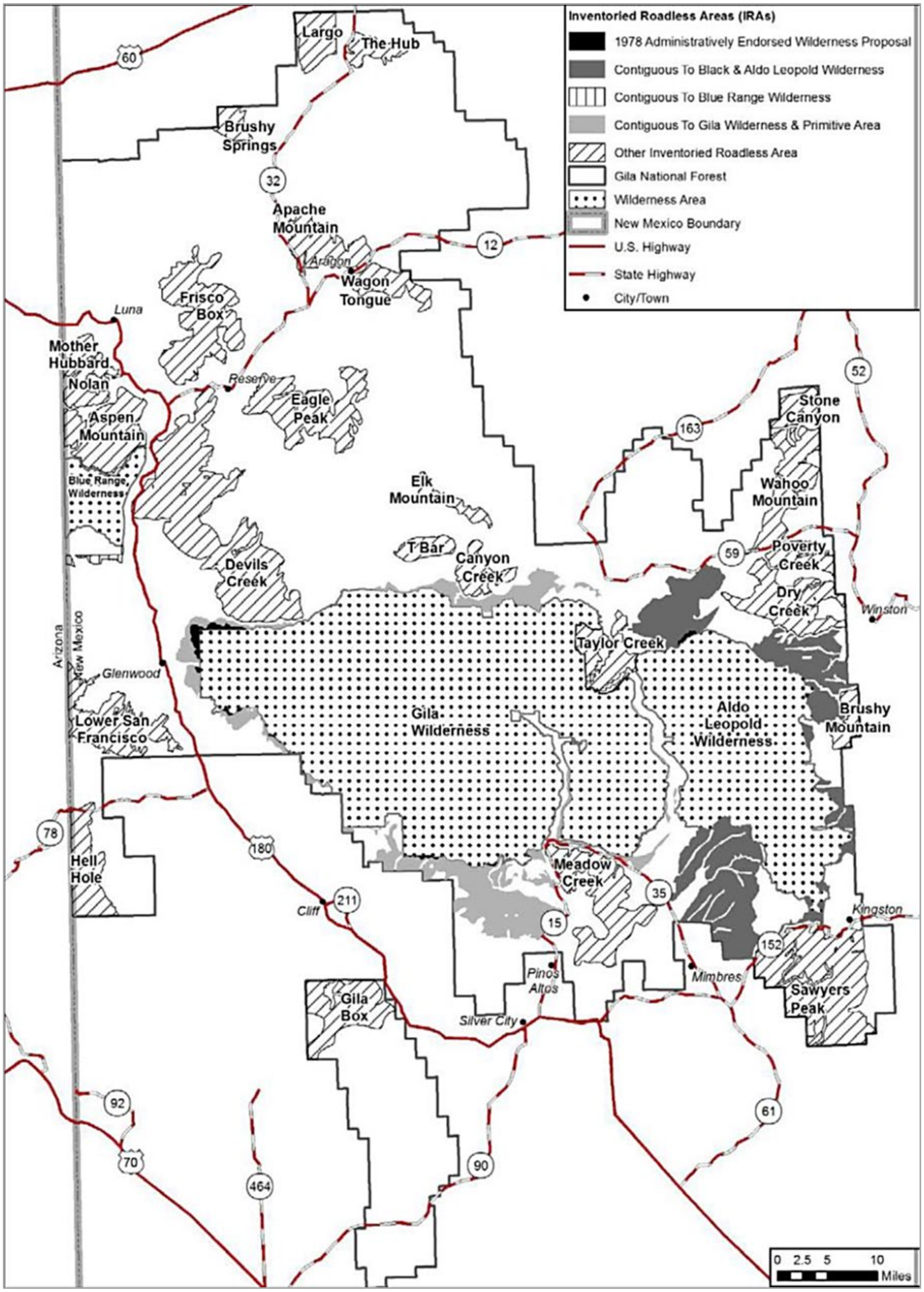


Figure 44. Gila National Forest inventoried roadless areas

Research Natural Areas

Affected Environment

Research natural areas are established to permanently protect and maintain natural conditions for the conservation of biological diversity and non-manipulative research, monitoring, and education. They are selected and established to maintain a wide spectrum of high-quality representative areas of the major forms of variability found in forest, woodland, shrubland, grassland, alpine, and natural situations that have scientific interest. In combination, research natural areas form a national network of ecological areas of research, education and maintenance of biological diversity. Research natural areas are managed to maintain the natural features for which they were established and natural processes. Because of the emphasis on natural conditions, they are excellent areas for studying ecosystems, their component parts, successional processes, and other long-term ecological change. The Gila National Forest has one designated research natural area and three additional areas that were proposed for establishment as part of the 1986 forest plan development. The proposed research natural areas are Largo Mesa, Agua Fria, Rabbit Trap, and Turkey Creek.

The Gila River Research Natural Area was established in 1972. It covers 402 acres near the Gila River Bird Area in the northern Burro Mountains on the Silver City Ranger District. The area provides a well-developed example of the riparian ecosystem in New Mexico and provides habitat for rich and unique birdlife. In the Gila River Bird Area, 231 species of birds, which represents 43 percent of the bird species verified in New Mexico, have been detected (Shook 2015). Some of these species are at the northern edge of their natural range. Federal or state threatened or endangered species using the area include the bald eagle, common blackhawk, peregrine falcon, Gila woodpecker, southwestern willow flycatcher, Bell's vireo, and Abert's towhee (Shook 2015). The Gila River in the Cliff-Gila Valley, including the Gila River Research Natural Area, is an important habitat area for native fish, including the federally listed loach minnow and spikedace.

The Burro Mountains are known to be rich in copper and there are existing mineral claims in the vicinity of the Gila River Research Natural Area, though the research natural area itself is withdrawn from mineral entry. Because of possible conflicts between uses, the research natural area was established downstream of the optimum bird habitat and riparian vegetation; however, none of the mining claims in the immediate vicinity of the research natural area have been developed into operational mines. The research natural area does have a developed trail that travels through it and the area receives recreational use such as hiking, birdwatching, river access, and dispersed camping. This trail may conflict with policy direction and the establishment record by introducing a source of human-caused environmental disruption; however, recreation in the river corridor is a long-standing use of the area. Cross-country motorized travel has been restricted in this area since 1986. Noxious plant species remain a threat, with noxious plants such as yellow star thistle being documented upstream.

The proposed Turkey Creek research natural area consists of 1,200 acres[45] within the Gila Wilderness near its southwestern boundary, south of the Turkey Creek hot springs. The area was originally proposed for its geologic features and to protect riparian and aquatic habitat associated with the Turkey Creek and Skeleton Canyon drainages. Intentions for the establishment record were to exclude the area from livestock grazing and withdraw it from mineral entry; however, it is already

[45] According to work supporting the original proposal, it was calculated to be 1,337 acres. However, when digitizing the proposed research natural area boundary from the original hardcopy maps using 200-foot contours as a guide, it came out at 1,200 acres.

withdrawn from mineral entry by virtue of its wilderness designation. There is some documentation indicating it contains an old mining claim.

The proposed Rabbit Trap research natural area consists of 300 acres in the northeastern Burro Mountains near Saddle Rock. The area has been excluded from livestock grazing since the 1940s. It is adjacent to a historic mining claim. It was originally proposed during the last planning cycle for as an example of ecological status and watershed recovery in a landscape that was historically overgrazed and continues to experience grazing impacts.

The proposed Largo Mesa research natural area is located roughly 2 miles northwest of Castle Rock on the Quemado Ranger District. It is approximately 178 acres and was originally proposed in the last planning cycle as a response to an identified need in the region for pinyon juniper woodland study sites.

The proposed Agua Fria research natural area is located on Agua Fria Mountain approximately 1.5 miles southwest of Castle Rock on the Quemado Ranger District. It contains approximately 266 acres on the northern summit and steep upper slopes of the mountain. It was originally proposed in the last planning cycle but documentation on the features or qualities it was proposed for were not found in the records. It is assumed this area was identified for the same reasons as Largo Mesa.

Environmental Consequences

Analysis Methodology

The effects to established and proposed research natural areas are analyzed under the assumption that management is largely decided by Forest Service Manual 4063. The management direction and guidance provided by the establishment record and the forest plan are consistent with and complementary to law, regulation, and policy. The effects of proposed research natural areas on the quality and representativeness of the research natural area network are also considered.

Effects Common to All Alternatives

Under all alternatives, the Gila River Research Natural Area would be retained. Livestock grazing and the harvest of wood products would not be permitted in established research natural areas. Recreational use of these areas would also be discouraged to align with policy direction and limit human-caused disturbance. Securing and maintaining a mineral withdrawal for established research natural areas would also be a management objective but would be dependent on the Bureau of Land Management's approval, revocation, or denial of those applications. Herbicide applications would only be authorized for invasive species management to maintain or restore native plant communities.

Effects of Alternative 1

Alternative 1 would retain the proposals for Largo Mesa and Agua Fria. As Largo Mesa and Agua Fria do not meet the criteria for research natural area status (see appendix J), retaining these proposals and working toward establishment would degrade the research natural area network and impinge upon the existing multiple uses of these areas, which include permitted livestock grazing.

Effects Common to Alternatives 1, 2, and 5

Alternatives 1, 2, and 5 would retain the proposals for Rabbit Trap and Turkey Creek research natural areas. Retaining Rabbit Trap and working toward its establishment would fill a regionally identified need with its semidesert grassland and shrubland vegetation communities. It is also likely a high-quality addition to the network, given historical grazing impacts to these systems and the length of time it has been excluded from permitted livestock grazing, but it is not in an unmodified condition and recent reports from stakeholders indicate the fencing has been down and cattle have been grazing in the area. Rabbit Trap is removed from permitted grazing by allotment-level decisions since the 1940s. While research natural area status may be a more durable way to remove livestock disturbance, but fence maintenance would remain an implementation issue regardless. Rabbit Trap is also reported to contain a population of Davidson's cliff carrot, which is a species of conservation concern that grows in cool, rocky areas. To our knowledge, these reports have not been validated recently. Research natural area establishment could contribute to biodiversity conservation by discouraging recreational disturbance that might impact this population of Davidson's cliff carrot.

The Turkey Creek proposed research natural area is located entirely within designated wilderness, and an allotment closed to permitted livestock grazing by National Environmental Policy Act decision (Watson Mountain Allotment). It is a popular recreational area with a trail leading up the drainage and discouraging recreational use where it is so established would be challenging, similar to the Gila River Research Natural Area. In terms of recreation, a research natural area designation is not necessarily consistent with the purpose of wilderness, which is the use and enjoyment of the American people. Otherwise, the management of this area would not substantially change. Establishment of the Turkey Creek proposed research natural areas would add value to the regional research natural area network associated with the upland ecosystems it contains, all of which fill an identified need.

Effects Common to Alternatives 3 and 4

Under these alternatives, none of the existing proposed research natural areas would be carried forward toward establishment and existing multiple-use management would continue. Plan direction for general forest areas would apply to Largo Mesa, Agua Fria, and Rabbit Trap, and Turkey Creek would continue to be managed as wilderness.

Cumulative Effects

There are many research natural areas across National Forest System lands in Arizona and New Mexico. The Bureau of Land Management also manages one research natural area in the San Juan Basin of northwestern New Mexico. Together, these areas are intended to contribute to biodiversity conservation and provide opportunities for research and education. Research natural areas can help define baseline, or reference conditions and when used as a research control, can help answer questions about the effects of management activities. While not all established research natural areas have been used for research, they remain useful for future studies and may be particularly useful for climate change research as management begins incorporating actions intended to foster ecological adaptation and alignment with predicted future climate.

National Recreation and Scenic Trails

Affected Environment

The National Trails System is a network of scenic, historic, and recreation trails created by the National Trails System Act of 1968 (Pub. L. 90-543). These trails provide for outdoor recreation needs, promote enjoyment, appreciation and preservation of open-air, outdoor areas and historic resources, and encourage public access and citizen involvement. The National Trails System Act identified three categories of trails as part of the National Trails System. National recreation trails are trails that provide a variety of outdoor recreation uses in or reasonably accessible to populated places. Recreation trails are designated by the Secretary of the Interior or the Secretary of Agriculture. National scenic trails are extended trails to provide for maximum outdoor recreation potential and for the conservation and enjoyment of nationally significant scenic, historic, natural, or cultural qualities of the areas though which such trails pass. Scenic trails are designated by Congress. Historic trails are extended trails that follow as closely as possible and practicable the original trails or routes of travel of national historic significance. National historic trails are designated by Congress.

The Gila National Forest administers segments of the Continental Divide National Scenic Trail, and three national recreation trails—the Catwalk National Recreation Trail, Sawmill Wagon Road National Recreation Trail, and Woodhaul Wagon Road National Recreation Trail (figure 45).

The Continental Divide National Scenic Trail closely follows its namesake—the Continental Divide—from Canada to Mexico, spanning approximately 3,100 miles. It traverses portions of 20 national forests, 3 national parks, a national monument, 13 Bureau of Land Management field offices, and various state and private lands in Montana, Idaho, Wyoming, Colorado, and New Mexico. Congress designated the trail in 1978 to provide high-quality scenic, primitive hiking, and horseback riding opportunities, and to conserve natural, historic, and cultural resources along the trail corridor. The intent of the trail, pursuant to the National Trails System Act of 1968, is for non-motorized use.

The Gila National Forest currently administers 254 miles of the trail, which is managed consistent with direction provided in The Continental Divide National Scenic Trail Comprehensive Plan (USDA FS 2009). The trail is one of the most renowned in the United States for its scenic beauty, recreational opportunities, elevation gains, and primitive character, making it a significant attraction that brings visitors to the Gila National Forest. Trail conditions vary throughout the forest, but the Continental Divide National Scenic Trail tends to be better maintained than other system trails due to partner groups like the Continental Divide Trail Coalition and the additional resources available to manage national scenic trails.

Recreational use of the trail includes day-hiking, backpacking, mountain biking, and horseback riding. While other types of uses may occur year-round, spring and fall are popular seasons for through-hikers travelling north and south, respectively. Through-hiking is a colloquial term for hiking a long-distance trail end-to-end within one hiking season. This may be accomplished in a single extended backpacking trip, or by a series of shorter excursions. Through-hikes may also vary in scope. For example, a hike of the Continental Divide National Scenic Trail across the state of New Mexico, or even just the Gila National Forest in either single trip or series of hikes might be considered a through-hike.

Most of the trail crosses some of the more remote sections of the forest with limited road access that limits resupply options for through-hikers. Sections of the trail pass through areas of the forest with limited water sources inhibiting visitor use overall. Some sections of the trail have been impacted by wildfires in the recent past, making it difficult to follow in some areas. Poor trail conditions, a desire to minimize travel distance, limited access to water sources, and prohibition of mechanized travel through wilderness prompts some users to follow alternative routes.

The trail corridor currently makes occasional use of motorized routes as it passes through the forest, following open motorized trail for 2.4 miles and open motorized road for 30.9 miles. Motorized use within these shared rights-of-way is not in alignment with trail objectives and intended uses under the legal designation of the trail. Public comments received have expressed concern that motorized use is incompatible with National Scenic Trail objectives, and detrimental to experiences of hikers and horseback riders. Specific areas identified included the Burro Mountains and Sapillo Campground, and motorized trespass on the trail has been an issue throughout the Quemado District. Ultimately, all segments of the trail will be realigned to avoid motorized routes and progress continues to be made toward that objective.

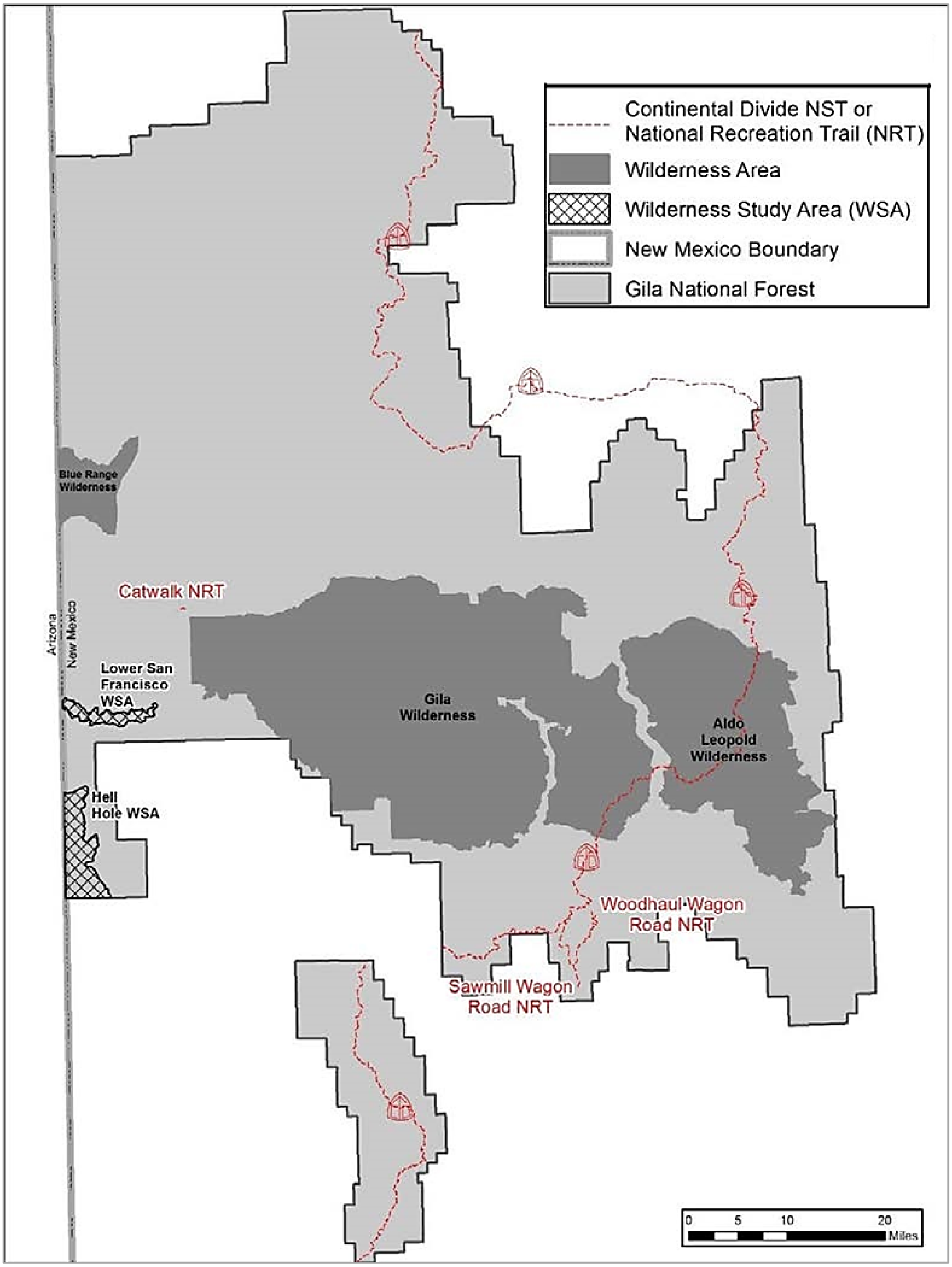


Figure 45. Location of the Continental Divide National Scenic Trail and National Recreation Trails

The Catwalk National Recreation Trail is a unique trail that consists of hanging walkways suspended from the sheer, rock walls within the canyon above Whitewater Creek. The Catwalk attracts significant numbers of visitors to the area, contributing to the local economy, and provides an important social connection to the forest. This trail is a "one of a kind" recreation experience and a unique opportunity for persons with disabilities, because its first half-mile is wheelchair accessible.

Due to its location within a narrow canyon, the trail is inherently at-risk to flooding impacts, and has been damaged and rebuilt multiple times. The most significant damage to the Catwalk was due to a 1,000-year flooding event when 10 inches of localized rainfall occurred within a 24-hour period. Few trails can be engineered to withstand such an event. The most recent Catwalk renovations were designed better than past efforts and are expected to better withstand future flooding and provide improved visitor experiences, particularly for disabled individuals.

The Woodhaul Wagon Road Trail and Sawmill Wagon Road Trail are both part of a larger system of trails near Silver City in the historic Fort Bayard area. The trails in this system are heavily used by hikers, mountain bikers, and equestrians, in part due to their proximity to Silver City. The Aldo Leopold Youth Conservation Corps has adopted the trail maintenance for this area. The Woodhaul Wagon Trail begins at the Fort Bayard Administrative Site, leading to a popular and historically significant feature of the trail known as the "Wagon Wheel Ruts." Soldiers used the wagon road to transport fuelwood and construction timber from the high ponderosa pine forests of the Piños Altos Mountain Range to the military reservation. The wagon wheel ruts are a result of the constant passing of mule- and oxen-drawn supply wagons hauling wood to the Fort Bayard Military Reservation. Eventually, the hard wagon wheels even cut into the volcanic cap rock, leaving a lasting testament to the historic significance of Fort Bayard.

The Sawmill Wagon Road was an integral part of the original Fort Bayard Military Reservation in the late 1800s. Soldiers used the trail to transport fuelwood and construction timber from the high ponderosa pine forests of the Piños Altos Mountain Range to the military reservation. Currently, the trail is used by hikers, cyclists, and equestrians, and serves as one leg of various possible loops with several other connected trails. It connects with the Continental Divide to the north, on the shoulders of the Twin Sisters peaks.

Environmental Consequences

Analysis Methodology

This qualitative analysis evaluated the effects of the alternatives on nationally designated trails toward meeting the nature and purpose of these trails and maintaining or enhancing the qualities for which they were designated. This analysis assumes that management under all alternatives would be consistent with the Continental Divide National Scenic Trail's most current comprehensive management plan. It also assumes that recreation opportunity spectrum settings associated with nationally designed trails may vary considerably depending on the alignment of the trail and its proximity to roads, but that these trails are primarily non-motorized, and the desired condition is for the trail to be within primitive or semi-primitive non-motorized settings. This analysis assumes that scenic resources would continue to be managed under the visual quality system in alternative 1 and the scenery management system in the action alternatives; and, that the retention visual quality objectives are equivalent to a high scenic integrity objectives and preservation visual quality objectives are equivalent to very high scenic integrity objectives. Finally, this analysis assumes that where these trails are currently co-located with open motorized routes, future projects would involve realigning the trail, not the motorized route.

Effects Common to All Alternatives

Under all alternatives, the Continental Divide National Scenic Trail would continue to be managed to protect the nature, purposes, and values for which it was designated and provide opportunities to view natural features and scenery. Multiple-use management activities may affect scenic resources viewed from nationally designated trails under all alternatives as discussed in the Scenic Resources section of this environmental impact statement. They may also impact recreation opportunities and experiences as discussed in the Sustainable Recreation section of this environmental impact statement. Nationally designated trails would continue to be subject to the effects common to all alternatives for the forest's trail system generally, as described in the Sustainable Recreation section of this environmental impact statement.

Projects and activities would generally have short-term impacts to trail access and conditions but be designed to promote movement toward desired scenic integrity objectives and recreation opportunity spectrum settings over the long term. Existing utility corridors and communication sites would diminish the scenic integrity of the landscape as viewed from the trail, where they are visible. Management would also continue to realign the trail where it is currently co-located with motorized routes, enhancing the physical condition and settings trail and moving toward the optimal condition for the trail's nature and purposes.

Effects of Alternative 1

Under alternative 1, more site-specific project planning and mitigation may be needed where the emphasis of the management area and the nature and purposes of nationally designated trails are not aligned. The scenery management system would not be implemented, which would be less effective in maintaining or improving scenic resources, with more area being managed for moderate to high scenic integrity objectives, rather than high to very high.

Over time, wildfires and the resulting effects to the forest trails program are not likely to diminish in occurrence or severity, until fuels become limiting. This is because the scope of vegetation treatments under alternative 1 is inadequate to achieve desired conditions in most vegetation communities and a net increase in closed-canopy conditions continues to accrue. Additionally, the effects to trails by agency-ignited prescribed fires would also be like those experienced under the 1986 plan since implementation and are not likely to be reduced over time.

Alternative 1 does not recommend any additional areas to Congress for wilderness designation. Wilderness settings generally complement the nature and purposes of the Continental Divide National Scenic Trail; however, management's ability to fulfill the nature and purposes is not contingent on wilderness status.

Effects Common to All Action Alternatives

Under alternatives 2, 3, 4, and 5, the scenery management system would be implemented and the scenic resources available from nationally designated trails would be maintained or improved over the long term as projects would be designed to maintain or move toward high and very high scenic integrity objectives. All these alternatives recommend some additional areas to Congress for wilderness designation, some containing segments of the Continental Divide National Scenic Trail. This would generally support management for the nature and purposes of the trail; however, wilderness trail maintenance requires expertise in the use of primitive tools and more time, leading to fewer miles being maintained overall. With more miles of the Continental Divide National Scenic Trail traversing lands with wilderness status, more resources would be required, taking away from the resources available to maintain other trails, both within and outside wilderness. Alternatives 2, 3, 4, and 5 recognize this tradeoff and provide the flexibility to authorize motorized equipment for the purposes of trail maintenance where it would not degrade the wilderness characteristics of the area. Should Congress decide to designate, the full force of wilderness restrictions on motorized and mechanized tools would apply.

Effects of Alternative 2

Implementation of revised forest plan direction under alternative 2 would result in use of varied mechanical harvest methods and vegetation treatments that are expected to affect trail conditions and opportunities as described in the Sustainable Recreation section of this environmental impact statement. Alternative 2's approach to vegetation management would reduce the likelihood of large, high-intensity fire events over time, and impacts to the public's use and enjoyment of the nationally designated trails, their nature and purposes, would decline as opposed to alternative 1. Recommendations for wilderness designation would prohibit mountain bike use on 6 miles of the Continental Divide National Scenic Trail where it was previously allowable.

Effects of Alternative 3

Implementation of revised forest plan direction under alternative 3 would result in more mechanical vegetation treatments and less prescribed fire, which is expected to affect trail conditions and opportunities as described in the Sustainable Recreation section of this environmental impact statement. Alternative 3's approach to vegetation management would not substantially reduce the likelihood of large, high-intensity fire events over time, and impacts to the public's use and enjoyment of the nationally designated trails, their nature and purposes, would not substantially decline. Recommendations for wilderness designation would prohibit mountain bike use on approximately 5.5 miles of the Continental Divide National Scenic Trail where it was previously allowable.

Alternative 4

Implementation of revised forest plan direction under alternative 4 would result in more mechanical vegetation treatments and less prescribed fire, which is expected to affect trail conditions and opportunities as described in the Sustainable Recreation section of this environmental impact statement. Alternative 4's approach to vegetation management would substantially reduce the likelihood of large, high-intensity fire events in forested vegetation communities, and impacts to the public's use and enjoyment of the nationally designated trails, their nature and purposes, would decline in these areas. However, it would not decline across much of the forest where woodlands and shrublands dominate. Recommendations for wilderness designation do not include any segment of the Continental Divide National Scenic Trail.

Alternative 5

Implementation of revised forest plan direction under alternative 5 would severely restrict mechanical vegetation treatments and expand the use of prescribed and naturally ignited fire, which is expected to affect trail conditions and opportunities as described in the Sustainable Recreation section of this environmental impact statement. Alternative 5's approach to vegetation management would substantially reduce the likelihood of large, high-intensity fire events over the long run, but may have high initial costs in terms of impacting the public's use and enjoyment of the forest, including nationally designated trails. Impacts to public access, use, and enjoyment would be reduced over time as movement toward desired conditions is realized. Recommendations for wilderness designation would prohibit mountain bike use on approximately 56 miles of the Continental Divide National Scenic Trail where it was previously allowable.

Cumulative Effects

No cumulative effects are expected for the Gila National Forest's National Recreation Trails as they are located entirely within the forest. The Continental Divide National Scenic Trail passes in and out of National Forest System lands, and settings and landscapes may change rather abruptly from undeveloped, natural settings to developed, rural, or urban settings. Since most private lands and other ownerships do not have the same regulations for natural resource management, the effects of ongoing developments or activities adjacent to or near national forests can sometimes be quite noticeable when viewing the continuous landscape. This can potentially affect visitor satisfaction and the quality of their experience on the trail. The comprehensive plan is developed to guide management along the entire length of the trail and to protect and enhance the nature and purposes for which the trail was designated, reducing any negative cumulative effects. However, the trail is not immune to the impacts of climate change. Those effects will be similar to those described in the Sustainable Recreation and Scenic Resources sections of this environmental impact statement.

National Scenic Byways

Affected Environment

The National Scenic Byways Program is administered by the U.S. Department of Transportation, Federal Highway Administration. The program was established to help recognize, preserve and enhance selected roads throughout the nation. The U.S. Secretary of Transportation recognizes roads designated as a national scenic byway through this program based on one or more intrinsic qualities—archaeological, cultural, historic, natural, recreational, or scenic (US DOT FHA 1995). National scenic byways provide tourism benefits to the region and communities they traverse.

Two designated national scenic byways exist in the forest. The Trail of the Mountain Spirits National Scenic Byway consists of a 93-mile loop, with an out- and back-route to the Gila Cliff Dwellings National Monument. The loop portion of the route connects Silver City, the Sapillo and Mimbres valleys, the Cobre mining district, and many points of interest in between. This route is also used during the Tour of the Gila, an annual multistage international cycling competition. The alignment it follows through the forest consists of State Highways 15 and 35. The Trail of the Mountain Spirits receives moderate use year-round, from visitors and local commuters.

The Geronimo Trail National Scenic Byway begins in Truth or Consequences, New Mexico. From there, one can explore the 82-mile northern route, or the 56-mile southern route. Each route ties together many charming locales and traverses life zones from the creosote and cholla swept sand of the Chihuahuan desert, to the woodlands and forests of the Gila National Forest. The routes through the forest are State Highway 180 to San Lorenzo along the southern route, and State Highways 52 and 59 to the Beaverhead workstation along the northern route. The North Star Mesa Road (National Forest System Road 150) is listed as a "side trip," connecting the two routes to form a loop; however, a 4-wheel-drive vehicle and knowledge of road conditions are needed. The portions of the forest along the northern byway receive low use and the southern route receives moderate use year-round.

A National Scenic Byway corridor management plan provides guidance and direction for the conservation and enhancement of the byway's intrinsic qualities and promotion of tourism and economic development. The Trail of the Mountain Spirits Corridor Management Plan (Trail of the Mountain Spirits Scenic Byway Committee 2004) supports efforts to strengthen volunteer participation, explore alternative sources for project funding, increase membership, leverage business support, and identify project managers for the implementation and completion of byway projects.

The Geronimo Trail National Scenic Byway Corridor Management Plan (Geronimo Trail Advisory Committee 2008) strives to showcase and preserve the byway corridor area for its historic, multi-cultural heritage and natural resources. Some of the goals of the plan are to market the byway as a unique tourism opportunity, develop interpretive signs and other amenities along the byway, ensure services provided along the route meet travelers' needs, and preserve the byway's resources so the route is a sustainable tourist and recreation attraction. The city, county, state, and federal agencies with management responsibilities along the byway work in concert with the advisory committee to achieve these goals.

Analysis Methodology

This qualitative analysis assumes scenic byways would continue to be managed under current law, regulation, policy, and corridor management plans for the continued benefits for which they were designated. This analysis assumes that scenic resources would continue to be managed under the visual quality system in alternative 1 and the scenery management system in the action alternatives; and, that the retention visual quality objectives are equivalent to a high scenic integrity objectives and preservation visual quality objectives are equivalent to very high scenic integrity objectives.

Effects Common to All Alternatives

No new scenic byways are proposed for any alternative. Corridor management plans would guide the management of scenic byways under all alternatives. Current scenic byways would continue to be managed to protect the values for which they were designated and provide opportunities to drive for pleasure and view natural features and scenery. Scenic byways would continue to provide tourism and economic benefits for the region and communities they traverse. Multiple-use management activities may affect scenic resources viewed from scenic byways under all alternatives as discussed in the Scenic Resources section of this environmental impact statement. While some short-term impacts may occur, scenic integrity objectives would still be met, particularly in the long term.

Effects of Alternative 1

Alternative 1's approach to vegetation management is not likely to reduce the risk of large, high-intensity wildfires over time as closed-canopy conditions generally increase. This may lead to negative impacts on the scenery visible from scenic byways, road conditions, and visitor experiences. The effects to scenic resources are described in more detail in the Scenic Resources section of this environmental impact statement.

Effects Common to All Action Alternatives

Desired conditions and guidelines in alternatives 2, 3, 4, and 5 emphasize natural-appearing scenery, managing for high scenic integrity, which provides better support for the management established in the corridor plan than alternative 1. However, all alternatives would include working with other agencies, highway departments and communities to improve scenery, service, and interpretive opportunities. It is possible that more beneficial effects would be incurred because of alternatives 2, 3, 4, and 5.

Effects of Alternative 2

Alternative 2's approach to vegetation management would reduce the risk of large, high-intensity wildfires over time and across much of the forest. There may still be some short-term negative impacts to scenery in the near term as progress toward desired conditions may be slow. The effects to scenic resources are described in more detail in the Scenic Resources section of this environmental impact statement.

Effects of Alternative 3

Implementation of revised forest plan direction under alternative 3 would result in more mechanical vegetation treatments and less prescribed fire, which is expected to affect scenic resources as described in the Scenic Resources section of this environmental impact statement. Alternative 3's approach to vegetation management would not substantially reduce the likelihood of large, high-intensity fire events over time, and impacts to the public's use and enjoyment of scenic byways could occur.

Effects of Alternative 4

Implementation of revised forest plan direction under alternative 4 would result in more mechanical vegetation treatments and less prescribed fire, which is expected to affect scenic resources as described in the Scenic Resources section of this environmental impact statement. Alternative 4's approach to vegetation management would reduce the likelihood of large, high-intensity fire events over time in forested vegetation types, but not in woodland vegetation types. This could influence the distribution of impacts associated with these types of fire, with the impacts to the public's use and enjoyment of scenic byways being less near treated forest areas, and greater near untreated forest and woodland areas.

Effects of Alternative 5

Implementation of revised forest plan direction under alternative 5 would severely restrict mechanical vegetation treatments and expand the use of prescribed and naturally ignited fire, which is expected to affect scenic viewing opportunities as described in the Scenic Resources section of this environmental impact statement. Alternative 5's approach to vegetation management would substantially reduce the likelihood of large, high-intensity fire events over the long run, but may have high initial costs in terms of impacting the public's use and enjoyment of the forest, including scenic byways. Impacts to public access, use and enjoyment would be reduced over time as movement toward desired conditions is realized.

Cumulative Effects

Scenic byways pass in and out of National Forest System lands and settings may change rather abruptly from undeveloped, natural settings to developed, rural or urban settings. Since most private lands and other ownerships do not have the same regulations for natural resource management, the effects of ongoing developments and activities on lands adjacent to National Forest System land boundaries can sometimes be quite noticeable when viewing the continuous landscape, potentially affecting the visitor's satisfaction and quality of their experience on a scenic byway. Forest visitors often view natural resources as a continuous landscape with little discernment regarding the land ownership being viewed. If activities on other ownerships and private lands are designed to lessen impacts to natural resources, including scenery, the differences between National Forest System lands and other jurisdictions and ownerships are less apparent.

Corridor management plans for scenic byways are developed to protect and enhance the byway's intrinsic qualities across ownership boundaries, reducing any negative cumulative effects and support movement toward desired conditions for scenic byways and the socioeconomic benefits they contribute to the region and communities they traverse.

Social and Economic Conditions

Affected Environment

The lands that are now the Gila National Forest have provided many resources essential for survival and prosperity for millennia. These lands served Native American Tribes, Spain, and Mexico long before it became a United States property. The heritage, culture, traditions, and values that grew from this time were handed down over generations and still exist today. Today, communities within and surrounding the Gila National Forest are diverse, multicultural, and have strong attachments to the land that may be generations old, or a newfound discovery. There is also a strong sense of belonging and community across the social and cultural diversity that exists within the four-county area.

Three major components characterize this sense of attachment. The first comes from traditional users having a sense of personal stewardship, based on historical associations with National Forest System lands (USDA FS 2006a). There is a significant generational element to this theme, which dates to the time before the Gila National Forest was established. The second component is derived from historical practices around the use of natural resources. These traditional users believe their first-hand knowledge and self-interest in management of forest resources results in a culturally based understanding and attachment to forest lands (USDA FS 2006a). The third component views the Gila National Forest as a sustainable legacy. It is viewed that this land is a unique resource that should be cared for, conserved, and passed down to future generations (USDA FS 2006a).

Traditional uses as they relate to the Gila National Forest have strong cultural ties to New Mexico's heritage. They hold historical significance, because they were necessities for survival, and many uses defined a way of life. While their prevalence has diminished somewhat over time, those with cultural ties to the area of influence still engage in many of these uses and view them as a vital part of their heritage. Those who have a cultural investment in the traditional uses of the area look to the Gila National Forest to continue providing these opportunities as a matter of right. These uses consist of livestock grazing, hunting and fishing, medicinal herb gathering, firewood gathering, open forest access, and wood harvesting for commercial uses. Acequias are an integral part of the cultural and traditional heritage. The Gila National Forest plays a role in this heritage by working with acequia commissions or ditch associations to support ongoing maintenance, accommodate access, and assist with authorized infrastructure improvements for the 30 historic ditches that originate on or cross the forest.

In the past, communities and families who lived within the area of influence relied on traditional uses of natural resources to get by. The main activities were logging, mining, grazing, ranching, and farming. Today, logging and farming especially are not as prevalent as they once were. The declines in traditional uses are generally due to market demands, regulatory changes, and other economic constraints such as the long distance to markets. The decline in traditional uses is still strongly felt in the local economies of some communities, and many people would like more opportunities for economic development.

For communities and counties reliant on the timber industry, the 1990s saw the decline of the amount of timber harvested and closure of the largest sawmill in Reserve. The primary reasons for the decline were related to new required practices for sustainable forestry, concerns for limited remaining old growth, for management needs of the northern goshawk and Mexican spotted owl, litigation, economic constraints, and declining Forest Service budgets. The result of this sudden downward shift in economic activity caused a significant unemployment impact to the logging community and rippled throughout the community infrastructure (USDA FS 1995). Catron County unemployment and poverty rates rose to 15 percent and 25 percent, respectively (Wilson 2006). Many residents of these communities and adjacent areas had made their living for decades working in association with the timber industry. For many residents and businesses of these communities, the change in management seriously disrupted their traditional way of life and sense of well-being (USDA FS 1995). Many families left the area in search of employment elsewhere, impacting the community social fabric, supporting businesses, and county tax base to provide services such as road maintenance, law enforcement, and health care. School enrollment declined, and since the formula for receiving state education money is based on enrollment numbers, the Reserve School District budget was significantly reduced (Thal et al. 1995). Social hardships grew with significant increases in social service and mental health caseloads, especially regarding family stability-related social problems (Thal 2003).

In addition to traditional uses that continue to weather the test of time, the Gila National Forest has also experienced a gradual progression more contemporary in nature. There has been a shift toward recreation and tourism, and when asked, some members of the public view the forest with a strong recreation emphasis, especially hunting (USDA FS 2006a). The elk hunting season attracts hunters from across the country, and private outfitter-guide companies provide a range of services to clients. Many other visitors come to experience the cultural distinctiveness, while others come to partake in various outdoor pursuits, and the beauty of the landscape is an attraction in and of itself. Approximately 390,000 people visited the forest during 2016 (USDA FS 2018d). However, some people doubt that recreation can replace the traditional uses as an economic base, especially with lower average salaries in the service sector (USDA FS 2006a).

The four-county area and the Gila National Forest elicit a strong sense of connection that is not only traditionally based but is also shared by those who are considered "non-traditional" users and live in the area or visit the forest. Many of these connections are also based on interactions with the forest and its resources, as well as personal experiences and values. Some users have special places in the forest, while others speak of the inspiration, solitude, and appreciation they feel by being in the Gila National Forest. The diversity of wildlife, plants, landscape, and other resources is another important value of the forest. There is a local environmental presence that has actively pursued implementing preservation values and beliefs about forest management and landscape conditions (USDA FS 2006a).

There is a perception that a transition is occurring within the social fabric of the area communities. This shift involves the exodus of younger people and the influx of newcomers. Younger people are believed to be leaving the area in search of jobs, which are limited within the area of influence. Despite a strong sense of attachment, many of these young people rarely make it back. It is also believed that newcomers are increasing in number attracted by the natural resources, rural lifestyle, and quality of life amenities. This influx has increased the diversity of lifestyles, most recently retirees and others who are not dependent on local economies for their income. Newcomers may not have the same appreciation for traditional uses and may even view natural resource issues in different ways than longer-term residents (USDA FS 2006a). These characteristics imply a mix of values and beliefs based on types of use, length of residence, and cultural background. These diverse views, especially those concerning polarized natural resource issues, have created some social tensions. These perceptions indicate a social scenario where communities are feeling a change, and possibly a loss of traditional ways of life.

One of the most unique characteristics of southwestern New Mexico is its diversity of people, culture, traditions, and values. People benefit, either directly or indirectly from multiple use of forest resources. The management of the Gila National Forest contributes to social and economic sustainability by maintaining a set of desired social, cultural, and economic conditions that benefit people. Demographic and economic characteristics have been shown to affect forest use, volunteerism, environmental attitudes, preferences for site development, and opinions regarding forest management (UNM-BBER 2014). Understanding the unique characteristics, trends, history, and challenges of the area of influence communities is an important consideration for public land managers working to meet the needs of the public.

This section provides social and economic analysis, including past and current conditions and the potential consequences of the alternatives on the social and economic environment. The affected environment section is split into five parts: (1) population statistics, (2) employment and income, (3) potential environmental justice populations, (4) relationship of the Gila National Forest to local social and cultural conditions, and (5) the Gila National Forest's contribution to the local economy. This section presents demographic and economic statistics within the context of a multi-county "area of influence." The area of influence concept recognizes that the forest provides contributions and affects social, cultural, and economic conditions outside the forest boundary. The Gila National Forest area of influence is composed of the four counties that contain the forest within their boundaries: Catron, Grant, Hidalgo, and Sierra Counties. Areas beyond these four counties are part of the broader landscape where forest contributions can affect a specific interest, but do not fundamentally affect the social, cultural, and economic conditions as within the four-county area.

Demographic and socioeconomic data reported for the area of influence are based on the U.S. Census Bureau county-wide data. Statistics for the state of New Mexico are presented for comparison with the area of influence. In some cases, the data for the multi-county area of influence has been aggregated using a program economic tool kit from Headwaters Economics (2015). Many statistics were compiled by the University of New Mexico Bureau of Business and Economic Research (UNM-BBER). Not all the data are reported in this section, and to read more, please see the Gila Final Assessment Report of Ecological/Social/Economic Sustainability Conditions and Trends (2017), UNM-BBER Socioeconomic Assessment Supplement for the Gila National Forest (2014), the UNM-BBER Socioeconomic Assessment for the Gila National Forest (2007), which are part of the planning record.

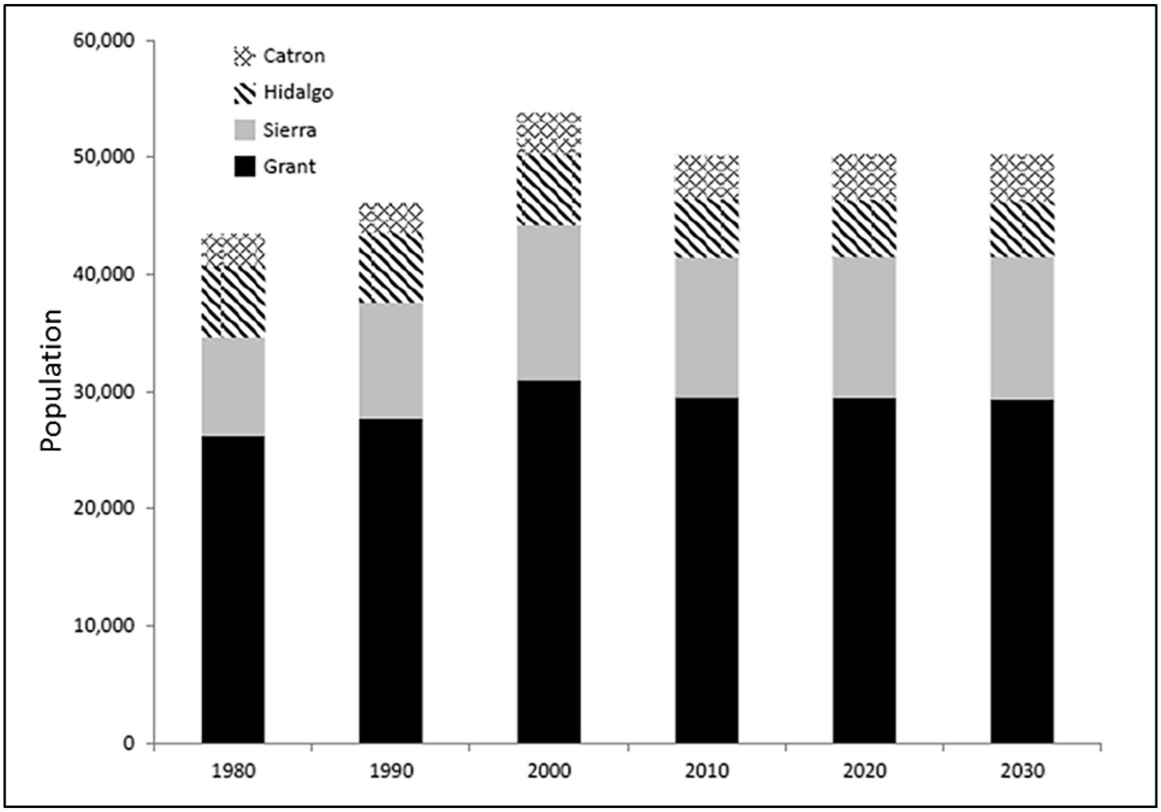
Population Statistics

This section describes population and demographic trends. Population is an important consideration in managing natural resources. Population size, composition, density, and the dynamics driving changes in these population attributes over time are essential to describing the consequences of forest management and planning on a social environment (Seesholtz et al. 2006).

Population

In 2022, New Mexico was home to more than 2 million people, which is less than 1 percent of the U.S. population (U.S. Census Bureau 2022a). Since 1980, the state's population has grown more rapidly than that of the United States as a whole. Studies have projected state population growth rates that are expected to result in a 2030 population of more than 2.6 million people (UNM BBER 2014).

The Catron, Grant, Hidalgo, and Sierra Counties contain approximately 2.4 percent of the population of New Mexico. In 2022, these counties had a combined population of 46, 952 with Grant County being the most populous (27,686) and Catron County being the least (3,827). Figure 46 shows the population trend for the four-county area, which has increased slowly from the 1980s to the early 2000s, when it reached a peak, and then declined slightly in 2010. The decline is tied to the Great Recession and depressed copper prices, which led to a temporary mine operation suspension and layoffs in Grant County. Between 2010 and 2030, the area's population is expected to hold relatively constant (UNM-BBER 2014).

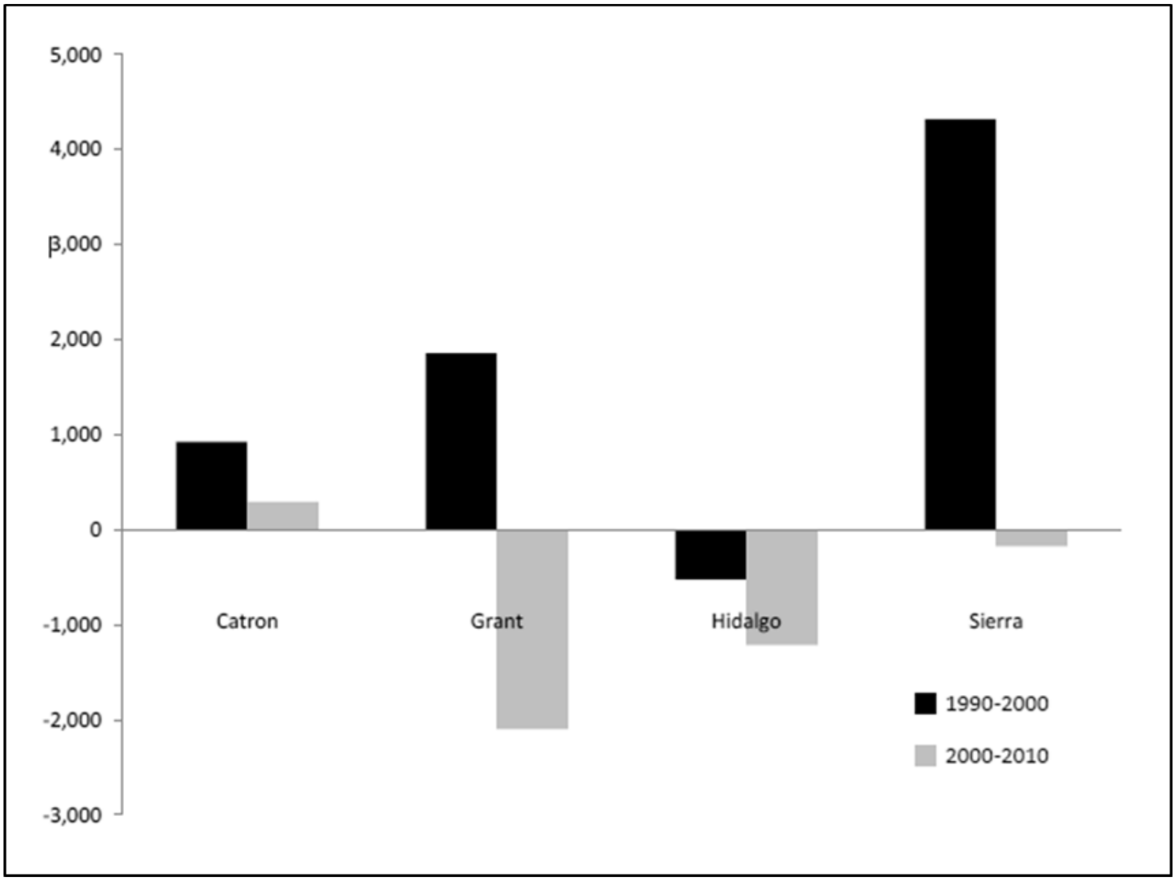


Source: UNM-BBER 2014.

Figure 46. Historical and projected population of Gila National Forest area of influence counties

The Gila National Forest area of influence is rural, with an average 2010 population density of fewer than 3 people per square mile. Due to the presence of Silver City, densities have historically been highest in Grant County, where the population density was more than 7 people per square mile in 2010. Catron County's population density is exceedingly low, at 0.5 person per square mile, making it one of New Mexico's least populated counties (UNM-BBER 2014).

Net migration is a useful indicator of the population dynamics of an area. Are people moving in or leaving or is the population stable? Between 1990 and 2000, most counties associated with the Gila National Forest area of influence experienced some level of net in-migration. Hidalgo County was the one exception possibly due to not attracting as much of an influx of retirees from the baby boomer generation (UNM-BBER 2007). Between 2000 and 2010 migration patterns changed with the exception of Catron County, all area of influence counties experienced net out-migration likely due to many people moving to find employment during the Great Recession (figure 47) (UNM BBER 2014).

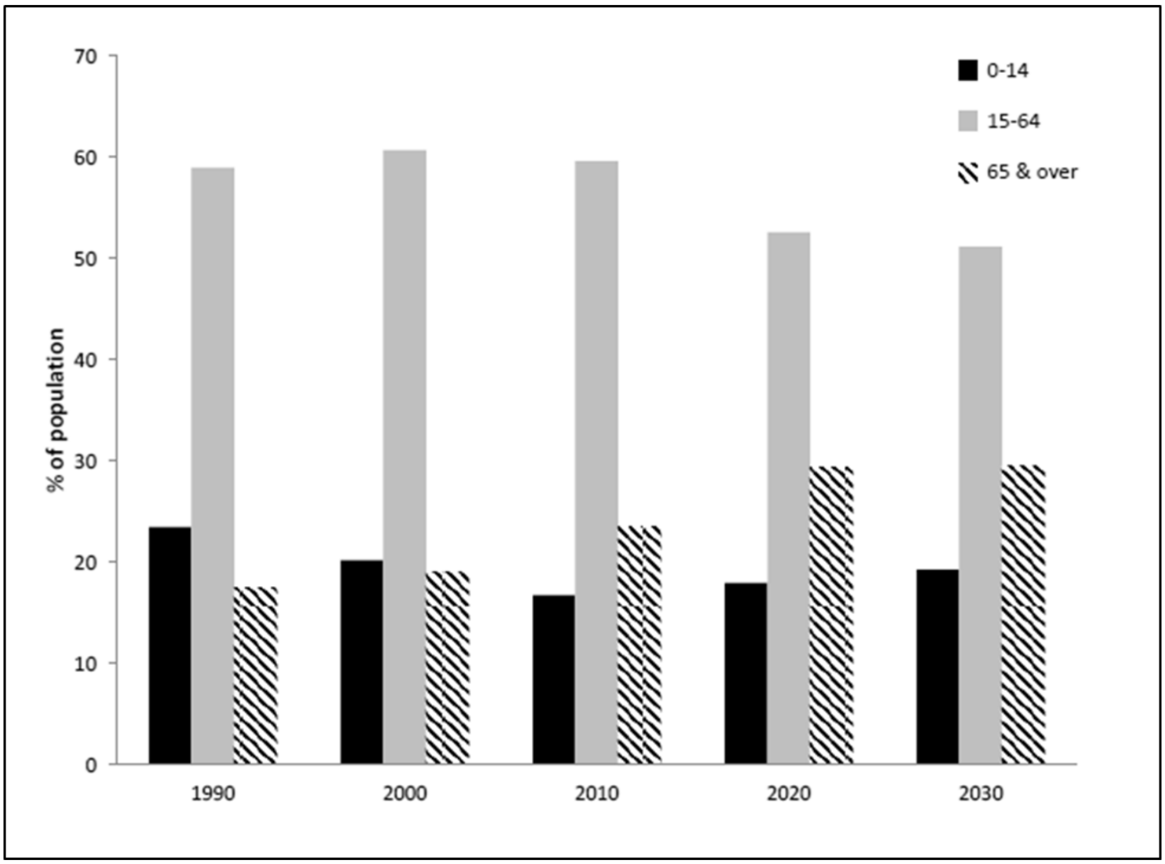


Source: UNM-BBER 2014.

Figure 47. Net migration in Gila National Forest area of influence counties

Age

Compared to the rest of New Mexico, a smaller portion of the four-county area's population is between the ages of 0 and 14, while a larger portion is age 65 or older. While the trend toward a population dominated by those age 65 or older is apparent throughout the state, it is happening at a faster rate in the four-county area. Figure 48 shows a continued increase in the proportion of the population over 64 projected in the area of influence for 2030, while the proportion of the population between 15 and 64 is expected to decline (UNM-BBER 2014). Facing limited opportunities for employment, younger people migrate to larger communities, accelerating the aging of the population. In addition, some counties in the area of influence are attracting an influx of retirees from the baby-boomer generation (UNM-BBER 2007). Catron County has one of the oldest populations in the nation, with a median age of 60.1 years old.



Source: UNM-BBER 2014

Figure 48. Historical and projected age distribution in Gila National Forest area of influence

Education

The state of New Mexico has historically struggled with educational performance, but the population has become more educated. The portion of individuals aged 25 or older with no high school diploma or GED 14 to 10 percent; and the portion with an associates or other advanced degree increased from 26 to 33 percent (UNM BBER 2014). In 1990, the four-county area was less educated than New Mexico’s population, but now they are similar in educational attainment (table 77). Between 1990 and 2010, the portion of the area of influence population with less than a high school education declined from nearly 33 to 16 percent. During this same time, the portion of the area's population with at least some college education increased from just over 33 to nearly 54 percent. The higher share for Grant County may be partly related to access to education because Western New Mexico University is in Silver City (UNM-BBER 2007). It is expected that educational improvements will continue throughout the four-county area (UNM-BBER 2014).

Rural communities generally offer fewer opportunities for educational or occupational advancement, and they typically struggle to retain and attract educated and highly skilled individuals. Residents interested in pursuing advanced education typically move from these rural communities to areas that support greater educational and economic opportunities.

Table 77. Education attainment within the area of influence, New Mexico, and U.S.

Education/Population	U.S. (%)	New Mexico (%)	Area of Influence (%)	Catron County (%)	Grant County (%)	Hidalgo County (%)	Sierra County (%)
Less than 9th grade	6%	7%	6%	2%	6%	11%	5%
9th to 12th grade, no diploma	8%	9%	9%	8%	9%	13%	10%
High school graduate (includes equivalency)	28%	26%	30%	33%	27%	31%	36%
Some college, no degree	21%	24%	25%	32%	25%	26%	24%
Associate degree	8%	8%	7%	5%	8%	5%	6%
Bachelor's degree	18%	15%	12%	11%	12%	10%	14%
Graduate or professional degree	11%	11%	10%	10%	13%	6%	5%
Percent high school graduate or higher	86%	84%	85%	91%	85%	77%	85%
Percent bachelor's degree or higher	29%	26%	23%	21%	26%	16%	19%

Source: U.S. Census Bureau 2010–2014

Language

Approximately 95 percent of the people living in the four-county area of influence speak English very well; however, nearly 30 percent speak a language other than English in their home (table X) (US CB 2014). Spanish is the most common language other than English. Under two percent speak a second language other than Spanish.

Table 78. Language spoken at home in the four-county area of influence, New Mexico, and the United States

Language	Area of Influence (percent)	New Mexico (percent)	United States (percent)
English Only	70.7	63.9	79.3
In addition to English	29.3	36.1	20.7
Spanish or Spanish Creole	27.7	26.7	12.9
Other Indo-European	0.6	1.2	3.7
Asian and Pacific Islander languages	0.4	0.9	3.3
Other languages	0.5	5.2	0.9
Speak English less than "very well”	5.0	9.6	8.6

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008–2013 and are representative of average characteristics during this period (US CB 2014).

Employment and Income

Employment and income data are key measures of the economic well-being of a local area. Table 79 lists the median household income for the four-county area, the state, and the nation. All counties in the area have median household incomes below the state and nation. The un-weighted average of household income in the four-county area is approximately $10,000 below the state median, and nearly $20,000 below the national median.

Table 79. Median household income

Location	Median Household Income
Catron County	$39,342
Grant County	$38,923
Hidalgo County	$35,048
Sierra County	$28,855
New Mexico	$44,968
United States	$53,482

Source: U.S. Census Bureau 2014

Total personal income comprises labor and non-labor income. Labor income is the wage or salary received by an employee or sole proprietor. Non-labor income includes investments like rent collection, dividends and interest, age-related transfer payments like Social Security, and hardship-related transfer payments like welfare or income assistance. Table 80 identifies the division of labor and non-labor income in the area counties, the state, and the nation.

Table 80. Share of labor and non-labor income

Location	Labor Income (%)	Non-Labor Income (%)
Catron County	45	55
Grant County	46	54
Hidalgo County	56	44
Sierra County	41	59
AREA OF INFLUENCE	**47**	**53**
New Mexico	62	38
United States	65	35

Source: U.S. Bureau of Economic Analysis 2010, REIS Table CA30

The four-county area is much more reliant on non-labor income than the state and the nation. Total personal income in New Mexico and the United States is composed of approximately two-thirds labor income and one-third non-labor income. In contrast, three out of the four area of influence counties receive more non-labor income than labor income. Sierra County is particularly skewed toward non-labor income. From 1990 to 2014, in the four-county analysis area, labor income grew from $594 million to $767 million (a 29 percent increase), while non-labor income grew from $487 million to $956 million (a 96 percent increase) (Headwaters Economics 2015). These data suggest that the area of influence has a growing concentration of retirees possibly attracted by high quality of life, mild climate, and affordable housing. The non-labor income is primarily from investments (35 percent), age-related transfer payments (35 percent), and hardship-related transfers (24 percent) (Headwaters Economics 2015).

Prior to this century, New Mexico's unemployment rate typically exceeded that of the United States. The relationship changed after 2002, and since 2006, the New Mexico unemployment rate has been considerably below the rest of the nation. Between 2000 and 2008, much of the growth in New Mexico non-farm employment occurred in health and social assistance, local government, professional and business services, and construction. In 2008 to 2009, the economy crashed, resulting in what is now referred to as the Great Recession. More than 34,000 New Mexico jobs were lost between 2008 and 2009. A large portion of these losses (nearly 10,000 jobs) occurred in the construction industry. Other areas of significant job loss during this time were manufacturing, administrative and waste services, retail trade, and mining. However, strength remained in the health care and social assistance industry, as well as government (UNM-BBER 2014).

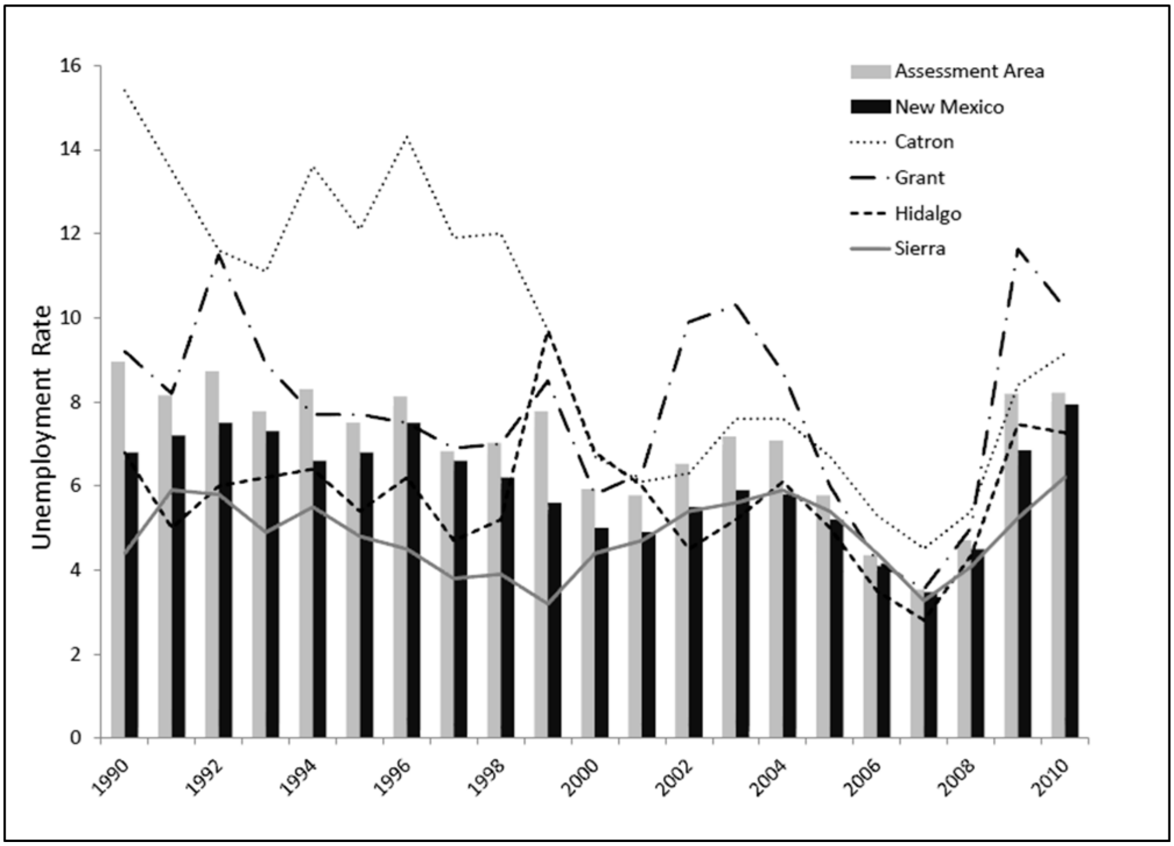
The gap between New Mexico and U.S. unemployment rates grew during the Great Recession, as the U.S. unemployment rate rose faster than New Mexico's. The gap between the two was greatest in 2009, when New Mexico had an unemployment rate of 6.8 percent, while the U.S. unemployment rate was 9.3 percent. In 2011, both the New Mexico and U.S. unemployment rates began to fall from their 2010 peaks. The U.S. rate fell more rapidly than the New Mexico rate, narrowing the gap between the two. As of 2011, the U.S. had an unemployment rate of 8.9 percent, while New Mexico had a rate of 7.4 percent. As the economy continues to recover from the Great Recession, unemployment rates are expected to continue declining (UNM-BBER 2014).

Since at least 1990, the area of influence has had an unemployment rate that exceeds that of New Mexico. In all but seven years between 1990 and 2010, Catron County had an unemployment rate higher than Grant, Hidalgo, and Sierra Counties. At the other end of the spectrum is Sierra County, which has had an unemployment rate that has frequently been lower than that of New Mexico. The spike in unemployment caused by the Great Recession is evident in figure 49. As the national economy continues to recover, unemployment rates should gradually decline (UNM-BBER 2014).

Sectors of the Economy

Economic diversity generally promotes stability and offers greater employment opportunities. Economies that depend on very few industries for the bulk of employment and income are prone to cyclical fluctuations and offer limited job opportunities. Understanding economic diversity is important for decision makers, particularly when the dominant industry can be affected by changes in policy. For Forest Service responsible officials, this is likely to be the case where the forest products industry or the tourism and recreation industries, for instance, are reliant on the local national forests.

Table 81 shows employment levels by aggregated job sectors within the area of influence. The table stresses the importance of the government, retail trade, health care and social assistance, mining, and agriculture job sectors. Together these industries provide 61 percent of the area's employment. These industries are consistent with findings discussed in the demographic section: namely, a substantial government presence, a retiree population that consumes health and social services, amenities that attract tourists who support the retail trade and accommodation and food services sectors, and natural resource mining and agriculture (such as cattle ranching) industries. Most of the area of influence jobs are located within Grant County (UNM-BBER 2014).



Please note that “assessment area” is the same as “area of influence.” Figure from UNM-BBER 2014.

Figure 49. Unemployment rate in Gila National Forest counties (1990 to 2010)

Table 81. 2014 employment levels by industry classification for Gila National Forest area of influence

Job Sector	Employment* In Area of Influence	Job Sector Employment as Percent of Total Employment
Agriculture (includes forestry)	1,615	8%
Mining	1,467	7%
Utilities	121	1%
Construction	1,175	6%
Manufacturing	473	2%
Wholesale Trade	257	1%
Transportation and Warehousing	353	2%
Retail Trade	2,432	12%
Information	221	1%
Finance and Insurance	449	2%
Real Estate, Rental, and Leasing	636	3%
Professional, Scientific, and Technical Services	824	4%
Management of Companies	151	1%
Administrative, Waste Management, and Remediation Services	438	2%
Educational Services	223	1%
Health Care and Social Assistance	2,177	10%
Arts, Entertainment, and Recreation	464	2%
Accommodation and Food Services	1,665	8%
Other Services	875	4%
Government	4,990	24%
Total	21,006	100%

* Employment: jobs in IMPLAN are the annual averages of monthly jobs in each industry. Thus, one job lasting 12 months is equivalent to two jobs lasting six months each, or three jobs lasting four months each. A job can be either full-time or part-time —the job estimates are not full-time equivalents (FTEs).

Source: MIG 2016 and USDA FS 2018e

A descriptive tool that can be used to analyze the composition of the local economic activity is an economic base study. Economic base studies can assist stakeholders to better understand regional economic dynamics including local and export product markets. An economic base analysis provides detailed information on local economic industries, such as which industries are the driving force of the economy, and which industries survive because the base industry exists. Base industries are important because they bring outside dollars to an area, much like an export, and serve as an anchor for other industries, which would otherwise not exist. For example, agricultural products grown in the region are sold to firms outside the local area, or dollars spent by tourists from other regions are spent in the local community. Non-basic industries serve residents and provide support to basic industries.

Local basic activity is identified using location quotients (LQs) (NMSU 2017). LQs are calculated as a single industry's percent of total local employment divided by that industry's percent of total state or national employment. For example, an LQ for a single New Mexico industry may be calculated as follows:

$$LQ = \frac{\text{Employment in industry, in NM/ total employment in NM)}}{\text{(Employment in industry, in US/ total employment in US)}}$$

The LQ illustrates the relative importance in the level of the local employment of that sector with respect to the benchmark economy, state or national. An LQ greater than 1.0 indicates that a particular industry employs proportionately more workers locally than it does at the state or national level. Conversely, an LQ of less than 1.0 indicates that the industry of note employs fewer workers locally as compared to the state or national average. Table 82 contains LQs for the area of influence counties in 2015, calculated using data for New Mexico and the United States as basis for comparison.

Table 82. Location quotients for area of influence counties, 2015 data (NMSU 2017) Location Quotients greater than 1 are shaded in gray.

Industry	Catron County LQ (compared to NM)	Catron County LQ (compared to US)	Grant County LQ (compared to NM)	Grant County LQ (compared to US)	Hidalgo County LQ (compared to NM)	Hidalgo County LQ (compared to US)	Sierra County LQ (compared to NM)	Sierra County LQ (compared to US)
Farm employment	**8.41**	**15.89**	**1.14**	**2.16**	**3.48**	**6.58**	**2.60**	**4.92**
Mining	N/A	N/A	**N/A***	**N/A***	0.36	**1.50**	N/A	N/A
Utilities	N/A	N/A	**1.17**	**1.57**	**1.36**	**1.84**	**1.50**	**2.03**
Construction	0.93	0.98	0.77	0.81	N/A	N/A	**1.29**	**1.36**
Retail Trade	N/A	N/A	**1.08**	**1.14**	**1.03**	**1.08**	**1.09**	**1.15**
Real estate and rental and leasing	N/A	N/A	0.83	0.67	N/A	N/A	**1.03**	0.83
Arts, entertainment, and recreation	N/A	N/A	0.77	0.78	N/A	N/A	**1.22**	**1.23**
Accommodation and food services	N/A	N/A	0.95	**1.06**	N/A	N/A	**1.27**	**1.43**
Transportation and warehousing	N/A	N/A	0.44	0.31	**1.65**	**1.15**	0.47	0.33
Federal government (civilian)	**2.25**	**4.05**	0.57	**1.02**	**4.67**	**8.43**	0.72	**1.30**
State government	0.49	0.96	**1.98**	**3.82**	0.65	**1.26**	**1.05**	**2.03**
Local government**	**1.01**	**1.29**	**1.42**	**1.81**	**1.58**	**2.02**	**1.02**	**1.30**

*= No information was available for 2015, but in 2014 the LQ for mining in Grant County was 15.28 (compared to the U.S.) and 3.70 (compared to NM) indicating a base industry.

**= Local government is generally categorized as non-basic since local governments collect taxes from local residents to provide for the local services to the community, including employment

Note: Data summarized from NMSU Arrowhead Center reports. For full reports on each county, please see http://arrowheadcenter.nmsu.edu/economic-and-policy-studies/

Gila National Forest's Contributions to Local Economic Conditions

For over a century, communities have relied on the Gila National Forest as a source of sustenance. This has manifested through various means ranging from utilizing the natural resources in the forest for livelihood; creating community synergy around issues and events; offering a place for groups to commune, work, and recreate together; to providing solitude, peace, and relaxation for individuals who want to get away from the social pressures and pace of their everyday world. While ways and means may have changed over time, people enjoy all manners of activities in the forest. Firewood gathering is regarded as a traditional family activity, since many residents still rely on wood to heat their homes during the cold winter months. Commercial woodcutters also sell firewood collected from the forest. Recreational group sites are used by families and friends who come together and celebrate weddings, birthdays, life-changing events, family reunions, and holidays. Permitted livestock grazing in the forest is a long-standing tradition. In addition, residents rely on the forest for parts of their livelihood, by capitalizing on the opportunity to provide outfitting and guiding, tourist activities, and other services on National Forest System lands. Forest management continues to bring communities together over issues that affect them or to foster involvement through volunteer work on their favorite part of the forest. Others continue to engage in some of the more traditional uses. All these uses help maintain social cultures and longstanding traditions.

Forest Service Gross Receipts from Commercial Activities

The Gila National Forest provides various economic opportunities to surrounding communities. These income-producing opportunities for local businesses include timber harvesting, ranching, and providing recreation services to the visiting public. Figure 50 shows the inflation adjusted total gross receipts from 1986 to 2015. Although before 2000, the receipts were not identified by source, historically most of the receipts collected in the Southwestern Region were from the sale of timber, and the significant decreases in the total receipts are apparent in the 1990s, when timber harvesting declined as previously discussed. Figure 51 shows the gross receipts the Gila National Forest collected by source from 2001 to 2014, which were deposited into the National Treasury as fees collected from those who use such opportunities. Grazing currently generates the largest share of gross receipts, with land special-use related activities like communication site leases coming in second.

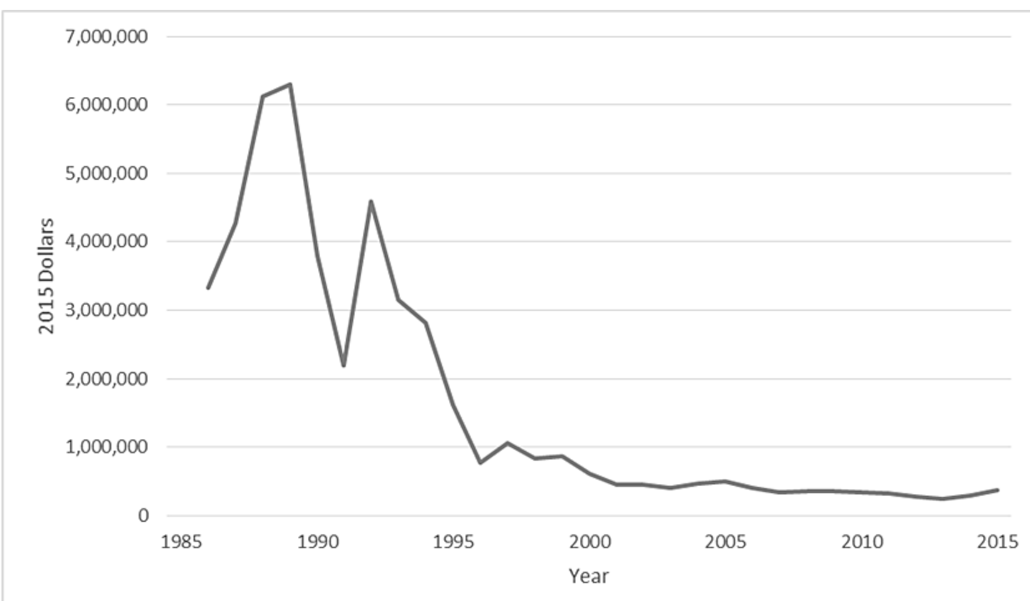


Figure 50. Gila National Forest inflation-adjusted total gross receipts, 1986 to 2015

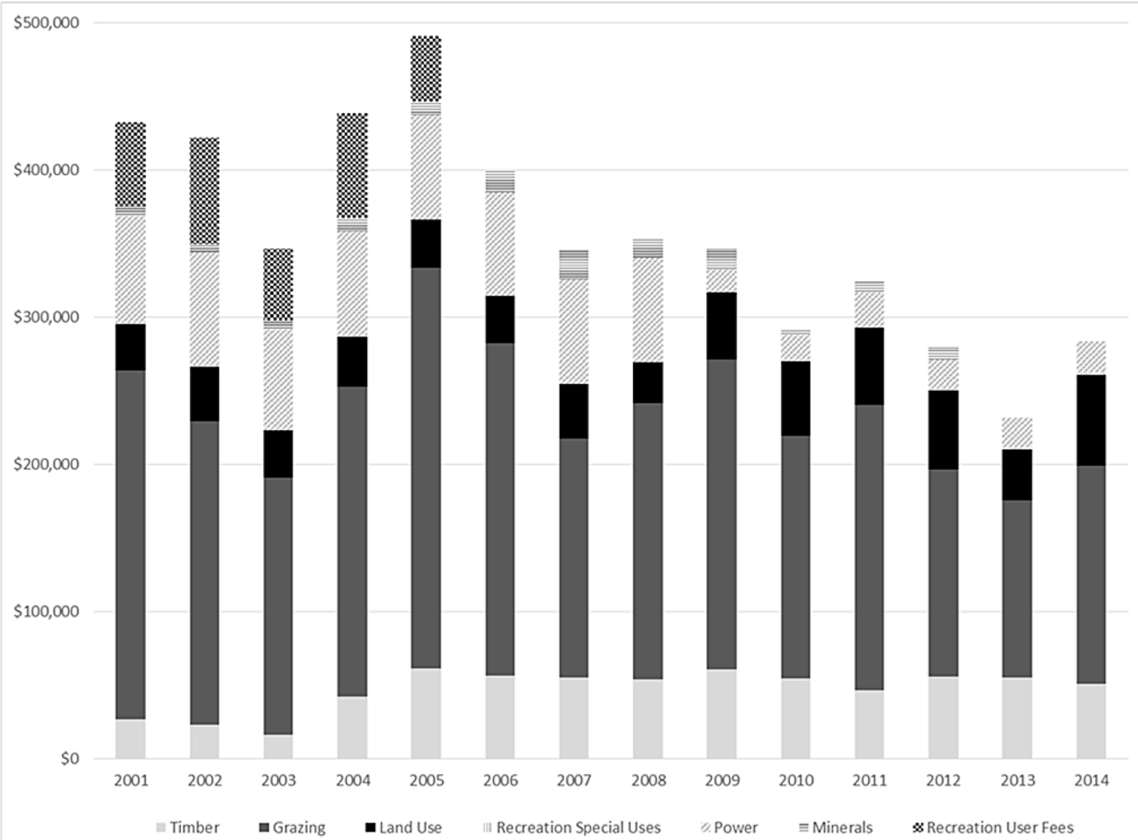


Figure 51. Gila National Forest gross receipts by source, 2001 to 2014

Current Economic Contribution

There are a total of approximately 21,006 jobs, and $762 million in labor income in the four-county area. Market transactions attributable to activities in the Gila National Forest support an estimated 1,124 jobs and $34 million in labor income in the regional economy. Table 83 displays the economic contribution of Gila National Forest's activities by program area. Grazing-related program and Forest Service expenditures contribute the most to employment and labor income in the regional economy, supporting 638 and 303 jobs, and $12 million and $16.3 million in labor income, respectively, on an average annual basis.

Table 83. Contribution of Gila National Forest, by Forest Service program area, 2016

Program Area	Employment	Labor Income (thousands of 2016 dollars)
Recreation	81	$1,501
Grazing	638	$11,920
Timber	12	$698
Minerals	<1	<$10
Payments to States/Counties	89	$3,796
Forest Service Expenditures	303	$16,278
Total Forest Management	1,124	$34,192

Source: Author generated using MIG 2016 and USDA FS 2018e

The estimation of jobs contributed by Forest Service program areas are distributed across sectors of the local economy (table 84). The two sectors with the most Gila National Forest-related employment are agriculture and government, followed by, accommodation and food services and retail trade. The latter two sectors are, in part, associated with the tourism economy, which is supported by the forest and other public and private lands in the area. Relatively, the agricultural sector is the most reliant on Forest Service activities. Approximately 35 percent of employment and 25 percent of labor income in the agricultural sector with the four-county analysis area is attributable to grazing allotments in the Gila National Forest.

Calculating average contribution per job by dividing the total labor income by the total number of jobs (table 83) suggests the average contributions of a grazing-related job is approximately $18,700 in labor income, Forest Service expenditures is $53,700, and recreation visitor-related jobs is $18,400. Jobs related to Forest Service expenditures and timber have the highest per job income and grazing-related jobs have the least, on average. Factors that may contribute to the differences in relative labor income include whether the job is seasonal or part-time or what education or skill level is required. Program areas with the greatest number of jobs, total income, or per job incomes may offer more economic contributions or more desirable employment to the local area.

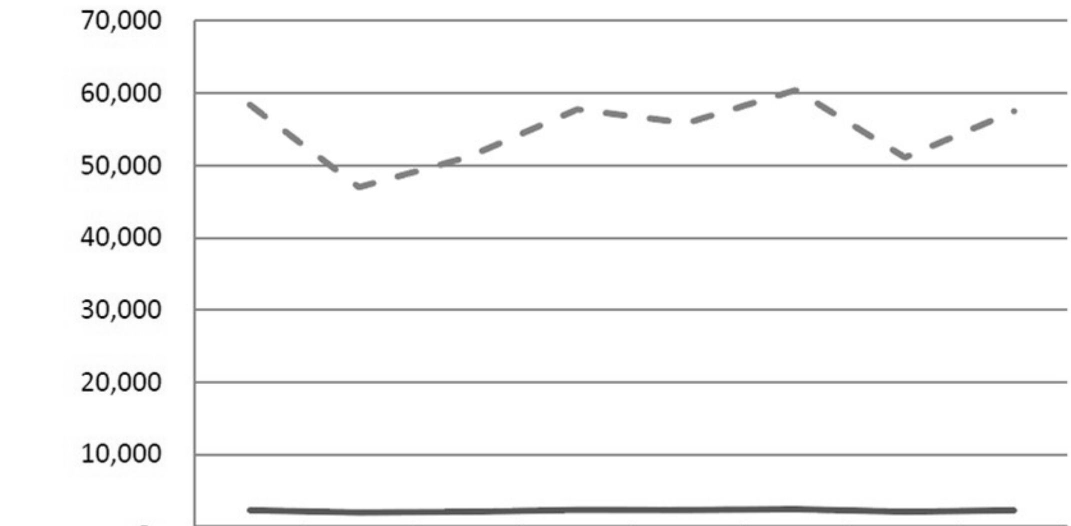
The amount of employment in the timber industry is greatly diminished from the 1980s. In 2005, a new mill was built in Reserve, New Mexico, which could handle more capacity and material from 9 to 24 inches in diameter. Since the mill's establishment, the number of acres treated mechanically, and the volume of material removed from the forest have increased dramatically. Treatments have included timber sales, commercial and personal use fuelwood sales, post and pole permits, and other forest product sales. Fuelwood gathering in the forest is still tied to livelihoods in some of the surrounding communities. Wood for fires continues to be widely used either aesthetically or as the primary heat source within homes. Many households in the four-county area use wood for heat. The use of wood for heating homes may be tied to long-term customs, traditions, and culture of the community, but it may also provide economic savings over propane, natural gas, and electricity.

Figure 52 displays the quantity and value (in nominal dollars) of fuelwood permits in the forest since 2005.

Table 84. Contribution of the Gila National Forest, by sector, 2016

Sector	Employment (jobs) *Area Totals*	Employment (jobs) *Forest Service-Related*	Labor Income (1,000s of 2016$) *Area Totals*	Labor Income (1,000s of 2016$) *Forest Service-Related*
Agriculture (includes forestry)	1,615	573	$35,642	$9,086
Mining	1,467	3	$85,648	$63
Utilities	121	1	$13,227	$185
Construction	1,175	8	$36,914	$265
Manufacturing	473	2	$11,572	$47
Wholesale Trade	257	12	$5,969	$447
Transportation and Warehousing	2,432	14	$51,113	$589
Retail Trade	353	69	$9,713	$1,464
Information	221	3	$7,645	$124
Finance and Insurance	449	9	$14,065	$435
Real Estate and Rental & Leasing	636	16	$6,920	$220
Prof, Scientific, & Tech Services	824	15	$24,161	$403
Management of Companies	151	2	$6,081	$121
Admin, Waste Mngt & Rem Serv	438	8	$10,096	$217
Educational Services	223	5	$2,473	$58
Health Care & Social Assistance	2,177	27	$78,106	$1,247
Arts, Entertainment, and Rec	464	8	$3,937	$77
Accommodation and Food Services	1,665	55	$28,835	$1,047
Other Services	875	17	$23,250	$582
Government	4,990	276	$306,365	$17,513
Total	21,006	1,124	761,729	34,192
Forest Service as Percent of Total	---	5.35%	---	4.49%

Source: Author generated using MIG 2016 and USDA FS 2018e



	2005	2006	2007	2008	2009	2010	2011	2012
Permits	2,339	2,059	2,131	2,378	2,398	2,493	2,116	2,333
Value	$58,468	$47,085	$51,261	$57,831	$55,967	$60,487	$51,208	$57,603

Figure 52. Quantity and value of forest fuelwood permits, 2005 to 2012

In addition to fuelwood, pinyon nuts, greenery, gravel, rocks, and other forest products are gathered on the forest for both commercial and personal uses. Gathering habits have been part of the customs, tradition, and culture of the people for many years (USDA FS 2006a). The above analysis considers only the market transactions that result from activities in the Gila National Forest. Numerous non-market social and economic values are also associated with the forest.

Total Federal Land Payments

Counties containing Federal lands have historically received a percentage of the revenues generated by the sale or use of natural resources on these lands. A steep decline in Federal timber sales on national forests during the 1990s significantly decreased revenues received by counties from the Forest Service. Federal land payments are payments made by the Federal government to state and local governments to compensate for non-taxable Federal land within their borders. In the area of influence, the Forest Service makes contributions through both appropriations and revenue sharing via various programs, such as the appropriated Payment in Lieu of Taxes (PILT), and revenue sharing programs, such as the Secure Rural Schools program.

PILT are federal payments to local governments that help offset losses in property taxes due to nontaxable Federal lands within their boundaries. PILT payments help local governments fund operations, such as emergency services and road maintenance. Payments are made annually for tax-exempt federal lands administered by the Bureau of Land Management, National Park Service, USDI FWS, Forest Service, and for federal water projects and some military installations. Payments to counties are based on population, receipt-sharing payments, and the amount of Federal land within a county (table 85).

Table 85. Payments in lieu of taxes (PILT) to counties, FY 2014 to 2017

County	2014	2015	2016	2017
Catron	$636,506	$619,691	$621,950	$617,372
Grant	$2,061,555	$2,078,740	$2,130,365	$2,185,171
Hidalgo	$768,743	$745,488	$749,220	$728,804
Sierra	$1,203,605	$1,205,512	$1,158,994	$1,166,412

Note: Portion of PILT attributable to Gila National Forest managed acres within four-county analysis area. Additional payments to the analysis area are made because of other federal land management (for example, Bureau of Land Management).
Source: USDA FS 2017 and USDI 2018

Historically, counties have received revenue sharing payments from commercial activities on Federal lands, such as oil and gas leasing and timber harvesting. For national forests, the payments are based on 25 percent of the 7-year rolling average annual receipts. These payments are commonly called 25-percent payments. However, in response to declining timber receipts, the Secure Rural Schools and Community Self-determination Act (SRSCS) was passed in 2000, which offered a guaranteed source of payments that was not tied to annual commercial revenue in national forests. All New Mexico counties with Gila National Forest lands elected to receive the Secure Rural Schools Act State Payment share in fiscal years 2014 through 2017, and not the 25-percent payments. SRSCS payments are intended to improve public schools, maintain infrastructure, improve the health of watersheds and ecosystems, protect communities, and strengthen local economies. Table 86 lists the Secure Rural Schools and Community Self-Determination Act payments from the Gila National Forest for fiscal years 2014–2017. Congress did not authorize the SRSCS and no payments were made in 2016. When Congress does not extend the SRSCS, federal resource agencies revert to paying states and counties via the original revenue-sharing programs, including the 1908 Forest Service 25-percent program, 1920 Federal Mineral Leasing Act, and the 1934 Taylor Grazing Act, which are considerably less than the SRSCS payments under current management. The Secure Rural Schools payments were reauthorized in 2018 for fiscal years 2017 and 2018.

Table 86. Secure Rural Schools and Community Self-Determination Act, FY 2014 to 2017 payments

	SRSCS			2016
County	2014	2015	2017	25-percent
Catron	$1,357,726	$1,559,361	$1,637,265	$66,283
Grant	$732,755	$712,149	$769,248	$26,062
Hidalgo	$5,184	$6,274	$7,539	$1,127
Sierra	$266,175	$294,143	$278,007	$12,621

Environmental Consequences

Management of public lands contributes to the economies of surrounding communities. The Gila National Forest makes up nearly 3.3 million acres or 7.9 percent of the area of influence, which is the multi-county analysis area of Catron, Grant, Hidalgo, and Sierra Counties, making it an important contributor to the local economies. These lands contribute a wide range of economic values to people. Market goods such as timber, forage for livestock, minerals, and recreation opportunities generate employment and income, as well as payments to local communities and revenue for the U.S. Treasury.

The 2012 National Forest System Land and Resource Management Planning Rule (2012 Planning Rule) guides the plan revision effort for the Gila National Forest (36 CFR 219.35(b)). Though not a requirement under the 2012 rule, job and income estimates—one measure of the economic contribution of forest management—by alternative is an informative indicator of the economic impacts of different management alternatives on the local economy. This report provides this economic impact analysis. This is only a portion of the full economic and social impacts of the current management and action alternatives. This analysis considers only the market transactions that result from activities in the Gila National Forest.

Numerous non-market social and economic values are associated with the forest. The value of ecosystem services, such as, clean air and water, are not captured in the economic impact analysis. Therefore, this analysis should be conflated with a representation of the total economic value of the forest. Non-market goods, such as existence values of Gila trout or unique ecosystems and habitats, generate value everyone reaps, but do not necessarily pay for. Other forest benefits such as outdoor recreation and scenery are valued by the people who use them, but only a portion of this value is represented in market purchases. Where appropriate, discussion of how the alternatives may affect nonmarket values is presented in other sections. However, due to the qualitative nature of those discussions, direct comparisons between changes in market and nonmarket values are not possible.

This section presents the likely economic consequences, in terms of jobs and income, of implementing the alternatives presented in chapter 2 of the final environmental impact statement. The tables presented in this section will be referenced in the alternative-specific descriptions of economic impacts.

Analysis Methodology

An economic contribution analysis estimates the role of Forest Service resources, uses, and management activities on employment and income in the communities that surround the Gila National Forest.

Economic contribution to counties local to the Gila National Forest was estimated with input-output analysis using the IMPLAN (IMpact analysis for PLANning) modeling system (MIG 2016). The modeling system allows the user to build regional economic models of one or more counties for a particular year and estimates the economic consequences of activities, projects, and policies on a region. IMPLAN uses Forest Service data on expenditures and resource uses to estimate the economic consequences of Forest Service management.

Input-output analysis represents linkages between sectors in an economy. IMPLAN not only examines the direct contributions from the Gila National Forest, but also indirect and induced effects. Indirect employment and labor income effects occur when a sector purchases supplies and services from other industries to produce their product. Induced effects are the employment and labor income generated because of spending new household income generated by direct and indirect employment. For example, visitors to forest spend money on accommodation and food. Accommodation and food service businesses buy supplies from other businesses. The employees of these firms spend their earnings on a variety of goods and services. These transactions result in direct, indirect, and induced effects, respectively, in the regional economy. Direct, indirect, and induced effects are combined in the discussion of effects.

Potential economic impacts are assessed using the Forest Economic Analysis Spreadsheet Tool developed by the Forest Service Inventory and Monitoring Institute in Fort Collins, Colorado. This tool uses a Microsoft Excel workbook as an interface between user inputs and data generated using the IMPLAN input-output modeling system.

The FEAST analysis assesses the economic impacts of the resource outputs projected under each alternative. Resource outputs in this context are the amount of a resource (forest products, animal unit months, recreation visits, etc.) that would be available for use under each alternative. Quantitative inputs (for example, animal unit months, recreation visits, and forest products) were obtained from Gila National Forest program areas for this analysis, unless otherwise cited. The model for this analysis used 2016 IMPLAN data, which is the latest available dataset.

The four counties surrounding the forest—Catron, Grant, Hidalgo, and Sierra Counties—comprise the Gila National Forest area of influence due to their social and economic linkages between residents and the forest (USDA FS 2017a). These four counties make up the regional economy for the purposes of this economic impact analysis. This analysis area is consistent with that used in the 2017 assessment.

Indicators under each alternative were collected from resource specialists at the Gila National Forest unless noted otherwise. In most instances, the precise change is unknown. Therefore, the changes are based on the professional expertise of the resource specialists. The purpose of the economic impact analysis is to compare the relative impacts of the alternatives.

Recreation

Total annual recreation visits were obtained from the National Visitor Use Monitoring program. For this analysis, an estimated 390,000 recreational visits annually were assumed based on the most recent round of monitoring that occurred in 2016 (USDA FS 2018f). The distribution of visitor type (local or non-local visitor) and use type (such as, was the visit wildlife-related?) from the most recent round of monitoring are used to estimate visitor spending. Average visitor expenditures by type were obtained from the Forest Service's National Visitor Use Monitoring program (White 2017).

Gila National Forest resource specialists provided estimates of changes in visitation across different activities (table 87). Actual changes in recreation are not known and will vary. For non-wildlife and fish-related recreation, there is very little difference in the alternatives that would be likely to affect visitation. For non-wildlife and fish related recreation, the percentage increases are to show that the potential for an increase in economic opportunity exists based on the average percentage of improvement in the departure ratings of desired conditions in the woodland and forested vegetation communities from existing conditions based, on the 10-year modeling results. The woodland and forested vegetation communities are used for these percentages because these are more commonly used by big game for which most hunters use the forest and comprise most of the watershed vegetation cover surrounding streams and lakes used by fisherpersons. This estimation assumes that improvements in upland conditions will translate to an improvement in riparian and aquatic conditions. This is not to say that conditions will all be good all the time.

The estimated recreation-related impacts capture the expenditures of local and non-local visitors. This analysis examining the economic impact of outdoor recreation on planning area lands to the local economy includes the effects of spending by all visitors, both those who reside in the planning area and those who do not. The analysis shows the size and nature of economic activity associated with these recreational experiences to show relative importance to the local economy.

Table 87. Estimated changes in recreation visitors, by alternative

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Recreation (non-wildlife and fish related)	No Change	No Change	No Change	No Change	No Change
Recreation (wildlife and fish related)	No Change	5%	2%	No Change	3%

Timber

Table 88 provides the estimated annual forest product volumes available, by alternative. Details of how these numbers were developed may be found in Timber, Forest, and Botanical Products section. Demand for fuelwood, post and poles from personal use permits are assumed to remain constant across alternatives. It is the intent under all alternatives to make these products available to people in proportion to the demand, which is not anticipated to increase substantially over the planning horizon. These volumes may increase or decrease depending on demand.

Modeled projections for future forest product volumes under the treatment objectives for each alternative provide variation in forest products across alternatives. The actual volume of forest products depends on how many acres can be treated, site-specific conditions on those acres, and site-specific silvicultural prescriptions. Plan objectives are based on estimations of what could be accomplished with congressionally allocated dollars only. Future congressionally allocated dollars for vegetation treatments are assumed similar to the 2007–2017 time period on which plan objectives were based. If budgeted dollars change substantially from the 2007–2017 time period, acres treated, and volumes produced could change. Likewise, if partnerships and associated funding make additional treatment acres possible, acres treated, and volumes could increase.

These timber volumes are used to estimate the economic impact of timber-related activities in the Gila National Forest. Alternative 4 would provide the highest annual forest product volumes. This table will be referenced in alternative-specific descriptions of the economic consequences of forest product removal.

Table 88. Estimated annual forest product volumes (CCF= one hundred cubic feet), by alternative

Forest Product	Alternative 1 (Current)	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Harvest-Softwood Sawtimber (CCF)	747	680	115	2,928	326
Fuelwood (CCF)	1,217	1,228	1,455	1,497	1,254
Poles (CCF)	15	17	39	40	19
Posts (CCF)	412	424	673	689	453
All Other (CCF)	100	112	358	373	141
Total (CCF)	2,490	2,494	2,639	5,499	2,194

Source: Gila National Forest resource specialists

Grazing

The authorized animal unit months in alternative 1 (table 89) was estimated using an average of authorized use between 1999 and 2018, which includes several periods of drought, as well as wetter years. Actual use is permitted annually based on several factors, such as current forage and market conditions. The main variable used to estimate the economic impacts of plan direction under a given alternative is the canopy cover of trees. Trees compete with the herbaceous vegetation that provide forage for permitted and authorized livestock. All alternatives contain plan objectives for varying levels of mechanical thinning treatments, prescribed fire and naturally ignited wildfire that reduce tree densities. For consistency, the analysis assumes that current market demand for livestock products would continue throughout the next several decades with a continuing demand for grazing of the forest lands. While new plan direction is designed to improve vegetation condition, periods of drought are also expected to continue.

Table 89. Estimated annual animal unit month (AUM) authorization, by alternative

	Current Authorized AUMs	Alternative 1 Continuation of Current Management	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Average annual	245,697	-8 to 0%	0 to 2%	-1 to 0%	0 to 1%	0 to 4%

Note: The economic impact analysis uses the midpoint of the range provided and assumes that projected changes in forage availability equates to changes in animal unit months. Actual changes in animal unit months will require separate, allotment-specific environmental analysis and decision-making.

Minerals

Of the three categories of minerals—locatable, leasable, and salable—the Gila National Forest produces locatable and salable minerals. Locatable mineral volumes are not tracked because under a mining claim the claimant already owns the mineral. The saleable minerals removed from the forest are crushed stone and construction sand and gravel. The forest does not produce any leasable minerals such as oil, natural gas, or coal because the geologic formations for those resources are not present on the forest. Mineral production and associated revenues, and therefore actual economic impact, will fluctuate based on global, national, and regional market conditions including supply and demand, commodity prices, other market or regulatory forces, and technical factors that play larger roles than Forest Service management.

Under all alternatives, the Gila National Forest would continue to have an active salable mineral materials program, and demand for these resources is expected to continue. Generally, external demand for mineral materials is related to population growth as construction occurs to accommodate growth. Based on population projections, the trend for salable minerals is expected to remain level. Efforts are under way to foster partnerships with local county governments through the opening of new gravel and aggregate sources in the forest to be used for road maintenance purposes including roads recently conveyed by the Forest Service to local governments. However, the effects of salable mineral materials activities would be relatively limited since this material is for road maintenance activities and not new road construction. Therefore, the quantities removed are not expected to differ between alternatives and no variation in mineral production across alternatives is therefore modeled. The reported mineral production is an average of 2011–2013 values for crushed stone (common variety and high-purity silica) and construction sand and gravel (table 90).

Table 90. Estimated annual mineral materials (short tons), by alternative

Minerals	Alternative 1 Average Volume	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Crushed stone (common variety/saleable)	16,305	No change	No change	No change	No change
Construction sand and gravel (common variety/saleable)	370	No change	No change	No change	No change
Crushed stone (high-purity silica, locatable)	1,750	No change	No change	No change	No change

Forest Expenditures

The Gila National Forest's annual budget (including expenditures and salaries) was approximately $20 million in fiscal year 2016. Approximately 67 percent of the budget was spent on salaries in fiscal year 2016. The remainder was spent on equipment and other non-salary expenditures that contribute to land management. The forest's operational expenditures contribute to economic activity in the communities that surround the forest. Forest Service employees live in these communities and spend their income on housing, food, and a variety of other local goods and services. The Gila National Forest's non-salary expenditures generate economic activity in businesses that supply goods and services to support Forest Service programs. Forest budgets may fluctuate over the life of the management plan but are not dictated by the management plan or alternatives. Forest budgets are distributed by an act of Congress, and therefore, no variation across alternatives is modeled.

Payments to States and Counties

The analysis uses an average of the PILT payments in fiscal years 2015 through 2017 (table 85). Forest management as directed by the forest plan has no impact on payments, and therefore, they do not vary across alternatives.

The analysis uses an average of the SRSCS payments in 2014, 2015, and 2017 (table 86). Because SRSCS payments are not responsive to changes in Forest Service receipts, no variation in these payments occur across alternatives. While the original revenue-sharing programs payments are responsive to changes in Forest Service receipts, which can vary because of management activities such as grazing and timber, no attempt has been made within this analysis to estimate any associated variation in these payments across alternatives due to the uncertainty of when or how often these revenue sharing programs would be used when the Secure Rural Schools authorization lapses.

Effects Common to All Alternatives

Under all alternatives, employment and labor income supported by activities in the Gila National Forest would account for approximately 5.5 percent and 4.5 percent, respectively, of regional totals (table 91 and table 92).

Table 91. Employment estimates by program area, by alternative (total number of jobs contributed)

Resource Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Recreation (non-wildlife and fish-related)	67	67	67	67	67
Recreation (wildlife and fish-related)	15	16	15	15	15
Grazing	612	644	635	641	651
Timber	12	12	11	31	10
Minerals	0	0	0	0	0
Payments to States/Counties	89	89	89	89	89
Forest Service Expenditures	303	303	303	303	303
Total Forest Management	1,099	1,131	1,120	1,146	1,135
Percent Change from Current	---	2.9%	2.0%	4.3%	3.3%
Percent of Regional Employment	5.2%	5.4%	5.3%	5.5%	5.4%

Source: Author generated using MIG 2016 and USDA FS 2018e

Table 92. Labor income estimates by program area, by alternative (labor income contributed in thousands of 2016 dollars)

Resource Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Recreation (non-wildlife and fish-related)	$1,234	$1,234	$1,234	$1,234	$1,234
Recreation (wildlife and fish-related)	$266	$279	$272	$266	$274
Grazing	$11,443	$12,039	$11,860	$11,979	$12,158
Timber	$698	$673	$538	$1,929	$516
Minerals	$0	$0	$0	$0	$0
Payments to States/Counties	$3,796	$3,796	$3,796	$3,796	$3,796
Forest Service Expenditures	$16,278	$16,278	$16,278	$16,278	$16,278
Total Forest Management	$33,715	$34,298	$33,977	$35,482	$34,256
Percent Change from Current	---	1.7%	0.8%	5.2%	1.6%
Percent of Regional Labor Income	4.4%	4.5%	4.5%	4.7%	4.5%

Source: Author generated using MIG 2016 and USDA FS 2018e

Under all alternatives, the Gila National Forest would continue to have an active salable mineral materials program, and demand for these resources is expected to continue. While mineral production, associated revenues, and, therefore, actual economic impact will fluctuate based on market conditions, this is outside the control of forest management. No quantitative variation in mineral production across alternatives is modeled.

Under all alternatives, mineral activities in the forest support less than one full-time equivalent job, annually. This material provides aggregate replacement for roads, riprap for drainage, silica rock for copper mining applications and other products that support regional infrastructure and for local and regional economic development. Therefore, the mineral program contributes jobs, income, and raw materials to the local and national economy under all alternatives. Although mineral extraction occurs in the forest, the quantities of stone, sand, and gravel removed are insufficient to result in measurable economic contributions to the four-county economy. In the four-county area, most of the active copper mines with large employment occur on private property, and mining employment generally follows copper prices.

As noted above, payments to local governments are received through the PILT and SRSCS programs. Across all alternatives, these payments would support approximately 89 jobs and $3.8 million in labor income annually (table 91 and table 92). In addition to the total employment and labor income supported by these programs, they provide relatively high average labor income contribution on a per job basis—approximately $42,000. PILT and SRSCS programs offer local economic stability in the form of jobs and labor income. However, dependency on these transfers exposes local services to changes in federal policy and spending decisions.

Forest management, as directed by the forest plan, has very little impact on the PILT payments. There could be a slight difference between alternatives over time where alternatives 2 and 5 would possibly show an increase in payments over time, and alternatives 3 and 4 remain relatively constant. This is because alternatives 2 and 5 allow flexibility in the occurrences of both land acquisitions (such as purchases) and land conveyances (such as sale, exchange, or donation), while alternatives 3 and 4 stipulate that land acquisitions would be balanced over time with land conveyances so that no net loss of private property in a county occurred. Based on the authorities available, it is easier for land acquisitions to occur than land conveyances, which could lead to the forest growing slightly over the plan implementation period under alternatives 2 and 5. This would shift slightly the amount of private property to National Forest System land under alternatives 2 and 5, and therefore, some of the property that was previously generating tax revenue for counties, often at the lower agricultural rate, would be now included in the PILT formula to compensate counties for this now non-taxable federal land within their borders. However, it is uncertain exactly how many acres would be acquired and conveyed especially with the regional consolidation of the lands program, so for the purposes of this analysis the PILT payments do not vary across alternatives.

The SRSCS law ensures counties across the country can receive payments that provide funding for schools and roads and make additional investments in projects that enhance forest ecosystems. The Secure Rural Schools Act authorizes the use of resource advisory committees as a mechanism for local communities to collaborate with federal land managers in recommending projects on federal lands that will benefit resources.

Across all alternatives, expenditures by Gila National Forest, including employee salary, field and office equipment and supplies, trail construction, and range improvement expenditures support approximately 303 jobs and $16.2 million in labor income in the local economy annually (table 91 and table 92). This accounts for the second largest contribution to the local economy in terms of jobs and largest in terms of labor income relative to other forest program areas and offers local economic stability both in number of jobs and total labor income. These values are the result of Forest Service spending on management activities, local lodging for Forest Service personnel, filling Forest Service vehicles at local gas stations, hiring local contractors for building maintenance, and similar expenditures.

Forest Service employees also engage in their local communities on a more social level, with many employees involved as youth sports coaches, nonprofit board volunteers, and school board volunteers. In addition, many employees help plan local charity events, participate in local events, are active in neighborhood events, and generally care about the quality of life and conditions in their communities.

Broad ranges of people derive benefits from the Gila National Forest but value these ecosystem services differently. These differences highlight different relationships with the Gila National Forest and different prioritization of ecosystem services with their inherent tradeoffs (Armatas et al. 2017). For instance, some people assign high importance to benefits that support biodiversity, abundance of plants and animals, and wildlife habitat and connectivity representing a landscape unmodified by human activities. While others place higher value on ecosystem services that support the economy like livestock grazing, timber production, outfitting and guiding, as well as those ecosystem services that support subsistence needs and the culture of resource use like hunting and fishing, traditional agricultural lifestyle, and forest materials for personal use. Others have a focus on specific water-related issues and valuing primarily water quantity, flood and erosion control, water quality, irrigation for agriculture, and water for household and municipal use. Others placed a high level of importance to motorized recreation, driving for pleasure, scenic beauty, aesthetics, and inspiration, solitude, quiet, and a clear night sky, and public ownership and access to public land. These diverse perspectives help the planning process understand the relationship the public has with the benefits provided by the forest.

Alternative 1 – 1986 Forest Plan

Alternative 1 would continue Gila National Forest management according to the 1986 plan. Management actions under alternative 1 are expected to support 1,099 jobs and approximately $33.7 million in labor income in the local economy (table 91 and table 92). The total contribution of jobs and labor income in alternative 1 is the lowest of all alternatives.

There are an estimated 390,000 recreation visits to the Gila National Forest annually; 52 percent of these visits originate outside of the local area. The expenditures of local and non-local visitors to the forest would support approximately 81 jobs and $1.5 million in labor income, annually. Alternative 1 provides the lowest estimated recreation-related contribution to the local economy in terms of jobs and labor income. However, the quantitative differences in economic impact due to recreation-related management changes is not meaningfully different across alternatives.

Under current management, annual forest product removal is projected to be 2,490 hundred cubic feet (table 88), the second lowest removal rate of all alternatives, although except for alternative 4, the differences in total volumes are small. However, the distribution of product types varies. Forest product removal under alternative 1 would support 12 jobs and approximately $0.7 million in labor income in the local economy annually. These estimated economic contributions, in terms of jobs and income, are moderate relative to other Forest Service program areas.

Under alternative 1, it is assumed available forage will decrease, relative to current conditions, because of continued tree encroachment and infill. Authorized use is estimated at 235,869 animal unit months. Actual use varies annually based on local forage and market conditions. This utilization supports 612 jobs and $11.4 million in labor income, which is the lowest estimated contribution relative to all other alternatives. Grazing-related activities support jobs and labor income in the local economy, as well as supporting a way of life for analysis area residents. Grazing-related employment is substantial relative to other resource areas in the Gila National Forest. Grazing is the largest single source of economic activity associated with forest management across all alternatives.

Alternative 2

Management actions under alternative 2 are expected to support approximately 1,131 jobs and $34.3 million in labor income in the local economy (table 91 and table 92). This represents a 15 percent and 20 percent increase, respectively, from the jobs and labor income levels reported in 2017 (USDA FS 2017a). The contribution of jobs and labor income to the local economy due to

Forest Service management activities in alternative 2 is estimated to be the third highest of all alternatives.

Fish- and wildlife-related visitation is estimated to increase under alternative 2, due to improved stream habitat for fishing opportunities. Alternative 2 contains the greatest potential to improve forage opportunity and improve habitat for wildlife. However, the amount of hunting that can occur in the forest is dependent upon the number of tags sold by New Mexico Game and Fish. It is not safe to say that hunting opportunity will increase just because habitat conditions may improve.

Fishing opportunity should improve because of alternative 2. Alternative 2 has better plan direction to improve stream quality and riparian health, which should lead to improved habitat to support fish important to fisherpersons. Improved riparian vegetation in many riparian areas will make access to some streams difficult, but not for all riparian types.

Plan direction that increases potential visitation would benefit the economy of surrounding communities with jobs and income from visitor expenditures, including lodging, meals, and other expenditures. Plan direction in alternative 2 would support 82 average annual jobs and $1.5 million in labor income. The estimated differences between action alternatives are small and differences in actual visitation and expenditures could make these estimated differences negligible.

Alternative 2 promotes increased use of prescribed and naturally ignited wildfire and allows for more mixed-severity fire on the landscape. Modeling results for alternatives 2 and 5 demonstrate that the use of fire has the potential to increase forage production and availability, a potential benefit to wildlife and livestock, as opposed to reliance on mechanical treatments. Based on the estimated annual authorized animal unit months listed in table 89, grazing under alternative 2 would support 644 jobs and $12 million in labor income in the local economy annually.

While fire has the potential to benefit forage opportunities, there may be increased costs associated with potential infrastructure damage that could occur with the use of fire. There is also inconvenience and additional costs associated with finding alternative locations to graze during and immediately following fire.

Sawtimber volumes projected under alternative 2 are lower than would be projected under current management for several reasons. Alternative 2 includes a slightly stronger emphasis on prescribed fire, leading to fewer acres treated mechanically overall. Additionally, alternative 2 shifts emphasis within the timber vegetation types to dry mixed conifer, which has received little attention under current management. Less sawtimber volume is projected with these acres, as the desired conditions retain higher tree densities as compared to ponderosa pine vegetation types. Conversely, an increase in lower value wood products is projected under alternative 2.

While there are differences in management and resulting forest product volumes, the estimated economic impacts are only minimally different from other action alternatives. Forest product removal under alternative 2 is estimated to support 12 jobs and approximately $0.7 million in labor income in the local economy, annually. These economic contributions, in terms of jobs and income, are moderate relative to other Forest Service program areas.

Effects Common to Alternatives 2, 3, and 4

Alternatives 2, 3, and 4 recommend substantially fewer acres for wilderness designation due to considerations made for the likelihood of extensive high-severity fire should a fire occur, the potential need for mechanical vegetation treatments and current modes of access to maintain infrastructure. None of the areas recommended under these alternatives are likely to be priority candidates for mechanical vegetation treatments, given relatively low likelihoods of extensive high-severity fire, and steep and rugged terrain that effectively limits modes of access and significantly increases the cost per acre for mechanical treatments. Additionally, much of the areas are also within inventoried roadless areas, which require special circumstances and permissions to harvest. There is no economic impact in terms of forest products given all three of these alternatives leave significantly more acres of every vegetation type without wilderness recommendations than are likely to be harvested in the foreseeable future.

Research indicates that there are likely economic benefits to surrounding communities due to nearby areas being designated by Congress as wilderness (Wilderness Society 2004; Bowker et al 2005; Rasker et al. 2013), and that there is no evidence that it causes a loss of local employment (Duffy-Deno 1998). However, additional designated areas can also impose opportunity costs on local economies due to land use restrictions and foregone commodities (Steed et al. 2011; Ashcroft et al. 2012) and may increase permit compliance obligations and raise maintenance costs due to more restricted access methods.

Alternative 3

Management actions under alternative 3 are expected to support approximately 1,120 jobs and $34 million in labor income in the local economy. This alternative supports the lowest estimated economic impact, in terms of jobs and labor income, in the local economy among the action alternatives (table 91 and table 92).

Gila National Forest fish- and wildlife-related visitation is estimated to increase under alternative 3, relative to alternative 1. Plan direction that increases potential visitation would benefit the economy of surrounding communities with jobs and income due to visitor expenditures, including lodging, meals, and other expenditures. Plan direction in alternative 3 would support 82 average annual jobs and $1.5 million annually in labor income to the local economy. However, the differences between action alternatives are small and differences in actual visitation and expenditures could make these estimated differences negligible.

Under alternative 3, only historically open-canopy woodland and grassland vegetation types are treated outside the wildland-urban interface. Alternative 3 reduces prescribed fire, maintains current use of naturally ignited wildfire, and emphasizes mechanical treatments. The potential decline in animal unit months projected under alternative 3 are associated with the relatively lower proportion of acres under closed-canopy conditions in the targeted vegetation types. While it is ecologically appropriate to continue working in open-canopy conditions, particularly in encroached grasslands where the desired tree densities are less than 10 percent, there are diminishing returns for doing so in terms of increasing forage production. Furthermore, focusing on mechanical treatments reduces the number of acres that can be treated as it is the most expensive way to reduce tree densities. Alternative 3 management direction result in an increase in estimated animal unit months relative to alternative 1, but the lowest increase of all action alternatives. Plan direction in alternative 3 would support 635 average annual jobs and $11.9 million annually in labor income to the local economy.

Alternative 3 sawtimber volumes are meaningfully lower, but other product volumes are higher as this alternative directs mechanical treatments in historically open-canopy woodlands and grasslands to the exclusion of timber vegetation types. Economic effects of forest product removal under alternative 3 would support an estimated 11 jobs and $0.5 million in labor income in the local economy annually.

Alternative 4

Management actions under alternative 4 are expected to support approximately 1,146 jobs and $35.5 million in labor income in the local economy. This alternative provides the largest economic contribution in terms of jobs and labor income impacts within the area of influence (table 91 and table 92). However, the estimated variation across alternatives is small.

Gila National Forest fish- and wildlife-related visitation is not estimated to increase under alternative 4, relative to alternative 1. No increases in visitation results in no change in the contribution to the economy of surrounding communities because of recreation-related management actions. Visitors to Gila National Forest will continue to contribute to the local economy through lodging, meals, and other expenditures. Again, the estimated differences between action alternatives are small and differences in actual visitation and expenditures could make these estimated differences negligible.

Under alternative 4, only forested or timber-producing vegetation types are treated outside of the wildland-urban interface. Alternative 4 reduces prescribed fire, maintains current use of naturally ignited wildfire, and emphasizes mechanical treatments. Although focusing on mechanical treatments reduces the number of acres that can be treated, as it is the most expensive way to reduce tree densities. Plan components in alternative 4 result in an increase in estimated animal unit months relative to alternative 1, but the second lowest increase of all action alternatives. Plan direction in alternative 4 would support 641 average annual jobs and $12 million annually in labor income to the local economy. Increasing the total animal unit months in the forest would have positive economic impacts to the local economy in terms of jobs and labor income.

Alternative 4 has the highest overall forest product removal because of emphasis of mechanical treatments in timber vegetation types. The resulting forest product-related economic impact is meaningfully greater than all other alternatives—supporting jobs (31, average annual) and labor income ($1.9 million annually) in the local economy.

Since the Secure Rural Schools inception, these funds have been mostly reauthorized (except in 2016); however, future approval is difficult to predict through the life of the forest plan. In addition to the risk of program cancellation, payments could be delayed or reduced. If Secure Rural Schools is not reauthorized, the program would revert to the 25-percent fund. If this were the case, it is likely that rural counties that rely on Secure Rural Schools payments would prefer alternative 4. The 25-percent fund distributes to counties where the forest is situated 25-percent of the receipts received from timber, grazing, mineral extraction, recreation, and power generation. Although even under alternative 4, this 25-percent of revenue may not offset the amount of Secure Rural Schools payment, which would have negative long-term consequences for the counties.

Alternative 5

Management actions under alternative 5 are expected to support approximately 1,135 jobs and $34.3 million in labor income in the local economy. This alternative provides the second largest economic contribution in terms of jobs and labor income impacts within the area of influence (table 91 and table 92). However, the estimated variation across alternatives is small and actual variation in resource use as well as changes in broad economic conditions will occur.

Gila National Forest fish- and wildlife-related visitation is estimated to increase under alternative 5, relative to alternatives 1, 3, and 4. Plan direction that increases potential visitation would benefit the economy of surrounding communities with jobs and income due to visitor expenditures, including lodging, meals and other expenditures. Plan direction in alternative 5 would support 82 average annual jobs and $1.5 million annually in labor income to the local economy. However, the differences between action alternatives are small and differences in actual visitation and expenditures could make these estimated differences negligible.

Alternative 5 has the lowest projected forest product volumes. This alternative invests in mechanical treatments in the wildland-urban interface only. As a result, acres of harvest are significantly lower.

Economic effects of forest product removal under alternative 5 would support an estimated 10 jobs and $0.5 million in labor income in the local economy annually. This is the lowest economic impact of all alternatives, although the estimated differences between alternatives 1, 2, 3, and 5 are small.

Alternative 5 relies entirely on prescribed fire and naturally ignited wildfire to reduce tree densities outside the wildland-urban interface. Of the available treatment methods, prescribed fire and naturally ignited wildfire occurring under favorable weather and fuel moisture conditions are the most cost-effective tools, allowing more acres to be treated. Based on the estimated annual authorized animal unit months listed in table 89, grazing under alternative 5 would support 651 jobs and $12 million in labor income in the local economy annually. This is the largest range-related economic contribution (in terms of jobs and income) to the local economy.

All action alternatives propose recommending additional acres for consideration for wilderness designation, but the socioeconomic effects of the recommendations associated with alternative 5 are different than alternatives 2, 3, and 4. While livestock grazing is compatible with wilderness recommendation or designation, it would increase costs associated with infrastructure maintenance and modes of access if Congress ultimately designated these areas. Alternative 5, which contains the largest number of recommended acres has the greatest potential for these impacts because range infrastructure was not a consideration in developing the wilderness recommendations. The other alternatives were built to minimize these potential impacts (see Appendix H: Documentation of the Wilderness Process).

Cumulative Effects

The economic analysis of the proposed plan is unique among the resources and uses in that the effects occur primarily off the forests. In this way, the indirect effects described above are cumulative in nature—they evaluate the role of Forest Service decisions under the proposed plan both within and outside of the Gila National Forest. However, the indirect effects analysis does not address how actions taken on adjacent lands would affect the economic consequences of the proposed plan.

Between 2010 and 2030, the area's overall population is expected to hold relatively constant (UNM-BBER 2014). Changing population size at finer scales may affect demand for recreation and other resources. Population growth may place pressure on popular recreation sites near urban centers. Additionally, population growth may lead to the expansion of the wildland-urban interface, which affects the cost and difficulty of managing wildfire. Shrinking populations may indicate fewer economic opportunities; therefore, economic opportunities on National Forest System lands may be particularly important to community livelihoods in areas with static or negative population growth.

The Gila National Forest’s area of influence is rural, with a low population density. However, the population is not evenly distributed within counties. The populations of all four counties were less than 30,000 in 2010, but the population of Grant County was 10 times larger than that of Catron County. Population density can serve as an indicator of several socioeconomic factors of interest: urbanization, availability of open space, socioeconomic diversity, and civic infrastructure (Horne and Haynes 1999). More densely populated areas are generally more urban, diverse, and offer better access to infrastructure. In contrast, less densely populated areas provide more open space, which may offer natural amenity values to residents and visitors. The study area has a great deal of publicly owned lands. This suggests that Forest Service decisions, and other federal actions, may have a substantial effect on social and economic well-being of the communities.

The area of influence population is aging due to younger people migrating to larger cities and an influx of retirees from the baby-boomer generation arriving to the area. Older populations are likely to have different needs and preferences related to forest use than younger populations. For example, older populations are more likely to desire easily accessible recreation opportunities. It is expected that educational improvements will continue throughout the Gila National Forest associated counties. Areas with more educated populations tend to be more resilient to economic changes (Florida 2002). All counties in the area have median household incomes below the state and nation. Higher income may signal greater job opportunities, highly skilled residents, greater economic resiliency, and well-developed infrastructure while lower income is typically a reflection of poor economic conditions and relatively few economic opportunities available in a community. These data suggest that area of influence residents are more likely to be socially and economically vulnerable. Lower median household incomes correspond with fewer household assets to allow consumption smoothing during difficult economic circumstances. Economic changes, either positive or negative, may have a more pronounced effect on the economic well-being of the area.

Non-labor income, such as retirement and investment funds, now make up over half of total personal income. The reliance on non-labor income may also indicate dependence on government transfer payments. Non-labor income may help to stabilize the economy, as it is not tied to employment status. However, non-labor income may fluctuate based on asset market performance or changes in government policy. If the influx of retirees into the planning area continues, the growing role of non-labor income in the economy can also be expected to continue. Older forest visitors may have different needs and preferences. Retirees have more leisure time than working-age adults have and may, therefore, be avid visitors. Retirees are also more likely to have mobility concerns, which make easily accessible sites more important.

The area has many environmental amenities, such as scenery and recreation opportunities, that improve quality of life. However, one of the biggest economic challenges of all the counties in the area of influence is their remoteness. To capitalize on environmental amenities in the form of economic growth, an area also needs to have access to markets, an educated workforce, and a diverse economy that welcomes newcomers (Rasker et al. 2008). The area of influence for the Gila National Forest is considered rural and isolated in terms of interstate airports and driving time length to major cities. Isolated rural counties in the West often have slower rates of growth in population, employment, and real income (Rasker et al. 2008). The area's ability to attract and retain people, businesses, and industry is limited by the lack of ready access to major population centers. Conversely, isolation may have some advantages in terms of slower pace of life and affordable housing. Recent research suggests that the way Americans have viewed the qualities of rural areas like those the four-county area provide has shifted due to the COVID-19 pandemic (Lei and Liu 2022). This could turn what have been limitations into a major draw for people looking to relocate.

Stakeholder input reveals areas of broader agreement that could be the focus of future collaboration efforts. Restoration of forests, grasslands, and watersheds is a perceived need that could improve ecosystem function and offers potential economic benefits to local communities. Despite the contentiousness of past relationships, there appears to be a potential foundation for future collaboration with stakeholders throughout the area. Coordinating with stakeholders, such as other federal agencies, state agencies, local governments, organizations, and private landowners would not only improve efficiency and effectiveness of these restoration efforts but could also bridge gaps between social differences and value conflicts within communities (USDA FS 2006a). There have been collaborative restoration efforts in the past, and this planning process is an opportunity to renew those relationships and continue and expand this important work.

Climate change may make forest resources more vulnerable to disturbances and may cause resource conditions to depart further from desired conditions. Vegetative vulnerability can lead to disruptions in forest product markets, reduce forage availability, change water supply, and degrade recreation opportunities. These consequences could change resource availability and use of the Gila National Forest. People and communities may be socioeconomically vulnerable if they are exposed, are sensitive, and have limited ability to adapt to ecological changes (Borchers et al. 2021 and Hand et al. 2018).

The Forest Service acknowledges the critical need to increase the pace of restoration to address a variety of threats including fire, climate change, and insect and disease outbreaks (USDA FS 2012c). Across the nation and in the Southwest, there is broad public support for actively managing forests to be more resilient to these threats. In response, the Gila National Forest is generally shifting planning and implementation efforts to encompass larger landscapes. This broad recognition is piquing interest in the feasibility of commercial use of traditionally sub-merchantable materials, such as small-diameter dimensional lumber and wood-based, biomass energy production. The forest will continue to work with other federal, state, and local government agencies, non-government organizations, and small businesses to build facilities and markets that will use this type of material.

The proposed plan emphasizes vegetation restoration under all alternatives. Current and proposed plans on adjacent National Forest System lands and other land management agencies also emphasize ecosystem restoration. The recent Farm Bill provides permanent “Good Neighbor” authority for the Forest Service and Bureau of Land Management to enter into cooperative agreements or contracts with states. Use of this authority would allow the states to perform watershed restoration and forest management services on National Forest System lands. The Gila National Forest was the first national forest in New Mexico to use the Good Neighbor Authority. Promoting more use of the Good Neighbor Authority in the southern part of the state would be beneficial for accomplishing needed watershed restoration and forest management and encouraging collaborative partnerships.

The scale of the future proposed treatments in Gila National Forest and adjacent lands and increasing the pace of restoration activities could draw new forest product harvesting and processing firms to the region. The timber estimates presented in the environmental consequences section are based on a static model of the economy. However, if additional firms locate in the area due to region-wide restoration efforts, the local economic impact of activities to occur under the proposed plan could increase. The Collaborative Forest Restoration Program in New Mexico provides cost-share grants to stakeholders for forest restoration projects on public land designed through a collaborative process. These projects may be entirely on any combination of federal, tribal, state, county, or municipal forest lands, and must include a diverse and balanced group of stakeholders in their design and implementation. A recent Collaborative Forest Restoration Program grant plans to construct a new mill in Luna, New Mexico, which could increase restoration treatments and economic activities in that area. Challenges facing contractors include a shrunken workforce, fewer federal timber sales, landowners’ understanding about the expense of mitigation work, and competition with illegitimate contractors (Vaughan and Mackes 2015).

Culturally, hunting is an important activity for the people of New Mexico. Early inhabitants hunted and lived off the land. Many people in rural areas and small towns in southwestern New Mexico continue this traditional practice that provides food, is a bonding activity between parents and children, and is a way of teaching children about nature and the land around them. Recently, hunting has emerged as a recreational activity, which can involve larger groups, off-highway vehicles, and hunting camps. Hunting can be very social, and many hunters return to the forest annually for this activity. The growth of recreational hunting has given rise to a community of commercial outfitters and guides. The Gila National Forest is known for its high-quality hunts, especially elk, which attract hunters from all over the country. Ranchers are taking advantage of the hunting opportunities by developing outfitting and guiding businesses. Outfitters and guides look to the forest for special-use permits that allow them to host tourist activities on National Forest System lands. Some rely on this as a main portion of their income. The COVID-19 pandemic affected guided tourism activities in many countries (Pröbstl-Haider et al. 2023), although it is undetermined what impact it had on the outfitters and guides that are permitted by the Forest Service. It is conceivable that any future public health emergencies could impact socioeconomic contributions provided by outfitter and guides.

The discussion related to the study commissioned by the New Mexico Department of Game and Fish (Southwick Associates 2014) in the affected environment is also relevant to this analysis. The expenditures of hunters and anglers support jobs and garner additional tax revenues. With 65 percent of New Mexico residents participating each year, outdoor recreation generates $9.9 billion in consumer spending annually and 99,000 direct jobs in New Mexico (Outdoor Industry Association 2018). In addition, wildlife watchers spent $327 million on equipment and travel in the state of New Mexico in 2011 (USDI-USDC 2014).

The recreation-related effects identified in the economic environmental consequences section may be influenced by trends and activities that occur off the forest, and by global events like the COVID-19 pandemic (see also cumulative effects for Sustainable Recreation). Under all alternatives, the proposed plan supports diverse and sustainable recreational opportunities in the forest. Increased recreational use on the Gila National Forest would lead to a higher economic impact than predicted in the indirect effects discussion. Population growth in the surrounding communities can contribute to high recreation visitation and can lead to changes in preferences for the types and qualities of recreation supported by national forests. Changes to visitation rates on public lands adjacent to the Gila National Forest may also impact visitation rates on the forest and influence the economic impact on surrounding communities.

Environmental Justice and Equity

Affected Environment

In 1994, President Clinton issued Executive Order 12898. This order directs federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities. The purpose of Executive Order 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations. In 2011, many federal agencies, including the Department of Agriculture, signed and entered the Memorandum of Understanding on Environmental Justice and Executive Order 12898. This document renewed attention to environmental justice issues, the interagency working group on environmental justice, and accountability processes.

Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of laws, regulations, and policies. Incorporating environmental justice considerations into planning processes helps make Forest Service resources and programs accessible to all Americans, regardless of race, economic status, or ethnicity. The goal of environmental justice is for federal agency decision makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that would avoid or mitigate those impacts.

The emphasis of environmental justice is on health effects, the benefits of a healthy environment, or both. The Council on Environmental Quality has interpreted health effects with a broad definition: "Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities, or Indian Tribes … when those impacts are interrelated to impacts on the natural or physical environment" (Council on Environmental Quality 1997).

In 2021, President Biden issued Executive Orders 13985 and 14008. Executive Order 13985—Advancing Racial Equity and Support for Underserved Communities directs federal agencies to produce a plan to address barriers to the full and equal participation of underserved communities in federal benefits, services, and programs, including agency procurement and contracting opportunities. Equity, as defined in Executive Order 13985 is the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, Indigenous, and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality.

Indigenous peoples include state-recognized tribes, Indigenous and tribal-community based organizations; individual members of federally recognized tribes, including those living on a different reservation or living outside Indian country; individual members of state-recognized tribes; Native Hawaiians; Native Pacific Islanders; and individual Native Americans. Minority populations are a population of people who are not single-race white. Populations of individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Low-income populations are populations characterized by limited economic resources. The U.S. Office of Management and Budget has designated the Census Bureau's annual poverty measure as the official metric for program planning and analysis, although other definitions exist.

Underserved communities are populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life. Namely, these are Black, Latino, and Indigenous and Native American persons, Asian Americans, Pacific Islanders, and other persons of color; members of religious minorities; LGBTQ+ persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality. Underserved populations are populations who face barriers in accessing and using victim services, and populations underserved because of geographic location, religion, sexual orientation, gender identity, racial and ethnic identity, and special needs such as language barriers, disabilities, alienage status, or age.

Disadvantaged communities include those that experience low income, high or persistent poverty or both; high unemployment and underemployment; racial and ethnic residential segregation, particularly where the segregation stems from discrimination by government entities; linguistic isolation; high housing cost burden and substandard housing; distressed neighborhoods; high transportation cost burden or low transportation access or both; disproportionate environmental stressor burden and high cumulative impacts; limited water and sanitation access and affordability; disproportionate impacts from climate change; high energy cost burden and low energy access; jobs lost through the energy transition; and access to healthcare.

The Environmental Protection Agency is now also defining overburdened communities are those minority, low-income, or indigenous populations or geographic locations in the United States that potentially experience disproportionate environmental harms and risks. This disproportionality can be because of greater vulnerability to environmental hazards, lack of opportunity for public participation, or other factors. Increased vulnerability may be attributable to an accumulation of negative or a lack of positive environmental, health, economic, or social conditions within these populations or places. The term describes situations where multiple factors, including both environmental and socioeconomic stressors, may act cumulatively to affect health and the environment and contribute to persistent environmental health disparities.

Socially vulnerable communities are identified by the Centers for Disease Control as those that have special needs for equity and environmental justice actions. This includes people who are living below the poverty line, those who are unemployed, low-income individuals, those without a high school diploma, people over 65 and under 17, people with disabilities, single-parent households, people who are a minority race or ethnicity, people with limited English proficiency; those living in multi-unit structures, those in mobile homes, those living in crowded conditions, those with no vehicle and those living in group quarters.

Frontline communities are identified by the National Association for the Advancement of Colored People as groups of people who are directly affected by climate change and inequities in society at higher rates than people who have more power in society. They are on the "frontlines" of the problem. In other words, those who experience oppression because of race, income, gender, sexual orientation, disability, gender identity, age, et cetera are more likely to have less resources and protections in our society in general.

Executive Order 14008–Tackling the Climate Crisis at Home and Abroad requires at least 40 percent of the benefits of certain federal programs must flow to disadvantaged communities. This mandate is referred to as Justice40. Climate justice is an extension of environmental justice. It is the fair treatment of all people and the freedom from discrimination in the creation of policies and projects that address climate change, as well as the systems that create climate change and perpetuate discrimination. The term recognizes that the multiple consequences of climate change (including but not limited to, increased flooding, more frequent and severe storms, prolonged drought, severe fires, and sea-level rise) disproportionately impact people who already experience more inequity in our society.

The Forest Service Equity Action Plan was released in 2022. The action plan includes a justice roadmap focused on tribal relationships, limited English proficiency, gender equity and equality, and Justice40 integration. The plan pledges the agency to expand tribal co-stewardship; enhance engagement with tribes and underserved communities through culturally relevant strategies and partnerships; achieve a representative, inclusive and thriving workforce; institutionalize the onboarding experience for new employees, increase equity in opportunities for small and disadvantaged businesses in delivering the agency's mission; reduce wildfire risk to tribes, underserved communities, and socially vulnerable communities; expand urban forestry benefits to underserved communities; and promote access to outdoor experiences within underserved communities (USDA FS 2022e).

The Council on Environmental Quality recently released the Climate and Economic Justice Screening Tool[46] to help federal agencies identify overburdened, underserved, and disadvantaged environmental justice communities. These communities have been marginalized by society, overburdened by pollution, and underserved by infrastructure and other basic services. This tool identifies those the lands of federally recognized tribes and non-tribal communities by census tracts meeting the threshold for at least one environmental burden and corresponding economic indicator, such as low income. Environmental burdens are organized into eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. It also identifies minority populations by tract demographic data for race and ethnicity. Table 93 displays the status of census tracts in the four-county area that encompasses the Gila National Forest and summarizes the data housed in the Climate and Economic Justice Screening Tool (CEQ 2022).

All but two of the census tracts in the four-county area are considered low-income, disadvantaged, overburdened, and underserved and all contain minority populations. These environmental justice communities are potentially impacted by management activities on the Gila National Forest.

[46] https://screeningtool.geoplatform.gov/en/#7.35/32.239/-108.224.

Throughout the planning process, Gila National Forest leadership and planning staff have gone beyond routine practices and minimum notice and comment requirements to achieve meaningful, regular involvement of the surrounding communities. Meetings were held in areas with high economic and ethnic diversity. Public meetings were held throughout the process in the many small rural communities within and around the forest, as well as in urban community centers. The forest advertised these meetings on local radio and in local newspapers. Flyers for the meetings were posted at libraries, post offices, and other community buildings. Flyers and some major documents were translated into Spanish, and a bilingual planning team member was available at community meetings to translate and engage in conversation. Meetings often used small group break-out sessions to ensure participants' comments and ideas were heard.

During comment periods, hardcopy documents, maps, and comment forms were provided at the front desks of the supervisor's and district offices to ensure those individuals without computers or Internet access could still participate in the process. Verbal comments at public meetings and mailed in comments were also considered, even outside of formal comment-request periods. This ensured that even those who could not attend a meeting, or get a comment form, were still able to have their voices heard.

While not every segment of the environmental justice communities impacted by the management of the Gila National Forest participated equally, the process has sought to bridge cultural and economic differences that could affect participation by holding meetings at different times of day, repeating meetings in multiple small communities, and attending meetings convened by local leaders and groups. Forest leadership and planning staff have worked closely with local government officials, community leaders, and tribes to ensure the voices of the rural, traditional, and tribal communities were represented in the planning process.

Table 93. Environmental justice communities in the Gila National Forest's four-county area of influence

Census Tract 2010 ID	County Name	Minority Percent	Low Income	Percent of Households Below Poverty Line	Climate Change Burden	Energy Burden	Health Burden	Housing Burden	Legacy Pollution Burden	Transportation Burden	Water and Wastewater Burden	Workforce Development Burden	Disadvantaged
35003976400	Catron	20	Yes	15	Yes	Yes	Yes	No	Yes	No	No	No	Yes
35017964100	Grant	29	Yes	10	Yes	No	Yes	Yes	Yes	No	No	No	Yes
35017964200	Grant	26	No	6	No	No	No	No	No	No	No	No	No
35017964300	Grant	57	No	16	No	No	No	No	No	No	No	No	No
35017964400	Grant	63	Yes	18	Yes	No	No	No	No	No	No	Yes	Yes
35017964500	Grant	74	Yes	25	Yes	Yes	No	No	Yes	No	No	No	Yes
35017964600	Grant	75	Yes	18	Yes	No	Yes	No	Yes	No	No	No	Yes
35017964700	Grant	42	Yes	8	Yes	No	No	Yes	No	No	No	Yes	Yes
35017964800	Grant	68	Yes	14	Yes	No	No	No	Yes	No	No	No	Yes
35023970000	Hidalgo	33	Yes	25	No	Yes	No	No	Yes	No	No	No	Yes
35023970200	Hidalgo	85	Yes	20	Yes	No	Yes	No	No	No	No	Yes	Yes
35051962200	Sierra	40	Yes	28	No	No	Yes	No	No	No	No	Yes	Yes
35051962300	Sierra	34	Yes	25	No	No	Yes	No	No	No	Yes	No	Yes
35051962401	Sierra	18	Yes	21	Yes	No	Yes	No	Yes	No	No	No	Yes
35051962402	Sierra	46	Yes	12	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes

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Analysis Methodology

The plan direction in each alternative is used to evaluate or predict short- and long-term effects to environmental justice issues on the Gila National Forest. Probably management activities are evaluated in relation to their major environmental and public health impacts for environmental justice communities and equity. This analysis assumes all projects implemented on the forest would require a site-specific analysis of their potential impacts to environmental justice communities.

Environmental Consequences

Most of the population surrounding the Gila National Forest is considered overburdened, underserved, disadvantaged, and low-income (table 93). Minority populations also exist within all the forest's communities (table 93). Many of these communities are facing climate change burdens associated with predicted losses in agricultural production, building loss due to natural disasters, wildfire risk, or some combination of these factors. Many also face health-related burdens such as high rates of cardiovascular or pulmonary conditions, and the legacy pollution associated with abandoned mine lands. A few communities face burdens associated with high energy costs or housing burdens like lack of indoor plumbing. Several face workforce development burdens related to lack of education, unemployment, income levels below the poverty line, or some combination of these factors (CEQ 2022).

Under all alternatives communities would experience smoke impacts from prescribed and natural fires, although the proportion of smoke impact attributable to prescribed or naturally ignited wildfires varies by alternative. Whether because of not treating enough acres, not treating the right acres, or accepting greater risk with prescribed and naturally ignited wildfire to treat more acres, there will be more fire on the landscape.

Disadvantaged, low-income communities already facing health burdens could experience disproportionate impacts because of lack of resources to prepare homes and an inability to temporarily relocate to avoid smoke impacts. During prescribed fire, Forest Service personnel would incorporate appropriate measures to comply with Clean Air Act requirements, mitigate health hazards and communicate unavoidable public health risks (see also the Air Quality section of this environmental impact statement). While only 5 percent of the area's population does not speak English very well (see Social and Economic Conditions Affected Environment table 78), language barriers do exist and can make these communications more difficult, as can lack of internet access. Under the action alternatives, environmental justice issues would be considered in the variety of methods used to communicate potential air quality hazards (Air Quality guideline 1).

Many of these communities have lack the capacity to adapt to climate change (Borchers et al. 2021) and carry a disproportionate climate change burden (CEQ 2022). Historically, fuels reduction investments were not always based on environmental justice considerations. Current and evolving law, regulation, and policy direction to provide that consideration would be enhanced by plan content incorporating environmental justice considerations would be incorporated into project-level fuels reduction treatments and priorities under all alternatives. Regional climate action plans that implement the national climate adaptation strategy will provide another layer of support for environmental justice.

Visitor use fees at developed recreation sites may be a limitation to low-income users. This may also disproportionately impact those low-income users with less physical mobility or those experiencing health burdens. The action alternatives include a quantitative desired condition for recreation equity that would help advance environmental justice and equity.

There are desired conditions and management approaches that emphasize partnering and collaborating with local communities, non-governmental organization, volunteers, and governmental entities when identifying, planning, and implementing projects in the forest (Community and Tribal Relationships desired conditions, objective, standards, guidelines, and management approaches). Under all alternatives, continued management of the forest's ecosystems for ecological integrity; sustainable production of forest products; traditional uses such as livestock grazing; and healthy plant, fish, and wildlife populations will contribute to environmental justice and equity for the communities using the forest.

None of the alternatives is expected to exacerbate the poverty rate or disproportionately worsen the economic well-being of low-income individuals and households. Under all alternatives, indigenous environmental justice would be elevated as the Forest Service, and Gila National Forest engage interested tribes and pueblos in co-stewardship of their ancestral lands and indigenous communities and practitioners would be able to gather forest products and visit sacred sites. None of the alternatives is expected to affect any other racial or ethnic minorities disproportionately adversely.

Cumulative Effects

Executive Orders 12898, 13985, and 14008 apply to all federal agencies, including the Environmental Protection Agency, the Army Corps of Engineers, the Department of the Interior, and the Department of Agriculture. Agencies are required to make achieving environmental justice and equity part of their mission by identifying and addressing, as appropriate, disproportionately high adverse human health or environmental effects from their activities on overburdened, underserved, disadvantaged, low-income and minority populations. The order requires agencies to work to ensure effective public participation and access to information.

In 2005, the State of New Mexico adopted Executive Order 2005-056, which sets out similar requirements for state cabinet-level departments, boards, and commissions. These State entities must use environmental and public health data to determine siting, permitting, compliance, enforcement, and remediation of existing and proposed industrial and commercial facilities. The order also created the Environmental Justice Task Force that includes representation by the U.S. Department of Agriculture. The taskforce advises state agencies regarding actions to address environmental justice issues consistent with agencies' existing statutory and regulatory authority.

No executive order can eliminate all disproportionate exposure or remove environmental hazards and risks, but together, they provide a framework for meaningful opportunities for involvement for all people regardless of race, ethnicity, or income. Working together on collaborative policy, state and federal governments will continue to make progress toward shared environmental justice and equity goals.

Summary of Environmental Consequences

This section provides a quick comparison of the anticipated effects of each alternative by summarizing trends in analysis indicators and key characteristics. These comparisons are made in table format and generally follow the order in which the forest's resources, activities, and uses are analyzed in this environmental impact statement.

Table 94. Trends[£] in the seral state diversity of Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	+*	+*	+*	+*	-
Mixed Conifer with Aspen	2	+*	+	+*	+*	+
Mixed Conifer-Frequent Fire	12	+	+	+	+	+
Ponderosa Pine Forest	19	+	+	+	+	-

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Ponderosa Pine-Evergreen Oak	12	o	+*	o	o	+*
Madrean Pinyon-Oak Woodland	1	-	-	-	-	-
Pinyon Juniper Woodland	26	+*	-	+*	+*	-
Pinyon Juniper Grass Woodland	9	-	+*	-	-	+*
Juniper Grass Woodland	4	-	o*	o*	-	-
Mountain Mahogany Mixed Shrubland	5	+	+*	+	+	+*
Montane/Subalpine Grasslands	4	o	o	o	o	o
Colorado Plateau-Great Basin Grassland	3	-	-	-	-	+
Semidesert Grassland	2	-	+	-	-	+

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions

Table 95. Trends£ in the amount of area expected to be dominated by old trees in the Gila National Forest's upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	+	+	+	+	-
Mixed Conifer with Aspen	2	-	-	o	-	-
Mixed Conifer-Frequent Fire	12	-	-	-	-	-
Ponderosa Pine Forest	19	-	-	-	-	-
Ponderosa Pine-Evergreen Oak	12	o	-	o	o	-
Madrean Pinyon-Oak Woodland	1	+	+	+	+	+
Pinyon Juniper Woodland	26	+	+	+	+	-
Pinyon Juniper Grass Woodland	9	+	-	+	+	-
Juniper Grass Woodland	4	+	+	+	+	-
Mountain Mahogany Mixed Shrubland	5	na	na	na	na	na
Montane/Subalpine Grasslands	4	na	na	na	na	na
Colorado Plateau-Great Basin Grassland	3	na	na	na	na	na
Semidesert Grassland	2	na	na	na	na	na

£Based on 100-year model results; "+" = upward trend; "-" = downward trend; "o" = maintains existing conditions; "na" = not applicable

Table 96. Trends£ in coarse woody debris density in Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	-	-	-	-	o
Mixed Conifer with Aspen	2	o	+	o	o	+
Mixed Conifer-Frequent Fire	12	+	+	+	+	+
Ponderosa Pine Forest	19	+	+	-	-	+
Ponderosa Pine-Evergreen Oak	12	-	+	-	-	+
Madrean Pinyon-Oak Woodland	1	-	-	-	-	-
Pinyon Juniper Woodland	26	-	+	-	-	+
Pinyon Juniper Grass Woodland	9	-	+	-	-	+
Juniper Grass Woodland	4	-	+	-	-	+
Mountain Mahogany Mixed Shrubland	5	na	na	na	na	na
Montane/Subalpine Grasslands	4	na	na	na	na	na
Colorado Plateau-Great Basin Grassland	3	na	na	na	na	na
Semidesert Grassland	2	na	na	na	na	na

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions; "na" = not applicable

Table 97. Trends£ in snag density in Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	+	+	+	+	o
Mixed Conifer with Aspen	2	o	-	o	o	-
Mixed Conifer-Frequent Fire	12	-	-	-	-	-
Ponderosa Pine Forest	19	-	-	-	-	-
Ponderosa Pine-Evergreen Oak	12	-	-	-	-	+
Madrean Pinyon-Oak Woodland	1	-	o*	-	-	o*
Pinyon Juniper Woodland	26	-	-	-	-	-
Pinyon Juniper Grass Woodland	9	o*	-	o*	o*	-
Juniper Grass Woodland	4	o*	o*	o*	o*	o*

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mountain Mahogany Mixed Shrubland	5	na	na	na	na	na
Montane/Subalpine Grasslands	4	na	na	na	na	na
Colorado Plateau-Great Basin Grassland	3	na	na	na	na	na
Semidesert Grassland	2	na	na	na	na	na

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions; "na" = not applicable

Table 98. Trends£ in the fire frequency of Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	o*	o*	o*	o*	o*
Mixed Conifer with Aspen	2	o*	o*	o*	o*	o*
Mixed Conifer-Frequent Fire	12	o*	o*	-	-	o*
Ponderosa Pine Forest	19	-	o*	-	-	o*
Ponderosa Pine-Evergreen Oak	12	-	o*	-	-	o*
Madrean Pinyon-Oak Woodland	1	-	-	-	-	-
Pinyon Juniper Woodland	26	+	-	+	+	-
Pinyon Juniper Grass Woodland	9	-	+	-	-	+
Juniper Grass Woodland	4	-	+	-	-	+
Mountain Mahogany Mixed Shrubland	5	o*	o*	o*	o*	o*
Montane/Subalpine Grasslands	4	o	+	-	-	+
Colorado Plateau-Great Basin Grassland	3	o	+	-	-	+
Semidesert Grassland	2	o	+	-	-	+

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions

Table 99. Trends[£] in the fire severity of Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	o*	o*	o*	o*	o*
Mixed Conifer with Aspen	2	o*	o*	o*	o*	o*
Mixed Conifer-Frequent Fire	12	o	o	o	o	o
Ponderosa Pine Forest	19	o*	-	o*	o*	-
Ponderosa Pine-Evergreen Oak	12	o*	-	o*	o*	-
Madrean Pinyon-Oak Woodland	1	-	-	-	-	-
Pinyon Juniper Woodland	26	+	+	+	+	+
Pinyon Juniper Grass Woodland	9	o*	-	o*	o*	-
Juniper Grass Woodland	4	o*	-	o*	o*	-
Mountain Mahogany Mixed Shrubland	5	o*	o*	o*	o*	o*
Montane/Subalpine Grasslands	4	o*	o*	o*	o*	-
Colorado Plateau-Great Basin Grassland	3	o*	o*	o*	o*	o*
Semidesert Grassland	2	o*	o*	o*	o*	o*

[£]Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions

Table 100. Trends[£] in the ecological status (plant community species composition) of Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	+	+	+	+	-
Mixed Conifer with Aspen	2	+	+	+	+	+
Mixed Conifer-Frequent Fire	12	+	+	+	+	+
Ponderosa Pine Forest	19	+	+	+	+	+
Ponderosa Pine-Evergreen Oak	12	o	+	o	o	-
Madrean Pinyon-Oak Woodland	1	-	-	-	-	-
Pinyon Juniper Woodland	26	+	-	+	+	-
Pinyon Juniper Grass Woodland	9	-	+	-	-	+

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Juniper Grass Woodland	4	-	+	+	-	-
Mountain Mahogany Mixed Shrubland	5	+	+	+	+	+
Montane/Subalpine Grasslands	4	o	o	o	o	o
Colorado Plateau-Great Basin Grassland	3	-	-	-	-	+
Semidesert Grassland	2	-	+	-	-	+

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions

Table 101. Trends£ in patch size of Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	+	+	+	+	-
Mixed Conifer with Aspen	2	+	+	+	+	+
Mixed Conifer-Frequent Fire	12	o*	o*	o*	o*	o*
Ponderosa Pine Forest	19	+	+	+	+	+
Ponderosa Pine-Evergreen Oak	12	o	+	o	o	+
Madrean Pinyon-Oak Woodland	1	-	-	-	-	-
Pinyon Juniper Woodland	26	+	-	+	+	-
Pinyon Juniper Grass Woodland	9	-	+	-	-	+
Juniper Grass Woodland	4	o	+	+	-	+
Mountain Mahogany Mixed Shrubland	5	na	na	na	na	na
Montane/Subalpine Grasslands	4	na	na	na	na	na
Colorado Plateau-Great Basin Grassland	3	na	na	na	na	na
Semidesert Grassland	2	na	na	na	na	na

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions; "na" = not applicable

Table 102. Trends£ in risk of epidemic levels of insects or disease in Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	+	+	+	+	-
Mixed Conifer with Aspen	2	+	-	+	+	-
Mixed Conifer-Frequent Fire	12	-	-	o	-	-
Ponderosa Pine Forest	19	-	-	-	-	-
Ponderosa Pine-Evergreen Oak	12	o	-	o	o	-
Madrean Pinyon-Oak Woodland	1	+	+	+	+	+
Pinyon Juniper Woodland	26	+	-	+	+	-
Pinyon Juniper Grass Woodland	9	+	-	+	+	-
Juniper Grass Woodland	4	+	-	-	+	-
Mountain Mahogany Mixed Shrubland	5	na	na	na	na	na
Montane/Subalpine Grasslands	4	na	na	na	na	na
Colorado Plateau-Great Basin Grassland	3	na	na	na	na	na
Semidesert Grassland	2	na	na	na	na	na

£Based on 100-year model results; "+" = increases risk; "-" = decreases risk; "o" = maintains existing risk; "na" = not applicable

Table 103. Trends£ in risk of invasive and noxious plant establishment and spread in Gila National Forest upland ecological response units

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	o	o	o	o	o
Mixed Conifer with Aspen	2	o	+	-	+	+
Mixed Conifer-Frequent Fire	12	o	+	-	+	+
Ponderosa Pine Forest	19	o	+	-	+	+
Ponderosa Pine-Evergreen Oak	12	o	+	-	+	+
Madrean Pinyon-Oak Woodland	1	-	+	-	-	+
Pinyon Juniper Woodland	26	o	+	-	-	+
Pinyon Juniper Grass Woodland	9	o	+	+	-	+
Juniper Grass Woodland	4	o	+	+	-	+
Mountain Mahogany Mixed Shrubland	5	+	+	+	+	+
Montane/Subalpine Grasslands	4	o	+	+	o	+

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Colorado Plateau-Great Basin Grassland	3	o	+	+	-	+
Semidesert Grassland	2	o	+	+	-	+

£Based on 100-year model results; "+" = increases risk; "-" = decreases risk; "o" = maintains existing risk

Table 104. Differences in the support provided for the climate change adaptation spectrum

ERU	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Spruce-Fir Forest	1	R-T	R-T	R-T	R-T	T
Mixed Conifer with Aspen	2	R-T	R-T	R-T	R-T	R-T
Mixed Conifer-Frequent Fire	12	R-T	T	R-T	R-T	T
Ponderosa Pine Forest	19	R-T	R-T	R-T	R-T	R-T
Ponderosa Pine-Evergreen Oak	12	R-T	R-T	R-T	R-T	T
Madrean Pinyon-Oak Woodland	1	T	T	T	T	T
Pinyon Juniper Woodland	26	R-R-T	T	R-R-T	R-R-T	T
Pinyon Juniper Grass Woodland	9	T	R-R-T	T	T	R-R-T
Juniper Grass Woodland	4	T	R-R-T	T	T	R-R-T
Mountain Mahogany Mixed Shrubland	5	R-R-T	R-R-T	R-R-T	R-R-T	R-R-T
Montane/Subalpine Grasslands	4	R-T	R-T	R-T	R-T	R-T
Colorado Plateau-Great Basin Grassland	3	T	T	T	T	T
Semidesert Grassland	2	R-R-T	R-R-T	R-R-T	R-R-T	R-R-T

"R-R-T" = Resistance-Resilience-Transition; "R-R" = Resistance-Resilience; "R-T" = Resilience-Transition; "T" = Transition

Table 105. Trends£ in carbon storage for Gila National Forest upland ecological response unit groups

ERU Group	Percent of Gila National Forest	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Cold, Wet Forests	3	o*	o*	o*	o*	o*
Warm, Dry Forests	43	+*	+*	+*	+*	-
Woodlands	40	o*	o*	o*	o*	-
Shrubland	5	-	+*	-	-	+*
Grasslands	9	+	+*	+	-	+

£Based on 100-year model results; "+" = trend toward desired conditions; "-" = trend away from desired conditions; "o" = maintains existing conditions outside of desired conditions; "+*" = trend toward and achievement of desired conditions; "o*" = maintains within existing desired conditions

Table 106. Estimated range of possible livestock generated methane emissions (in tons) per 10-year period

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Minimum	26, 915	29, 255	29, 255	29, 255	29, 255
Maximum	29, 255	29, 840	28,963	29,401	30,425

Table 107 displays model projections for greenhouse gas emissions (in millions of tons) per 10-year period from vegetation treatments (mechanical thinning, prescribed and naturally ignited fire). **It is important to note that those alternatives with lower modeled emissions are likely to have the highest actual emissions because of wildfires management needs to suppress because of unfavorable weather and fuel conditions.**

Table 107. Greenhouse gas emissions (in millions of tons) per 10-year period from vegetation treatments

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total Greenhouse Gas Emissions	10.49	46.92	9.07	9.25	87.77

Table 108 displays model projections for criteria pollutant emissions (in tons) per 10-year period from vegetation treatments (mechanical thinning, prescribed and naturally ignited fire). **It is important to note that those alternatives with lower modeled emissions are likely to have the highest actual emissions because of wildfires management needs to suppress because of unfavorable weather and fuel conditions.**

Table 108. Criteria pollutant emissions (in tons) per 10-year period from vegetation treatments

Criteria Pollutant	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Carbon monoxide	464,325	2,026,128	403,122	411,385	3,789,141
PM2.5	55,468	244,195	48,125	49,096	456,690
PM10	61,235	269,606	53,167	54,229	504,253
Total	581,028	2,539,929	504,414	514,710	4,750,084

Table 109 summarizes the effects of the alternatives on all other resources, activities and uses. Where a quantitative measure of comparison is not generated by the analysis, alternatives are ranked on a scale of 1 to 5. The alternative that is expected to perform best for the identified resource, activity, or use is given a rank of 1. The alternative that performs worst is given a rank of 5. Where alternatives are expected to perform similarly, the ranking scale is adjusted to reflect "ties." For example, if there is no difference expected between alternatives, all would be given a rank of 1. Upland conditions, as reflected by the summary of trends at the beginning of this section, are ranked here to reflect the number of times an alternative maintains, moves toward, or achieves desired conditions for vegetation community structure, function, pattern, and processes. Upland conditions are an important factor in determining the relative performance of each alternative for most resources, activities, and uses.

Table 109. Summary of alternative support of resources, activities, and uses

Resource, Activity or Use	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Upland Condition Model (rank)	5	1	3	4	2
Soil and Watershed Resources (rank)	2	1	4	4	2
Riparian and Aquatic Ecosystems (rank)	2	1	4	4	3
Wildlife, Fish and Plants (rank)	4	1	2	3	5
Cultural Resources (rank)	1	1	1	1	1
Wildland, Fire and Fuels Management (rank)	2	1	3	3	1
Suitable Timber Base (acres)	354,246	352,922	351,028	354, 205	29,998
Timber, Forest, and Botanical Products – Sustained Yield Limit (MMBF per decade/MMCF per decade)	583/130	583/130	583/130	583/130	583/130
Projected Timber Sale Quantity (MMCF/decade average)	9	9	1.5	28	3.5
Projected Wood Sale Quantity (MMCF/decade average)	10.5	10.5	12	40.5	7.7
Projected Saw Timber (MMBF/decade average)	34	29.5	5	129	7.9
Livestock Grazing (potential changes in available forage rank)	4	2	3	3	1
Livestock Grazing (flexibility rank)	2	1	3	3	2
Sustainable Recreation (rank)	2	1	1	1	1
Scenic Resources (rank)	2	1	1	1	1
Roads (rank)	2	1	1	1	1
Facilities (rank)	2	1	1	1	1
Lands (rank)	2	1	3	3	1
Minerals (rank)	1	1	1	1	2
Wilderness (rank)	2	1	3	3	1
Eligible Wild and Scenic Rivers (rank)	1	1	1	1	1
Inventoried Roadless Areas (rank)	1	1	1	1	1
National Recreation and Scenic Trails	1	1	1	1	1
National Scenic Byways	1	1	1	1	1
Social and Economic Conditions – Jobs	1,099	1,131	1,120	1,146	1,135
Social and Economic Conditions – Labor Income (thousands of 2016USD)	$33,715	$34,298	$33,977	$35,482	$34,256
Tribal Relationships and Co-Stewardship	1	1	1	1	1
Environmental Justice	1	1	1	1	1
Climate Change Adaptation	4	1	3	3	2

Short-term Uses and Long-term Productivity

The National Environmental Policy Act requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The revised forest plan is anticipated to govern management of the Gila National Forest's resources for the next 10 to 15 years. The environmental impact statement discloses the analysis of effects for a range of alternatives, including no action. It considers effects on the significant issues and other resources for this timeframe. Overall, under all alternatives, design and implementation of projects and activities consistent with the direction in this forest plan would ensure the short-term uses, long-term productivity, ecological integrity, and ecological diversity of National Forest System lands within the Gila National Forest.

Unavoidable Adverse Effects

The revised forest plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore, none of the alternatives causes unavoidable adverse impacts.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road.

The revised forest plan provides a programmatic framework that guides site-specific actions, but does not authorize, fund, or carry out any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore, none of the alternatives causes an irreversible or irretrievable commitment of resources.

Other Required Disclosures

The National Environmental Policy Act at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with…other environmental review laws and executive orders." As a proposed federal project, the proposed plan decisions are subject to compliance with other federal and state laws. Determinations and decisions made in the proposed plan have been evaluated in the context of relevant laws and executive orders. Various state and federal agencies collaborated throughout the development of the proposed plan.

Preparers and Contributors

The Forest Service consulted the following individuals: federal, state, and local agencies; tribes; and other organization and individuals during the development of this environmental impact statement.

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Brian Park – GIS Coordinator, USDA Forest Service, Gila National Forest. Education: M.S. Applied GIS emphasis Rural Planning; Certificate in Parks and Recreation emphasis Wilderness Management; B.A. American History; B.A. English Literature. Experience: spatial data collection, management, analysis and presentation; GIS coordinator at the Gila National Forest 2014 to present; GIS specialist at the Gila National Forest 2009 to 2014; GIS specialist for the Vale District BLM 2008; cartographer for Yellowstone National Park 2007; GIS technician for the city of Flagstaff 2005 to 2006.

Jenny (Nessa) Rasmussen – Forest Planner, Interdisciplinary Team Leader, and Interdisciplinary Ecologist/Soil Scientist, USDA Forest Service, Gila National Forest. Education: B.S. in Soil Science, New Mexico State University. Certified Professional Soil Scientist (CPSS) through the Soil Science Society of America. Experience: 15 years working for the Forest Service focused on soil, watershed resources, riparian and upland ecosystems, and ecosystem processes in the Southwestern Region.

Matt Schultz – Realty Specialist, USDA Forest Service, Southwestern Regional Office and former Forest Planner and Interdisciplinary Team Leader, USDA Forest Service, Gila National Forest. Education: B.A. Biology/Environmental Studies, Grinnell College; M.S. Ecology/Geospatial Science, Colorado State University; and graduate training in hydrology through the New Mexico Institute of Mining and Technology. Experience: 20 years working for federal land management agencies, a state regulatory agency, and research institutions across the Southwest and Pacific focused on evaluating site characteristics and monitoring, assessing, and restoring terrestrial, riparian, and wetland systems.

Jeffrey Shearer – Natural Resources and Planning Staff Officer, USDA, Forest Service, Gila National Forest. Education: B.S. Environmental Science, Allegheny College; M.S. Wildlife and Fisheries, South Dakota State University. Experience: Over 20 years in land management in riparian and aquatic ecosystem management, planning and analysis; 8 years Forest Service; 8 years with the Park Service; 5 years with South Dakota Department of Game, Fish and Parks.

Sandra Taylor – Wildlife Biologist, USDA Forest Service, Gila National Forest, Glenwood Ranger District. Education: B.S. Wildlife and Fisheries Resources, West Virginia University. Experience: 15 years of federal service beginning as an agricultural specialist with Customs and Border Protection, wildlife biologist with the Bureau of Land Management and Forest Service.

List of Contributors

Harley Allsup – Recreation, Heritage, Engineering, Lands and Minerals Staff Officer and former Facilities Engineer, USDA Forest Service, Gila National Forest. Education: B.S. Civil Engineering with a minor in Mathematics, New Mexico State University. Experience: mining reclamation design and implementation, mine design and construction, and project engineer for private industry; 13 years Forest Service.

Elizabeth Bigelow – Regional Tribal Relations Program Manager, USDA Forest Service, Southwestern Regional Office. Experience: Over 30 years working as an archaeologist and tribal relations.

Kendall Brown – Rangeland Management Specialist, USDA Forest Service, Gila National Forest, Glenwood Ranger District. Education: M.S. Wildlife and Rangeland Ecology, Oklahoma State University; B.S., Ecology, Western New Mexico University. Experience: Over 30 years working with range, wildlife, and fisheries ecology in the Forest Service Southwestern Region.

Liz Carver – Fuels Specialist, USDA Forest Service, Gila National Forest, Wilderness Ranger District. Education: B.S. Biology, Whittier College. Experience: 30 years working with wildlife, wildfire, and fuels.

Marcus Cornwell – Fire Management Officer, USDA Forest Service, Gila National Forest, Silver City Ranger District. Education: B.A. in History and Philosophy, Portland State University Experience: 27 years of service in wildland fire and fuels management including many seasons as a climbing ranger at Mount Saint Helens National Volcanic Monument and firefighter on many hotshot crews across the Pacific Northwest and Southwestern Regions.

Samuel Dannenberg – Forester (Silviculture), USDA Forest Service, Gila National Forest Supervisor's Office. Education: M.S. Forest Resources, Pennsylvania State University; B.Sc. in Forestry, Northern Arizona University. Experience: Research Assistant, Leites Quantitative Forest Ecology Lab 2019–2021; Forester Intern, Lassen National Forest, Hat Creek Ranger District 2017-2019; Forester (Silviculture), Gila National Forest 2021-present.

Mary Dowse – Geologist, Education: B.A. Geology/Earth Science, Beloit College; M.S. Geology, University of New Hampshire; PhD, Geology, West Virginia University. Experience: many years of experience in private industry and Western New Mexico University, Professor of Geology, retired.

Marc Estrada – Forester, USDA Forest Service, Southwestern Region and Rocky Mountain Research Station Forestry Sciences Lab and former Forester, USDA Forest Service, Gila National Forest, Reserve Ranger District. Education: B.S, Forestry, New Mexico Highlands University. Experience: timber sale preparation, geographic information systems.

Dennis Fahl – Fire Management Officer, retired, USDA Forest Service, Gila National Forest, Black Range District, retired. Over 25 years of experience in wildland fire and fuels management.

Aaron Fargo – Landscape Architect, USDA Forest Service, Enterprise Program. Education: M.S. Landscape Architecture, University of Michigan. Experience: 10 years Forest Service.

Ralph Fink – Rangeland Program Manager, USDA Forest Service, Apache-Sitgreaves National Forest and former Rangeland Management Specialist, USDA Forest Service, Gila National Forest, Quemado Ranger District. Education: M.S. in Range Science, Plan Taxonomy and Floristics, New Mexico State University; B.S. in Secondary Education, Natural Sciences, Chadron State College. Experience: Over 15 years as Range Management Specialist in the Forest Service Southwestern Region.

Joshua Hall – Program Specialist, USDA Forest Service, Washington Office, Fire and Aviation Management and former Air and Water Quality Specialist, USDA Forest Service, national forests in New Mexico. Education: B.A. Cultural Anthropology, University of California, Santa Cruz. MES Aquatic Ecology, MPA Environmental Policy and Natural Resource Management, Indiana University. Experience: 8 years Forest Service, 5 years Environmental Protection Agency.

Nicole Hill – Regional Landscape Architect, USDA Forest Service, Southwestern Region and former Landscape Architect, USDA Forest Service, Enterprise Program. Education: B.S. Landscape Design and Environmental Management, South Dakota State University. Experience: 18 years Forest Service.

Delilah Jaworski – Economist, USDA Forest Service, Rocky Mountain Region and former Social Scientist, USDA Forest Service, Enterprise Program. Education: B.A. Middle Eastern Studies with a minor in history, The George Washington University; M.S. Environment and Development, The London School of Economics. Experience: Economist on Great American Outdoors Act Team, Rocky Mountain Region (2020 to present); rocky Mountain Region regional social scientist (2018 to 2021); social scientist with USDA Forest Service Enterprise Program 2010 to 2018; social scientist with Bureau of Land Management 2008 to 2010.

Aaron Jones – Fire Management Officer, USDA Forest Service, Gila National Forest, Wilderness Ranger District. Over 20 years of experience managing wildland fire and fuels.

Cass Klee – Geographic Information Specialist, USDA Forest Service, Enterprise Program. Education: B.S. Natural Resource Planning, Humboldt State University. Graduate Studies, Geographic Information Science, Oregon State University. Experience: 29 years Forest Service.

Carolyn Koury – Hydrologist and Watershed Program Manager, USDA Forest Service, Gila National Forest. Education: B.S. Speech Communication, Northern Arizona University, 1991; M.S. Hydrology, University of Arizona, 1998. Experience: forest hydrologist on Gila National Forest 2002 to present; hydrologist on Apache-Sitgreaves National Forests, 1998 to 2002; hydrologist trainee on Apache-Sitgreaves National Forests 1994 to 1998.

James A. Miller – Air Resource Specialist, Bureau of Land Management, former Air Quality Specialist, USDA Forest Service, Region 6, Regional Office. Education: B.S. Meteorology, University of Utah. M.A. Geography with Graduate Certificate in Environmental Policy, University of Colorado, Boulder. PhD Geography, Arizona State University. Experience: 3 years as a Professional Research Assistant at the National Snow and Ice Data Center, Boulder, Colorado; 8 years as a professor of geography at California State University, Fullerton; 4 years as an air quality specialist for the USDA Forest Service, including a detail to national forests in New Mexico; air resource specialist at BLM from 2020 to present.

Belinda Mollard –Tribal Relations Program Manager, USDA Forest Service, Carson National Forest, former Gila National Forest Heritage Program Manager and Tribal Liaison. Education: Bachelors of Anthropology, University of Colorado; Masters of Anthropology, New Mexico State University; PhD in Archaeology, University of Leicester, United Kingdom. Experience: Worked in archaeology for over 25 years in multiple regions of North America, Europe, Melanesia, Polynesia and Southeast Asia specializing in the prehistory of the American Southwest. Designed and taught programs in archaeology education, worked in contract archaeology, and worked as a federal archaeologist for multiple federal agencies. Served as a forensic archaeologist with the U.S. Department of Defense, recovering fallen soldiers, and as an interdisciplinary team member on many federal projects. Serves on the board of directors for two archaeological non-profit groups and works with STEM programs in regional schools with under-represented groups.

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Michael Natharius – Soil Scientist, retired, USDA Forest Service, Gila National Forest. Education: B.S. Agriculture with Major in Soil Science. Experience: terrestrial ecological unit inventory, riparian inventory and monitoring, vegetation inventory and monitoring, burned area emergency response team leader and member, and interdisciplinary team specialist. Soil scientist with the Forest Service in Region 3 since 1991.

Zachary Neumann – Geographic Information Specialist, USDA Forest Service, Enterprise Program. Education: Bachelor of Environmental Science and Management with a minor in Geographic Information Systems. Experience: 4 years Forest Service.

Rex A. Null – Civil Engineer, retired, USDA Forest Service, Gila National Forest. Education: B.S. Civil Engineering, New Mexico State University. Experience: project manager for Burn Construction 2 years, civil engineer for Gila National Forest over 20 years.

Christa Osborn – Public Services Staff Officer, USDA Forest Service, Cibola National Forest and former Recreation Program Manager, USDA Forest Service, Gila National Forest.

Jenna Padilla – Geologist and Minerals Program Manager, USDA Forest Service, Cibola National Forest. **Education:** B.S. Geology, University of New Mexico. Experience: more than 10 years of Forest Service experience in mining and minerals, including positions on the Black Hills, Humboldt-Toiyabe and Cibola National Forests.

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Jan Spencer – Recreation and Landscape Architecture Supervisor, USDA Forest Service, Enterprise Program. Education: Bachelor of Landscape Architecture, Utah State University. Experience: 34 years Forest Service**.**

Wendy Sutton – Deputy Regional Archaeologist and Regional Native American Graves Protection and Repatriation Act Coordinator, USDA Forest Service, Southwestern Regional Office; former Heritage Program Manager and Tribal Liaison, USDA Forest Service, Gila National Forest. Education: PhD Anthropology, Colombia University; M.A. Anthropology, Columbia University; B.A. Anthropology and Mesopotamian Art and Archaeology, University of California, Berkeley. Experience: Over 30 years as a contract archaeologist, university instructor, and archaeologist with both the Bureau of Land Management and the Forest Service.

Matthew Taliaferro – Geographic Information Specialist and former Archaeologist, USDA Forest Service, Gila National Forest. Education: B.A. Anthropology; M.A. Anthropology; Ph.D. Anthropology. Experience: Ten years of Section 106 and 110 CRM work in the southern United States, geographic information sciences, peer-review process, lithic analysis, ceramic analysis, and technical writing. With the Forest Service since 2010.

Arthur Telles, Jr. – Planning and Resource Staff Officer, retired, USDA Forest Service, Gila National Forest. Education: B.S. in Wildlife Science and Fishery Science. Experience: 30 years with the Forest Service in three regions and five national forests; district fisheries biologist (5 years), forest fisheries biologist (2 years), district wildlife biologist (5 years), district wildlife/range/and watershed staff (3 years), and forest wildlife and fish program manager (8 years), and forest natural resources staff officer (7 years).

Laura Vallejos – Silviculturist, retired, USDA Forest Service, Gila National Forest. Education: B.S. Forest Management. Experience: vegetation effects modeling and NEPA analysis, silviculture vegetation prescriptions for wildlife habitat, fuels reduction, forest health, restoration, watershed improvement, reforestation, invasive and noxious weed control, with the Forest Service since 1991.

Kyra Walton- Wildlife Biologist, USDA Forest Service, Mountain Planning Service Group. Former biologist on the Humboldt-Toiyabe National Forest and Quemado Ranger District, Gila National Forest. Education: B.S. Fisheries and Wildlife Biology, Utah State University. Master of Natural Resources and Graduate Certificate in Restoration Ecology, University of Idaho. Experience: USDA Forest Service district wildlife biologist for seventeen years, NEPA writer/editor for three years, and biological technician for five years.

Sheila Williams –Natural Resource Specialist, retired, USDA Forest Service, Apache-Sitgreaves National Forest. Education: B.S. Botany with Minor in Geography, Western New Mexico University. Experience: 19 years in land and resource management. Professional botanist with the BLM, Las Cruces District Office (2001 to 2004): rare plant/special status species habitat management (Aplomado falcon, lesser prairie chicken, long-nosed bat) and McGregor Range land management plan amendment (2001 to 2004); professional botanist with BLM, Socorro Field Office (2004 to 2009): rare plants, forestry, vegetation ecology and fuels management, and land management plan revision; professional botanist with BLM, Farmington Field Office (2009 to 2015): team lead New Mexico plant conservation program, plant materials for reclamation/restoration, technical team member Colorado Plateau Rapid Assessment, vegetation lead for Mancos-Shale Oil Development amendment to the land management plan; NEPA planner, Apache Zone, Apache-Sitgreaves National Forests (2015 to present): NEPA process and interdisciplinary team lead.

Cooperating Agencies

New Mexico Department of Agriculture

New Mexico Department of Game and Fish

San Francisco Soil and Water Conservation District

Tribes

Comanche Nation

Fort Sill Apache Tribe

Mescalero Apache Tribe47

Pueblo of Acoma

Pueblo of Laguna

Pueblo of Zuni

The Hopi Tribe

The Navajo Nation, including the Alamo and Ramah Chapters

San Carlos Apache Tribe

White Mountain Apache Tribe

Ysleta Del Sur Pueblo

47 The Yavapai-Apache Nation defers to the Mescalero and White Mountain Apache Tribes

Distribution of the Environmental Impact Statement

This environmental impact statement has been distributed to individuals who specifically requested a copy of the document and those who are on the forest plan revision contact list. The final environmental impact statement is available on the forest plan revision website and available for review at the Supervisors Office. In addition, copies have been sent or provided electronically to the following federal agencies, federally recognized tribes, state and local governments, and organizations representing a wide range of views:

Advisory Council on Historic Preservation

Alamo Navajo Chapter

American Motorcyclist Association

Audubon New Mexico

Back Country Horseman Association

Bureau of Land Management

Bureau of Reclamation

Caballo Soil and Water Conservation District

Catron County

Center for Biological Diversity

City of Bayard

City of Las Cruces

City of Truth or Consequences

Coalition of Arizona and New Mexico Counties

Continental Divide Trail Alliance

Defenders of Wildlife

Deming Soil and Water Conservation District

Dona Ana Soil and Water Conservation District

El Paso Electric

Federal Aviation Administration

Federal Highway Administration

Friends of Cosmic Campground

Freeport McMoRan Inc.

Fort Sill Apache Tribe

Gila Basin Irrigation Commission

Grant County

Grant County Cooperative Extension Service

Grant Soil and Water Conservation District

Gila Farm and Livestock Bureau

Gila Livestock Growers

Gila Native Plant Society

Hidalgo County

Hidalgo County Public Lands Advisory Committee

Hidalgo Soil and Water Conservation District

International Mountain Bicycling Association

Luna County

Luna Irrigation Company

Mescalero Apache Tribe

Mesilla Valley Fly Fishers

Mimbres Farm and Livestock Bureau

National Park Service

National Outdoor Leadership School

National Wild Turkey Federation

Native Plant Society of New Mexico

Natural Heritage New Mexico

Navopache Electric Cooperative Inc.

New Mexico Association of Conservation Districts

New Mexico Cattle Growers Association

New Mexico Central Arizona Project Entity

New Mexico Council of Outfitters and Guides

New Mexico Department of Agriculture

New Mexico Department of Game and Fish

New Mexico Department of Transportation

New Mexico Economic Development Department

New Mexico Environmental Department

New Mexico Farm and Livestock Bureau

New Mexico Federal Land Council

New Mexico Forest and Watershed Restoration Institute

New Mexico Interstate Stream Commission

New Mexico Land Conservancy

New Mexico Livestock Board

New Mexico Off Highway Vehicle Alliance

New Mexico Office of the State Engineer

New Mexico Pilots Association

New Mexico State Forestry Division

New Mexico State Land Office

New Mexico State University

New Mexico Wilderness Alliance

New Mexico Wildlife Federation

New Mexico Wool Growers Inc.

NOAA Fisheries Service

PNM

Pueblo of Acoma

Pueblo of Laguna

Pueblo of Zuni

Ramah Navajo Chapter

Recreational Aviation Foundation

Rocky Mountain Elk Foundation

Salado Soil and Water Conservation District

San Carlos Apache Tribe

San Francisco Soil and Water Conservation District

Sierra County

Sierra County Cooperative Extension Service

Sierra Soil and Water Conservation District

Socorro Soil and Water Conservation District

Southwestern Council of Governments

State Historic Preservation Office

The Comanche Nation

The Hopi Tribe

The Nature Conservancy

The Navajo Nation

The Quivera Coalition

The Trust for Public Land

The Wilderness Society

Town of Hurley

Town of Lordsburg

Town of Silver City

Trout Unlimited

Tucson Electric Power

U.S. Army Corps of Engineers

U.S. Coast Guard

U.S. Department of Energy

U.S. Department of the Navy, Energy and Environmental Readiness Division

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

USDA APHIS PPD/EAD

USDA National Agricultural Library

USDA Natural Resources Conservation Service

USDI Office of Environmental Policy and Compliance

Upper Gila Watershed Alliance

Village of Reserve

Village of Santa Clara

Western New Mexico University

White Mountain Apache Tribe

WildEarth Guardians

Wildlands Network

Ysleta Del Sur Pueblo

Glossary

Adaptation – adjustment in natural or human systems to a new or changing environment. Adaptation includes, but is not limited to, maintaining basic ecological functions such as primary production, nutrient cycling, predation, herbivory, and natural disturbances such as fire, wind-throw, and natural levels of native insects and disease. Adaptation occurs primarily by organisms altering their interactions with the physical environment and other organisms.

Adaptive capacity – ability of a species or system to respond, cope, or adapt to disturbances and stressors, including environmental change, to maintain options for future generations.

Adaptive management – a general framework encompassing the three phases of planning: assessment, plan development, and monitoring (36 CFR 219.5). This framework supports decision-making that meets management objectives while simultaneously accruing information to improve future management by adjusting the plan or plan implementation. Adaptive management is a structured, cyclical process for planning and decision-making in the face of uncertainty and changing conditions with feedback from monitoring, which includes using the planning process to actively test assumptions, track relevant conditions over time, and measure management effectiveness.

Assessment – for the purposes of the forest plan revision, an assessment is the identification and evaluation of existing information to support land management planning. Assessments are not decision-making documents but provide current information on select topics relevant to the plan area, in the context of the broader landscape (36 CFR 219.19).

Administrative use – authorized motorized on routes not designated for motorized use to carry out forest management activities. This includes use by permittees as authorized by permit or written authorization to conduct authorized activities.

At-risk species – a term used in land management planning to refer to, collectively, the federally recognized threatened, endangered, proposed, and candidate species and species of conservation concern within a plan area.

Basal area – the area covered by tree trunks and stems of shrubs, forbs and grass species where they meet the ground.

Best management practices (BMPs) – site- and project-specific methods or measures to prevent or mitigate potential adverse impacts to environmental quality, especially water quality. They include protection measures to address potential detrimental changes in water temperatures, blockages of water courses, deposits of sediment in streams, streambanks, shorelines, lakes, wetlands, and other bodies of water that are likely to affect water conditions or fish habitat seriously and adversely.

Candidate species – for species under the purview of the U.S. Fish and Wildlife Service, a species for which the Service possesses sufficient information on vulnerability and threats to support a proposal to list as endangered or threatened, but for which no proposed rule has yet been published by the Service.

Coarse woody debris – fallen dead trees and the remains of large branches on the ground in forest, woodland, riparian, and aquatic ecosystems.

Collaboration – a structured way people with diverse interests share knowledge, ideas, and resources while working together in an inclusive and cooperative manner toward a common purpose.

Common variety mineral materials – a collective term to describe petrified wood and common varieties of sand, gravel, stone, pumice, cinders, clay, and other similar materials. Common varieties do not include deposits of those materials that are valuable because of some distinct property.

Connectivity – ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long-distance range shifts of species, such as in response to climate change (36 CFR 219.19).

Critical habitat – for a threatened or endangered species, (1) the specific areas within the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act, on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act, upon a determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

Disturbance – any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure, function, or both, and changes resources, substrate availability, or the physical environment (36 CFR 219.19).

Disturbance regime – a description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (36 CFR 219.19).

Ecological conditions – the biological and physical environment that can affect the diversity of plant and animal communities, the persistence of native species, and the productive capacity of ecological systems. Ecological conditions include habitat and other influences on species and the environment. Examples of ecological conditions include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads and other structural developments, human uses, and invasive species (36 CFR 219.19).

Ecological integrity – the quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (36 CFR 219.19).

Ecological process – physical, chemical, and biological actions or events that link organisms and their environment including decomposition, production, nutrient cycling, fire, and windthrow.

Ecological response unit (ERU) – vegetation type concepts and map units that combine themes of site potential, or potential natural vegetation, historic disturbance regimes, and natural succession. Site potential is a term used to describe the characteristic ecological conditions at the latest successional state, resulting from the interactions among climate, soil and vegetation over time.

Ecosystem services – benefits people obtain from ecosystems.

Encroachment – an increase in the density and cover of trees or shrubs in grasslands that reduces grass biomass, density, and cover.

Endangered species – any species that the Secretary of the Interior or Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range. Endangered species are listed at 50 CFR sections 17.11, 17.12, and 224.101.

Environmental justice – fair treatment and meaningful 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. Fair treatment means that environmental justice populations do not bear a greater burden of environmental harms and risks than the general population from Forest Service programs and policies.

Endemic species – species that occur only in a certain area. In this context, the term is used to describe species that exist only on the Gila National Forest, or only in New Mexico and are found nowhere else in the world.

Ephemeral stream – streams that flow water only in direct response to precipitation in the immediate locality and whose channel is at all other times above the zone of saturation.

Historic Property – as defined by the National Historic Preservation Act: "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register"; such term includes artifacts, records, and remains which are related to such district, site, building, structure, or object.

Indian sacred site – a "sacred site" retains the same meaning as provided in Executive Order 13007; that is " ... any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." Within this document, the term also refers more broadly to those sites that could in the future be so identified. Such sacred sites may also be eligible for the National Register of Historic Places as historic properties of religious and cultural significance to Indian tribes.

Infill – an increase in trees per acre in forests and woodlands, resulting in a decrease in the quality and size of openings and interspaces.

Integrated resource management – multiple-use management that recognizes the interdependence of ecological resources and is based on the need for integrated consideration of ecological, social, and economic factors (36 CFR 219.19).

Invasive plants – reproduce rapidly, spread over large areas of the landscape, and have few, if any, natural controls, such as herbivores and diseases, to keep them in check. Many invasive plants share some important characteristics that allow them to grow out of control: (1) spreading aggressively by runners or rhizomes; (2) producing large numbers of seeds that survive to germinate; and (3) dispersing seeds away from the parent plant through various means such as wind, water, wildlife, and people.

Maintenance levels. The level of service provided by, and maintenance required for, a specific road (FSH 7709.59, ch. 60, sec. 62.3).

> *Level 1*. These are roads that have been placed in storage between intermittent uses. The period of storage must exceed 1 year. Basic custodial maintenance is performed to prevent damage to adjacent resources and to perpetuate the road for future resource management needs. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are to "prohibit" and "eliminate" all traffic. These roads are not shown on motor vehicle use maps. Roads receiving level 1 maintenance may be of any type, class, or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being

maintained at level 1, they are closed to vehicular traffic but may be available and suitable for nonmotorized uses.

Level 2. This level is assigned to roads open for use by high-clearance vehicles. Passenger car traffic, user comfort, and user convenience are not considerations. Warning signs and traffic control devices are not provided with the exception that some signing, such as W-18-1 "No Traffic Signs," may be posted at intersections. Motorists should have no expectations of being alerted to potential hazards while driving these roads. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either to "discourage" or "prohibit" passenger cars. "Accept" or "discourage" strategies may be employed for high clearance vehicles.

Level 3. This level is 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. The manual on uniform traffic control devices is applicable. Warning signs and traffic control devices are provided to alert motorists of situations that may violate expectations. Roads in this maintenance level are typically low speed with single lanes and turnouts. Appropriate traffic management strategies are either to "encourage" or "accept" passenger cars. "Discourage" or "prohibit" strategies may be employed for certain classes of vehicles or users.

Level 4. This level is assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved, dust abated, or both. The manual on uniform traffic control devices is applicable. The most appropriate traffic management strategy is to "encourage" passenger cars. However, the "prohibit" strategy may apply to specific classes of vehicles or users at certain times.

Level 5. This level is 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. The manual on uniform traffic control devices is applicable. The appropriate traffic management strategy is to "encourage" passenger cars.

Minority – a person who is an American Indian or Alaskan Native, Asian or Pacific Islander, Black, not of Hispanic origin, or Hispanic.

Minority population – (1) a readily identifiable group of people living in geographic proximity with a population that is 50 percent minority. The population with a 50 percent minority may be made up of one minority or a number of different minority groups; together the sum is 50 percent. (2) a minority population may be an identifiable group that has a meaningfully greater minority population than the adjacent geographic areas or may also be a geographically dispersed or transient set of individuals such as migrant workers or Native Americans (Council on Environmental Quality 1997).

Mitigate – to avoid, minimize, rectify, reduce, or compensate the adverse environmental impacts associated with an action.

Motor vehicle use map (MVUM) – map reflecting the designated system of open motorized roads, trails and areas on an administrative unit or ranger district of the National Forest System.

Multiple use – The management of all the various renewable surface resources of the National Forest System so that they are used in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output, consistent with the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528–531) (36 CFR 219.19).

National Environmental Policy Act (NEPA) – United States environmental law (42 U.S.C. 4321 et seq.), enacted January 1, 1970, that established a national policy promoting the enhancement of the environment and to “encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation.” This law also established the President’s Council on Environmental Quality, or CEQ.

National Forest Management Act (NFMA) – United States environmental law, enacted October 22, 1976, requiring the Forest Service to assess forest lands and develop resource management plans based on multiple-use, sustained-yield principles. It is the primary statute governing the administration of National Forest System lands.

Native species – occurs naturally in a particular place without human intervention. Species native to North America are generally recognized as those occurring on the continent prior to European settlement.

Nonnative plants – species that have been introduced to an area by people from other continents, states, ecosystems, and habitats. Many nonnative plants have great economic value for agriculture, forestry, horticulture, and other industries and pose little to no threat to our natural ecosystems. Others have become invasive and pose a serious ecological threat.

Natural range of variation (NRV) - ecosystem conditions that pre-date European settlement. This timeframe is considered sufficiently long enough to include the full range of variation in conditions produced by dominant natural disturbance regimes such as fire and flooding, as well as short-term variation and cycles in climate (FSH 1909.12, zero code, sec. 05). The variation of ecological characteristics and processes over scales of time and space that are appropriate for a given management application.

Off-highway vehicle (OHV) – any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain; except that the term excludes (1) any registered motorboat, (2) any fire, military, emergency or law enforcement vehicle when used for emergency purposes, and any combat or combat support vehicle when used for national defense purposes, and (3) any vehicle whose use is expressly authorized by the respective agency head under a permit, lease, license, or contract (Executive Order 11644 as amended by Executive Order 11989).

Potential natural vegetation – vegetation classification system and an ecological concept referring to the late successional vegetation that would be expected under the constraints of the physical environment in the absence of human intervention or high-severity disturbance.

Proper functioning condition (PFC) – a methodology for assessing the physical functioning of riparian and wetland areas. The term is used to describe both the assessment methodology and a defined, on-the-ground condition of a riparian or wetland area.

Resilience – the ability of an ecosystem or watershed and its component parts to absorb, or recover from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape.

Restoration, ecological – the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystems sustainability, resilience, and health under current and future conditions (36 CFR 219.19).

Riparian areas – three-dimensional ecotones [the transition zone between two adjoining communities] of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (36 CFR 219.19).

Riparian management zone – a site-specific delineated area around lakes, streams and wetlands with riparian vegetation and function and to which plan direction for riparian and aquatic ecosystems applies.

Risk – a combination of the likelihood that a negative outcome will occur and the severity of the subsequent negative consequences (36 CFR 219.19).

Scenery management system (SMS) – classification system that recognizes scenery as the visible expression of dynamic ecosystems functioning within places that have unique aesthetic and social values. It recognizes that in addition to naturally occurring features, positive scenery attributes associated with social, cultural, historical, and spiritual values, including human presence and the built environment, can also be valued elements of scenery. The scenery management system allows for seamless analysis and conservation beyond National Forest System lands into adjacent communities and other jurisdictions, through the application of varying scenery themes within a single analysis. It is structured to emphasize natural-appearing scenery.

Scenic character – combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and measure scenic integrity (36 CFR 219.19).

Scenic integrity objective – desired level of intactness and wholeness of scenic character based on physical and sociological characteristics of an area. Refers to the degree of acceptable human alteration to the character valued for its aesthetic appeal. Objectives include very high, high, moderate, low, very low, and unacceptably low.

Seral state – one of a series of transitional plant communities that develop during gradual successive change over time following disturbance.

Site potential – term used to describe the characteristic ecological conditions in the latest successional state, resulting from interactions among climate, soil, and vegetation.

Species of conservation concern – a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long term in the plan area (36 CFR 219.9(c)).

Sustainability – The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For the purposes of the land management planning regulation at 36 CFR part 219 ‘‘ecological sustainability’’ refers to the capability of ecosystems to maintain ecological integrity; ‘‘economic sustainability’’ refers to the capability of society to produce and consume or otherwise benefit from goods and services including contributions to jobs and market and nonmarket benefits; and ‘‘social sustainability’’ refers to the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another, and support vibrant communities (36 CFR 219.19).

Threatened species – any species the Secretary of the Interior or Secretary of Commerce has determined is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Threatened species are listed at 50 CFR sections 17.11, 17.12, and 223.102.

Timber harvest – removal of trees for wood fiber use and other multiple-use purposes (36 CFR 219.19).

Timber production – purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19).

Traditional cultural property – a property or site that is eligible for inclusion on the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that are rooted in that community's history and because of its importance to maintaining the cultural identity of that community.

Upland – areas, species, systems, or conditions that are characteristic of terrestrial ecosystems, as opposed to riparian or aquatic ecosystems.

Vegetation structure – both vertical and horizontal arrangement of vegetation. Horizontal structure may refer to tree size, density, or patterns of trees or groups of trees and their adjoining openings. Vertical structure may refer to the layers, appearance, and composition of vegetation between the ground and the top of the vegetation canopy, including grasses, forbs, shrubs and trees.

Watershed –defined by the topographic extent of an area that drains to a single point in a stream or river system. Watersheds are cataloged using a uniform hierarchical system developed by the United States Geological Society (USGS) where the United States is divided and subdivided into successively smaller hydrologic units. There are six levels of hydrologic units: region (1st level), subregion (2nd level), basin (3rd level), subbasin (4th level), watershed (5th level) and subwatershed (6th level).

Watershed Condition Classification – an interdisciplinary evaluation of watershed condition used across all National Forest System lands. It offers a systematic, flexible means of classifying watershed condition based on a core set of indicators. The system uses existing data, local knowledge, professional judgement, written rule sets and criteria. Watershed condition indicators and overall watershed condition are described as Functioning Properly, Functioning at Risk, or Impaired Function. More information about this system is contained in Potyondy and Geier (2011) and online.

Wild and Scenic River – river designated by Congress as part of the National Wild and Scenic Rivers System that was established in the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 (note), 1271-1287) (36 CFR 219.19).

Wilderness – any area of land designated by Congress as part of the National Wilderness Preservation System that was established in the Wilderness Act of 1964 (16 U.S.C. 1131-1136) (36 CFR 219.19).

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