Valles Caldera National Preserve

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Environmental Assessment

Multiple Use and Sustained Yield of Forage Resources

April 7, 2009

Stewardship Register

MUSY-Forage

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EXECUTIVE SUMMARY

Introduction

The attached Environmental Assessment (EA) was prepared to document compliance with the spirit and the legal standards put forth in the National Environmental Policy Act of 1969 (NEPA) as amended. It has been prepared by the Valles Caldera Trust (the Trust), a wholly owned government corporation who oversees the management of the Valles Caldera National Preserve (the Preserve), located in Sandoval and Rio Arriba Counties, New Mexico.

A document in itself does not meet either the spirit or the legal standard of NEPA. It is the process leading up to and in combination with, the document that must meet the standard. In the instance of the Stewardship Action, Multiple Use and Sustained Yield of Forage (MUSY-Forage), the word, *journey* may reflect a more accurate connotation of what has occurred than *process*. The journey has included an exploration and quantification of a newly acquired jewel of public land, (the Preserve), as well as developing the organization and system to embark on this "experiment in public land management".

It has been an arduous journey at times, and many *travelers* have been along for all or part of the adventure! Like many other aspects of government, successful implementation of the NEPA is best achieved through participation by an engaged citizenry, objective experts, and an open government organization. The investment in this particular journey will allow future planning efforts related to the use and management of natural resources to be accomplished in much shorter *trips*!

The following paragraphs summarize key elements and findings of the EA: Preface, Purpose and Need, Issues and Alternatives, Environmental Consequences, and a summary of the environmental consequences in relation to key issues.

Preface "*Multiple Use and Sustained Yield of Forage*" and "*Operation of a Working Ranch*"

The Valles Caldera Preservation Act (the Act) frames the use of the Preserve's renewable resources by the definitions put forward in the Multiple Use and Sustained Yield act of 1960. The preface to the EA recalls these definitions, in their original text so readers can better understand the direct relationship the proposed management of forage to this law.

The Act also refers to the continued management of the Preserve as a working ranch in numerous sections. The Act however, failed to define or reference the meaning of "working ranch". The preface states the definition for a working ranch put forward by the Board of Trustees in their framework document, (*Framework and Strategic Guidance for Comprehensive Management*) which was completed in 2005.

Purpose and Need/Proposed Action

The NEPA procedures of the Trust (Federal Register, 2003) require a clear statement of the proposed Stewardship Action as well as the purpose and need for action. This statement describes what is being proposed, why it is being proposed, and frames the scope of the analysis; especially the range of alternatives to be considered.

The Valles Caldera Trust (the Trust) is proposing to continue operation of Valles Caldera National Preserve (the Preserve) as a working ranch consistent with the goals stated in the Valles Caldera Preservation Act of 2000 (the Act). Toward this end, the Trust is proposing to continue programs for domestic livestock grazing and to manage the Preserve's ranch infrastructure. The trust would allocate 60 percent of the forage produced annually to remain on site in support of sustaining ecosystem services a portion of the remaining 40 percent would be allocated for domestic livestock grazing or other purposes based on the annual conditions and expected use by the Preserve's elk herd. The Trust is also proposing to adopt goals,[1] establish objectives,[2] and identify monitored outcomes[3] that would guide or prescribe the proposed multiple use and sustained yield (MUSY) of forage, as well as other future implementing decisions.

The purpose and need for action is based on the Act and other applicable laws; the existing condition of the Preserve's resources, infrastructure, and facilities; and lessons learned from the implementation of the interim program for domestic livestock grazing.

Issues and Alternatives

The development of alternatives and the focus of the analysis was framed by key issues developed through feedback from stakeholders, implementation of an interim grazing program, and environmental analysis. These key issues were associated with balancing the goals put forward in the Act.

- *Key Issue: Domestic livestock grazing can combine with use by elk and other native fauna to affect sensitive riparian areas.*
- *Key Issue: Domestic livestock grazing programs can conflict with, or affect visitor activities and experiences.*
- *Key Issue: Optimizing the attainment of any one goal is not exclusive of the attainment of any other goal but is likely to affect the level and timing of such attainment.*

The alternatives vary in both the allocation and use of forage and the types of programs developed for domestic livestock grazing. Connected infrastructure management varied accordingly.

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[1] "Goals" means a desired condition for the Preserve sought by the Trust and/or a desirable condition as described in Public Law 106-248 or the Management Principals adopted by the Trust (Federal Register 2003)

[2] "Objective'' means the desired outcome that can be meaningfully evaluated by location and timing within the Preserve. (Federal Register 2003)

[3] "Monitored outcome'' means the short-, mid-, or long-term outcome selected for systematic evaluation. (Federal Register 2003)

- Alternative 'A' is the *No Action* alternative. Required by NEPA, the no action alternative provides a baseline from which to measure environmental consequences.
- Alternative 'B' emphasizes the relative values of the forage resources, allocating only a small portion (5%) for domestic livestock grazing. Depending on annual conditions, this would limit grazing to less than 500 cow/calf pairs. Also under this alternative, much of the interior fencing could be removed. Earthen tanks could be repaired or rehabilitated as needed to support wildlife, protect resources, or even provide recreation opportunities.
- Alternatives 'C' and 'D' both allocate 15-20% (depending on annual conditions and current estimates of elk population, see Appendix C) of the Preserve's forage in support of domestic livestock grazing or other uses. Both alternatives propose the management of interior fences to protect resources, wildlife, and improve the efficiency of livestock operations. Earthen tanks would be repaired, maintained, or rehabilitated, as needed to support resource protection, as well as wildlife and livestock.

  Under Alternative 'C', programs for domestic livestock grazing would be required to be economically sustainable but relative benefits would be given equal or greater consideration when selecting or developing domestic livestock grazing programs. Relative benefits could include benefits to local producers and communities, enhancing the objectives on surrounding National Forest System land (the Santa Fe National Forest), providing educational opportunities, or gaining scientific knowledge.

  Under Alternative 'D', the Trust would give the economic return of programs and program efficiencies equal or greater consideration than other relative values.

  Alternatives 'C' and 'D' are considered with and without proposed improvements to buildings and facilities in support of ranching activities.

The lines between these alternatives are not as stark as the preceding descriptors may indicate. All the action alternatives include adopting goals for continued improvements in the ecological condition of the Preserve. No alternative limits nor guarantees participation based on residency or socioeconomic condition. Furthermore, the Trust is required to achieve a variety of goals and will continue efforts to balance goal attainment. However, by framing the alternatives in this manner both decision makers and stakeholders can clearly understand the direct and indirect benefits and tradeoffs, which can be realized from working towards various objectives.

Environmental Consequences

This chapter summarizes the effects to the natural and human environment expected to occur because of either taking no action or implementing an alternative action. Each of the nine sections of this chapter describes the affected environment and the likely consequences using quantifiable data whenever possible. Outcomes or effects are measured by context (the spatial or temporal extent of the effect) and intensity (the

magnitude of the effect). Outcomes may be beneficial or adverse and may be direct, indirect, or cumulative. *Outcome* is used interchangeably with *effect*.

This chapter provides information used to aid in decision-making and assess significance as required under NEPA.

A summary of the context and intensity of the effects is presented in a supporting narrative. The spatial extent of an effect is described in a narrative statement with or without a map for reference. Methodologies are included where helpful. The temporal extent of the effect is defined by three categories of duration (Federal Register, 2003):

- *Short-term*: 0-3 Years
- *Mid-term*: 3-10 Years
- *Long-term*: 10+ years

The intensity of the effect is defined by the following four levels of magnitude (intensity is influenced by context):

- *Negligible: No change would occur or the magnitude of change would not be measurable*
- *Minor: Changes would be measurable but would not alter the structure, composition, or function of the resource and would be limited in context.*
- *Moderate: Changes would be measurable and may influence the structure, composition, or function of the resource but would be limited in context.*
- *Major: Changes would be measurable, would alter the structure, composition, or function of the resource and may be extensive in context.*

As directed by NEPA, the environmental consequences section focuses on the key issues. The watershed and socioeconomic sections are lengthy and detailed. The following is a brief summary of *Chapter Three - Environmental Consequences*.

3.1 Watershed

Effects are considered on a Preserve-wide basis. Direct, indirect, and cumulative effects to water, soil, and vegetative resources combined at various watershed scales are presented. The current ecological condition of the Preserve is described as cumulatively impacted by historic grazing and timber harvest. Effects under each alternative, as measured from the existing condition are expected to be minor to moderate.

Overall conditions are expected to be maintained and/or improved, with somewhat greater improvements in both context and intensity to occur under Alternative 'B'. Localized moderate improvements to watershed conditions are expected as a result of infrastructure maintenance under all action alternatives. Proposed improvements to buildings and facilities were predicted to have negligible effects on watershed conditions at any scale.

3.2 Fire Ecology

The effect of the action alternatives to the management of fire and the natural fire regime are considered in this section. The effects paralleled the watershed effects and are expected to be negligible to minor.

3.3 Wildlife and 3.4 Aquatic Species

These sections focus on the effects to threatened and endangered species, sensitive species, as well as species of interest. Effects are expected to be negligible to minor and localized. None of the action alternatives are expected to adversely affect any of the species considered.

3.5 Cultural Resources

Effects to cultural resources are anticipated to be negligible.

3.6 Socioeconomic

Socioeconomic impacts are considered within a two-county (Sandoval and Rio Arriba Counties) analysis area over a four-year period. In the context of this analysis area, effects were negligible. Direct benefits resulting from domestic livestock grazing would be limited to the individuals who would actually graze livestock. Benefits to individuals would not likely be significant or change the current socioeconomic condition of any community or even individual. The number of cattle that would graze on the Preserve under any action alternative would not be significant relative to the number currently grazing on the surrounding lands. Even if the animals grazing on the Preserve were redistributed from the surrounding lands, it would not be sufficient to significantly affect the surrounding socioeconomic condition. Benefits could be meaningful at the individual level.

The analysis also considered the contribution of cattle grazing to the financial condition of the Preserve. Relative to the revenue required for overall Preserve operations, the contributions from domestic livestock grazing are predicted to be minor without considering the legacy of debt in the form of deferred maintenance needs for fences and tanks. Under Alternative 'D', by achieving a maximum economic return under the most efficient operation, deferred maintenance needs over the four-year analysis period could be addressed. Under Alternative 'C', contributions would be required beyond the income received through grazing fees to meet the deferred maintenance needs. These sources could include grants, volunteer projects, goods for services, and funds appropriated by Congress. Under Alternative 'B' the majority of the deferred maintenance needs would have to come from alternative sources. However, future maintenance would be reduced under Alternative B, which includes the removal of much of the interior fencing.

3.7 Sensory Resources

This section considers the potential effects to the Preserve's sights, sounds, and overall "sense of place". The effects of any alternative were predicted to be minor. The Preserve

has been a working ranch for a century and a half. This aspect of the Preserve is retained on the landscape through the remnants of the historic ranch infrastructure including picturesque cabins and corrals. All the action alternatives retain a modern component of a working ranch although the dominance of ranching activities varies between the alternatives. Relative to past management, the action alternatives include only conservative livestock programs being managed in context with a variety of programs on the Preserve, creating a contrast with the "working ranch" of the previous century.

3.8 Recreation

The effects of the action alternatives to recreation programs and activities are considered in this section. Overall, the effects are expected to be localized and minor to moderate. Recreation programs are affected by both the presence of livestock, livestock management activities as well as fences and gates that constrain movement across the landscape. While the no action alternative would eliminate logistical challenges of managing livestock in context with managing recreation programs, fences, gates, and other barriers would still impact recreation activities. Under Alternative 'B', there would be only minimal numbers of livestock and therefore impacts to recreational programs would likely be negligible to minor and localized. Most interior fences and gates would be removed creating unimpeded access for equestrian and pedestrian movement. The larger earthen tanks could be used to support recreation activities.

Under Alternatives 'C' and 'D', the number of cattle would be similar to the level grazing on the Preserve over the last five years (under the interim grazing program). However, the increased distribution of cattle supported by the management of infrastructure would reduce potential conflicts with recreation activities.

3.9 Significance

The President's Council for Environmental Quality identifies elements that need to be considered in the determination of significance. This section ensures that that the deciding official has access to all information necessary for making a determination of significance and implementing decision.

Effects in Relation to Key Issues

- *Key Issue: Domestic livestock grazing can combine with use by elk and other native fauna to affect sensitive riparian areas*.

Alternative B best addresses this key issue. While Alternative A eliminates grazing by domestic livestock, grazing by elk and other herbivores would continue. In addition, resource damage being caused by fences and tanks would persist under Alternative A. Alternative B includes only a minor allocation of forage to domestic livestock; less than what has been allocated during the interim period during which a steady improvement in ecological condition has been measured. In addition, Alternative B addresses sources of sediment deposit and erosion through the management of infrastructure.

Alternatives C and D would maintain or continue to improve ecological conditions. The degree of improvement over time would likely be somewhat less than under Alternative B. While minor or localized effects from livestock could occur under Alternatives C and D, improvements would also occur from the maintenance and improvement of infrastructure.

- *Key Issue: Domestic livestock grazing programs can conflict with, or affect visitor activities and experiences.*

This issue would be best addressed by Alternative B. Alternative A eliminates grazing by domestic livestock thereby eliminating potential conflict between recreation and grazing. However, Alternative B includes only a minor allocation of forage to domestic livestock, well within the ability of the Trust to all but eliminate any potential conflicts. In addition, Alternative B includes the removal of most interior fences, increasing opportunities to traverse the Preserve unimpeded by fences and gates. Under Alternative B, several of the larger earthen tanks on the Preserve would be repaired creating possible locales for picnicking or the development of flat-water fisheries in the future.

Alternatives C and D would allow the Trust to reduce conflicts with recreation activities by allowing greater flexibility in distributing livestock than has been the case during the interim grazing period. In addition, the management of infrastructure would support the desired distribution and management of livestock. While these alternatives would retain much of the interior fencing currently in place, they would also permit the construction of ride or walk through gates to improve cross-country access. These alternatives include the repair of earthen tanks however; the purpose of these tanks would primarily be to improve the distribution of cattle and would limit opportunities to develop these water sources for recreational purposes.

- *Key Issue: Optimizing the attainment of any one goal is not exclusive of the attainment of any other goal but is likely to affect the level and timing of such attainment.*

All the action alternatives allow for the operation of the Preserve as a "working ranch" consistent with other goals and purposes. Alternative B has only a minor component of what is traditionally the dominant activity on ranches. However, it permits a variety of land-based revenue generating activities that are consistent with a working ranch and may reflect a more modern trend increasingly common on small ranches. Alternative B does not include a sufficient cattle operation to cover the deferred maintenance costs of the ranching infrastructure.

Alternative C provides for the most "balanced" level of goal attainment. This alternative allocates forage in context with wildlife and goals for continued improvement to ecological measures. Domestic livestock programs implemented under Alternative C would weight relative values such as benefits to local communities and enhancement of objectives on surrounding forest land as equitable to monetary returns (provided that monetary returns were sufficient to cover operational costs).

Alternative D_1 is the only alternative where revenue generated through domestic livestock grazing are estimated to not only pay for annual operations but would be sufficient to cover the deferred and annual maintenance of infrastructure. Under Alternative D_1,

forage is allocated in context with wildlife and the continued improvement to ecological measures. Where consistent with ecological goals and the needs of wildlife, the emphasis would be on economic returns. Relative benefits could be considered where they did not outweigh revenue concerns.

Alternatives C_2 and D_2 address the deferred maintenance needs of several ranch related facilities. Unlike Alternative D_1, D_2 could not be implemented with revenues generated from domestic livestock grazing. It is important to note that the deferred maintenance of both facilities and infrastructure represent a debt inherent with the acquisition of the Preserve. Facilities maintenance and improvements proposed under C_2 and D_2 are not connected or necessary to the implementation of livestock grazing or other programs. Either of these Alternatives could be selected with the caveat that implementation may or may not occur based on available funding or sufficient revenue generation.

None of the action alternatives would make more than minor contributions towards the Trust's goal for financial self-sufficiency. Federal overhead required to ensure compliance with laws and program oversight are not included in the financial assessment.

Findings and Decisions

The EA was distributed and otherwise made available for public review and comment from December 19, 2008 through February 2, 2009 (45 days). In response to timely requests made by the public, the Trust extended the comment period through February 12, 2009 (55 days).

On March 2, 2009 the Trust released a preliminary Finding of No Significant Impact (FONSI) and a summary of comments and responses for a 30 day public comment and review period through April 1, 2009. This permitted a feedback loop for public comment prior to making a final determination regarding significance and a subsequent implementing decision.

On April 07, 2009 the Responsible Official (Gary Bratcher, Executive Director) signed the final FONSI and made the decision to implement Alternative D_2, stating, "I find this alternative to be most compliant with the Valles Caldera Preservation Act, specifically in the ability of O*ptimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the multiple use and sustained yield capability of the land*."

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ACRONYMS AND ABBREVIATIONS

Act	Valles Caldera Preservation Act of 2000
AOM	Annual Operating Instructions
AU	animal unit
AUMs	animal unit months
CEQ	Council on Environmental Quality
CHU	Critical Habitat Unit
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
Framework	*Framework and Strategic Guidance for the Comprehensive Management of the Preserve*
FSM	Forest Service Manual
HUC	Hydrological Unit Code
lbs/acre	pounds per acre
MANLAA	may affect, not likely to adversely affect
MBTA	Migratory Bird Treaty Act
MIG	Minnesota IMPLAN Group
MIIH	may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population.
MUSY	multiple use and sustained yield
n.d.	no date
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFS	National Forest System
NI	no impact
NM	New Mexico State Highway 4
NMED	New Mexico Environmental Department
NPV	net present value
NRCS	National Resource Conservation Service
P.L.	Public Law
PAC	Protected Activity Center
Preserve	Valles Caldera National Preserve
TES	threatened, endangered, or sensitive
TMDLs	total maximum daily loads
Trust	Valles Caldera Trust
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

Multiple Use and Sustained Yield of Forage Resources

The Valles Caldera Trust (the Trust) has purposely used the term "multiple use and sustained yield" in the naming convention of the Stewardship Action.[4] In the Valles Caldera Preservation Act of 2000 (the Act), Congress references the multiple use and sustained yield (MUSY) of resources when describing the purposes for the acquisition of the Valles Caldera National Preserve (the Preserve) and the six goals assigned for its comprehensive management. Congress clarified its use of the term under Section 103 (5), as consistent with the Multiple Use and Sustained Yield Act of 1960 (16 U.S. Code [U.S.C.] 531), which states:

> *[A]s used in this Act, the following terms shall have the following meanings:*
>
> *(a) "Multiple use" means: The management of all the various renewable surface resources of the national forests so that they are utilized 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.*
>
> *(b) "Sustained yield of the several products and services" means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.*

Working Ranch

In 2005, the Trust's Board of Trustees published the *Framework and Strategic Guidance for the Comprehensive Management of the Preserve*. In the *Framework*, a working ranch is defined as "*an operation that places its primary emphasis on stewardship of resources as the foundation for both ecological and economic sustainability*". The *Framework* continues that a working ranch "*runs a sustainable level of livestock, adjusting numbers as necessary; makes resources available for other revenue-generating activities such as bird watching, hunting, fishing, and other low-impact recreational activities; applies adaptive management on a day-to-day basis to ensure resource protection; and monitors the impacts of its activities* (Valles Caldera Trust 2005). This definition is compatible with English dictionary, industry, and other "plain language" definitions. In addition, it frames the meaning of a working ranch in context with the other goals put forward in the Act.

[4] means an activity or group of activities consisting of at least one goal, objective, or performance requirement proposed or implemented by the Responsible Official that may: (1) Guide or prescribe alternative uses of the Preserve upon which future implementing decisions will be based; or (2) Utilize or manage the resources of the Preserve (Federal Register 2003).

1.1 Introduction

The Valles Caldera Trust (the Trust) is proposing to continue operation of Valles Caldera National Preserve (the Preserve) as a working ranch consistent with the goals stated in the Valles Caldera Preservation Act of 2000 (the Act). Toward this end, the Trust is proposing to continue programs for domestic livestock grazing and to manage the Preserve's ranch infrastructure. The Trust is also proposing to adopt goals, establish objectives, and identify monitored outcomes that would guide or prescribe the proposed multiple use and sustained yield (MUSY) of forage, as well as other future implementing decisions.

1.1.1 The Valles Caldera National Preserve

The federal government acquired the Preserve in 2000. The Preserve is a nearly 89,000-acre unit of National Forest System (NFS) land located in the Jemez Mountains of north-central New Mexico, primarily in Sandoval County (see Figure 2).

Nearly one-third of the Preserve is comprised of grasslands while the remaining two-thirds are largely forested. The name "Valles Caldera" refers to the series of expansive grassy valleys, or "valles", contained within an approximately 13-mile-wide collapsed volcanic crater, or "caldera". Caldera is Spanish for cauldron or kettle as well as a geologic term. Most people associate the Preserve with the "Valle Grande", one of the largest of the valles. New Mexico State Highway 4 (NM 4) traverses the southern edge of the Valle Grande, providing a panoptic view of this landmark, iconic of the Preserve (see Figure 1).

1.1.2 The Valles Caldera Trust

Forests and grasslands designated as NFS land are typically managed by the U.S. Forest Service (USFS). However, the Trust, a wholly owned government corporation, manages the Preserve.

Management of the Preserve by the Trust began in 2002 when President William Jefferson Clinton appointed the nine-member governing Board of Trustees. The management of the Preserve by the Trust is considered an experiment in public land management. The Trust is charged with mixing elements of both private and public administration while working to achieve the goals of the act, including financial self-sufficiency (U.S.C., 2000).

For the past 5 years, the Trust has been managing a variety of "interim" programs for public use and access to the Preserve and resource management, including seasonal domestic livestock grazing. During this period, the Trust has also made a considerable investment in quantifying the resources of the Preserve.

Based on the knowledge acquired over the past 5 years, the Trust is proposing to transition from the interim program for domestic livestock grazing to a comprehensive program for the multiple use and sustained yield of the Preserve's forage resources consistent with the Act.

Figure 1 – The Valle Grande

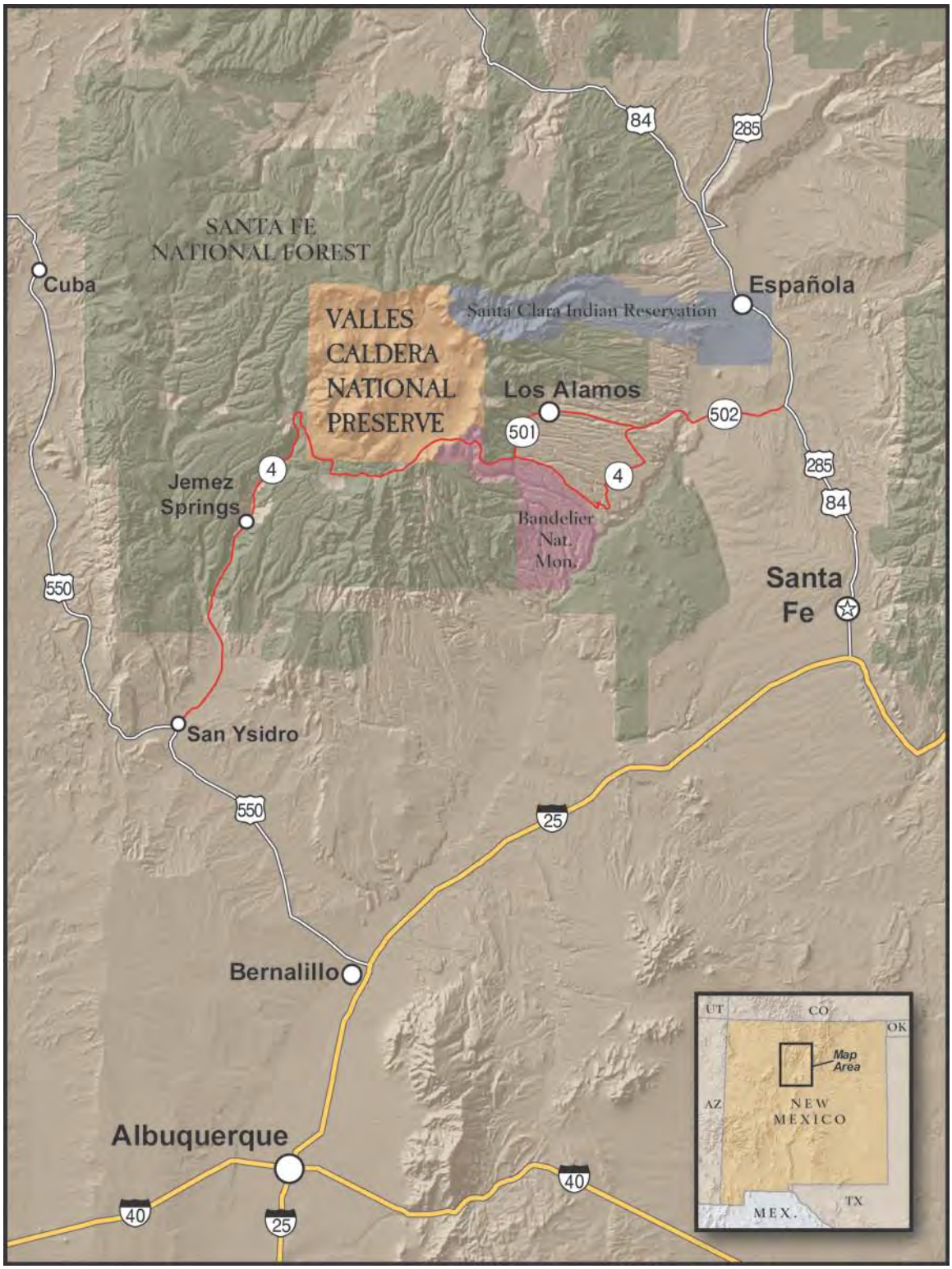

Figure 2 – Vicinity Map of the Valles Caldera National Preserve, Sandoval and Rio Arriba Counties, New Mexico.

1.2 Purpose and Need

The purpose and need for action is based on the Trust's enabling legislation and other applicable laws; the existing condition of the Preserve's resources, infrastructure, and facilities; and lessons learned from the implementation of the interim program for domestic livestock grazing.

1.2.1 Purpose and Need – Statutory Purposes

To meet the purposes and goals of the act consistent with the Trust's procedures for implementing the National Environmental Policy Act (NEPA) published by the Trust in 2003 (Federal Register 2003), the Trust needs to adopt goals, and identify objectives, monitored outcomes, and performance requirements to guide the multiple use and sustained yield of forage resources.

Direction to manage the Trust as a working ranch, as well as the parameters for doing so, is provided in the Act. Section 102 (b) lists five purposes for the passage of the Act:

1. *to authorize federal acquisition of the Baca ranch;*
2. *to protect and preserve for future generations the scientific, scenic, historic, and natural values of the Baca ranch, including rivers and ecosystems and archaeological, geological, and cultural resources;*
3. *to provide opportunities for public recreation;*
4. *to establish a demonstration area for an experimental management regime adapted to this unique property which incorporates the elements of public and private administration in order to promote long-term financial sustainability consistent with the other purposes enumerated in this subsection; and*
5. *to provide for sustained yield management of Baca ranch for timber production and domestic livestock grazing insofar as it is consistent with the other purposes stated herein."*

Section 108 (d) sets forth six goals for comprehensive management of the Preserve as follows:

1. *operation of the Preserve as a working ranch, consistent with paragraphs (2) through (4);*
2. *the protection and preservation of the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural and recreational values of the Preserve;*
3. *multiple use and sustained yield of renewable resources within the Preserve;*
4. *public use and access to the Preserve for recreation;*
5. *renewable resource utilization and management alternatives that, to the extent practicable –*
   - A. *benefit local communities and small businesses;*
   - B. *enhance coordination of management objectives with those on surrounding National Forest System land and; and*
   - C. *provide cost savings to the Trust through the exchange of services, including but not limited to labor and maintenance of facilities, for resources provided by the Trust; and*
6. *optimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the multiple use and sustained yield capability of the land.*

1.2.2 Purpose and Need – Ecological Goals

To meet the goals for resource protection and preservation established by the Act and comply with the Multiple Use and Sustained Yield Act of 1960 (see "Preface"), the Trust needs to establish goals to sustain the forage resources of the Preserve and protect the resiliency of the associated ecosystems into perpetuity. Activities that use or may affect these resources need to identify measurable objectives and select monitored outcomes that ensure progress toward ecological goals.

The *Framework and Strategic Guidance for the Comprehensive Management of the Preserve (Framework*) (Valles Caldera Trust, 2005) introduces the concept that the central goal for management at the Preserve "*should be to increase the resilience and, to the extent possible, the integrity of its ecological condition."* The concept of ecosystem resilience and integrity are somewhat quantified in the term "reference condition", which refers to "*the composition of landscape vegetation and disturbance attributes that, to the best of our collective expert knowledge, can sustain current native ecological systems and reduce future hazard to native diversity"* [USDA- Rocky Mountain Research Station 2005).

Based on a systematic assessment of field sampled data collected over a 5-year period, the ecological condition of the Preserve can be described as stable or improving (T.E.A.M.S., 2007). Upland and riparian characteristics synthesized at a sub basin watershed[5] level (Figure 3) indicate that most of the Preserve is moderately departed from the reference condition with only three sub basins rated as within the range of variability of the reference condition.

Stream bank characteristics such as width-to-depth ratios, average temperatures, and stream-bottom attributes showed a measurable improvement from 2002 to 2006. Water quality assessments completed in 2006 by the New Mexico Environment Department (NMED) acknowledge the general upward trend but found that water quality continued to be impaired with exceedances in temperature and turbidity (State of New Mexico, 2006).

[5] A watershed is defined as the land area that drains water to a particular stream, river, or lake. The Preserve is contained within the Jemez Watershed or the lands that ultimately drain into the Jemez River. The Trust has defined smaller landscapes based on water drainage as useful units for analysis.

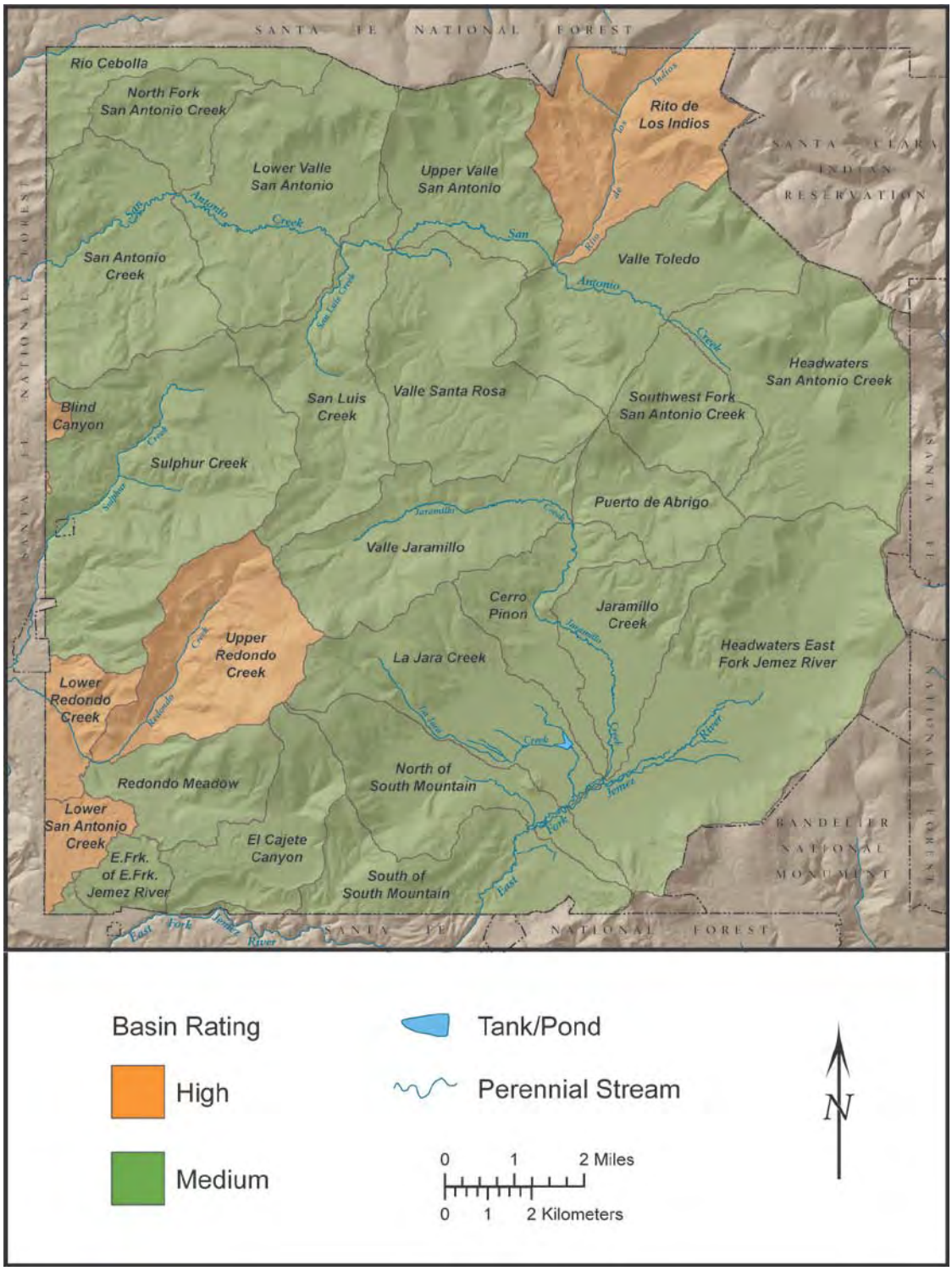

Figure 3 – The ecological condition of the Preserve is displayed at the sub basin level. Condition Class I (High) indicates the ecological condition is within the range of the reference condition; Condition Class II (Medium) indicates a moderate but measurable departure from the reference condition (T.E.A.M.S., 2007)

1.2.3 Purpose and Need – Forage Allocation

The Preserve needs to allocate forage in context with continued improvement in ecological condition, in support of the needs of native fauna, and in consideration of the variability of the Preserve's resources and climate.

Approximately 7,000 elk travel freely across their range in the Jemez Mountains. This range includes the Santa Fe National Forest, Bandelier National Monument, and the Preserve, as well as surrounding tribal and private lands. Approximately 2,500 elk (+/-1,000) reside on the Preserve for most of the year, leaving only when deep, heavy snows limit their access to forage (Teams Enterprise Unit – USFS 2007). There is an overlap of 96 percent between land suitable for grazing by elk and grazing by cattle.

The annual productivity of forage is highly variable depending on climate. The primary indicator for forage productivity is winter and spring precipitation and the resulting soil moisture. Spring temperatures influence the length of the growing season. Production values are higher in the valles with an overall decline in production occurring in the forests.

1.2.4 Purpose and Need – Multiple Use of Forage

Since 2002, the Trust has administered annual programs for domestic livestock grazing on an interim basis. The purpose of the interim grazing program, in part, has been to provide information to contribute to the design of livestock grazing programs that are ecologically and economically sustainable. Based on information gained from managing the interim grazing program, the Trust needs to implement and manage diverse and conservative programs for the multiple use and sustained yield of the Preserve's forage resources. The Trust needs flexibility to respond to environmental and market conditions, develop opportunities to work with stakeholders, and try innovative approaches to realize opportunities or address issues. Program outcomes need to be transparent to interested stakeholders.

1.2.5 Purpose and Need – Infrastructure Management

The Trust needs to manage the infrastructure, including fences, tanks, corrals, and structures connected to the management of the Preserve as a working ranch. The Trust needs to improve or modify existing facilities in support of annual programs utilizing forage resources.

Over the past century, fences, corrals, earthen-stock tanks, outbuildings, barns, and pole sheds were constructed in support of ranch operations. Much of the infrastructure was poorly constructed and, for purposes of operating the Preserve under the Act, poorly located. Fences constructed of woven wire (also known as "sheep fence") are extremely hazardous to wildlife (see Figure 4) and need to be removed or replaced. Fences aligned perpendicular to streams cause trailing and subsequent erosion (see Figure 5) and need to be removed or relocated. In addition, some existing fences bisect the valles, which limits recreational opportunities and detract from scenic values. The existing fences do not provide a comprehensive system of barriers necessary

for the efficient control of livestock and maximum resource protection. The Trust currently maintains over 54 miles of perimeter fence and 64 miles of interior fence.

Figure 4 – Young bull elk entangled in woven wire fencing.

Figure 5 – Fence constructed perpendicular to San Antonio Creek leads to concentrated trailing by elk and livestock, causing erosion and sediment deposits in streams.

The Trust has inventoried and assessed 136 earthen stock tanks on the Preserve. More than 30 percent of the tanks are no longer functioning, causing erosion and sediment deposition in streams. Some earthen tanks have the potential to breach and damage Preserve resources. Some of the functioning tanks are in disrepair and currently causing resource damage (T.E.A.M.S., 2007). Existing stock tanks need to be repaired, maintained, relocated, removed, or replaced.

Figure 6 – Even tanks that are still considered functional are causing resource damage during high water events.

The Preserve currently lacks on-site facilities suitable to administer ranch operations. The "Horse Barn" (see Figure 7) located just east of the headquarters area is potentially suitable to support ranching activities. However, deferred maintenance needs to be addressed including, structural, electrical, ventilation, accessibility, and rodent and other health and safety concerns (USFS Gila NF, Engineering Department, 2006).

Figure 7 – The horse barn, located northeast of the historic ranch district, (SWCA Environmental Consultants, 2007).

1.3 Proposed Action(s) and Performance Requirements

The Trust is proposing to continue operation of the Preserve as a working ranch consistent with the goals stated in the Act. Toward this end, the Trust is proposing to continue programs for domestic livestock grazing and to manage the Preserve's ranch infrastructure. The Trust is also proposing to adopt goals, establish objectives, and identify monitored outcomes that would guide or prescribe the proposed use of forage, as well as other future implementing decisions.

1.3.1. Proposed Action – Goals Objectives and Monitored Outcomes

The Trust is proposing to adopt ecological goals[1] and establish objectives[2] and monitored outcomes[3] to measure goal attainment. This action is programmatic in nature, intending to guide or prescribe both current and future activities on the Preserve. This system of goals, objectives, and monitored outcomes would be used to implement adaptive management as described in the NEPA procedures of the Trust (Federal Register, 2003).

Goals

Goals describe a desirable condition as sought by the Trust. Based on a review of the *State of the Preserve* (Valles Caldera Trust, 2007) and in pursuit of the central goal for management put forward in the *Framework*, the Trust is proposing to adopt the following goals for the ecological condition of the Preserve measured at the sub basin watershed level (see Figure 3):

Ecological Condition

The ecological condition of the Preserve would be moving toward the composition of landscape vegetation and disturbance attributes that, to the best of our collective expert knowledge, can sustain current native ecological systems and reduce future risk to native diversity (USDA-USFS Rocky Mountain Research Station 2005).

Watersheds at the sub basin level would be in, or making continued progress toward, properly functioning physical condition, including their upland, riparian-wetland, and aquatic components. Soil and plant conditions would support water infiltration, storage, and release that would be in balance with climate and landform. Water quality, water quantity, and timing and duration of flow would be maintained or improved.

Ecological processes, including the hydrologic cycle, nutrient cycle, and energy flow, would be maintained or making progress to support healthy biotic populations and communities.

Water quality would meet or exceed state water quality standards or would be making significant progress toward achieving those standards.

Habitats for federal threatened and endangered, federal proposed, Category 1 and 2 federal candidate, other special status, and native species would be sustained or improving.

Objectives

Objectives are desired outcomes for the Preserve that can be meaningfully evaluated in time and space. The following objectives are being proposed as metrics to measure progress in attaining the ecological goals previously described.

Upland Objectives

Objectives for upland characteristics, including percent cover of bare ground, vegetation, litter, and trees are based on values predicted for the Ecological Site represented using National Resource Conservation Service (NRCS) approved ecological sites descriptions, which have been refined based on site-specific field sampled data.

Because of the variability of data from individual plots, the Trust would measure objectives in several ways:

1. The mean value summarized by ecological site (see Table 1 and Table 2).
2. Departure from the cumulative mean for each of 41 monitoring sites.
3. Departure from the cumulative mean summarized by ecological site.

Table 1 – Objective Upland Characteristics

Ecological Site	Bare Ground	Grass/Forbs	Litter
Riparian	<2 – 5%	>90%	>80%
Mountain Meadow	<3%	>90%	>80%
Mountain Valley	<4 – 5%	>90%	>80%
Grazeable Woodland	<4%	>70%	>80%

Table 2 – Species Composition Objectives

Ecological Site	All Grass	Native Grass	Shannon-Weiner Diversity Index[6]
Riparian	>90%	>50-70*%	>2.5
Mountain Meadow	>90%	>50-70*%	>2.5
Mountain Valley	>90%	>80-90*%	>2.0
Grazeable Woodland	>70%	<60-80*%	>2.0

*Depending on site

[6] A diversity index combines the number of species (richness) within the distribution and relative abundance of the species.

Species Composition Objectives

Native species would be sustained or increase in represented abundance. Current levels of diversity would be sustained or increased. Noxious weeds (Class A, B, or C as listed for the State of New Mexico) would not be present.

Riparian Function/Stream Condition/Water Quality Objectives

Riparian areas and streams would be properly functioning as indicated by measurements of water quality, habitat characteristics, and channel condition (Pritchard, et al., 1998).

Water quality would meet standards for designated use as established by the NMED and indicated by measures of total maximum daily loads (TMDLs) or the amount of pollutant a stream or river can assimilate. Table 3 presents the factors and indicators measured within streams and riparian areas.

Table 3 – Water Quality and Riparian Characteristics

Factors	Indicators
Water Quality	Temperature; 3-day average Temperature; 7-day average Maximum temperature/duration of exceedances Turbidity, Dissolved Oxygen, pH
Habitat Characteristics	Sediment Large woody debris Pool development Pool quality
Channel Conditions and Dynamics	Stream bank conditions; width to depth ratios

Monitored Outcomes

Outcomes are the results or consequences of a Stewardship Action that can be meaningfully evaluated by location and time of occurrence (Federal Register, 2003). The Trust is proposing to monitor the following outcomes as metrics toward meeting the described objectives. The monitored outcomes[3] being proposed are short- to mid-term (1- to 5-year) outcomes. Measurements would be taken annually at 41 existing ecological monitoring sites (see Figure 56); every 5 years within the five permanent ungulate exclosure sites; and daily during ice-free seasons at water quality stations. Additional monitoring sites, including upland and woodland exclosures may be added.

Production and Utilization

Production and utilization of forage would be monitored annually. Currently, production and utilization are monitored using field-sampled data. Other methods yielding results of equal or greater accuracy and precision may be adopted.

Ecological Condition

Changes in vegetative structure, species composition, and ecological function would be synthesized annually using field sampled and other data.

Species Composition

Species composition and diversity would be evaluated annually using field sampling.

Noxious Weeds

Inventories for noxious weeds would be ongoing.

Water Quality

Water quality would be measured continuously during ice-free seasons, evaluated annually, and evaluated cumulatively every 3 to 5 years.

Proper Functioning Condition (Stream)

Stream morphology (form and functions) would be measured annually, and the proper functioning condition would be evaluated every 5 years.

Cumulative Effects

Monitored outcomes would be synthesized every 5 years to measure cumulative effects. This synthesis would be documented in the *State of the Preserve*. The *State of the Preserve* provides a concise account of the systematic review of monitored outcomes and interpretive information from, but not limited to, observations studies, public comment, research investigations, natural resources data or information summaries, and other sources to provide the technical and scientific basis for considering the cumulative effects of the past, present, and reasonably foreseeable future actions of the Trust (Federal Register 2003).

1.3.2. Proposed Action – Forage Allocation, Multiple Uses of Forage, and Infrastructure Management

This section describes the proposed allocation and use of forage, connected infrastructure management, and proposed improvements to facilities. Associated with each activity is a list of performance requirements, which would guide the implementation of the proposed activities. The performance requirements would serve to mitigate any adverse impacts that could result from the proposed activities. These performance requirements would be included in any action alternative unless otherwise noted.

Forage Allocation

Forage Allocation – Actions

To fulfill the purpose and goals enumerated in the Act, the Trust is proposing to allocate the forage resources of the preserve as follows:

- 60 percent to preserve and protect ecosystem processes and faunal habitats and to sustain production of these resources into perpetuity.
- 20 to 25 percent, depending on current conditions and elk population estimates, to support elk and other herbivore wildlife.
- 15 to 20 percent, depending on current conditions and elk population estimates, for use by the Trust to support domestic livestock grazing or other commercial uses, as well as scientific, education, or other public uses.

This allocation would be based on accepted standards for estimating the quality and quantity of forage emphasizing the use of field-sampled or otherwise measured values. This allocation should vary in time and space considering variations in production and climate inherent in wildland environments. The Trust would use the values listed in Tables 4 and 5 for allocating forage on an annual basis:

Table 4 – Animal Unit (AU) Equivalents

Animal	AU Value	Monthly Forage Allocation Pounds (dry weight)
Cow/calf pair, Bull (bovine), Horse	1.0	900
Steer/heifer/yearling	.7	630
Elk	.6	540

Table 5 – Animal unit capacity in context with elk and climate

Elk Population Estimate	Number of Animal Units for 120 days under various climate scenarios				
	Optimum	Favorable	Average	Unfavorable	Drought
2500 elk	2732	1862	991	227	*-536*
3000 elk	2282	1412	541	*-223*	*-986*

Optimum: Capacity of the wettest year evaluated
Favorable: Modeled capacity between average and optimum
Average: Mean capacity 2002-2008
Unfavorable: Modeled capacity between drought and average
Drought: Capacity under driest conditions evaluated

Forage Allocation – Performance Requirements

- 60 percent of the aboveground forage would be allocated to ecosystem services (Crider 1954).
  - Exceptions could be made to support specific projects for research, inventory, or monitoring or projects to accomplish specific objectives through utilization; provided that those projects would be limited in time and location.
- Allocation of forage for use by domestic livestock grazing or other uses by the Trust would include allocation for elk based on current year population estimates.
- The animal unit[7] (AU) values in Table 4 would be assigned.

[7] A mature cow with a calf at her side is considered 1.0 animal unit (AU) and is expected to consume 30 pounds of forage per day. Allocation is often expressed as animal unit month (AUM). One AUM equals 900 pounds of forage.

- Animals not listed would be assigned an AU value based on size or published data.

- Capacity for elk and domestic livestock would be determined using areas with weighted[8] production values greater than 225 pounds/acre (use could occur Preserve-wide).
  - Exceptions could be made to support specific projects for research, inventory, or monitoring, provided that those projects would be limited in time and location.
- Commitments for numbers (animal unit months [AUMs]) in out years would be based on average capacities (Table 5) and adjustable based on actual conditions.
- Commitments for numbers based on optimum or favorable capacities (Table 5) would be made based on actual winter or spring precipitation and resulting soil moisture conditions.
- The Trust would continue annual monitoring to measure use and make management adjustments as necessary.
- The Trust could add additional monitoring sites and exclosure systems.
- Elk population estimates, currently at 2,500, would be updated as new verifiable information is available.
- Climate data, including temperature and precipitation, would be collected in a manner that can be correlated with production. Allocation can be adjusted based on trends identified in field-sampled production data or other method of actual measurement.

Multiple Use of Forage

Multiple Use of Forage – Actions

Based on the proposed allocation of forage and annual conditions, the Trust is proposing to continue programs for domestic livestock grazing. To meet the purposes and goals of the Act further, the Trust is proposing to operate programs that contribute to the long-term financial self-sufficiency. Where practicable, the Trust would consider programs that benefit local producers and enhance the management objectives on surrounding NFS lands while seeking to optimize the generation of income based on existing market conditions.

Annual capacity would be determined by available forage and water as well as the consideration of other programming needs.

Besides domestic livestock grazing, the Trust is proposing other commercial uses of forage such as the harvesting of native and nonnative seeds and plants. The Trust is also proposing multiple use of forage to support research and education.

Multiple Use of Forage – Performance Requirements

- The area surrounding the historic district and individual cabins or historic features would continue to be excluded from grazing by domestic livestock.
- The headwaters of the East Fork Jemez River, Jaramillo Creek, San Antonio Creek, Indios Creek, and Alamo Canyon (see Figure 11 – *Landscape Features* and Figure 43 – *Aquatic*

[8] Total forage production factored by actual slope and distance to water (T.E.A.M.S. 2007).

Habitats) would be protected from domestic livestock grazing using herding, fences (either temporary or permanent), or other barriers such as logs or rocks.

- Fencing or other barriers would be used to protect populations of bog birch (*Betula pumila)* in Alamo Canyon from browsing by ungulates.
- Site selection for the placement of supplements would be on roadbeds or otherwise disturbed areas.
    - Exception: Supplements may be otherwise placed upon completion of the Valles Caldera Trust Interdisciplinary Clearance Process (Appendix A).
- Annual operating plans would coordinate livestock use to reduce conflicts with recreational, interpretive, educational, and other program activities.
- Commitments would be contingent on actual economic return to the Trust and would allow termination if expected returns are not realized.
- Domestic livestock grazing programs would return an amount to the Trust greater than or equal to operational costs incurred by the Trust. If such a program does not provide a sufficient return, it may be extended only if there is reasonable certainty based on market conditions or program adjustments to expect the necessary increase in return. Any such program that does not provide sufficient return for 2 years would be terminated.
    - Exception: The Responsible Official (in this case, the Executive Director of the Trust) or their designee may request authorization from the Board of Trustees to continue such a program. The request must be made and authorization given at a public meeting of the Board of Trustees. The request would be presented with a summary of the costs and benefits of the program and the reason for requesting its continuation.
- Programs should avoid long-term increases in the allocation of forage throughout the regional area and long term commitments to individuals and organizations.
    - To meet this requirement, programs could limit commitments in duration or could redistribute existing allocations. Programs that can easily be adjusted on an annual basis such as yearling, stocker-steer, or replacement heifer operations could also meet this requirement.
- Contracts and agreements for domestic livestock use will include measures to prevent noxious weeds. These measures could include confining animals prior to or upon arrival, cleaning vehicles and otherwise minimizing risks associated with vehicles.
- To protect the Mexican spotted owl, its habitat and prey[9], activities:
    - would not occur within Mexican spotted owl habitat during the breeding season,
    - would be managed for levels that provide the woody and herbaceous vegetation necessary for cover for rodent prey species,
    - include monitoring Mexican spotted owl foraging areas and maintain forage utilization at conservative use levels (30 to 40 percent utilization), and

[9] Currently there are no Mexican spotted owl on the Preserve or using the Preserve. This performance requirement would be in effect if/ when Mexican spotted owl move onto the Preserve to nest or forage.

- maintain good to excellent range conditions within key grazing areas based on objectives and monitored outcomes being evaluated.

Infrastructure Management

Infrastructure Management – Actions

In support of efficient and environmentally sound management of the Preserve as a working ranch consistent with resource protection, public use and access, and the multiple use and sustained yield of resources, the Trust is proposing the following activities to manage existing fences:

- Locate and document the character of the historic fence lines.
- Fences constructed with woven wire may be removed or replaced.
- Fences perpendicular to streams, which are causing resource damage, may be removed or relocated.
- Fences bisecting valles may be removed, relocated, or replaced with temporary fencing.
- Superfluous and nonfunctioning fences may be removed, reconstructed or relocated.
- Additional gates for equestrian/pedestrian access may be constructed.
- Gates and cattle guards may be removed, replaced, maintained, or relocated.

In addition, temporary or drop-down fences[10] would be employed as needed to split larger pastures; create paddocks for greater herd control; support research, inventory, or monitoring, or other temporary needs. The Trust may also use natural barriers or construct barriers from natural materials. Rocks and woody debris may be used to protect stream banks, specific vegetation, or cultural resources effectively.

Activities connected with the removal, repair, and construction of fences include the hauling of materials, tools, and equipment using all-terrain vehicles (ATVs), livestock, or trucks. Construction of new temporary or semi permanent fences would be guided, limited, or constrained by the listed performance requirements.

Table 6 – Estimate of fence, construction, maintenance, repair, and removal

Activity:	Remove	Replace	Repair/Upgrade	New Permanent or Temporary
Distance (miles)	12-14	17-19	6-7	2.5-3.5

The Trust is also proposing to repair, replace, maintain, or close and rehabilitate existing earthen tanks as needed to stop or prevent resource damage and to improve the distribution of elk and cattle. New watering systems could be developed as needed to support distribution of livestock and wildlife.

[10] Drop down fences use a combination of permanent and temporary fencing to where a barrier is need in a location for a short period on a reoccurring basis.

Four earthen tanks would be prioritized for improvements. These are the larger tanks in the Valle de los Posos, Valle Seco, Rincon de Soldados, and Valle Grande. These four tanks have not been able to handle large storm events, resulting in damage over time to the spillways of each (Ericson Engineering and Consultants, 2006).

The proposed improvements include lining of the spillways with erosion-resistant materials such as concrete or wire wrapped riprap; grading, widening, and leveling of the dams, followed by reseeding with natural vegetation. Dams that have breaches in portions of the downstream berms would need additional repair. Silt may be removed from within ponds of some or all of the tanks and used as fill for repairing the spillways. Work at some or all of the tanks may involve earth removal and grading to improve tank access. Local material would be used for repair, but some foreign fill or specialized media may be needed. To make these repairs, heavy equipment, including (but not limited to) bulldozers, backhoes, graders, dump trucks, or cement trucks, may be used. These tanks have been prioritized based on the likelihood of their failure and the effects of their failure. These are the largest tanks on the Preserve, and their failure would have the greatest effect.

Other tanks would require similar activities for repair and maintenance. The intensity of the action would be scaled to the size of the tanks with the aforementioned tanks being the largest and requiring the greatest intensity of activity. New drinking systems could be developed as needed to improve the distribution of elk and cattle. The installation of solar-operated tanks or other systems that have less potential to deteriorate would be considered for new water development.

Infrastructure Management – Performance Requirements

- Building, repairing, removing, or obliterating earthen tanks other water systems, fences, corrals, other barriers or similar ranch infrastructure would require the completion of the Valles Caldera Trust Interdisciplinary Clearance Process (Appendix A).
- The Valles Caldera Cultural Resources Clearance Process would be completed prior to initiating any ground-disturbing activities.
- To minimize impacts to the northern goshawk, proposed construction activities (fences, water developments, earthen tanks) planned within suitable habitat should occur October 1 through February 28 to avoid disturbance during breeding season. If goshawk surveys were completed in May/June at each project site within suitable habitat and were negative for response, then construction at that site can proceed with no seasonal restrictions.
- To minimize impacts to the northern leopard frog and other small native faunal species, water troughs should be designed with exit ramps so that any small wildlife can escape.
- To minimize impacts to the Jemez Mountains salamander:
    - Do not construct range improvements in potential Jemez Mountain salamander habitat during wet periods from July 1 through September 30, when salamanders would be on the surface.

- Do not disrupt fractured rhyolitic rock outcrops, large woody debris piles, or large decomposing Douglas-fir logs during placement of earthen tanks or water development construction.

- To minimize impacts to elk and other native fauna species, new fence construction and replacement, and even maintenance activities (as practical) should include the following specifications.
  - Total fence height would be at 40 to 42 inches
  - Spacing between top wire and second wire would be at least 12 inches
  - Bottom wire would be 16 inches from the ground and smooth
  - All new fence sections should be marked (flagging or poly vinyl chloride (PVC) piping) initially to alert wildlife of a new barrier

1.4 Laws, Regulations, and Policies

Besides the performance requirements specific to the implementation of the proposed activities, the following laws and regulations would guide or constrain the proposed Stewardship Action and alternatives:

1.4.1 Applicable Laws

- The Valles Caldera Preservation Act of 2000 – Authorizes the acquisition and management of the Valles Caldera National Preserve.
- The National Environmental Policy Act (NEPA) of 1969 as amended – Established a national policy for the environment.
- The Multiple Use and Sustained Yield Act of 1960, as amended 1996.
- The Endangered Species Act (ESA) of 1973 – Provides for the protection and conservation of threatened and endangered animal and plant species.
- The National Historic Preservation Act – Establishes a requirement for the consideration of potential adverse impacts to historic properties.
- The Migratory Bird Treaty Act (MBTA) – Implements various treaties and conventions between the United States and Canada, Japan, Mexico and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful.
- Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds , January 10, 2001
- The Clean Air Act of 1990 – Defines the National Ambient Air Quality Standards (NAAQS).
- Clean Water Act of 1977 – Establishes the basic structure for regulating discharges of pollutants into the waters of the United States.

1.4.2 Regulations and Procedures

- The NEPA Procedures of the Valles Caldera Trust, Federal Register, July 17, 2003 – Established to guide comprehensive management of the Preserve and achieve the purposes of NEPA.
- The Valles Caldera National Preserve Cultural Resources Compliance Process, September 30, 2003 – Provides procedures for implementing the National Historic Preservation Act.
- Total Maximum Daily Load Management Plan-Jemez Watershed December 2002 and August 2006 – Documents the amount of pollutant a water body can assimilate without violating the state's water quality standards.

1.5 Decision(s) to be Made

The Executive Director of the Trust as governed by the Board of Trustees is the Responsible Official charged with making the implementing decision for this Stewardship Action. The Responsible Official will decide:

- The goals, objectives, and monitored outcomes for livestock management and other activities that use or affect forage and riparian resources and associated habitats.
- Whether to allocate a portion of the Preserve's forage for use by the Trust to support livestock grazing or other commercial purposes as well as scientific, educational, or other public purposes.
- The timing, quantity, and distribution of forage allocation and use.
- The management of infrastructure such as earthen tanks, water-holding and distribution systems, fences, barriers, corrals, and pens.
- Whether to address the deferred maintenance needs of the horse barn, tack room, and pole barn.
- The performance requirements that would guide the development and management of programs and facilities for livestock management and forage use.

Using the selected monitored outcomes, these decisions will be reviewed every 5 years. This review would be documented in the *State of the Preserve* (Federal Register, 2003). Based on this review, the Trust would decide whether to continue, adjust, or terminate this action.

1.6 Scope of the Analysis

1.6.1 Environmental Documentation

The procedures for the Trust's implementation of NEPA indicate that long-term programs for the management of livestock would normally require the preparation of an Environmental Impact Statement (EIS) (§101.51) (Federal Register, 2003). These procedures also identify activities where an implementing decision could normally be made after the preparation of an Environmental Assessment EA) (§101.52). Such activities include, "Livestock management actions utilizing land, resources, and facilities of the Preserve, defined in location and time, the effects of which are anticipated to be short-term and minor in scope" (§101.52).

The action being proposed by the Trust does not fall clearly into either an action requiring an EIS or an action that could normally be implemented following the preparation of an EA. While the Trust is proposing to make a decision regarding the use of forage, primarily by livestock, which extends forward in time, the proposed Stewardship Action considers programs implemented through short- to mid-term commitments. Domestic livestock grazing would be defined in location and time on an annual basis. The management of associated infrastructure would be expected to have effects that would be short term and minor in scope.

The Trust has prepared this EA, in part, to determine whether to prepare an EIS or a Finding of No Significant Impact (FONSI) ((CEQ, 1977) §1508.9). A FONSI is a document prepared by a

federal agency briefly presenting the reasons why an action will not have a significant effect on the human environment ((CEQ, 1977) §1508.13).

1.6.2 Significance

The Trust will use guidance provided by CEQ in the regulations for implementing the procedural provisions of NEPA ((CEQ, 1977) §1508.27) to determine significance. In addition, Chapter Three, "Environmental Consequences," focuses on key issues, and effects are presented in both context and intensity.

1.6.3 Public Participation

This Stewardship Action is of interest to many stakeholders. They include:

- Ranchers interested in grazing livestock on the Preserve.
- Groups and individuals concerned with the potential environmental consequences resulting from livestock grazing.
- Those interested in preserving the historical use of the Preserve as a working ranch in the traditional sense.
- Recreationists who are concerned about the presence of livestock affecting their recreation experience.
- Educational and research institutions seeking to acquire more information on grasslands, grazing, elk, and associated interactions and effects.
- Neighboring land and game managers who see opportunities to collaborate with the Trust in addressing regional issues.

The Trust is committed to informing and involving the public in planning and decision making for MUSY Forage. The Trust also foresees opportunities to collaborate in the development and planning of programs for the use of forage, based on the selection of an action or no action alternative.

The Trust used a combination of public meeting and open house events, information shared at public meetings of the Board of Trustees, Web site postings, e-mail, and surface mail distribution to provide information and invite public participation and comment. Information and comment forms were also available at the Preserve. The response from stakeholders was used to inform the development of the purpose, need, and proposed action; identify key issues' and develop the alternatives presented in this document.

1.6.4 Key Issues

The scoping process allowed the Trust to identify key issues on which to focus the analysis and to deemphasize issues that are not significant. Key issues should be concerns, possible outcomes, or conflicts between the uses or allocation of resources that will drive decision-making and subsequent management.

Key issues were identified during the development of the existing condition report (T.E.A.M.S., 2007), through comments and concerns presented by stakeholders, and through information gathered throughout the interim period of domestic livestock grazing.

- *Key Issue: Domestic livestock grazing can combine with use by elk and other native fauna to affect sensitive riparian areas.*
- *Key Issue: Domestic livestock grazing programs can conflict with, or affect visitor activities and experiences.*
- *Key Issue: Optimizing the attainment of any one goal is not exclusive of the attainment of any other goal but is likely to affect the level and timing of such attainment.*

CHAPTER TWO – ALTERNATIVES

Decision making under NEPA requires agencies to consider reasonable alternative methods and actions for achieving a desired condition and meeting the purpose and need for action. The presentation of alternatives in a comparable form informs the Responsible Official, allows the public to understand the rationale behind the Trust's decisions, and allows the public to participate in agency planning and decision making in a meaningful way.

2.1 Alternatives Eliminated from Detailed Analysis

2.1.1 Alternative Values/Assumptions for Allocation and Use of Forage

AU equivalent values, production values, suitability, and capacity for forage allocation identified in the proposed action (see Section 1.3) were based on a combination of standard (published) values, values determined by site-specific field-sampled data, and/or values supported by annual monitoring. Where uncertainty existed, the Trust proposed using a conservative value. All the values are combined in a "model" that can be refined and improved over time as data collection and monitoring continue.

The Trust has proposed to calculate forage allocation and annual capacity using only areas with a minimum production value greater than 225 pounds per acre. This includes the valles, open woodlands and forest, and forest meadows but excludes most of the forested areas of the Preserve. Ranchers with many years of experience in managing livestock believed the Trust was not giving adequate consideration to the forage available in the forest.

To include more of the forest, the production values would have to be reduced to 125 pounds per acre as the production value in the forest is reduced by the actual slope and distance to water. This would likely result in the over allocation of forage. If/when a detailed inventory of production in the forest is complete, additional areas containing the minimum production value may be identified. Under the proposed Stewardship Action, the Trust would then consider those areas for determining allocation and capacity. In addition, the areas modeled as producing 250 pounds per acre or greater are consistent with the areas preferred by elk (Rupp, 2005).

Alternative values for AU equivalent, productivity, and suitability may or may not have proven adequate. These alternative values were eliminated from detailed analysis. Starting with a conservative value and refining that value based on actual field sampling verified through monitoring best defined a system that could be measured over time and is in keeping with science and adaptive management as described in the Management Principles and the NEPA procedures of the Trust (Federal Register, 2003).

2.1.2 Limiting Domestic Livestock Grazing to Areas Considered Suitable for Allocation

Developing capacity and allocating forage based on production values from the most productive land on the Preserve ensures that the use of forage by the Trust (primarily through domestic livestock grazing) does not combine with the use by native fauna to exceed 40 percent utilization overall. Generally, ungulates will graze from the most productive and easily accessed lands that have the closest proximity to water. If forage is not over allocated, it is unlikely that overgrazing would occur to any measurable level.

The intent of the allocation is to ensure that the system retains vigor as a whole and to ensure adequate capacity to herd livestock away from sensitive areas such as wet meadows without leading to overutilization elsewhere.

It is recognized that productive grazing areas not yet inventoried are distributed throughout the forested areas of the Preserve and that cattle are likely to graze within the forested areas, especially during summer rains when water is ubiquitous, and appealing forbs and mushrooms are abundant in the forest. The Trust may deliberately herd cattle into the forests to alleviate pressures in key areas, reduce conflicts with recreation programs or events, gain information, or achieve site-specific objectives.

The conservative approach to determining capacity and allocating forage was designed to provide needed flexibility in livestock management.

2.1.3 Increasing the Allocation of Forage for Multiple Use to 50 Percent

Based on historic stocking rates, increasing the allocation of forage to domestic livestock grazing was frequently suggested. The 50-percent allocation applies the "take half, leave half" rule long used by ranchers. This would require reducing the allocation of forage in support of ecosystem services and native fauna. Based on the best data and information available, allocating forage to livestock at the expense of ecosystem services would not meet the purpose and need for action and would indirectly lead to a violation of state and federal environmental laws applicable to public lands listed in 1.4, Laws, Regulations and Policies. Many of which did not apply to management of the Preserve while under private ownership and do not apply to the operation of a private ranch.

Both the purposes and goals enumerated in the Act emphaisize the protection and preservation of the Preserve's resources and values, including fish and native fauna. Grazing forage past the point at which root production and plant vigor is impacted, or, to the degree, where cover by bare ground increases, is known to directly and indirectly affect both upland and riparian ecosystem structure, composition, and function.

In addition, persistent utilization over 40 percent directly and indirectly affects productivity (Crider 1954, Milchunas 2006) ultimately reducing capacity.

2.1.4 Emphasizing the Benefits to Local Communities and Enhancing the Objectives on Surrounding National Forest System (NFS) Land

This alternative would have emphasized the use of forage on the Preserve in addressing regional livestock issues. Opportunities to redistribute livestock to meet the needs of the regional area

best would have been emphasized. This program would have been implemented through collaboration with a variety of stakeholders and placed less value on economic return to the Trust.

Alternative C, as currently described allows for equitable consideration of nonmonetary and relative values without limiting opportunities to graze on federal land solely based on geographic ties. This alternative would have limited the Trust to an array of programs not yet proven successful. The Trust needs flexibility to work with a variety of stakeholders to develop programs that may ultimately optimize numerous goals and objectives.

2.1.5 Alternatives to the Scope of the Analysis and Decision

The Trust considered broadening the scope of the analysis to include activities such as, prescribed fire or thinning, which could improve the health and vigor of forage plants and manage habitats and ecosystem processes. The Trust also considered taking actions to manage the resident elk herd.

The use of thinning and prescribed fire will be considered at a later time, in context with plans to specifically restore and manage forests, grasslands, and ecosystems.

The management of elk populations in the Jemez Mountains (and the state of New Mexico) is under the jurisdiction of New Mexico Game and Fish (NMGF) while federal and state land managers, private landowners, and tribal governments own or manage the habitat. It is desirable for all those affected by or interested in elk in the Jemez Mountains to collaborate on the development of a management plan. The framework for such collaboration exists in the Seeking Common Ground committee, established specifically to address the regional social, political, and ecological issues of elk in the Jemez Mountains. The Trust would participate in such collaboration and would work to incorporate the results of such collaboration into future management. At this time, the management of elk on the Preserve and the surrounding range are outside the scope of this analysis and the jurisdiction of the Trust.

2.1.6 Establishing a "Working Ranch" zone

Establishing zones on the Preserve that emphasize the "Working Ranch" and livestock grazing was considered. Establishing zones that emphasize a particular use or value is a common practice on public lands. Use zones are usually established to reduce conflicts between activities that may not be compatible or, to protect sensitive resources or habitats. The Trust determined that use zones would be best considered in context with long-term planning for public use and access.

Under the action alternatives, the Trust has the flexibility to limit livestock grazing to a specified area of the Preserve. Such limitations may be placed for a number of reasons: to accommodate a program or event, in support of research or education, for resource protection, or to accomplish specific resource objectives. A zone may be temporarily established to inform public use and access planning or other purposes.

2.1.7 Summary

The proposed action provides parameters for incorporating new information as appropriate to achieve the goals and objectives of the Stewardship Action within specified bounds. New information may indicate a need to update values used for allocating forage and determining suitability and capacity. Future decisions regarding ecosystem management, collaborative elk management, or public use and access may include amending decisions regarding MUSY Forage. This would only occur following adequate environmental review and opportunity for public comment as required by NEPA.

2.2 Alternatives Analyzed in Detail

Four alternatives are being analyzed in detail. Consideration of the "No Action" alternative is required under NEPA and provides a baseline for comparison of all action alternatives. Three action alternatives vary in the allocation of forage for multiple use, the implementation of programs for domestic livestock grazing, the management of connected infrastructure and improvements to facilities. The action alternatives address key issues in a comparable form.

2.2.1 Alternative A – No Action

Goals, Objectives and Monitored Outcomes

No goals, objectives, or monitored outcomes would be established.

Forage Allocation

Under this alternative, no allocation of forage resources would occur resulting in a de facto allocation of all forage to elk, other native fauna, and ecosystem services.

Multiple Use of Forage

The Trust would not continue annual programs for domestic livestock grazing beyond commitments made prior to this decision (under the interim grazing program). Other uses of forage would not be implemented.

Infrastructure Management

Infrastructure would remain in current location and general condition; current maintenance activities would continue (boundary fence, minor repair maintenance). Deferred maintenance activities and improvements on buildings would not be implemented under this alternative.

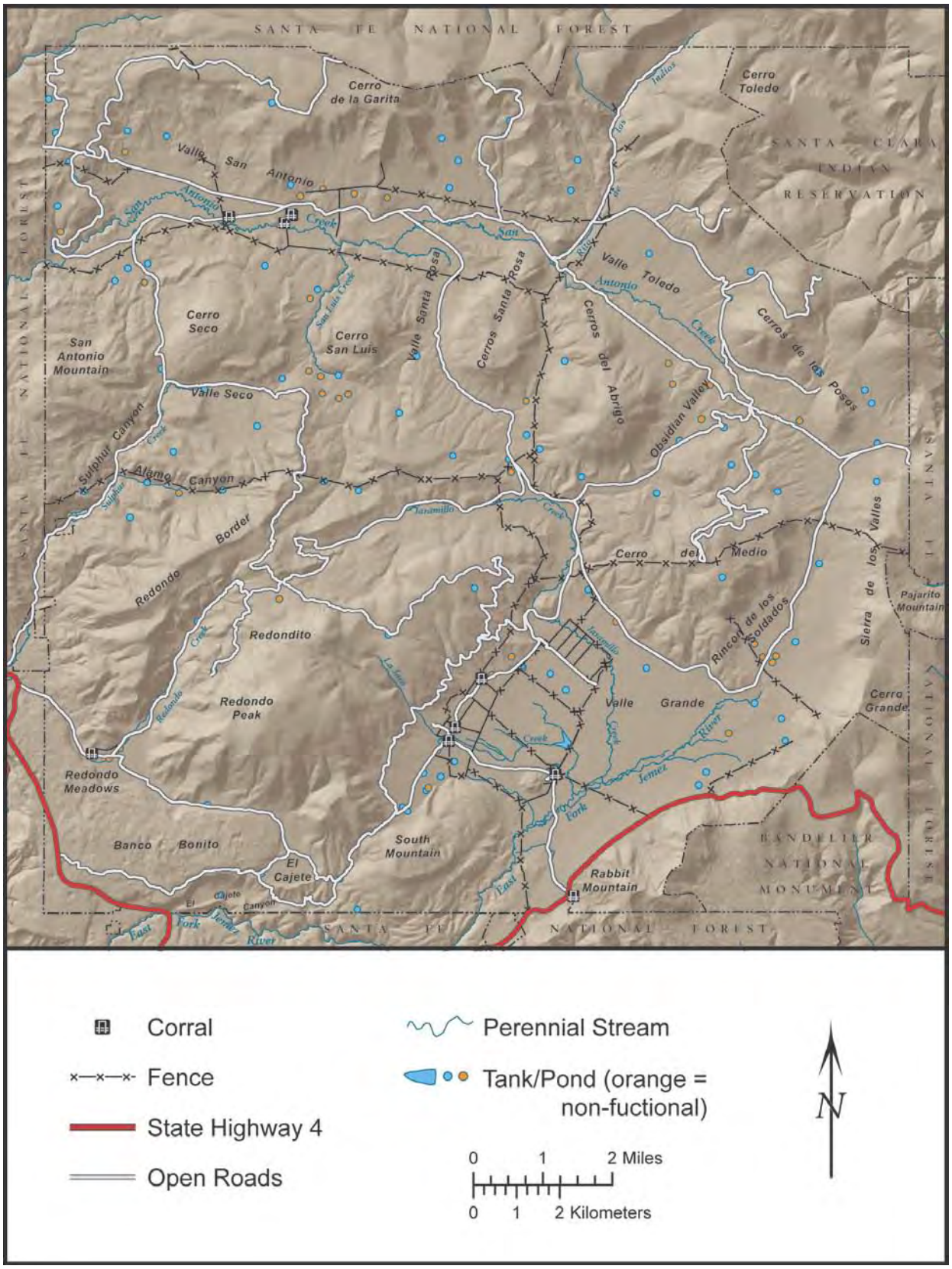

Figure 8— Existing ranch infrastructure (fences, corrals, water sources)

2.2.2 Alternative B – Emphasizing Resource Protection and Recreational Values

Goals, Objectives and Monitored Outcomes

Under this alternative, the Trust would adopt ecological goals, objectives, and monitored outcomes as described in Chapter One.

Forage Allocation

Most forage resources would be allocated toward elk, other native fauna, and ecosystem services. The Trust would emphasize the protection and preservation of the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural, and recreational values of the Preserve. Under this alternative, the Trust could allocate and use up to 5 percent of the available forage for domestic livestock grazing in support of education, research, recreation, or other purposes. Recreational and scenic values of the valles and associated riparian resources would be emphasized.

Multiple Use of Forage

Under this alternative, conservative annual programs for domestic livestock grazing could be managed on the Preserve for research, education, recreational purposes, or other purposes.

The collection of grass seed and other uses of forage could occur.

Infrastructure Management

Under this alternative, the Trust would consider the removal of much of the interior fencing (Figure 9). The priority would be woven wire fencing and fences lying perpendicular to streams, causing resource damage. Fences in disrepair and interior fences would follow in priority.

Earthen tanks would be maintained, repaired, replaced, or constructed, or obliterated as described in Chapter One. The timing of infrastructure management would be based on available funding.

Facilities Management

No facilities maintenance or improvement would occur.

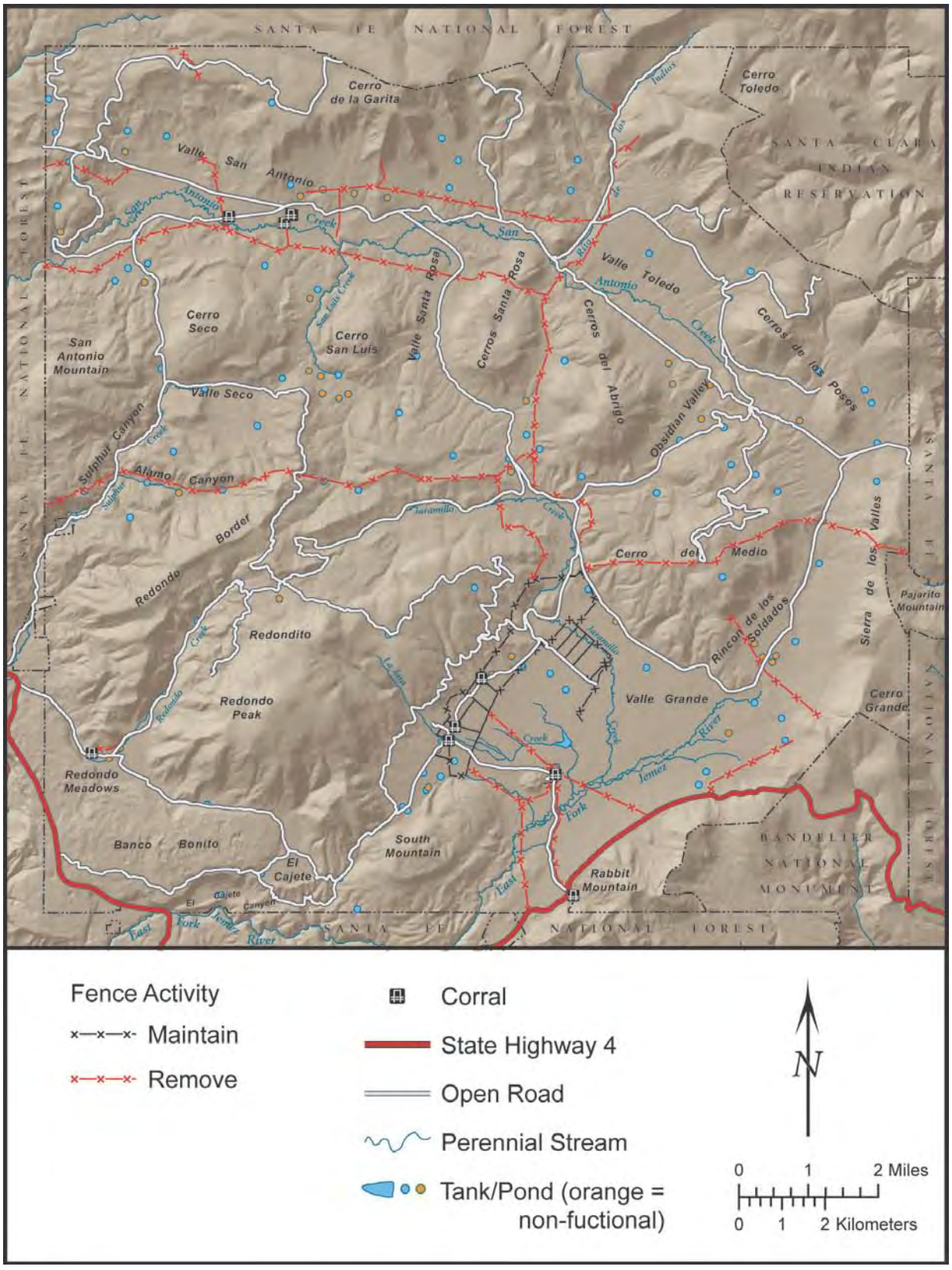

Figure 9 – Proposed infrastructure management: Alternative B

2.2.3 Alternatives C – Proposed Action with Programs that Weight Relative Values and Benefits.

Goals, Objectives, and Monitored Outcomes

Under this alternative, the Trust would adopt ecological goals, objectives, and monitored outcomes; and allocate and use forage, and manage infrastructure as described in Chapter One.

Forage Allocation

Under this alternative, forage would be allocated as described in the Chapter One to preserve and protect ecosystem processes, to sustain faunal habitats, to support elk and other herbivores, and for use by the Trust to support domestic livestock grazing or other commercial uses, as well as scientific, education, or other public uses.

Multiple Use of Forage

Domestic livestock grazing programs would be developed that balance, as practicable, the management goals from Section 108 of the Act. Three of those goals are directly tied to the operation of the Preserve as a working ranch; the protection and preservation of resources and values, the provision of public access, and the multiple use and sustained yield of resources. Programs for domestic livestock grazing can also contribute to the remaining goals, including providing benefits to local communities, enhancing the objectives on surrounding NFS land, and optimizing returns based on existing market conditions (to the degree that it does not diminish the multiple use and sustained yield capability of the land).

Under this alternative, domestic livestock grazing programs would return an amount to the Trust greater than or equal to operational costs incurred by the Trust (Chapter One, 1.3.2 "Proposed Action," Performance Requirements for domestic livestock grazing programs); however, the financial return to the Trust beyond that level may not receive the greatest consideration. The Trust could give greater consideration to resource protection or enhancement, benefits to local communities, enhancing the management objectives on surrounding NFS land, compatibility with ongoing recreation programs and levels of use, contributions to scientific research and knowledge, inclusion of opportunities for learning such as seminars, or the inclusion of universities or student projects. Programs may be in place for one or more seasons.

During the interim grazing program, the Trust offered several programs that provided these relative benefits. These programs returned less that they cost to operate. However, through collaborative relationships with surrounding land managers, producers, associations, universities, the USDA extension service, and others financially sustainable programs could be developed **(**Personal Interviews: Trujillo et al. 2007-2008, Chacon and Rosauer 2008, Santa Fe National Forest 2007**)**. By contributing to other societal needs such as, education, resource protection and restoration, and contributions to rural communities, these types of programs could be eligible for funding through grants, tuition, and other sources outside of grazing fees.

In addition, the Trust could have multiple programs that varied in economic returns. Under this alternative, the Trust would continue to seek opportunities to increase the generation of income to the degree that this consideration would not outweigh other relative benefits.

Other uses of forage such as seed collection could occur.

Infrastructure Management

Under this alternative, infrastructure management and the associated performance requirements would occur as described in Chapter One (see Figure 10). These activities include the removal, maintenance, repair, and construction of fences as well as repair, replacement, maintenance, or closure and rehabilitation of earthen tanks.

Facility Management

Under this alternative, the deferred maintenance needs and improvement of Preserve facilities as described in Chapter One would not occur.

2.2.4 Alternative D – Proposed Action with Programs that Emphasize Economic and Administrative Efficiencies.

Goals, Objectives, and Monitored Outcomes

Under this alternative, the Trust would adopt ecological goals, objectives and monitored outcomes as described in Chapter One.

Forage Allocation

Under this alternative, forage would be allocated as described in the Chapter One to preserve and protect ecosystem processes, sustain faunal habitats, support elk and other herbivores, and support domestic livestock grazing or other commercial uses, as well as scientific, education, or other public uses.

Multiple Use of Forage

Domestic livestock programs would be developed that optimize economic and administrative efficiencies. Decisions regarding annual programs for domestic livestock grazing would heavily weight the optimization of income generation to the to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the multiple use and sustained yield capability of the land. Single or multiyear contracts awarded through competitive process would be the likely instrument to permit grazing. Under this alternative, the Trust would optimize the use of forage based on market conditions seeking to meet, without exceeding 40 percent utilization of aboveground forage in suitable areas Preserve-wide.

Relative and nonmonetary benefits from domestic livestock programs could be realized under this alternative to the degree that they did not diminish the return to the Trust based on existing market conditions.

Other uses such as the collection of seeds and plants could occur.

Infrastructure Management

Under this alternative, infrastructure management and the associated performance requirements would occur as described in Chapter One (see Figure 10). These activities include the removal, maintenance, repair, and construction of fences as well as repair, replacement, maintenance, or closure and rehabilitation of earthen tanks.

Facility Management

Under this alternative, the deferred maintenance needs and improvement of Preserve facilities as described in Chapter One would not occur.

2.2.5 Alternatives C_2 and D_2 Facility Improvements

Alternatives C and D are proposed in two variations:

1. C_1 and D_1 with the superscript indicating that the Trust is not considering actions to improve, maintain, or address the deferred maintenance needs of facilities.
2. C_2 and D_2 with the superscript indicating that proposed management of facilities is being considered.

Facility Improvements would include completing deferred maintenance on the existing horse-barn, tack shed, and pole barn to support ancillary administration of the livestock program, including classrooms, office space, rodent-proof storage for tack, feed, and supplements and outdoor clinic facilities.

In their 2007 assessment of the Preserve's facilities, SWCA Environmental Consultants provided the following description of the horse barn and paddock area being considered for maintenance and repair (SWCA Environmental Consultants, 2007):

> *The Horse Paddocks Barn is a large (approximately 104-ft by 30 ft) southwest-facing rectangular building comprised of a residential apartment and shop/garage area at its southern end, and a paddock comprised of 18 stalls on its northern side. The paddock and apartment/shop area are separated by an open-air drive-through space that is currently being used to store horse trailers. A side-gabled roof topped with corrugated metal extends across the length of the building, which is situated east of the Headquarters Area and is consistent with the livestock-oriented nature of the ranch complex.*
>
> *The apartment and shop/garage area are located at the southwest end of the building. This portion of the building is approximately 30-ft by 15-ft and has a sawn board and batten exterior. The residential apartment occupies the southeast corner of the building and measures approximately 15-ft by 15-ft.*
>
> *The shop/garage area occupies the southwest corner of the building, adjacent to the residential apartment. This space is partitioned with a three-quarter height wall running north to south with the garage area occupying the westernmost portion of the building. The shop area is accessed*

through two single-leaf cross-braced imitation Dutch doors at its northeast and southwest corners. The shop is accessed through one single-leaf cross-braced imitation Dutch door at its northeast corner and one double-leaf cross-braced barn-type door that extends across its south side. The shop/garage area has two horizontally oriented three-ribbon woodframed clerestory windows on its southwest side and two horizontally oriented three-ribbon clerestory windows on its northeast side.

The horse paddock portion of the building consists of eighteen stalls. Stalls are situated back-to-back in two rows along a northeast to southwest axis, so that nine stalls face northwest and nine stalls face southeast. Each stall is accessed through a one-leaf dutch door, though two of the stall doors are currently missing. A post and rail fence surrounds the stalls on the east, west, and north sides of the paddock approximately 10-ft from the stall entrances, creating a wide walkway. Single wire gates on the east, west, and north sides of the rail fence provide access to the paddock. An associated corral is located adjacent to the buildings north side.

Repairs and upgrades would be made to the foundation, frame, and finished interiors. These facilities would serve as an ancillary facility, supporting immediate needs of the domestic livestock program.

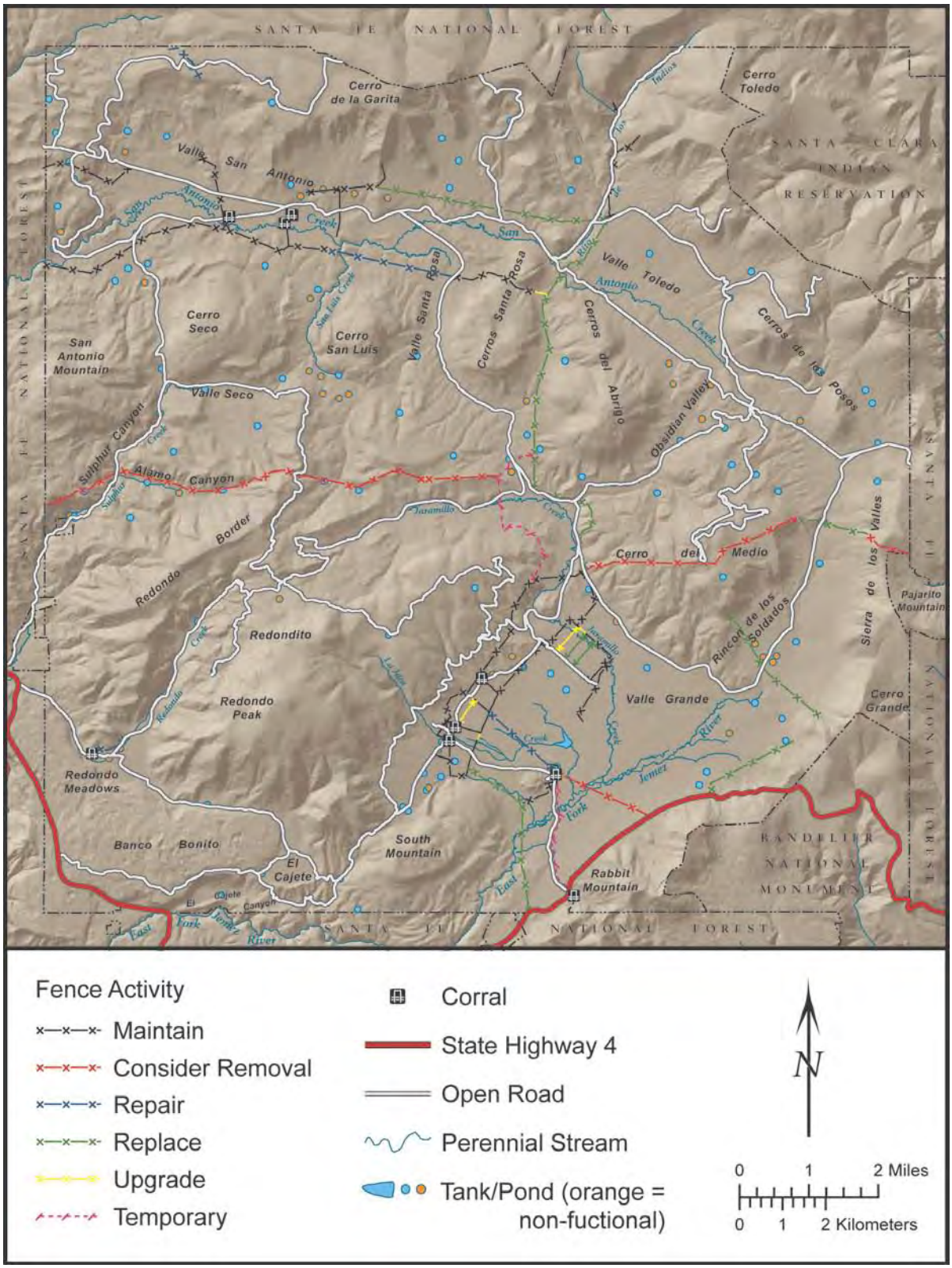

Figure 10 – Proposed infrastructure management: Alternatives C and D

CHAPTER THREE – ENVIRONMENTAL CONSEQUENCES

This chapter summarizes the effects to the natural and human environment expected to occur as a result of either taking no action or implementing an alternative action. Outcomes or effects are measured by context (the spatial or temporal extent of the effect) and intensity (the magnitude of the effect). Outcomes may be beneficial or adverse and may be direct, indirect, or cumulative.

The temporal extent of the effect is defined by three categories of duration (Federal Register 2003):

- Short-term: 0 to 3 years
- Mid-term: 3 to 10 years
- Long-term: 10+ years

The intensity of the effect is defined by the following four levels of magnitude (intensity is influenced by context):

- Negligible: No change would occur, or the magnitude of change would not be measurable
- Minor: Changes would be measurable but would not alter the structure, composition, or function of the resource and would be limited in context.
- Moderate: Changes would be measurable and may influence the structure, composition, or function of the resource but would be limited in context.
- Major: Changes would be measurable; would alter the structure, composition, or function of the resource; and may be extensive in context.

Alternatives C and D are proposed in two variations:

- C_1 and D_1 with the superscript indicating that the Trust is not considering actions to improve, maintain, or address the deferred maintenance needs of facilities.
- C_2 and D_2 with the superscript indicating that proposed management of facilities is being considered.

Throughout this section, the superscript versions will be used to discuss effects between the variations of the alternatives. Simply "C" or "D" will be used when discussing effects that do not vary between the two variations of the alternatives.

This chapter provides information used to aid in decision-making and assesses significance as required under NEPA.

3.1 Watershed

This section discusses the affected area, existing condition and environmental consequences for watershed resources, including vegetation, soils, and hydrology with regard to structure, composition, and function (Ecological Condition), capacity and suitability for grazing.

The *Affected Environment* (3.1.1) is presented in a detailed summary to provide context. The *Existing Condition* (3.1.2) describes the existing ecological condition, capacity and suitability of the resources relative to forage allocation. The *Environmental Consequences* are grouped according to grazing intensity and focus on the effects ecological condition influenced by vegetation, hydrology, and soils.

The analysis area considered encompasses the Valles Caldera with emphasis on the grasslands where herbaceous forage is most abundant (T.E.A.M.S., 2007), (Valles Caldera Trust, 2002). Effects on ecological condition, soils, and hydrology are based on field reconnaissance and the robust monitoring built since federal acquisition, cross-referenced to published reports and standards used by the Natural Resource Conservation Service, Bureau of Land Management, and USFS.

3.1.1. Watershed – Affected Environment

Physical Setting

The Valles Caldera National Preserve is composed of nearly 89,000 acres within the volcanic complex known as the Valles Caldera, and is located in the north central portion of New Mexico in the Jemez Mountains.

Geology

About 1,250,000 years ago, a spectacular eruption created the 13-mile wide crater now known as the Valles Caldera. The eruption tapped a vast magma chamber, which erupted catastrophically, depleting the magma chamber and creating a void into which the surface landscape collapsed. The enclosed caldera filled with water, forming a vast fresh-water lake. the turmoil continued beneath the earth's surface as new magma refilled the now-collapsed chamber, and within 50,000 years Redondo Peak rose up through the lake bottom. Following the resurgence of Redondo, the first of many eruptive flows from ring fractures within the caldera formed the dome at Cerro del Medio, followed by Cerro del Abrigo and , and continued counter clockwise around the ring fracture creating the domes in the northern half of the caldera (Valles Caldera Trust, 2007).

The present day landscape features of the Preserve, as shown in Figure 11, include a rim of timbered mountains that enclose a series of open grassland valleys or *valles*, separated by forested domes. The largest of the domes is Redondo Peak in the southwest quarter of the caldera that rises from 8,500 feet at the valley floor to 11,308 feet. The largest of the valles, the Valle Grande, is a depression more than three miles across at its widest and nearly 2000 feet below the surrounding terrain (Valles Caldera Trust, 2002).

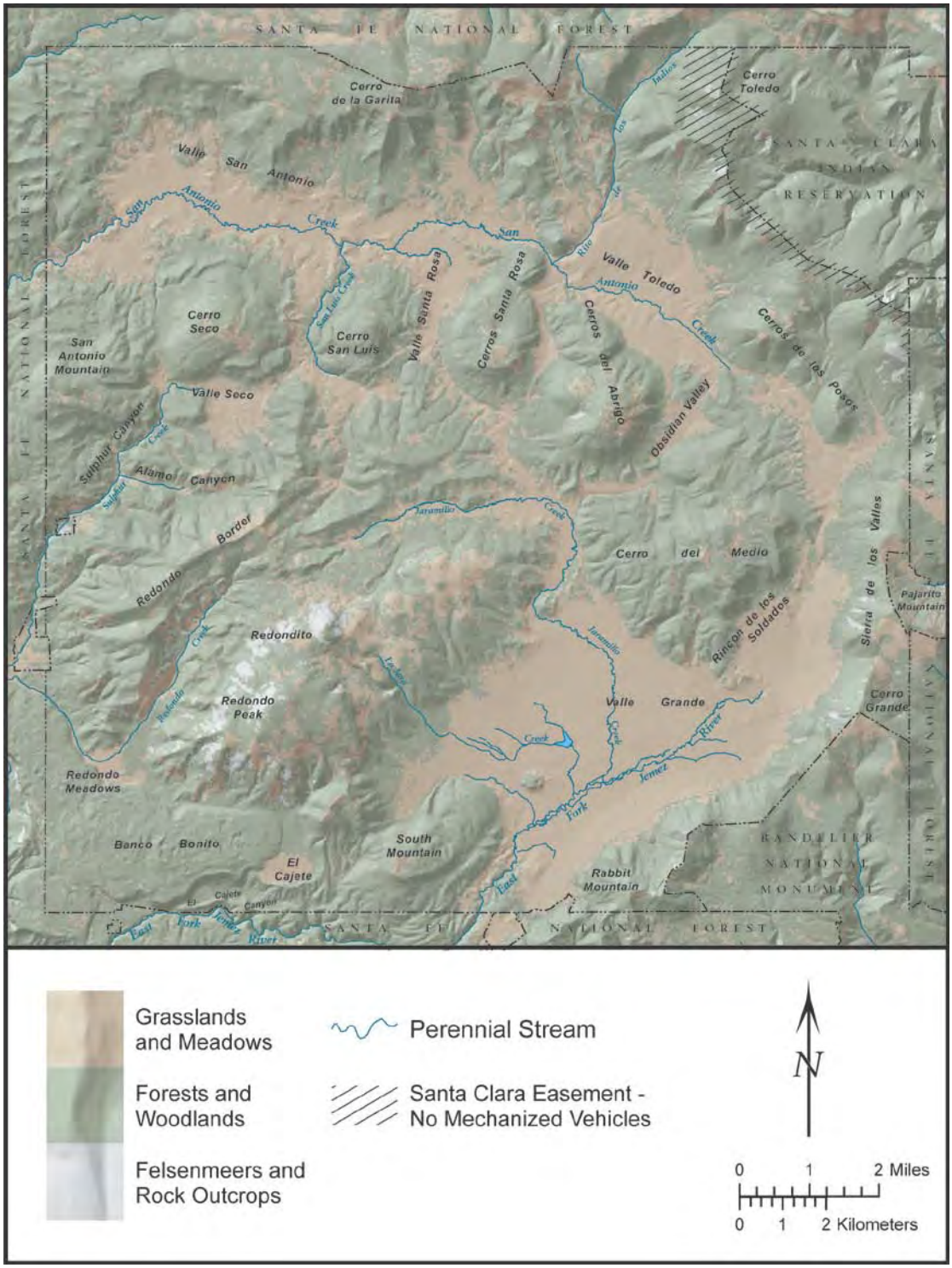

Figure 11 – Landscape Features of the Preserve

Climate

The regional climate is semi-arid continental. Cyclonic storms associated with the polar jet stream bring snow in the winter and rain in the spring and fall. April through June is usually dry. The majority (60%) of the precipitation comes in the summer months (Figure 11) in the form of convectional "monsoon" storms when the Bermuda high-pressure system drives moist oceanic air into the Southwest. Periodic El Niño events bring increased winter and spring precipitation to the Southwest, while interspersed La Niña events cause droughts. El Niño events affect stream flows, wildfire activity, and plant productivity (Allen 2004).

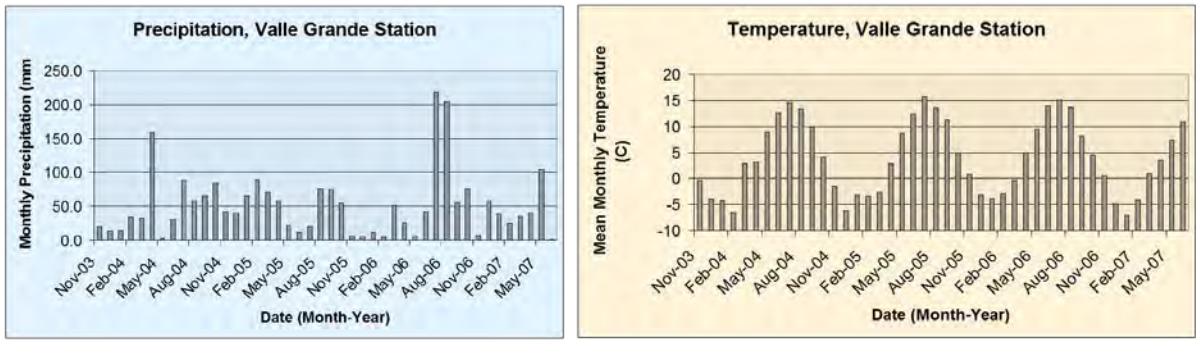

Figure 12 – Precipitation and Temperature in the Valle Grande 2003-2007

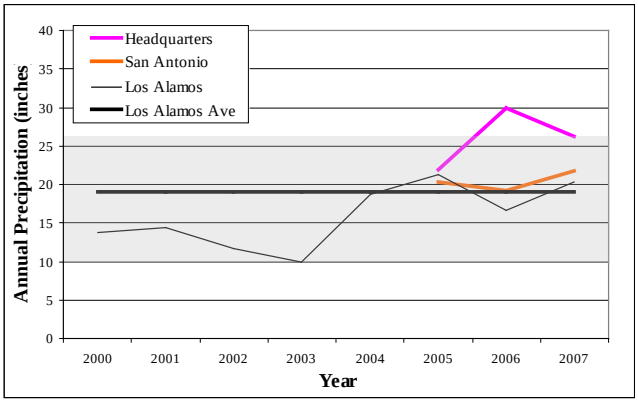

Figure 13 - Precipitation data from Los Alamos and the Valles Caldera National Preserve

The climate scenario is modified by the high elevations and topographical variability of the Preserve. For example, the average precipitation reported for Los Alamos is 18.4 inches (see Figure 12) while it is over 35 inches at the caldera rim (Allen 1989). The annual average precipitation at the Valle Grande weather station (2003-2007) was 24.4 inches. Snow accumulation, while minimal at Los Alamos, can be significant within the Preserve. The temperatures at the highest elevations of the Preserve may be anywhere from 25-35°F colder than Los Alamos, and the valles are 10-15°F colder still. The effect of the cold air drainage into the valle bottoms may drive temperatures down even further (Muldavin et. al. 2006); the record low temperature recorded in the Valle Grande was -16.6°F.

Water

The Preserve was established based on watershed[11] boundaries with waters of the Santa Clara watershed going to Santa Clara Pueblo and waters of the Frijoles watershed going to Bandelier National Monument. The remaining lands are within the Jemez Watershed (USGS 5th Hydrologic Unit Code).

Nearly 75 miles of perennial stream originate in the forests and meander through the valles of the Preserve. The headwaters of two major tributaries to the Jemez River, the East Fork of the Jemez River and the Rio San Antonio (San Antonio Creek) arise within the Preserve. These tributaries converge below Battleship Rock to form the Jemez River, a tributary to the Rio Grande. The headwaters of the other perennial streams including Jaramillo and Redondo Creeks and Rito de los Indios also originate within the caldera.

Soils

The soils of the Preserve mirror its geology. Scientists from the Natural Resources Conservation Service, Sandoval County Soil Survey, have mapped nearly 80 soil series (the soil survey will be completed in 2008). The soils fall into two groups: forest and grassland. Forest soils are primarily mountain soils (Andisols, Alfisol and Inceptisol soil orders) and are derived from the volcanic rocks and gravel (rhyolites and andesites, with some dacites and latites, tuffs and pumices) along with some windblown deposition. These soils tend to be rocky with loamy textures in the matrix. Grassland soils are mostly Mollisols that have developed in the volcanic alluvium of the alluvial fans and piedmonts, or in recent water-deposited sediments of the valley bottoms. They are deep and have rich organic material accumulations in the top layers along with fine textures and little rock accumulation (Muldavin and Tonne 2003).

Flora and Fauna

The Preserve is one the most diverse areas in the Southern Rocky Mountains Ecoregion (southern Wyoming to northern New Mexico). About 65% of the Preserve is forested and 30% is grasslands; shrubs, water, and bare ground including rock outcrops, account for about 1% each. The plant associations encompass high elevation, sub-alpine forests, down through mixed conifer to open foothill pine woodlands, and high montane grasslands down to valley floor wetlands. The montane grasslands and wetlands on the Preserve are some of the largest and highest quality habitats for ecological function and biodiversity within the Southern Rocky Mountains Ecoregion (Muldavin and Tonne 2003). Twenty habitat-mapping units, including vegetation associations and characteristic flora as shown in Table 7, and Figure 14, were identified and described by Muldavin (2006).

[11] Watershed boundaries define the aerial extent of surface water drainage. The boundaries are determined by hydrologic principles as opposed to administrative or political.

Ponderosa pine is the major tree species below 9,000 feet elevation that rings the valles, except on some north-facing slopes where blue spruce has recently gained importance (Hogan & Allen, 1999), (Muldavin & Tonne, 2003). Ponderosa forests grade into mixed-conifer forests 10,000 feet and contain combinations of ponderosa pine, Douglas-fir, white fir, quaking aspen, and limber pine. Spruce-fir forests dominated by Engelmann spruce and corkbark fir are found in the highest elevations above 9,000 feet. Aspen stands occur throughout the forested landscape. Soil characteristics, cold air drainage, hydrology, fire and grazing contribute to the maintenance of the grasslands that span the valles in the enclosed caldera (Allen, 1989), (Coop & Givinish, 2007). High elevation grasslands that were historically maintained, at least in part, by fire also occur on upper, south-facing slopes in the mixed conifer and spruce-fir zones (Allen, 1989).

Table 7 – Vegetation and area covered (Muldavin E., 2006)

Unit No.	Map Unit	Acres	Hectares	%
1 & 2	**Spruce-Fir Forest**	**7,005**	**2,835**	**7.89**
1	*Spruce-Fir Forest and Woodland (Dry Mesic)*	*4,304*	*1,742*	*4.85*
2	*Spruce-Fir Forest and Woodland (Moist Mesic)*	*2,701*	*1,093*	*3.04*
4, 5 & 7	**Mixed Conifer Forest and Woodland**	**36,566**	**14,798**	**40.41**
4	*Mixed Conifer Forest and Woodland (Dry Mesic)*	*21,829*	*8,834*	*24.59*
5	*Mixed Conifer Forest and Woodland (Moist Mesic)*	*13,963*	*5,651*	*15.73*
7	*Blue Spruce Fringe Forest*	*774*	*313*	*0.87*
10 & 11	**Aspen Forest and Woodland**	**5,103**	**2,065**	**5.75**
10	*Aspen Forest and Woodland (Dry Mesic)*	*3,204*	*1,297*	*3.61*
11	*Aspen Forest and Woodland (Moist Mesic)*	*1,899*	*768*	*2.14*
13	**Ponderosa Pine Forest**	**9,241**	**3,739**	**10.41**
14	**Gambel Oak-Mixed Montane Shrubland**	**1,443**	**584**	**1.63**
16, 17 & 3	**Montane Grassland**	**19,858**	**8,035**	**22.37**
16	*Upper Montane Grassland*	*4,933*	*1,996*	*5.56*
17	*Lower Montane Grassland*	*12,631*	*5,111*	*14.23*
3	*Forest Meadow*	*2,294*	*928*	*2.58*
19 & 20	**Wetlands and Wet Meadows**	**6,853**	**2,773**	**7.72**
19	*Wet Meadow*	*5,832*	*2,360*	*6.57*
20	*Wetland*	*1,021*	*413*	*1.15*
21	**Montane Riparian Shrubland**	**14**	**6**	**0.02**
24	**Sparsely Vegetated Rock Outcrop**	**159**	**64**	**0.18**
25	**Felsenmeer Rock Field**	**915**	**370**	**1.03**
26	**Roads-Disturbed Ground**	**1,536**	**622**	**1.73**
27	**Open Water**	**56**	**23**	**0.06**
28	**Post-Fire Bare Ground**	**17**	**7**	**0.02**
	Total	**88,765**	**35,922**	**100.00**

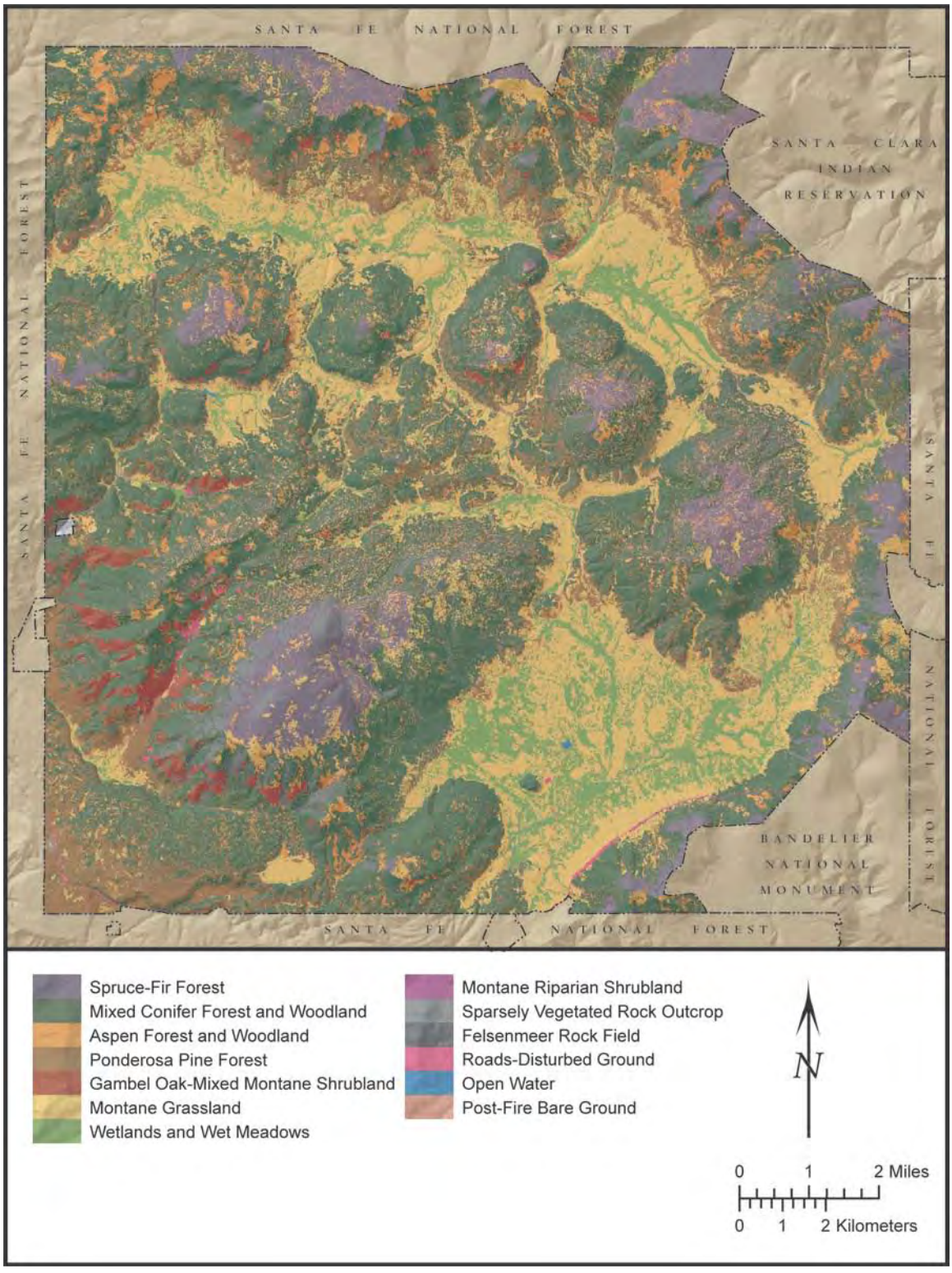

Figure 14 – Vegetative Types

The ecosites from which forage has been allocated and utilization has been monitored are the *upper montane* and *lower montane grasslands, wet meadow,* and *riparian grasslands* as described by

Muldavin (Muldavin E., 2006), as well as *grazeable woodlands*. Grazeable woodlands are the open shrublands and forests adjacent to the grasslands. They can be represented by many of the forest and shrub plant alliances described by Muldavin, including open ponderosa pine, aspen forest and woodland, mixed conifer forest and woodland and gambel oak – mixed montane shrublands (see Table 8). The naturalized European pasture grass Kentucky bluegrass (*Poa pretensis)* is often abundant and favored by both elk and cattle.

The upper montane grasslands provide nearly 6,000 acres of rangeland suitable for grazing by elk and cattle. This ecotype occurs on the upper alluvial fan piedmonts of the valles, and occasionally in the valley floor. The primary components are associations of Parry's danthonia-Thurber's fescue (see Figure 15) and Thurber's fescue-Kentucky bluegrass.

Also supported by the upper alluvial fans, usually below a band of upper montane grasslands, are the lower montane grasslands (see Figure 16), which provide over 12,000 acres of suitable forage. The lower montane grasslands contain primary associations of Arizona fescue-pine dropseed grassland and Arizona fescue -Kentucky bluegrass.

Figure 15 - Upper montane grassland

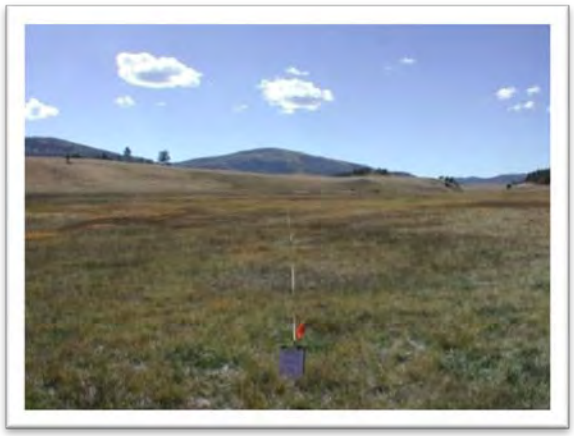

Figure 16 – Lower montane grassland

Nearly 6,000 acres of wet meadowlands (see Figure 17) occur on valley bottom surfaces that are not part of the active floodplain (terraces and lower alluvial slopes). They contain a diverse array of wetland and upland species. Primary components include the associations of tufted hairgrass-woolly cinquefoil, baltic rush-Kentucky bluegrass, baltic rush-tufted hairgrass, and Kentucky bluegrass-common dandelion.

Just over 1,000 acres of grassland dominated by obligate and facultative wetland species (see Figure 17) occur along valley bottom drainages that are part of the active floodplain. The primary components include northwest territory sedge-smallwing sedge and woolly sedge-common spikerush.

Figure 17 – Wet meadow and wetland vegetation

It is noteworthy that non-native Kentucky bluegrass is a primary component found in most of the grasslands. Other European pasture grasses are frequently dominant to abundant (Barnes, 2006). The presence and dominance of these grasses is related to historic land use including intensive grazing and seeding. The Dunigans seeded European pasture grasses to speed recovery of deforested areas and the lengthen the grazing season (Anschuetz & Merlan, 2007). Intensive grazing pressure and climate have favored these exotic grasses.

Historic Land Use

Factors relating to climate and geology have produced a heterogeneous environment capable of supporting sustained land use throughout the human history of the Preserve (Anschuetz & Merlan, 2007). The system has remained, to a degree, somewhat resistant and resilient to disturbance over time. However, the existing condition of the Preserve is in part a cumulative effect of the intense extractive uses of the past, especially timber harvest and domestic livestock grazing.

Timber Harvest

Historic timber harvesting and livestock grazing introduced a great deal of environmental pressure on the Preserve. From 1963 to 1972 timber harvest was primarily by clear-cutting using a jammer logging system that required building numerous roads and stream-crossings (Balmat & Kupfer, 2004). Hundreds of roads were carved into the hillsides, breaking the forests into narrow, linear patches to clear-cut large swathes of trees. Figure 18 shows the forested dome, Redondito (northeast of Redondo Peak; see Figure 11), prior to logging in the 1960s, following clear-cutting and road building, and in the present, reforested with small trees, and with the visible scars of the roadbeds easily discernable.

Figure 18 - Redondito in 1963 (top left), 1972 (top right), and 2000 (bottom)

Figure 19 illustrates Preserve-wide, roads constructed in the 1960's to facilitate clear cutting. These activities resulted in accelerated run-off and erosion, some of which is still evident or active today. Since the cessation of logging, forest cover has returned to the mountains of the Valles Caldera. Mature stands of pine, spruce, and fir flank the hillsides in places and dense stands of young conifers are expanding. In some instances, lands traditionally grazed by livestock are being encroached upon by forests.

Figure 19 - Roads were constructed in a spiral pattern to facilitate the clear cutting of timber in the 1960's

Livestock Grazing

In the late 1800s and early 1900s as many as 45,000 sheep occupied the ranch during the summer months (Anschuetz & Merlan, 2007). Grazing usually occurred from early May through October with little herd management. Mixed herds of cattle and sheep were often run in the 1940s and 1950s (cattle herd sizes have been reported as high as 12,000 head at their peak); however, cattle alone have been run on the Preserve for the last 40 years. The 1960s and 1970s saw the beginning of a decline in livestock numbers and herd sizes were down to 5,000—7,000+ head of heifers and steers by the 1980s. Upon acquisition of the Preserve, livestock numbers continued to drop after a period of rest, and have remained comparatively low (Valles Caldera Trust, 2007). Table 8 lists the number of AUMs (a function of animal class and duration of grazing) by year for 23 years preceding federal acquisition (1976-1999) and for the past 8 years following acquisition (2000-2008). Prior to federal acquisition, cattle grazed on the Preserve for a five to six month grazing period; since federal acquisition the grazing season has been limited to four months or less.

Table 8 – Animal Unit Months (AUMs) by Year

Year	Animal Numbers	Estimated AUMs
1976	3,500	12,250
1981	4,000	14,000
1985	6,000	21,000
1988	5,600	19,600
1989	5,230	18,305
1992	5,870	20,545
1993	6,404	22,414
1994	5,510	19,285
1995	7,200	25,200
1996	4,960	17,360
1997	6,734	23,569
1998	5,282	18,487
1999	5,749	20,122
2000	*0*	*0*
2001	*0*	*0*
2002	*703*	*879*
2003	*675*	*2,270*
2004	*666*	*2,010*
2005	*600*	*1,918*
2006	*200*	*280*
2007	*500*	*1,400*
2008	*1,950*	*5,460*

Despite a long history of heavy livestock use, the Preserve has proven surprisingly resistant and resilient to the effects of anthropogenic disturbance. Stream, soil, and vegetative condition were likely degraded during the early grazing period (Figure 15) because forage use standards and ecological considerations were not applied, and stocking rates were based on purely economic considerations (Valles Caldera Trust, 2002). Upon acquisition, stream conditions were rated as nonfunctioning or functioning-at-risk in many locations and poorly engineered roads were contributing to run-off. Evidence of past disturbance is still apparent on the Preserve today; but range condition remains moderate to high (T.E.A.M.S., 2007). Monitoring over the past 8 years suggests strong regrowth potential with water as the limiting factor and stream conditions have improved rapidly. In addition, road reclamation activities are decreasing the amount of surface run-off. Recent analysis (T.E.A.M.S., 2007) suggests range conditions are on an upward trend.

Figure 20 - Left Jaramillo Creek in 1935; right: Jaramillo Creek 2001

3.1.2. Existing Condition

Ecological Condition

Methodology

In this section "condition" is the term used to reflect ecological health functions associated with land health. The ecological function of the range was evaluated using health indicators derived from site data and inventory. Ecologic function was considered at two scales: site-specific ground data and evaluation at the sub basin watershed level. Sites were evaluated using procedures to interpret rangeland health indicators similar to the protocol presented in "Interpreting Indicators of Rangeland Health – Version 4" (Pellant 2005). These procedures generally assess how well ecological processes on a site are functioning, and include the abiotic (soil/site stability and hydrologic function) and biotic (relating to living organisms) attributes.

The quality of water in streams and rivers is an indicator of the health of the watershed and the ecosystem and can be considered a measure of the cumulative effect of past and present actions. Therefore, it is appropriate to use the watershed as the basic land unit when determining ecological condition. A watershed is an area or region of land that drains into a stream or river. Ridges of higher land separate watersheds from each other. Since the intent is to monitor effects

resulting from land-use practices, working within a smaller watershed is preferred. To meet this intent, 6th order watersheds (U.S. Geological Survey [USGS] Hydrological Unit Code [HUC] 14-digit watersheds) were subdivided into 44 smaller sub basins, and each of these received an overall rating as (see Figure 20).

The condition rating was based on key quantitative and qualitative assessment indicators assessed from 672 locatable plots. Quantitative indicators included measures of ground surface cover such as grass, forbs, litter, and bare ground. The presence of rills, waterflow patterns, pedestals and other erosive activities were among the qualitative indicators assessed. The field data were collected by Muldavin and Tonne (Muldavin E. a., 2003) for their 2003 vegetation survey, Barnes (Barnes, 2006) for range monitoring, and the USFS (USDA-Forest Service, 2006) for their Terrestrial Ecosystem Survey[12].

The land area of the Preserve is primarily within five 6th order HUC watersheds (see Figure 20). The results of the watershed analysis are grouped within these larger watersheds. The Preserve's eastern and northern boundary does not exactly match the 6th order watershed boundaries; therefore, there are small fragments of land that are within the Preserve that slightly overlap into other 6th order watersheds.

Sub basins of the Preserve were evaluated for abiotic and biotic factors that indicate watershed health. These indicators were derived from criteria used in *Herrick Rangeland Health Criteria* (Pellant, 2005) in addition to common watershed health measures such as road density, stream condition measures such as Proper Functioning Condition (Pritchard, et al., 1998), and stream invertebrate diversity.

Results

Results indicated that all sub basins of the 6th order watersheds are in good to fair condition showing a moderate departure from the reference condition (see Figure 20). Most showed an upward trend in condition (T.E.A.M.S., 2007). Five sub basins (11 percent of the acres) were in good condition with stream and upland information indicating slight to no departure from the reference condition. These five sub basins contain 9,831 acres (11 percent of the total). The remaining sub basins (89 percent of the acres) were in fair or moderate condition due to either upland or riparian degraded conditions. These sub basins contain 80,002 acres (89 percent of the total). None of the sub basins showed significant departure from the reference condition. The results are summarized by sub basin, grouped by 6th order watershed.

[12]Terrestrial ecosystem survey consists of the systematic analysis, classification, and mapping of terrestrial ecosystems. This integrated survey is hierarchical with respect to classification levels and mapping intensities. A terrestrial ecosystem is an integrated representation of the ecological relationship between climate, soil, and vegetation.

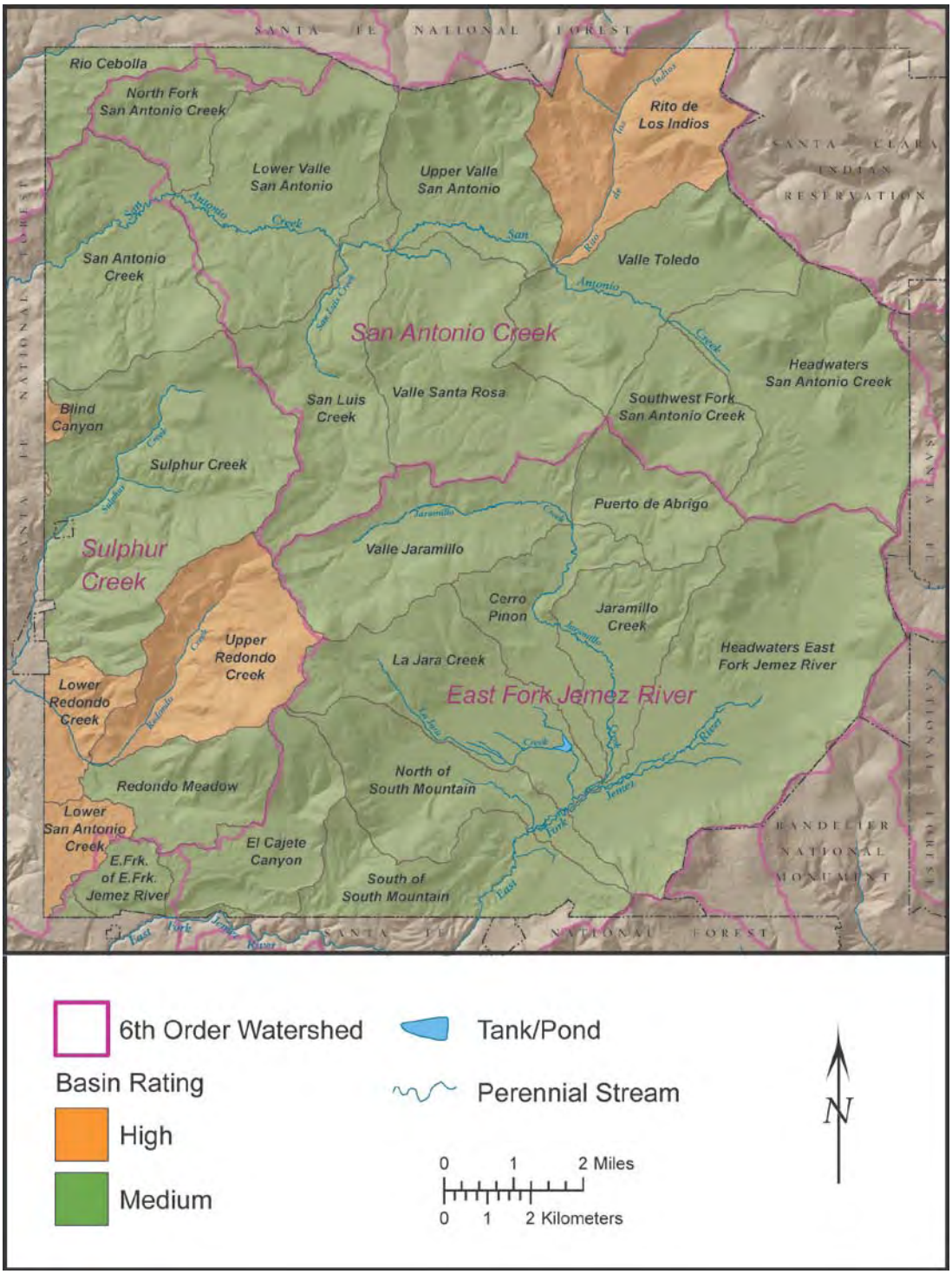

Figure 21 – Ecological Condition Map; *High* indicates conditions at or near the reference condition, *Medium* indicates moderate departure from the reference condition.

East Fork of the Jemez River Watershed

Table 9 – Ecological condition rating for sub-basins within the East Fork Jemez River watershed

Sub-basin	Acres	Overall Rating	Upland Rating	Riparian Rating
East Fork Jemez [HUC 13020202020030]				
Cerro Piñon	2,183	MED	MED	MED
El Cajete Canyon	2,454	MED	MED	
Headwaters East Fork Jemez River	8,772	MED	MED	MED
Jaramillo Creek	2,354	MED	MED	HIGH
La Jara Creek	3,778	MED	MED	HIGH
North of South Mountain	3,035	MED	MED	MED
Puerto de Abrigo	1,783	MED	HIGH	
South of South Mountain	3,108	MED	MED	MED
Valle Jaramillo	3,930	MED	MED	MED

The East Fork of the Jemez River 6th order watershed is dominated by the Preserve's largest valle, Valle Grande, and is the headwaters for the East Fork of the Jemez River. Major tributaries are Jaramillo Creek and La Jara Creek. This watershed area would have been routinely exposed to the earliest seasonal grazing by livestock when cattle were shipped on and off the ranch (Havstad, Kris, 2002).

Condition for this watershed was based on 287 upland vegetation plots plus stream condition data. A total of 67 percent of the watershed is in forest and 55 percent of the forest has a canopy closure greater than 35 percent where forage production is low, usually 225 pounds per acre or less. The range condition is functioning with all nine sub-basins being rated as medium based on length of streams in a proper functioning condition and whether bare ground, litter, and plant cover met or exceeded ecological site description values developed by the NRCS for this area.

East Fork of the Jemez River Sub-basin

Water Quality

A number of water quality issues have been documented on the East Fork of the Jemez over time. Using benthic organisms as an indicator of water quality, this stream was issued a rating of moderately impaired (Simino, East Fork of the Jemez River 2002), and the New Mexico Environment Department (NMED) Surface Water Quality Bureau has documented specific concerns regarding State water quality standards (Simino, 2002), (State of New Mexico 2002). Water quality impairments were reported in the year 2000 on the East Fork of the Jemez (along the lower reach below the confluence with Jaramillo Creek) for temperature, total suspended solids, fecal coliform, and stream bottom sediments (Valles Caldera Trust, 2002). In its 2002 report, the New Mexico Environmental Department cited two exceedances regarding turbidity between the confluence with the San Antonio and its headwaters, but temperature, fecal coliform, and stream bottom sediments were not cited as concerns (State of New Mexico 2002). Summer

water temperatures are generally warm and have exceeded the recommended maximum of 23°C (or 20°C for 4 hour duration). The pH of the stream is neutral to basic and can exceed 8.8. Ammonia and aluminum levels also can exceed water quality standards (Vieira and Kondratieff 2004).

Benthic invertebrate surveys were performed during 2000 (Simino, East Fork of the Jemez River 2002); the dominant organisms found were primarily tolerant ones that can survive in altered aquatic habitat. The East Fork had a low number of taxa (23), probably due to homogeneity of the substrate (fine materials) and thermal consistency (Simino, East Fork of the Jemez River 2002). Pool habitat had been reduced by high levels of fine sediment, and riffle habitat had excessive amounts of fine materials. Trout spawning habitat throughout this reach had been greatly reduced due to sedimentation (Valles Caldera Trust, 2002).

Stream Morphology[13]

Early surveys revealed that this river was not properly functioning for all of the criteria in categories of habitat characteristics and channel condition and dynamics, except pool quality and stream bank condition (Simino, 2002). In 2004 a total of 1.8 and 5.2 miles of the East Fork of the Jemez River were classified as proper functioning condition (PFC) and non-functioning (NF), respectively (Santa Fe National Forest 2004). The remainder was classified as functioning at risk (FAR). The National Riparian Service Team rated the lower segment of the East Fork Jemez River below the main access to the Preserve headquarters as FAR with an upward health trend rather than NF (National Riparian Service Team 2002, S. McWilliams 2001). The East Fork Jemez River Stream Inventory (Simino, 2002) noted pool formation concerns, and excessive amounts of long riffles and altered width:depth ratios and stream types. Hydrologists and soil scientists found that high sediment loads, loss of undercut banks, and straightening of channels were causing structural and functional problems to the stream system.

The East Fork of the Jemez River was revisited in 2006 and Proper Functioning Condition surveys showed that changes are occurring in this stream system (Table 10). The perennial segments of the East Fork have improved from the below the spring to the southern boundary. The installation of an appropriately designed bridge along the headquarters road is likely responsible for the improved conditions. Unlike the lower reaches of the East Fork, the spring area did not appear to be responding to management action over the last 6 years. The intermittent segment below the stock tank and above the non riparian segment appeared to be of concern as well. In 2000 this segment was in properly functioning condition; however, in 2006 this segment was found to be FAR and with a downward trend. Areas of concern around the spring and the intermittent segment below the stock tank seem to be reflective of drought and herbivory as noted by responses associated with the elk exclosure fence (McWillams 2006).

[13] **Stream morphology** refers to the condition and changes of stream gradient and cross-section shape due to sedimentation and erosion processes.

Table 10 - A comparison of PFC results between 2000 and 2006 for the East Fork of the Jemez River.

Stream Segment	2000 PFC Rating	2006 PFC Rating
Segment 1	FAR (no trend)	FAR (upward trend)
Segment 2	PFC	FAR (downward trend)
Segment 3	Non-Riparian	Non-Riparian
Segment 4a	FAR (no trend)	FAR (no trend)
Segment 4b	FAR (no trend)	PFC
Segment 5	PFC	PFC
Segment 6	FAR (upward trend)	PFC
Segment 7	NF	FAR (upward trend)
Segment 8	PFC	PFC

Riparian Vegetation

The potential vegetation in the Valle Grande and similar low-gradient stream meadow systems on the Valles Caldera National Preserve is expected to be primarily herbaceous. Primary species were well represented and included mannagrass, water sedge, beaked sedge, silver sedge, and occasional Nebraska sedge in the saturated areas near the stream. Tufted hairgrass is the primary species for the semi-wet areas; Baltic rush may occur throughout. Occasionally, large-stature willows may occur on the outer margins where the fluctuating water table and conditions allow for germination and establishment. Headwaters and steeper stream segments leaving the Caldera are thought to have potential for a combination of herbaceous and woody components such as willows and/or alder. Riparian aspen may also be a component in places. Alder were noted on a few segments, but very few willows were observed. It is unclear whether some past management activity removed the woody component or the woody component was never there. Present browsing of woody species in the area by elk could easily prevent reestablishment if they were part of the system. Shrubby cinquefoil is heavily browsed throughout the caldera and is generally considered a less palatable shrub than most of the native willows and aspen (National Riparian Service Team 2002).

Jaramillo Creek Sub-basin

Water Quality

Benthic invertebrate surveys were performed during 2000 by Chic Spann, Region 3 Forest Service hydrologist; Steve McWilliams, Santa Fe NF Watershed Program Manager; and Dr. Gerald Z. Jacobi (Spann, McWilliams and Jacobi 2000). The benthic survey used Jaramillo Creek as the reference site for other streams and was classified as non-impaired. Jaramillo Creek had the largest number of taxa (31) and the most diversity of organisms within the Valles Caldera (benthic organism diversity index was 3.53) (Valles Caldera Trust, 2002).

Stream Morphology

Jaramillo Creek, a narrow and deep tributary to East Fork of the Jemez River, is a meandering 1st order stream that predominantly runs through Valle Grande and Valle Jaramillo. A total of 4.3 miles of Jaramillo Creek, starting at the East Fork of the Jemez River, was classified as being in a PFC during early surveys. The remainder of Jaramillo Creek up to the headwaters was classified as FAR (Santa Fe National Forest 2004). Surveys conducted in 2006 revealed that Jaramillo Creek continues to improve with the length of stream channel at risk having been reduced over the intervening 6 years (McWillams 2006) (Table 11).

Table 11 – A comparison of PFC results between 2000 and 2006 for Jaramillo Creek

Stream Segment	2000 PFC Rating	2006 PFC Rating
Segment 1	PFC	PFC
Segment 2a	FAR (upward trend)	PFC
Segment 2b	FAR (upward trend)	FAR (upward trend)
Segment 2c	FAR (upward trend)	PFC
Segment 3	PFC	PFC

Gravel and silt are the dominant bed substrate; some areas have cobbles. The upper headwaters of the Jaramillo Creek consist of seeps and natural wetland areas. The dominant substrates of these seeps were mud, silt, and inundated meadow vegetation. Prior to entering the Valle Grande, the creek is fed by a spring. Cobble and sand, and some boulders, dominate the substrate, and aquatic mosses are also present. The spring tributary is shallow, and the tops of most cobbles are exposed (Vieira and Kondratieff 2004). In 2006, following an extremely dry winter and spring, Jaramillo Creek was dry for nearly 30 days during the early summer.

Stream Vegetation

Large woody debris was partially submerged in some areas of the upper headwaters of Jaramillo Creek and the riparian zone around the majority of the creek consisted of meadow vegetation, wetland vegetation, and conifers (Vieira and Kondratieff 2004). Recent surveys indicate that thin-leaf alder and Bebb's willow have started vegetative reproduction in the upper segment as well (McWillams 2006, Barnes 2006, Parmenter 2007).

La Jara Creek Sub-basin

Water Quality

La Jara Creek had a fair diversity of benthic organisms (27 species), but was sampled at a lower frequency than other small creeks.

Stream Morphology

La Jara Creek has been classified as FAR (Santa Fe National Forest 2004). Dominant bed substrate includes cobbles and gravel. This stream is higher gradient, with faster current and shallower depth than most lotic systems of the Preserve.

Stream Vegetation

Conifers and aspen are the predominant vegetation in the riparian zone, and the stream is littered with large woody debris. There is anecdotal evidence that Bebb's willow (*Salix bebbiana*) once occurred along La Jara (Willow) Creek (Valles Caldera Trust, 2002) although no willow are currently present.

San Antonio Creek Watershed

Table 12 - Ecological condition rating for sub-basins within the San Antonio Creek watershed

Sub-basin	Acres	Overall Rating	Upland Rating	Riparian Rating
San Antonio Creek [HUC 13020202020010]				
Headwaters San Antonio Creek	5,385	MED	MED	HIGH
Lower Valle San Antonio	4,962	MED	MED	MED
North Fork San Antonio Creek	1,616	MED	MED	MED
Rito de los Indios	4,080	HIGH	HIGH	HIGH
San Luis Creek	3,818	MED	MED	MED
Southwest Fork San Antonio Creek	2,024	MED	N/R	HIGH
Upper Valle San Antonio	3,431	MED	MED	MED
Valle Santa Rosa	4,779	MED	MED	N/R
Valle Toledo	4,379	MED	MED	HIGH

The San Antonio Creek 6th order watershed is dominated by Valle Toledo and the San Antonio Creek and its tributaries. Condition for this watershed was based on 208 plots. A total of 63 percent of the watershed is in forest and 84 percent of the forest has a canopy closure greater than 35 percent where forage production is low, usually 225 pounds per acre or less.

Range condition is functioning ecologically throughout the watershed with all but one sub-basin being rated as medium. The Rito de los Indios sub-basin was rated as high. Ratings were based on whether or not stream segments were in a proper functioning condition and whether bare ground, litter, and plant cover met or exceeded ecological site description values developed for this area.

San Antonio Creek Sub-basin

Water Quality

In 2000, the majority of San Antonio Creek was found not to meet State water quality standards for its designated uses because of temperature, total suspended solids, fecal coliform, and stream bottom sediments (Valles Caldera Trust, 2002). However, in 2002 NMED found that conditions had improved somewhat, citing only temperature and turbidity as concerns between the confluence with the East Fork of the Jemez River and the headwaters of San Antonio Creek

(State of New Mexico 2002). Water temperature is a crucial parameter for fish health and development. Five stream temperature stations were strategically placed along the length of San Antonio Creek. The stations recorded water temperatures every 4 hours between June 11 and November 24, 2002. The water temperature data were compared to both Forest and NMED standards. The Forest standards classified San Antonio Creek as not properly functioning for salmonid development at all sites except station 5 located near the headwaters. The NMED standards classified two of the five sites as not properly functioning for water quality (State of New Mexico 2002). In 2003 Goodman noted that mitigating human-caused elevated stream temperatures should be a focus in the management of San Antonio Creek (Goodman 2003).

In 2003 NMED found that the stream was generally in accordance with standards based on two sites, although summer water temperatures have exceeded the recommended 23°C maximum (or 20°C for 4 hour duration), the pH of the stream is neutral to basic and often exceeds 8.8, and ammonia and aluminum levels can occasionally exceed water quality standards (Vieira and Kondratieff 2004).

Using benthic invertebrate surveys, San Antonio Creek was rated as slightly impaired (Spann, McWilliams and Jacobi 2000). The dominant organisms found were primarily those tolerant of altered aquatic habitat (Valles Caldera Trust, 2002). San Antonio Creek was found to have moderate diversity with 32 species (Vieira and Kondratieff 2004).

Stream Morphology

Early surveys indicated that a total of 6.2 miles, mostly in the upper sections of San Antonio Creek (above confluence with Rio de los Indios Creek) were classified as PFC. The remaining 13.3 miles of San Antonio Creek were determined to be FAR (including the section crossing Sulphur Creek Watershed) (Santa Fe National Forest 2004). The parameters that were not properly functioning included water temperature, relative sediment content in riffles, the density of large woody debris, pool development, width-to-depth ratio, and stream bank condition (Goodman 2003).

Surveys conducted in 2006 showed some improvement in stream condition Table 13. San Antonio Creek has shown an increase in riparian wetland species along the bank and an improved rating at the lower end of the stream as it exits the Preserve. The upper end of the San Antonio from the headwaters of the Valle Toledo to below the confluence with the Rito de los Indios was well above the minimum required for PFC, as were the intermittent reaches around and above the stock tank. Several small head cuts associated with bogs above the stock tank have the potential to continue upstream and could pose a future threat to the headwaters (McWilliams 2006).

Table 13 – A comparison of PFC results between 2000 and 2006 for San Antonio Creek

Stream Segment	2000 PFC Rating	2006 PFC Rating
Segment 1	Proper Functioning Condition	Proper Functioning Condition
Segment 2	Proper Functioning Condition	Proper Functioning Condition

Segment 3	Non-Riparian	Non-Riparian
Segment 4	Proper Functioning Condition	Proper Functioning Condition
Segment 5	Proper Functioning Condition	Proper Functioning Condition
Segment 6a	Functioning At Risk (upward trend)	Functioning At Risk (upward trend)
Segment 6b	Functioning At Risk (upward trend)	Proper Functioning Condition

Stream Vegetation

The riparian vegetation is not consistent for the entire length of the stream. There are three distinct riparian environments between the mouth and headwaters of San Antonio Creek. From the headwaters is a unique riparian habitat with high diversity. Alder, willow, locust and dogwood are the primary woody streamside vegetation; while water hemlock, grasses, and sedges dominate the herbaceous vegetation. Moving west, the diversity of vegetation decreases. Streamside woody vegetation is primarily comprised of alder and willow, while the herbaceous vegetation is mostly grasses, sedges, horsetail, and rushes (though overall quantity of herbaceous vegetation is severely decreased). Continuing west into the Valle Toledo, woody vegetation dramatically decreases, while herbaceous riparian vegetation diversity increases. The only woody vegetation is an occasional patch of cinquefoil. The majority of streamside herbaceous vegetation is sedges, rushes, grasses, buttercups, sorrel, flea bane, dandelion, yarrow, thistle, horsetail (in wetter areas), hair bell, heal-all, clover, spearmint, sunflowers, and scarlet Gila. Aquatic vegetation (*Potomogeten*, *Elodea*, *Ceratophyllum demersum*, and algae) was present in the entire stream, but increased in the upper reaches (Goodman 2003).

In 2000 the Valle San Antonio had up to 85 percent of the bank vegetation comprised of upland species such as Kentucky bluegrass. In 2006 that percentage had been reduced to around 40 percent upland species. Herbivores may slow recovery within the Valles San Antonio and future analysis of changes within elk exclosure fences will be important in quantifying these impacts (McWillams 2006).

Rito de los Indios Creek Sub-basin

Water Quality

Benthic invertebrate surveys were performed during 2000. The benthic survey indicated that the stream reach was non-impaired with 82 percent of the reference attributes (Spann, McWilliams and Jacobi 2000). Among the running water habitats, small creeks with well developed riparian vegetation (such as Rito de los Indios) were the most diverse with the most number of benthic species (48 total species) (Vieira and Kondratieff 2004).

Stream Morphology

The spring-generated tributary is very shallow, with the tops of most substrates exposed (Vieira and Kondratieff 2004). Temperatures remain cool throughout the summer. Dominant bed substrate includes gravel and cobble; large woody debris can be found throughout the creek channel in the forested reaches.

Rito de los Indio Creek, located in the Rito de los Indios sub-watershed, is a tributary to San Antonio Creek. This small stream is approximately 4 miles long; earlier surveys characterized 2.6 miles as FAR and 1.4 miles in PFC (Santa Fe National Forest 2004). T-Walk's Tarzwell substrate ratio was used to characterize the reference reach above the confluence with San Antonio Creek; the creek was assessed as impaired due primarily to the amount of sands and silts in the gravels.

In 2006 the system had improved and degraded channels had begun to stabilize. Rito de los Indios also showed improvement in species composition on the banks and expansion of riparian wetland vegetation both toward the stream and into the floodplain. As shown in Table 14, the entire length of the Rito de los Indios system was considered to be in PFC or better (McWilliams 2006).

Table 14 – A comparison of PFC results between 2000 and 2006 for Rito de los Indios

Stream Segment	2000 PFC Rating	2006 PFC Rating
Segment 1	PFC	PFC
Segment 2	FAR (no trend)	PFC
Segment 3	PFC	PFC

Sulphur Creek Watershed

Table 15 - Ecological condition rating for sub-basins within the Sulphur Creek watershed

Sub-basin	Acres	Overall Rating	Upland Rating	Riparian Rating
Sulphur Creek [HUC 13020202020030]				
Blind Canyon	136	HIGH	HIGH	
Lower Redondo Creek	1,117	HIGH	HIGH	HIGH
Lower San Antonio Creek	817	HIGH	HIGH	
Redondo Meadow	2,115	MED	HIGH	MED
San Antonio Creek	4,267	MED	HIGH	MED
Sulphur Creek	7,370	MED	MED	HIGH
Upper Redondo Creek	3,676	HIGH	HIGH	HIGH

The Sulphur Creek 6th order watershed is dominated by mountainous terrain and forests, except where San Antonio Creek (Valle San Antonio) crosses the watershed at the north end and at Valle Seco (a small valle located within Sulphur Creek sub-watershed). Except the section of San Antonio Creek, no other streams were surveyed as to proper functioning condition. One source of data for stream condition came from benthic invertebrate surveys conducted in 2004.

Condition for this watershed was based on 127 vegetation plots and 15.6 miles of perennial stream. A total of 88 percent of the watershed is in forest and 81 percent of the forest has a canopy closure greater than 35 percent where forage production is low, usually 225 pounds per acre or less. A total of 12 percent is in grassland with 66 percent of the grassland being dry

upland grassland. Small amounts of low and upland grassland can be found in association with Alamo Canyon, Redondo, and Sulphur Creeks; but most of it is found in Valle San Antonio.

These sub-basins, with the exception of San Antonio Creek, have received less livestock use because of the mountainous terrain and lack of waters. Most of the elk concentrate near or within the primary valles outside of this watershed with the exception of San Antonio Creek[14]. Historically an elk herd utilized this side of the Preserve and wintered to the south and west, but elk now concentrate on the east and north sections of the Preserve, which are in or associated with the large grassland valles, and winter to the north and east. This may be due to the lack of hunting on the north and east within Los Alamos or Bandelier National Monument.

Within the Sulphur Creek Watershed, four of seven sub-basins received a high rating; most of these are around Redondo Creek. The remaining three sub-basins received a medium rating. All ratings were based on stream condition and whether bare ground, litter, and plant cover met or exceeded ecological site description values developed by the NRCS for this area.

San Antonio Creek Sub-basin

The lower section of San Antonio Creek within the Preserve is located in the San Antonio sub-basin of the Sulphur Creek 6th order watershed. San Antonio Creek is approximately 2.5 miles, all of which is FAR. The remainder of San Antonio Creek was previously described under the San Antonio Creek 6th order watershed.

Sulphur Creek Sub-basin

The acidic Sulphur Creek (5.6 miles long) showed very low benthic diversity (6 species) receiving a rating of "least diverse" (Vieira and Kondratieff 2004). Sulphur Creek is a 2nd order stream aptly named for its high sulfur content. Its acidity (pH of 2 to 4) makes it one of the most unique habitats on the Preserve. Most of the drainage, including Alamo Creek which feeds into Sulphur Creek at lower elevations, is characterized by geothermal activity and sulfur springs(Vieira and Kondratieff 2004).

The length of herbaceous and limited shrub riparian vegetation has increased since 2000. Earlier the riparian/wetland vegetation extended to a point just above the confluence with Alamo Creek. Today the riparian/wetland vegetation has extended its range to the stock tank at the lower end of the Valle Seco. Acidic deposition along Sulphur Creeks is natural and although this stream has been cited for exceedences regarding conductivity and pH (State of New Mexico 2002), this stream has been rated as being in Proper Functioning Condition (McWillams 2006).

Alamo Creek Sub-basin

Alamo Creek is a small stream approximately 2.1 miles in length that feeds into Sulphur Creek at lower elevations. It is characterized by geothermal activity and sulfur springs. The primary substrate of the 1st order tributary was cobble and gravel, and the entire streambed was covered in a white precipitate. This tributary and pools feeding it were geothermally active (Vieira and Kondratieff 2004). The acidic wetlands complex in Alamo Canyon showed the least benthic

[14] Meeting with New Mexico Game and Fish Department, May 15, 2006, between Darrel Waybright, Steve Kohlmann, James Biggs (Las Alamos Lab), Anton Jackson, and Keith Menasco.

diversity (no species) of all sampled (Vieira and Kondratieff 2004). Alamo Creek has been rated as being in PFC (McWillams 2006).

Redondo Creek Sub-basin

Redondo Creek is approximately 5.4 miles long. A benthic survey in 2004 rated Redondo Creek "most diverse", having the highest number of benthic invertebrate species (39); it was considered the most diverse of any stream on the Preserve (Vieira and Kondratieff 2004). The lowest site sampled was at the Redondo gate along the Preserve's western boundary on the VC02 road, where the cool-water 1st order creek runs predominantly through meadow habitat, with some conifers on hillslopes and riparian vegetation along the banks. Substrate consists of cobble and sand, with CWD (course woody debris) present on the stream bed and along the margins. Riparian vegetation is better developed at upper sites, including 24, the reach above where the VC02 and 03 roads meet and at the Union Building. Cobble and gravel substrate dominate these two upper sites, and course woody debris is more prevalent than at the Redondo gate site. While temperatures and ammonia levels typically remain at or below water quality standards, aluminum standards were often exceeded (Vieira and Kondratieff 2004). Exceedences for temperature and turbidity have also been documented for Redondo Creek as recently as 2002 (State of New Mexico 2002).

One segment of this stream was rated as FAR with an upward trend and two segments were rated as being in PFC (McWillams 2006). There are concerns about Redondo Creek within Redondo Meadow below the road junction of VC02 and VC03 and extending for approximately a half mile to the North West end of the meadow. This segment could be a candidate for site-specific action to speed the recovery. The old drill pads have stabilized and the riparian/wetland areas are improving with a robust shrub component.

Onion, Confluence, and Various Other Watersheds

Table 16 - Ecological condition rating for sub-basins within the Onion, Confluence, and various other watersheds

Sub-basin	Acres	Overall Rating	Upland Rating	Riparian Rating
Confluence [HUC 13020202020040] [1]				
Confluence East Fork Jemez River	101	MED	MED	MED
East Fork of East Fork Jemez River	736	MED	HIGH	MED
Onion Creek [HUC 13020202010030]				
Rio Cebolla	1,524	MED	MED	
Various Small Parcels Along North and East Edge of Boundary	1,065			

The portion of Onion 6th order watershed within the northwest corner of the Preserve is only 1,524 acres; mountainous terrain and forests, virtually all with a canopy greater than 35 percent crown closure resulting in low forage production, dominate. All acres were rated as medium. All ratings were based on whether bare ground, litter, and plant cover met or exceeded ecological site description values developed by the NRCS for this area. Road densities are low.

The Confluence 6th order watershed within the southwest corner of the Preserve is only 837 acres; it is dominated by mountainous terrain and is entirely forested; 89 percent of the forest has a crown closure greater than 35 percent resulting in very low forage production. All acres were rated as medium. All ratings were based on whether bare ground, litter, and plant cover met or exceeded ecological site description values developed by the NRCS for this area. Road densities are very low.

There were various small pieces of land that were part of other 6th order watersheds along the east and north boundaries. These small parcels equaled 1,065 acres, ranging from 0.5 to 428 acres. Most were woodlands with most having a crown closure greater than 35 percent resulting in very low forage production. These small parcels were not rated.

Suitability

Methodology

Suitability for allocating forage was based on an assessment of slope, distance to water and available forage (T.E.A.M.S., 2007). Forage growing on gentle terrain (lands with less than 30% slope), within 1 mile of water, and producing more than 225 pounds of forage per acre, annually, under typical conditions, was considered suitable for allocation to both elk and domestic livestock grazing or other uses. Production values were based on field sampled data where available, and modeled values where field data was not available. Modeled values were based on ecological site descriptors adjusted for current conditions such as forest canopy. Production values were further adjusted based on actual slope and actual distance to water (T.E.A.M.S., 2007).

Forage on lands areas meeting distance to water and forage production requirements but occurring on steeper terrain (slopes from 30 to 60 percent) were considered suitable for allocating forage to elk only. Forage growing on the steepest terrain (greater than 60% slope) or greater than one mile from water was not considered suitable for the allocation of forage.

Results

Approximately 31 percent of the Preserve is considered suitable for the allocation of forage for sustainable use by livestock and native fauna (T.E.A.M.S., 2007). The remaining 69 percent is not suitable for allocation due to limited forage, limited quantifiable information about the forage, and, to a lesser degree because of steep slopes and a lack of nearby water sources. Vegetation management in forested areas may increase forage production slightly, but limiting site factors, especially soils, would limit gains in production. Only an estimated 10 percent of forested acres, primarily in the ponderosa pine type, have the potential to meet or exceed production levels considered suitable for allocating forage for sustainable use (under reasonable forest management).

Across the Preserve, the highest potential herbaceous productivity is located in the broad grassy valles. Climate, especially moisture, is the limiting factor of forage production on the majority of sites and rates vary widely depending on the timing and form of annual precipitation. As a result, average biomass production can change significantly in relatively short timeframes. For example, overall forage production doubled between a dry year in 2002 and a wet year in 2007.

Climate is the overarching factor that regulates overall production on the Preserve, and changes are most apparent on the productive lower slopes within the valles. Climate has a smaller effect on herbaceous production on upper slopes where soils become limiting. Concurrently, the greatest opportunity to manage grazing capacity during favorable climatic years exists outside of densely forested areas. The 2007 existing condition assessment of the Preserve found the vast majority of production, and hence capacity, is found on slopes less than or equal to 30 percent (T.E.A.M.S., 2007).

Approximately 4 percent of available grazing capacity occurs on steep slopes (31 to 60 percent) where forest cover dominates. Grazing capacity has increased in the recent years with the onset of favorable monsoons and springs rains. However, this increase occurred in the valles and adjacent woodlands; the proportion of grazing capacity on steeper, forested slopes has remained around one percent of the total. If climate cycles revert to droughty conditions (as anticipated in many climate change predictions), a corresponding decrease in production and capacity would follow.

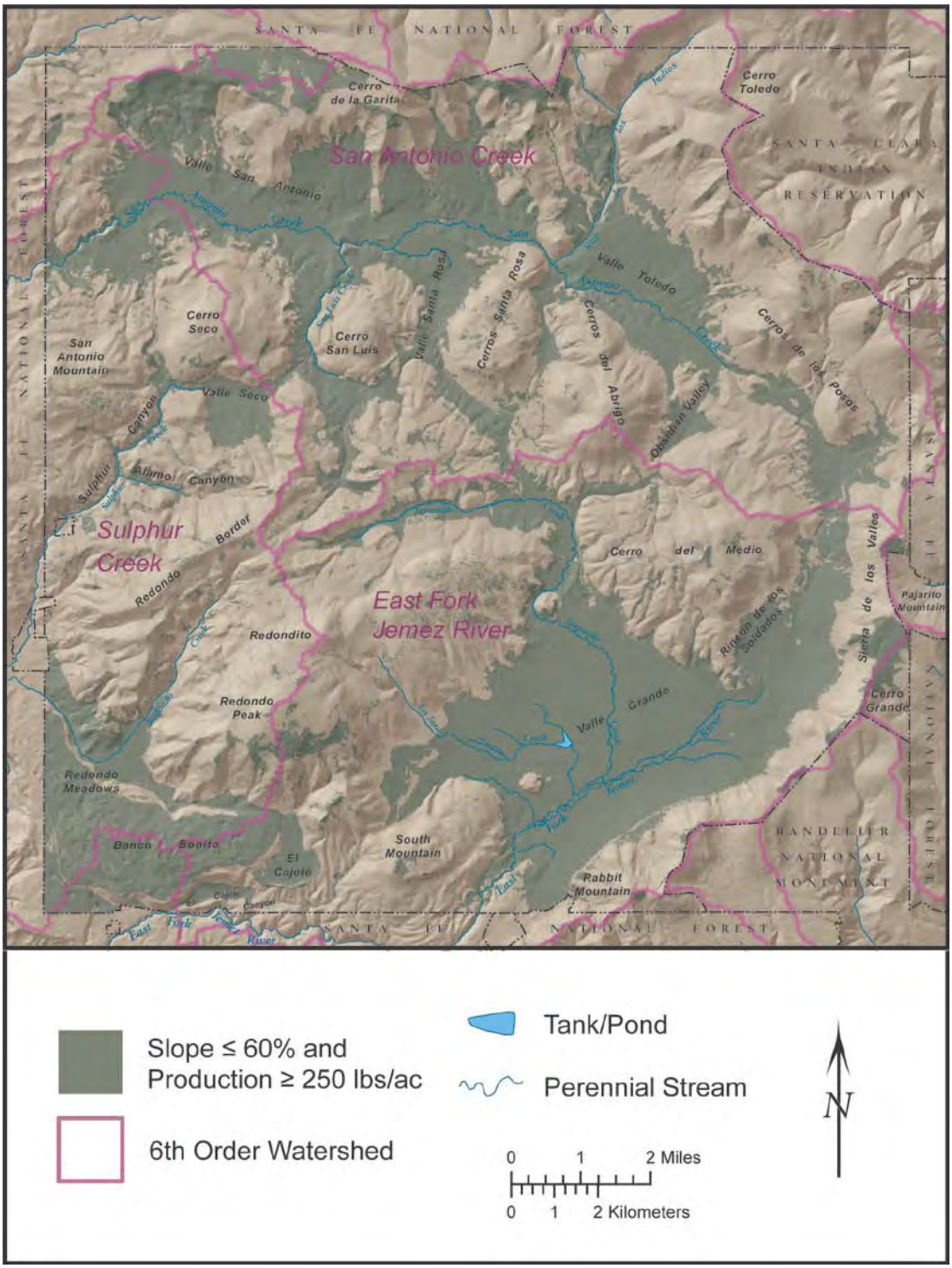

Figure 22 – Areas suitable for allocating forage to elk and domestic livestock grazing.

Capacity

Methodology

Under the proposed Stewardship Action and alternatives, the Trust is proposing to allocate a portion of the Preserve's forage for multiple uses, primarily domestic livestock grazing. The objective of forage allocation is to ensure that total use of the available forage does not exceed 40 percent. The threshold of 40 percent utilization is being proposed as a firm indicator of when grazing could adversely affect grassland health. For perennial herbaceous rangeland species, approximately 60 percent of the aboveground biomass is needed to sustain production and ecosystem services (Dietz 1989, Frank 1993, Crider 1954).

To determine the amount of forage that can be allocated for domestic livestock grazing, the total amount of forage is estimated on areas determined suitable for allocation. Of that total, 60 percent is allocated toward sustaining the resource. A portion of the remaining forage is allocated to native fauna. This allocation is based on the current estimate of elk residing on the Preserve and considers use for a six month growing season. While this simple calculation does not account for use by insects and rodents or the range of the elk outside the Preserve's boundary and may not reflect the actual duration of the elk residency, it has proven to produce an accurate estimate of use over 6 years of monitoring. It can be adjusted based on specific conditions and updated as better information becomes available.

Figure 23 shows utilization in mountain meadow and mountain valley grasslands ranged from 20 to 40 percent for years 2002 through 2004. Drops in livestock numbers and recent good moisture years led to a drop in utilization below 20 percent for years 2005 through 2007 (T.E.A.M.S., 2007).

Another climate related condition involved the lack of snow in 2004 and 2005, which led to higher use by elk. Elk overwintered in 2005 and only were gone a short time in winter 2004. This overwintering may explain the higher usage measured in riparian areas. Riparian utilization was 45 percent and 34 percent for years 2004 and 2005, respectively.

After allocating forage to ecosystem services and native fauna, the remaining forage is allocated for multiple uses by the Trust. The estimated quantity of this forage is used to determine *capacity* for domestic livestock. Capacity is typically described in terms of Animal Unit Months or *AUMs*. One AUM represents the amount of forage required to sustain one lactating cow with a calf by her side (cow/calf pair) for one month. A cow/calf pair is considered an Animal Unit or an *AU*. For the purpose of this analysis, it is assumed that a cow/calf pair uses 900 pounds of forage per month. Values commonly used range from 600 – 1000 pounds depending on the animal size (Alberta Agriculture and Rural Develoment n.d.,Gum and Ogden 1993). Weight factors are applied to steers, heifers, as well as other ungulates such as sheep and elk to account for their smaller body weight and smaller forage requirements. The number of AUs multiplied by the weight factor and the number of months grazed equals total AUMs (AU * weight factor * number of months = Total AUMs).

Results

The current capacity for domestic livestock grazing is approximately 6,000 AUMs, or 1,500 AUs for a four month grazing season (depending on environmental conditions and elk population estimates). This is a revised estimate from the 2007 TEAMS report and capacity shown in Appendix C: Table 51, and includes data from 2002 – 2007. Under drier, less productive conditions, capacity is reduced by more than half; 2,000-2,200 AUMs or approximately 600-700 AUs for a 4-month grazing season. Figure 22 shows the yearly apportioned share of livestock and elk AUMs in relation to an average carrying capacity that incorporates both wet and dry years. Livestock grazing for the same habitat target elk preference—primarily the grasslands associated with the valles and the surrounding woodlands. Notice, using a conservative population estimate, elk use accounts for 9,000 AUMs. This is 75 to 90 percent of the forage depending on the available moisture (T.E.A.M.S., 2007). The elk AUM calculation is displayed below:

9,000 AUM = 2,500 elk * 0.6 (forage weight factor) * 6 (months)

The 2007 report by TEAMS estimates elk numbers between 2000-3000. The 0.6 weight factor is based on reports by New Mexico Department of Game and Fish (Kohlman 2005). The six-month grazing season reflects the variability of elk grazing on the Preserve, in the area of consideration over the year.[15] Elk population and their actual use are assumed constant across years. Although overall stocking was below the estimated carrying capacity and livestock numbers were well below historic levels; Figure 23 shows stocking levels were appropriate and nearing the actual capacity on an annual basis based on utilization. Appendix C shows capacity under a variety of climate scenarios

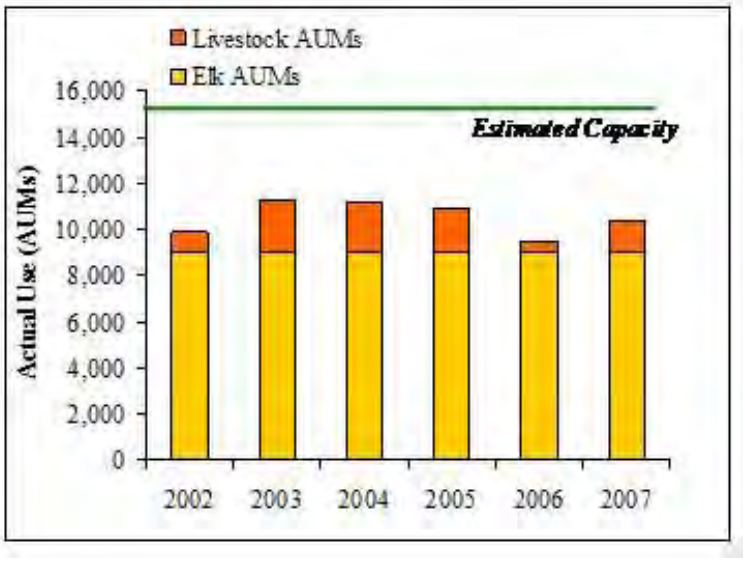

Figure 23 – Actual use by cattle and elk

[15] The formula (2500 * .6 * 6) is a model of elk utilization on the preserve, supported by cumulative utilization data, estimates of elk populations and seasonal movement (T.E.A.M.S. 2007). Population can be adjusted as population estimates are updated. Duration of grazing season can be adjusted based on annual climate conditions.

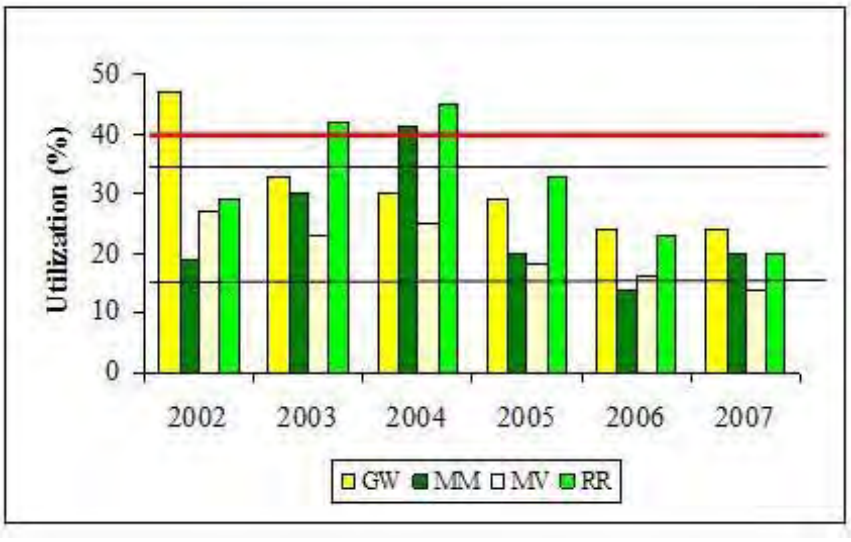

Figure 24 - Percent utilization by ecosite

Favorable precipitation years have shown the Preserve is capable of supporting larger ungulate populations when moisture is abundant. Although carrying capacity increases during wet years, stocking rates would not necessarily increase to full capacity. To safeguard resources effectively, grazing management would focus on livestock use and distribution within the context of environmental conditions and interactions with relatively healthy and stable elk populations.

During the interim grazing period, the Preserve has focused on remedying livestock distribution structures while distributing livestock numbers appropriately to promote grassland health. Historically, water catchments were developed away from lowland riparian areas on hill slopes to encourage use of forage resources on steeper mountain slopes, transitory range, and subalpine grasslands. However, these water developments were earthen stock tanks, which have not been maintained; some have failed and many are silted in and have limited capacity for holding water. Fences also support some livestock distribution, but many fences are in poor condition or no longer serve the needs of the Preserve. Much of the historical "sheep" fence (fence constructed of woven wire) still remains, causing resource damage from improper location across drainages and acting as barriers to wildlife. In addition, much of the "upland" pasture acreage existing on the Preserve in the late 20th century was a result of the forest clear-cutting activities in the 1960s and early 1970s, which created expansive mountain meadows and grasslands. However, forest regrowth since then has greatly reduced the area of meadows and grasslands available for elk and livestock grazing as previously illustrated in Figure 13. Therefore, continued emphasis is placed on herding livestock using range riders to adequately distribute livestock and avoid overutilization of forage resources.

In summary, while 40 percent use is the objective, it is not possible to manage native fauna and domestic livestock with such precision. The proposed allocation of forage is a conservative approach to ensure that over use is not ubiquitous, repeated, or excessive. Adaptive management, guided by the proposed system of goals, objectives, and monitored outcomes is designed to inform managers at various scales to ensure the integrity of the system as a whole is maintained or

improved over time. Actual allocation and capacity can be adjusted based on the assigned area and duration of use, the types or class of animals, available management tools (herding, fences, lures), and environmental conditions.

3.1.3. Watershed – Environmental Consequences

Ecological Condition

Vegetation

The upward trend in range and watershed health that has been observed over the past 8 years is expected to continue under each alternative. Improved conditions could be maintained with either the cessation of livestock grazing or with modest livestock management with allocation similar to that practiced by the Trust under the interim grazing program. Each of the alternatives proposes management that is conservative compared to practices under past ownership and historic private use. Regardless of the alternative selected, elk would continue to be the primary source of grazing pressure on the Preserve. Because the grazing alternatives are similar in scope to the interim program, the effects would be analogous to those seen since the inception of livestock grazing under the Trust's management. Alternatives B, C and D include maintenance and repair of structural range improvements that would indirectly improve range and watershed conditions. Cumulative effects from the heavy land use in the past would not vary measurably between any of the alternatives because that legacy would continue to heal under each alternative.

Alternatives A and B

Direct and Indirect Effects

Both alternatives would lead to continued recovery as observed within the last 8 years. Range resources would continue to improve as soil cover collects and stream channels revegetate as a result of increased production by native and nonnative grassland species following recent trends. Native species will continue to thrive under all climatic conditions while exotic grassland forage species such as Timothy and Kentucky bluegrass fluctuate according to annual precipitation. Alternative B would not impact range health measurably over Alternative A because outside of the natural ecosystem, forage would be used only for education and seed collection and small programs for domestic livestock grazing focused on education, research or other public purposes. Discretionary use of forage would be relatively small-scale, of short duration and subject to resource safeguards.

Results are mixed on the effects on removing cattle from forests and montane meadows. In high elevation semi-arid rangelands, Loeser et al. (2007) found removing cattle had no consistent differences in either plant functional group or native plant cover as compared to moderate grazing treatments, though it may take decades for forage to fully respond. Similarly, Vavra et al. (1994) in arid and semi environments found recovery either slow or nondetectable if range conditions were poor. On the other hand, Milchunas (2006) found positive response by removing grazing with increased growth of native bunchgrasses and less abundance of nonnative grasses. In

addition, grazing removal led to a conversion from abundant annual weeds to a smaller proportion of perennial weeds (Milchunas 2006).

The relief of livestock grazing will not likely lead to a change the current composition of native and nonnative species. Native species will continue to thrive on the less productive soils on the uplands. Exotic species such as European pasture grasses will persist where water and nutrients are abundant, such as wet valley bottoms and grassland ridge soils. These areas have Kentucky bluegrass (*Poa pratensis*), Timothy (*Phleum pratense*), and redtop (*Agrostis stolonifera*). The nonnative grasses are a sign of overgrazing (Milchunas 2006), but once established, these species are known to persist despite presence or absence of grazing (Vavra M. 1994). The productivity of these European pasture grasses is highly susceptible to drought, and may relate to reduced native biodiversity (Flombaum 2008). Barring seeding, the plant composition will remain the same in these productive soils and bottomlands.

It is unlikely that the removal of grazing would result in a proliferation of weeds on the Preserve, though modest grazing is shown to reduce exotic grass and forb species (Loeser 2007). The threat of noxious[16] weed spread is low because invasive weeds are not common on the Preserve. Exotic forb species, such as dandelions (*Taraxacum officinale*) that signify overgrazing will continue to either persist or decrease if livestock grazing is discontinued. In contrast, invasive weeds like bull thistle (C*irsium vulgare*) are only found in isolated patches; and when found, are aggressively treated and removed to prevent their spread. As a result, the current low weed densities are not able to compete with native species. Elk are a vector for weed invasion, but this is a low risk because elk grazing provides a patch disturbance that resists weed invasion (Loeser, 2007). Without a livestock grazing program, plant communities could be more resistant to invasion or retrogression and resilient to natural disturbance because the likelihood of overgrazing would be reduced (Dietz, 1989).

Removing or minimizing grazing by livestock would have positive response in moist areas. Riparian and wetland habitat on the Preserve is similar to wetland habitat throughout the montane west or southern Rocky Mountains eco-region. When wetland and riparian habitat is grazed heavily, even to a poor condition, reducing or removing livestock grazing can lead to quick recovery. This resilience is largely due to available water from capillary sources (Vavra M. 1994).

Although Alternative A would discontinue annual livestock grazing programs and Alternative B would allocate only 5 percent of the available forage to domestic livestock grazing, it is assumed that forage utilization by elk and other native herbivores would continue. Therefore, the selection of either alternative would not constitute an *elimination* of grazing, but the further reduction of ungulate stocking rates on the Preserve. Elk have used the majority of the allocated forage on the Preserve during the interim grazing program (see Affected Environment, Figure 23). Because elk and cattle can share a significant dietary overlap (Torstenson, 2006), the potential for overgrazing exists when both ungulates are present. Although elk make use of a wider range of sites, they primarily graze in the valley bottoms as do the cattle (Rupp, 2005). In drought years when

[16] For the purpose of this analysis "*Noxious Weeds"* are non-native, invasive weeds identified by the New Mexico Natural Resources Conservation Service and New Mexico Department of Agriculture pursuant to the *"Noxious Weed Management Act of 1998"*

snowpack is light, elk will stay on the Preserve longer; increasing the chance that forage could be overutilized. In 2002, livestock use was light so overuse in the grazeable woodlands was probably due to elk. Moisture being below what would be considered a typical year, a greater number of elk likely remained on the Preserve during the winter and grazed earlier in the spring.

Although elk are now the primary grazers on the Preserve, the plant communities are in medium to high health with an upward trend. The upland plant communities have the most robust populations of native species with few invaders despite a long history of intense use, suggesting an inherent resistance to the effects of overgrazing, even by elk. The lack of a significant increaser, shrubby cinquefoil, is also a sign of resistance to overgrazing. This species is abundant on overgrazed range adjacent to the Preserve (Figure 24.)

Figure 25 – Rangeland adjacent to the Preserve subject to season long use by livestock.

Alternative B would indirectly affect range health by improving range infrastructure that is impacting water quality and concentrating wildlife. Although the existing watershed condition and trend are expected to persist under the No Action Alternative, range fences and tanks will deteriorate and potentially contribute to adverse localized or cumulative effects. Alternative B would fix fences on the Preserve that pose a risk of injury to wildlife. Alternative B also would fix other fences that are inadequately placed and cause resource damage to streams by channeling elk movement on and around stream banks.

Alternative B also improves range health by fixing livestock tanks that cause stream channel erosion, which degrades adjacent range production. Elk and livestock have trampled these gully channels increasing the amount of erosion. By not repairing the tanks, elk could continue to adversely affect species composition and long-term production in localized areas. Functional water tanks and appropriate fencing could help achieve greater distribution of grazing ungulates and reduce resource damage by spreading out forage use across a wider area and reducing overgrazing. Overuse can suppress preferred species (Vavra, 2005) and physiologically tax plants, allowing increaser and invader species to flourish (Dietz, 1989).

Cumulative Effects

No adverse cumulative effects are expected with either Alternative A or B. Despite a long history of heavy grazing on the Preserve, upland plant communities are in moderate to high health. Ground cover is adequate to protect soil resources from overland flow and erosion, and vegetation is rapidly reestablishing itself and rebuilding stream banks where disturbance has occurred. Vegetative production has increased in response to adequate rainfall and appears to be benefiting from reduced stocking rates. Plant litter cover has increased as a result of favorable production and conservative use, contributing protective cover and organic matter to soil nutrient cycles. Plant roots will continue to contribute an important source of organic matter to the soil as well. Native species composition is high and while naturalized European pasture grasses have established themselves, their presence for the most part appears restricted to the moist bottomlands and riparian corridors. The integrity of healthy native plant communities, and micro-site conditions in their habitat, make them resistant to the spread of nonnative species. Reduction of grazing pressure could help maintain native plant communities by encouraging physiological health and limiting vectors of exotic species introduction.

Reduced stocking has allowed stream banks to begin rebuilding and this trend would continue under Alternatives A and B. Currently, the condition and placement of infrastructure is having a cumulative effect on water quality; this trend would continue under Alternative A, but be addressed under Alternative B.

Alternatives C and D

Direct and Indirect Effects

Alternatives C and D allocate a conservative portion (15 to 20 percent) of forage towards grazing by domestic livestock, and also propose the use of forage for other commercial, scientific, or educational purposes. Both alternatives affect range resources similarly. These alternatives differ in monetary return and impacts to local communities (see 3.6 Socioeconomic). The emphasis on economic return in Alternative D would be more likely to lead to the maximum allocation of available for livestock annually. While both alternatives permit the same allocation of forage, Alternative C would likely result in grazing by cow-calf pairs and herd bulls while Alternative D would likely result in grazing by stocker steer. A cow-calf herd would lead to grazing by larger less mobile animals. Stocker steer would lead to grazing by greater numbers of smaller, younger animals who tend to be very mobile. While different types of programs and classes of animals are likely to graze under Alternatives C and D, this analysis will consider the greatest potential for effect under the proposed allocation of forage for both alternatives.

The favorable response of some range plants to grazing, demonstrated by an increase in their productivity, is well documented by many authors (McNaughton 1993, Dyer 1993). Positive effects result when grazing is light to moderate while negative effects result from heavy grazing (Dyer 1993). Rocky mountain grazing studies in Yellowstone National Park have shown that forage production can average 48 percent higher in plots grazed by elk and bison versus plots excluded from grazing (Frank 1993). Yet, prolonged heavy grazing can change the productivity and/or composition of most rangeland ecosystems.

Milchunas (Milchunas 2006) proposed the following successional stages of range degradation for montane meadows and other openings within a ponderosa pine forest:

(1) native bunchgrass stage (Arizona fescue and mountain/screwleaf muhly);

(2) sod-forming grass increase or invasion (black dropseed, Kentucky bluegrass, blue grama);

(3) prostrate perennial forbs increase or invasion (pussytoes and sandwort);

(4) short-lived half-shrub increase or invasion (snakeweed and hymenoxys);

(5) annual plant increase or invasion (annual dropseed); and

(6) denuded soil.

Currently, the Preserve's rangeland is on par with Milchunas' stage 2. In montane meadows, heavy grazing can result in the replacement of wet species by dry upland species. Similar species composition changes have been noted between nongrazed, lightly grazed, and moderately grazed treatments; however, the heavily grazed treatments displayed a considerably higher composition of colonizing weed ruderals (Milchunas, 2006).

Heavy grazing or overgrazing is detrimental to the aboveground and belowground plant community and to soil properties (Milchunas, 2006). Roots are the primary form of input of organic matter into the grassland soils, whereby differences in grazing would eventually manifest as differences in soil carbon. Heavy grazing can adversely affect leaf growth and cause shallow rooting depth, whereas no discernable differences have been observed in some studies between grazing exclusion, light use, and moderate use of species such as mountain muhly and Arizona fescue.

As sensitive species like Thurber's fescue and Parry's oatgrass are grazed, forbs and secondary species increase (Milchunas, 2006); naturalized forbs such as dandelion (*Taraxacum officinale*) occupy sites on the Preserve where grasses were likely overgrazed at one time. Unpalatable forbs and shrubs are likely to replace palatable grasses when overgrazed by cattle. Conversely, grasses are likely to replace palatable forbs when sheep overgraze. Moderate grazing can result in greater native species cover and fewer exotics compared to no grazing or heavy grazing, especially during drought for the latter (Loeser, 2007). Noxious weeds like bull thistle (*Cirsium vulgare*), are not a significant threat on the Preserve and are only located in isolated patches and are aggressively treated when found.

Elk and cattle prefer the same habitat although elk make use of a wider range of sites (Rupp, 2005); therefore, the potential for overgrazing exists with Alternatives C and D. Heavy use during drought may constitute an especially significant threat to desirable native plant species and causing a shift toward exotic species (Loeser, 2007).

It is unlikely that grazing as proposed would result in a proliferation of weeds already present on the Preserve because the density is very low, and management to control their spread is aggressive. Livestock would continue to act as a vector for weeds from one area of the Preserve to the other, but elk and livestock would also continue to provide a patch disturbance effect, increasing resistance to invasion (Loeser, 2007). Introducing livestock from outside the local area poses the highest risk of weed invasion. The danger, nonetheless, is small due to quarantine practices that

isolate livestock once they enter the Preserve. Time is allowed for weed seeds to pass through the digestive tracts of livestock before they are put to pasture. This way, the entry point of potential weed introduction is confined and easily treated if noxious plants are found.

Plant communities are in medium to high health across the Preserve, displaying a resistance and resilience to historic impacts. Upland systems have a very high composition of natives with few invaders. Most of the nonnative species on the Preserve are naturalized European pasture grasses such as Kentucky bluegrass, Timothy, and redtop, as well as European forbs (dandelions [*Taraxacum officinale*] and clover [*Trifolium spp*.]).

Various authors have suggested Kentucky bluegrass replaces desirable natives after overgrazing (Milchunas 2006, USDA-Natural Resources Conservation Service 2003, Sather 1996). Recommended control is to manage for native grass rather than against Kentucky bluegrass (USDA-Natural Resources Conservation Service 2003, Sather 1996). Kentucky bluegrass is able to thrive in the wetter bottomlands, but production is highly variable and susceptible to drought. In addition, some south-facing semi-arid slopes support populations of cheatgrass brome (*Bromus tectorum*), a Eurasian invader that has caused substantial damaging changes to rangelands and fire regimes in the Intermountain West. If global climate change continues and the Preserve becomes warmer and drier, cheatgrass brome could expand its dominance to other habitats on the Preserve, and heavy grazing would accelerate the spread of this annual spring grass.

Conservative stocking rates compared to past grazing practices, and herding management are believed to be responsible for the rapid stream improvement seen in a 6-year period on the Preserve. Stream conditions have improved under interim grazing management and that trend is expected to continue under proposed livestock management. Proper Functioning Condition surveys conducted shortly after the cessation of private grazing, in 2000, found that many stream segments were FAR. Follow-up surveys in 2006 showed that six out of nineteen stream segments improved to PFC.

The impact of the grazing program under Alternatives C and D would have uncertain consequences on willow growth. The presence of suitable willow habitat on the Preserve is disputed; assessments of the National Riparian Service Team (S. McWilliams 2001) found no potential habitat for willow species along the valley bottoms while Trust staff have evidence for Bebb's willow (*Salix bebbiana*) occurring along La Jara Creek (Valles Caldera Trust, 2002). In addition, a few remnant clumps of old willow are found along steeper gradient reaches and cienegas (wet meadow). If willow was completely eliminated from the valles by historic heavy grazing, natural regeneration may take a long time. The herbaceous community that inhabits the stream banks may represent a stable state requiring planting to restore willow (Vavra M. 1994). Degraded sites may not recover after release from browsing if they have lost critical willow establishment and survival processes (Baker 2005).

If willows or other woody riparian vegetation once existed on the Preserve, it would be unlikely that it could reestablish itself under current conditions without grazing exclosures. Recovery of willows may depend on redistribution of herbivores, reduced stocking rates, and perhaps population control of wild ungulates (Baker 2005). Herding and barriers could be employed as effective tools to keep livestock from suppressing woody riparian vegetation if it is

established. In fact, two willow shrubs have been observed growing on a gravel bar in the experimental elk/livestock exclosure established in 2004 on the western Rio San Antonio; hence, it is likely that willows can indeed survive in the valle bottoms if they can successfully colonize and are protected from browsing elk and livestock.

The maximum forage allocation on the Preserve adequately addresses the physiological requirements of grassland systems, taking into account all ungulate foraging activity. The Trust has managed livestock conservatively under the interim grazing program, consistently meeting or falling below average utilization standards across the Preserve. Because livestock management will respond to monitoring data, no adverse impacts on range resources are expected to occur. Data to determine forage production values are collected annually at monitoring sites (see Figure 56). A minimum amount of biomass (tons/acre) must be retained at the end of each grazing season and is specific to ecological sites. Each year livestock numbers, with due consideration of elk numbers are adjusted so 40 percent of the available forage is allocated toward use. If forage production values fall below minimum standards, then the number of livestock can be reduced. Current capacity estimates show the Preserve could support livestock grazing of up to approximately 16 percent of the available forage resource and a little over one-third (39 percent) of the total grazing allocation. After elk use, 60 percent of the available forage is left for soil cover, nutrient cycling, and other native fauna. Dry and fluctuating climate has resulted in recent stocking rates below the maximum recommended numbers. Conservative stocking has resulted in continued recovery of upland and riparian sites despite drought. Due to recent increases in rainfall, production has grown, creating the conditions in which it is likely that livestock use could be increased in the near future.

The strategy of allocating no more than 40 percent of forage to livestock and elk is based on overgrazing effects and knowledge of plant physiology. Past effects are apparent in localized areas across the Preserve (especially on moist sites) where forb cover has become abundant within the grass dominated valles. Species like dandelion (Taraxacum officinale) have been able to invade areas where native systems have been weakened in the past. The amount of leaf volume removed from a grass plant has a direct effect on the growth of new roots. To remain healthy and productive, 20 to 50 percent of a grass' total root system must be replaced annually. Grass plants produce more leaf matter than is needed to complete their growth functions and remain productive; however, if more than half of that leaf volume is removed during the growing season, the plant is deprived of part of its food processing and storage mechanism, and the amount of forage is reduced accordingly (see Table 17 and Figure 26). All root growth has been shown to cease at 80 percent removal, for a dozen or more days, and does not begin again until leaves are once again actively growing. Increased removal, or severe repeated removal can lengthen the period of root growth stoppage. Where grass roots have been weakened, weeds, or grazing increasers can take hold and grow; creating a less productive rangeland (Dietz 1989).

Table 17 – How the grazing of aboveground forage affects root growth

Percent Leaf Volume Removed	Percent Root Growth Stoppage
10%	0%
20%	0%
30%	0%
40%	0%
50%	2-4%
60%	50%
70%	78%
80%	100%
90%	100%

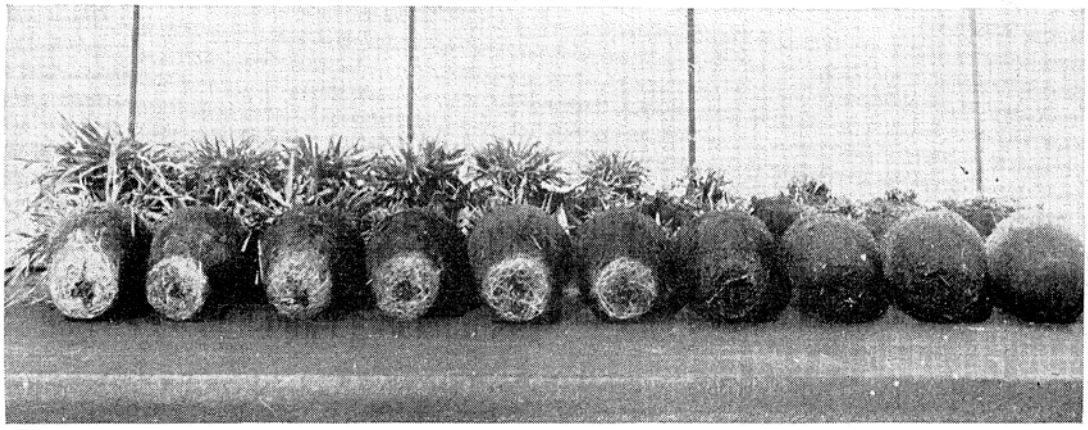

Figure 26 – *From left to right 0-90% (at 10% intervals) of the aboveground biomass was clipped over a 33 day period. Two days prior to any clipping the roots were blackened; white indicates new root growth. Plants shown are Kentucky bluegrass (Crider 1954).*

Maintaining plant diversity, especially native species composition, is a monitored outcome of management and a prominent indicator of rangeland health. Plant diversity indices will be tracked at monitoring sites Figure 56). Monitoring plant diversity allows managers to preserve plant community components by altering management in response to species and population dynamics, and has a positive effect on vegetative biomass production (Flombaum, 2008). Homogeneous plant communities do not utilize resources efficiently, which likely accounts for the exceptionally varied production values recorded for moist bottomlands mostly occupied by monoculture forming European grasses. When environmental conditions become stressful, such as during drought, production values at these sites plummet. Not only are the nonnative species less likely to possess the survival mechanisms that native species have developed evolutionarily, but nonnative species tend to exclude the presence of natives, effectively limiting how and when site resources can be used by plants.

Across much of the west, moderate grazing during the last half-century has probably not decreased species diversity of either plants or animals and may have actually increased diversity because:

- Plants are distributed in patches, and grazing usually increases the patchiness of plants
- Diversity of habitats (patchiness) and edges where different vegetation types meet are important as native fauna habitat and create diversity on a landscape level
- Grazing generally reduces a relatively few dominants in a system and they are replaced by more numerous secondary species (Vavra 2005)

Productivity is enhanced by diversity because each species assumes a specific niche. Different species use the resources available via different mechanisms such as extending their roots at different depths in the soil, using different forms of nitrogen, and staggering when they photosynthesize (Flombaum, 2008).

It is expected that biotic and abiotic condition will be maintained or improved under either Alternative C or D because standards have been established with the aim of preserving native species composition. Baseline cover values have been determined for monitoring plots around the Preserve. If cover composition values of bare soil, total grass, native grass, or litter are measured outside of the 95 percent confidence interval of the established standards for 2 years in a row, a trend would be identified and managers would need to interpret the cause of the change. Livestock management could change if it were identified as the cause of a downward trend, or was likely to cause resource damage due to environmental circumstances such as drought.

If Alternatives C or D were selected, stock tanks and fences would be maintained, repaired, replaced, relocated, or removed, depending on the site-specific circumstances. Removal or relocation of fences could aid in stream bank recovery by reducing trailing and trampling. Maintenance and repair of earthen tanks could help distribute elk and cattle away from sensitive riparian areas, also reducing stream bank damage. Water quality may also benefit by reducing a sediment source such as a faulty tank. Opportunities to rewater meadows and stream channels, and restore hydrologic function could increase vegetative production, reestablish habitat, and initiate restorative ecological change in some areas of the Preserve.

Annual grazing programs would be authorized under Alternatives C and D and the discretionary allocation of forage for educational purposes and seed collection could occur as well. Any discretionary use of forage would be relatively small-scale, of short duration, and subject to the same resource safeguards as the grazing program. Standards for suitability, capacity, production, utilization, ground cover/composition, and diversity would be applied and monitored to assure that objectives are being met.

Cumulative Effects

Because no adverse direct or indirect outcomes are expected as a result of Alternatives C or D, no adverse cumulative effects are anticipated either. Despite a long history of heavy grazing on the Preserve, upland plant communities are in moderate to high health. Ground cover is adequate to

protect soil resources from overland flow and erosion, and vegetation is rapidly reestablishing itself and rebuilding stream banks where disturbance has occurred. Vegetative production has increased in response to adequate rainfall and may be benefiting from conservative stocking rates. Aboveground litter cover has increased as a result of favorable production and conservative use, contributing protective cover and organic matter to soil nutrient cycles. Plant roots will continue to contribute an important source of organic matter to the soil as well. Native species composition is high and while naturalized European pasture grasses have established themselves, their presence for the most part appears restricted to the moist bottomlands and riparian corridors. The integrity of healthy native plant communities and micro-site conditions in their habitat make them resistant to the spread of nonnative species. Conservative grazing pressure could help maintain native plant communities by encouraging physiological health of plants, promoting biodiversity, and by preventing the deteriorated conditions that are conducive to exotic species introduction.

Streams would likely continue to improve as well. Heavy historic grazing degraded riparian conditions and left the waters of the Preserve in an at-risk state. Conservative stocking under a program of monitoring and adaptive management has allowed stream banks to begin rebuilding and it is expected that this trend would continue under Alternatives C and D.

A robust monitoring and adaptive management program would ensure that stocking was accomplished within climatic context and that the outcome of livestock grazing protects watershed health. Existing condition has arisen under conservative livestock management in conjunction with on-going elk use. Livestock use constitutes a relatively small proportion of the overall forage allocation, and managers have adjusted stocking rates to ensure that adequate forage is allocated to soil cover, nutrient cycling and native fauna, especially during drought. Reduced productivity as a result of low rainfall reduces the margin between conservative and heavy use (Milchunas, 2006) because consumption of forage increases while the overall availability of forage declines.

Alternative C and D authorizes the maintenance of stock tanks, fences and roads, and so presents a number of opportunities to improve resource conditions that could potentially contribute to adverse cumulative effects if not addressed. Resource conditions are generally satisfactory and improving across the Preserve despite existing infrastructure problems but current condition of infrastructure improvements may create localized impediments to recovery.

Alternatives C_2 and D_2

This alternative would authorize addressing the deferred maintenance needs of facilities in support of a livestock program and could be adopted if either Alternatives C or D is selected. Remodeling would occur within about 20 percent of the existing facility's footprint. Off grid power sources would be used. No utility construction is planned at this time and little disturbance is anticipated to result from this alternative; any that does occur will be localized and short-term. There are no direct, indirect, or cumulative effects to watershed conditions associated with this alternative.

Soils and Hydrology (Stream Morphology and Water Quality)

The impacts to hydrology and soils would be minor to moderate and localized across all action alternatives. Under Alternative A, No Action, cessation of domestic grazing would continue and possibly accelerate recovery along streams and uplands. Yet, Alternative A, which does not include repair, maintenance, or removal of stock tanks and fences, would do nothing to eliminate the prominent sediment sources that exist, or their impacts. No adverse cumulative effects are expected from any alternative.

Alternatives A and B:

Direct and Indirect Outcomes

If either alternative A or B is selected stream banks, channel form and function would continue to heal from the historic higher grazing levels, possibly at a faster rate than under the implementation of Alternatives C or D. Upland and lowland soils would continue to recover from grazing effects.

Proper Functioning Condition surveys conducted shortly after the cessation of private grazing found that many stream segments were Functioning At Risk (McWilliams S. , 2001) (McWilliams S. A., 2000) (National Riparian Service Team, 2002). After a period of rest, livestock grazing was restored but stocking rates were reduced compared to historic levels. Follow-up surveys have shown that six out of nineteen stream segments improved to Properly Functioning Condition or are now exhibiting an upward trend (McWillams, 2006). One stream segment declined from Properly Functioning to Functioning at Risk with a downward trend. Twelve segments showed no change, many of those remaining in Proper Functioning Condition. Reduced stocking rates compared to past grazing practices is believed to be responsible for the rapid stream improvement seen in a 6-year period.

If livestock grazing were minimized or discontinued altogether, it is likely that stream recovery would continue to take place because physical disturbance of stream banks was a significant factor in stream degradation. Reduced grazing pressure could not only reduce stream bank trampling, but also allow riparian vegetation to recover; revegetation being a significant mechanism of stream bank rebuilding processes. Recognizing that elk will continue to disturb stream banks and affect water quality, the areal extent of stream bank disturbance would still be reduced with little to no livestock because fewer animals would congregate close to these natural watering places.

Alternative A does not propose maintenance for stock tanks and fences, so some of these features that are in poor condition would continue to be sediment sources. Inappropriately placed fencing would continue to concentrate elk on stream banks. Four large earthen tanks in the Valle de los Posos, Valle Seco, Rincon de Soldados, and the Valle Grande would continue to erode and deposit sediment. These four tanks have not been able to handle large storm events, resulting in damage over time to the spillways of each (Ericson Engineering and Consultants, 2006). Further, earthen tanks within Sulphur Creek and Redondo valleys are causing stream bank erosion. Stock tanks in

the valley bottom, just above Sulphur Springs have lost structural integrity and are a large source of fine sediment.

Alternative B has the highest benefit for continued recovery on the Preserve for soils and watershed resources. Failing tanks would be repaired on a priority basis, including the four large earthen tanks outlined in an engineer's assessment and report (Ericson Engineering and Consultants, 2006). Though lower priority, the tanks above Sulphur Springs and within Redondo Creek valley would be either repaired or removed. Removing the tanks would sequester that material from future sediment source.

Either removing or repairing earthen tanks and dams would reduce sediment sources and return hydrologic function to streams and floodplain areas. For example, in the Redondo Creek drainage a small stock tank above Redondo Meadows has diverted the stream from its channel away from the meadow and into an incising ditch. Removal of the dam could return the stream to its original course and allow it to directly water the meadow surface with flooding flows.

Alternative B would also remove or relocate roughly 4 to 7 miles of fence to lower stream bank damage. These old fences currently divert livestock to stream channels leading to trailing along stream banks and therefore add to bank erosion. Though little grazing is planned with Alternative B, removing and relocating these fences would reduce the diversion of wildlife to creek bottoms.

Wetland and grassy upland soils would continue to recover as the leaf litter continues to accumulate. The forage use under the interim grazing program has contributed at least 60 percent of annually produced forage for litter decomposition, insects, and animals. The elk have used approximately 20 percent of the forage. Leaving the remaining 15 to 20 percent for natural processes, including elk, would continue inputs of organic matter that enhance soil biological processes. In monitoring, approximately 25 percent of total herbaceous litter is lost to decomposition annually (Parmenter 2008, personal communication). Thus, more litter available translates to greater integration of organic matter into soils.

Alternative C and D

Direct and Indirect Outcomes

Alternatives C and D essentially continue the present level of forage use by allocating a similar percent of the forage. Both of these alternatives propose maintenance and repair of fences and stock tanks as described for Alternative B. Therefore, some short-term improvement over existing condition in channel form and function, and water quality in terms of amount of sediment entrained within the channels could be expected. Grassland production would continue to improve as soils aggregate organic matter and soil surfaces are covered with grassland herbaceous litter. The general upward trend in watershed quality would continue.

However, there would be a higher risk for sediment from bank trampling than for the elimination or reduction in grazing proposed under alternatives A and B. Further watershed impacts are contingent on implementation of range readiness prior to spring domestic grazing and the skills of the herding operators throughout the grazing season. Impacts would be similar to the interim grazing program with continued improvements. The degree of improvement would depend on annual conditions and climatic trends.

Under Alternative C, annual allocation and use of forage would vary. Under Alternative D, the maximum amount of forage available under the current conditions would generally be allocated for use. Performance requirements that limit long-term commitments would ensure the Trust retained the flexibility necessary to adjust numbers and balance grazing with other program needs. The performance requirements listed in Chapter One, 1.2 *Proposed Action and Performance Requirements* would apply to all action alternatives.

Water quality is effectively unchanged from the present condition for all alternatives. It is unclear at present time that reported turbidity is related to current management activities rather than persistence of colloidal particles deposited naturally and over a long period of time. Failing stock tanks contribute some amount of fine sediment. This fine sediment is transported in suspension by streams and contributes to turbidity. The sources of this sediment may be either eventually eliminated or reduced by Alternatives B, C, and D, but not A. Conversely, some amount of suspended sediment introduced to the channels by the continued use of livestock, most likely through bank trampling, would be eliminated, or minimized by Alternatives A and B, but not the Alternatives C or D.

Alternative B would have the least effect to water turbidity and promote the faster rate of bank recovery. In qualitative terms, Alternative A would be the better option among the remaining alternatives, despite no provisions for repair and maintenance of fences and tanks. In the long term, most effects of management features are mitigated through natural erosion and transport of sediment to achieve stability, however undesirable that process may be in the meanwhile. For example; eventually a natural angle of repose for channel banks is reached, a new and fully functional floodplain area is created in incised and newly aligned channels caused by a breached tank.

Under Alternatives C and D, pervasive use by livestock ensures a level of disturbance and consequential effects to water quality despite a long-term upward trend. In time, a convergence of sorts would be reached, where channels would be properly functioning and stable, if somewhat degraded relative to potential without annual use by livestock.

Soil impacts from domestic grazing include loss of plant litter inputs along with physical impacts from cattle trailing (Naeth 1991, Dormaar 1998). Indirectly, grazing induced changes to plant composition impact soil function with the shift in plant species. Biotic integrity (i.e., the numbers of species within plant functional groups in addition to the groups represented) was recognized for its ecological importance for productivity at both plant and soils levels (Pyke 2002). On the Preserve, grazing increasers that have lowered biotic integrity, though are not adverse to grazing livestock include Timothy, Kentucky bluegrass, and dandelion. These species primarily impact total grassland production and biological diversity. Productivity of soils and plants varies much greater where these species are common. Prominence of exotic species impacts the complex web of soil and plant inter-relationships that become increasingly important during dry periods (Burke 1998). This risk is most prominent in the wet meadow areas along the valles.

During drought stress, the inter-relationships between soil mycorrhizae, soil microbes and plants become important for adequate access to nutrients and water (Perry 1989). These interrelationships are compromised in some areas such as wet meadows and deep soil swales

where exotics like Timothy grass thrive and displace native plant species. Exotic species are assumed to not have the same interconnections as the natives since they are new arrivals. However, during wet years, soil resources are abundant and thus exotics such as Kentucky bluegrass thrive since they are better adapted at taking advantage of soil nutrients. This is demonstrated for grassland steppe in Colorado (Vinton 1995) and in the Great Basin (R. a. Jackson 1996). In particular, Biondini et al. (1998) showed that Kentucky bluegrass expanded during periods of moderate to heavy grazing during wet years.

Good examples of the connection between productivity and exotics are found at the monitoring plots MM6 and RR3 in San Antonio and Valle Grande, respectively (Barnes, 2006). Plot MM6 in San Antonio had production at 5332 lbs/acre for the wet year 2007 as opposed to 1230 lbs/acre during the dry year 2001. Plot RR3 showed a similar dramatic drop between wet and dry years varying as much as 4200 lbs/acre. In contrast, drier uplands where productivity is fair to moderate, fluctuates from around 2,000 lbs/acre in wet years to 1,000 lbs/acre in dry years. These areas are characterized as grazeable woodland and mountain meadow ecological sites in the range analysis. Although less productive, these marginal habitats with higher proportion of native species vary less than the high production valley bottom areas where exotic naturalized species thrive.

The proposed level of domestic grazing, at only a third of the level historically grazed under private ownership (see Table 8 in *3.1.1 Affected Environment*, *Land Use History*), should not impact diversity. The past heavy use prior to the 1970s and use by domestic livestock coupled with heavy logging in the 1960s led to the movement of exotic species into the wet meadow areas. The dry marginal grassland and forested habitats have resisted influx of species (with exception to dandelion) given the harsher conditions. In addition, species diversity is tracked at 40 sites that are monitored annually. This monitoring will allow the tracking of biotic integrity that indirectly impacts soil and plant productivity, with adjustments in management if 2-year trends emerge (see Appendix B).

Any potential impacts from a loss of soil cover would be buffered under the proposed level of grazing. Soil groundcover is important for moderating moisture and soil temperature to facilitate soil processes. The Preserve is targeting no more than 40 percent utilization in any area across the Preserve. Recent monitoring again reinforces the importance of climate. Wet years had much lower utilization by percentage than drier years. Wet years during 2007 had utilization averaging 25 percent compared to dry year average of 35 percent (see Figure 24 in *3.1.2*, *Existing Condition*, C*apacity*).

Using the monitoring data, the trend for litter and bare soil is mixed, though the absolute values indicate a very high potential when compared to threshold values published for the ecological sites (T.E.A.M.S., 2007). Measurements for bare soil and herbaceous litter average 3 percent and 83 percent, respectively. Comparatively, the values for the ecological site descriptions published by NRCS indicate a tolerance for bare soil of 5 to 22 percent for mountain meadow and mountain valley ecological sites (USDA-Natural Resources Conservation Service 2008), the broad grassland areas within the valles. Similarly, the monitoring sites show litter accumulation is better than two fold the thresholds for these ecological sites. Thus, sufficient herbaceous litter persists

over the past interim grazing management plan to continue soil site stability, hydrologic function, fire fuel loads, and biotic integrity. These indicators are in line with the National Riparian Team recommendations and show that proposed allocation of forage to domestic livestock grazing would allow for continued recovery.

Cumulative Effects

There are no increased adverse effects expected from any of the alternatives, and in fact, a net decrease in cumulative effects from all sources is expected. The grazing Alternatives C and D continue livestock use yet also provide for maintenance of management features, which will be beneficial for water quality and channel stability. In the long term, some degree of a degraded condition is likely to persist under any of the action or the no action alternatives. For all the alternatives, there will be continued improvement in channel form and function.

Given the imprint of past management on the landscape, soil productivity would continue at the current levels with an upward trend as soil organic matter accumulates augmenting soil moisture during drought. All alternatives would not adversely affect overall soil productivity.

Monitoring and Adaptive Management

The Trust has developed a systematic approach to monitoring, evaluation, and adjusting management actions (Adaptive Management) to limit impacts of the interim domestic livestock program. The adaptive management program has 41 ecological stations where attributes are tracked to gauge impacts on an annual and cumulative basis. Ongoing statistics will give a running tally on where each year's performance is compared to long-term averages (see Appendix B). For example, the percent of cover by native grasses for the station at grazeable woodland site GW7 has a long-term average of 71 percent (see Appendix B). Measurements during 2005 found native grass composition at 68 percent, within the 95 percent confidence level. However, if the native grass level was found below the lower threshold for two sequential years, then management in this area would be adjusted to lower grazing impacts. Factors that are considered are the relevance to other ecological variables such as grass and herbaceous litter cover, total bare soil, total grass cover, and site diversity. Additional variables could include soil moisture and climate to interpret site condition trends. Cumulative impacts are assessed and documented in a current State of the Preserve report every five years. This cumulative effects analysis allows the Trust to assess the cumulative effects of all activities (grazing, forestry, recreation, road maintenance etc.) as well as climate and any natural events (such as wildland fire) at various scales.

3.2 Fire Ecology

3.2.1 Fire Ecology – Affected Environment/Existing Condition

The role and importance of fire in any ecosystem is dependent on the natural fire regime, or the general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee, 1993). This regime is often described by frequency that fire burns across an ecosystem and the intensity[17] and severity[18] at which fire typically burns. While a study is underway to accurately describe fire regimes on the Preserve, reasonable estimates can be made based on the existing plant associations as described by Muldavin and Tonne, a small sampling of fire scars completed on the Preserve and the well-established fire regime information surrounding the Preserve.

The grasslands and ponderosa pine forests on the Preserve are within Fire Regime I, characterized by frequent surface fires that would spread quickly through the grasses and needles, and burn with low severity, replacing less than 75 percent of the overstory vegetation (Hann & Bunnell, 2001). The dry-mesic mixed conifer forests usually dominated by ponderosa pine growing in association with Douglas-fir, would burn less frequently allowing a greater amount of fuel to accumulate between fires but still considered within Fire Regime I (Hann & Bunnell, 2001), (Schmidt, 2002). As elevation increases, the fire return intervals lengthened to about 35 to 100 years. These longer intervals between fires allowed a greater buildup of forest fuels (dead branches, trees, and litter) and an increase in conifers in the understory. These heavier fuel loadings caused fire to burn more intensely sometimes moving through the tree crowns. This type of fire return and intensity is called Fire Regime III, which is characterized by varying return intervals and intensity and severity still creating mortality in less than 75 percent of the overstory vegetation (Hann & Bunnell, 2001), (Schmidt, 2002). Even age stands of aspen are often the result of the patchy crownfires associated with this fire regime. Patches of high elevation, north facing aspects found on the Preserve would likely burn infrequently. These areas would hold snow through late spring and early summer. In spite of the long interval between fires, the short growing season did not lead to a significant build of fuel. These forests, distributed in a patchwork across the highest parts of the Preserve would only burn during seasonal droughts and under the driest and windiest conditions. When fire burned through these high elevation forests under severe conditions, it could do so with 100 percent mortality. These areas would often be reforested with stands of pure aspen. Fire Regime IV, is characterized by this frequency and severity (Hann & Bunnell, 2001), (Schmidt, 2002).

The natural fire regimes of the Preserve appear to have been disrupted in the late 1800s with the introduction of domestic livestock grazing. During that period, natural fire regimes were interrupted throughout the Jemez Mountains (Allen, 1989). Sheep and cattle grazed the grasses

[17] Fire intensity, generally refers to how fast the fire spreads across the landscape and the characteristics of the fire such as flame length and the radiant heat produced by the fire front.

[18] Fire severity generally refers to the effect of a fire, is related to the temperature, duration, and downward flux of heat from the fire, and can be measured by effect s to productivity and soils, and the mortality of trees and plants. Severity does not always correspond to intensity.

that carried the fires and created trails further disrupting the spread of fire. Wagon trails, roads, and agricultural clearing associated with settlement further contributed to the de facto removal of fire from these ecosystems. Fire suppression, first by settlers then by the government, succeeded in removing the natural fire regime.

The Preserve shared this history and likely shared the timing of fire disruption (Personal Communication, Craig Allen) as indicated by the small sampling of fire scars taken in the Preserve (Muldavin & Tonne, 2003).

Fire continues to be largely excluded from the Preserve. Planning is to be initiated that will propose and consider how and where the Trust may reintroduce fire on this landscape. A small controlled burn ignited by the Trust in the Valle Toledo in the NE corner of the Preserve (see Figure 11) in 2004 had no deleterious effects and appeared to generally create an overall positive response within the burn area. Published findings are forthcoming. Upland montane grasslands supported fire continuously throughout the fuel type. Lower montane grasslands, montane meadows, and riparian fuels supported fire in a patchy mosaic depending on fuel continuity and moisture.

3.2.2 Environmental Consequences

Alternatives A and B

Direct and Indirect Effects

Neither of these alternatives would apply enough grazing pressure to affect the availability of fuel to carry fire through the upper montane grasslands or open woodlands. Both these alternatives would promote a continued increase in cover by grass and littler through the lower montane grasslands and likely improve the ability of this ecotype to carry fire.

Indirectly by adopting goals to move the ecological condition toward the reference condition, as proposed under Alternative B., stated objectives and monitored outcomes would be consistent with the conditions that would be expected under a natural fire regime.

Cumulative Effects

Some use of wildland fire to achieve resource objectives, either through controlled burning or managing lightning-caused fires is a reasonably foreseeable future action. Planning for this type of activity is likely to occur through the 3- to 5-year mid-term planning horizon of the proposed MUSY of forage. While small controlled burning projects (e.g., the completion of the Fuel Reduction Project located in Banco Bonito on the southwest corner of the Preserve (see Figure 11)) are likely, fire management activities that could measurably combine with forage use activities are unlikely within the mid-term planning horizon. As fire management activities are considered in the future, cumulative effects of both using and managing forage resources will be considered.

Alternatives C and D

Direct and Indirect Effect

During the interim grazing period, characteristics important for using fire on the landscape have been improving. These characteristics are cover by litter, cover by grass, and ratio of grass to forbs. Provided that grazing by domestic livestock does not combine with use by elk and other native fauna and result in overuse, these characteristics should be maintained or continue to improve.

While over grazing could occur locally, the conservative allocation of forage is unlikely to lead to overuse consistently or repeatedly in any area. In addition, the conservative allocation of forage allows the Trust flexibility to manage livestock grazing prior to or following controlled burning to help achieve the desired outcome.

In addition, the presence of livestock can provide opportunities to explore livestock grazing as a surrogate for fire where fire may not be desirable at a particular location or time.

Indirectly grazing, especially overgrazing in forests and woodlands, can lead to forest fuel loadings that could contribute to a fire hazard. Reducing competition from native grass and the scarifying soil by heavy bovine hooves leads to an increase in the establishment of conifer seedlings and woody plants, resulting in additional fuel for wildland fire, leading to fires burning with higher intensities. Tree seedlings also provide a vertical "ladder" of fuel that can move fire into the tree crowns.

The allocation of forage under both Alternatives C and D avoids allocating forage from the forest to use by domestic livestock. Generally, grazing by livestock in the forest is expected to be incidental and widely dispersed in time and place.

Cumulative Effects

Cumulative effects under Alternatives C and D are expected to be similar to those under Alternative B. The monitored outcomes identified for evaluation, especially cover by grass and litter can also be evaluated to estimate any effects to the fuels and cumulative effects that could result from any planned or unplanned fire occurrence.

3.3 Wildlife – Threatened, Endangered, or Sensitive Species

This section addresses potential effects of the project to threatened, endangered, or sensitive (TES) fauna (including those species proposed for such listing) (USDA-USFS 2007) that have been documented or have suspected occurrences on the Preserve. This evaluation is required by the Interagency Cooperative Regulations (Federal Register 1978), to be compliant with the provisions of the Endangered Species Act (ESA) of 1973, Public Law (P.L.) 93-205 (87 Stat. 884), as amended. This section also addresses potential effects to species of interest. The scale of analysis used in this document to analyze the effects of the treatment activities on native fauna is Preserve-wide.

The two principle laws relevant to wildlife management are the ESA and the Migratory Bird Treaty Act (MBTA) of 1918.

ESA requires land managers to manage for the recovery of threatened and endangered species and the ecosystems upon which they depend. Agencies are required to consult with the U.S. Fish and Wildlife Service (USFWS) if a proposed activity may affect the population or habitat of a listed species.

An endangered species is an animal or plant species listed under the ESA that is in danger of extinction throughout all or a significant portion of its range. A threatened species is an animal or plant species listed under the ESA that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. A sensitive species is an animal or plant species identified by the USFS Regional Forester for which species viability is a concern either:

a) because of significant current or predicted downward trend in population numbers or density, or

b) because of significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. TES species effects are summarized in this section by TES status and species.

The MBTA established an international framework for the protection and conservation of migratory birds. The MBTA makes it illegal, unless permitted by regulations, to "pursue, hunt, take, capture, purchase, deliver for shipment, ship, cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird . . . ."

Landbirds, including Neotropical Migratory Birds (NTMB), are discussed because many species are experiencing downward population trends. Discussion can be found in the section "Species of Concern – Landbirds including NTMB."

Species presence/absence determinations were based on habitat presence, wildlife surveys, recorded wildlife sightings, and non-USFS databases. Effects on habitats are discussed, with the assumption that if appropriate habitat is available for a species, then that species occupies or could occupy the habitat. This strategy is based upon science that demonstrates connections between species populations and viability and the quantity and condition of habitat at appropriate scales of analysis (Baydack, Campa III, and Haufler 1999).

Effects on species will be determined by assessing how alternatives affect the structure and function of vegetation relative to current and historical distributions. Some wildlife habitats require a detailed analysis and discussion to determine potential effects on a particular species. Other habitats may either not be impacted or are impacted at a level that does not influence the species or their occurrence. The level of analysis depends on the existing habitat conditions, the magnitude, and intensity of the proposed actions, and the risk to the resources.

Landbirds, including NTMB, were analyzed based on review of wildlife databases for the Preserve and local scientific knowledge.

3.3.1. Federal Threatened, Endangered, and Sensitive (TES) Species (including Species Proposed for Listing)

Table 18 summarizes determinations of effect (Moser 2008) to species currently listed as TES, that are deemed to have suitable habitat identified, and have either documented or suspected occurrence within the project area. Effects or impacts summarized are in reference to the proposed action. There are no recognized effects or impacts to TES species from no action. No endangered or proposed species occur within the Preserve.

Table 18 – Summary of Effect Determinations

Species	Status	A	B	C or D	C_2 or D_2
Mexican Spotted Owl	Threatened	NI	MANLAA	MANLAA	MANLAA
Bald Eagle	Sensitive	NI	NI	NI	NI
New Mexico Meadow Jumping Mouse	Sensitive	NI	MIIH	MIIH	MIIH
Northern Goshawk	Sensitive	NI	NI	MIIH	MIIH
Peregrine Falcon	Sensitive	NI	NI	NI	NI
Jemez Mountain Salamander	Sensitive	NI	MIIH	MIIH	MIIH
Northern Leopard Frog	Sensitive	NI	MIIH	MIIH	MIIH
Dwarf Shrew	Sensitive	NI	NI	NI	NI
Water Shrew	Sensitive	NI	NI	MIIH	MIIH
Goat Peak Pika	Sensitive	NI	NI	NI	NI
Gunnison's Prairie Dog	Sensitive	NI	NI	NI	NI
Southern Red-Backed Vole	Sensitive	NI	MIIH	MIIH	MIIH
Long-Tailed Vole	Sensitive	NI	MIIH	MIIH	MIIH
American Marten	Sensitive	NI	NI	NI	NI
Ermine	Sensitive	NI	MIIH	MIIH	MIIH

Table 18 *Key: NI = no impact; MANLAA = may affect, not likely to adversely affect; MIIH = may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population.*

Threatened or Endangered Species Considered But Eliminated from Analysis

Species were eliminated from evaluation and/or consideration based upon the lack of potential habitat; area not included in historic or current range of the species; or extirpation of the species without current feasibility for reintroduction. There will be no further discussion of the following species in this environmental analysis.

Black-footed Ferret – (*Mustela nigripes)* – Endangered

The USFWS had determined that if prairie dog towns are less than 200 acres in size there is no need to survey for black-footed ferrets. No prairie dog towns >200 acres are located on the Preserve; therefore, the black-footed ferret will not be addressed further in this document.

Southwestern Willow Flycatcher – (*Empidonax traillii extimus*) – Endangered

Southwestern willow flycatcher require extensive riparian habitat. Southwest willow flycatcher requires dense patches of trees or shrubs with slow to still water available at or near nesting habitat (USFWS 2002). Currently, there is no habitat within the Preserve. Due to the absence of suitable habitat for this species, the proposed action or any of the alternatives would not affect Southwestern willow flycatcher; therefore, the Southwestern willow flycatcher will not be addressed further in this document.

There are no Critical Habitat Units (CHUs) for the southwestern willow flycatcher located within the Preserve.

Least Tern (Interior population) – (*Sterna antillarum athalassos*) – Endangered

Habitat for the least tern does not exist within the Preserve. Due to the absence of suitable habitat for this species, the proposed action or any alternatives would not affect the least tern; therefore, the least tern will not be addressed further in this document.

Federally Listed Threatened and Endangered Species Considered in Detail

Currently listed threatened and endangered species are managed under the authority of the ESA (P.L. 93-205, as amended in 1973) and the National Forest Management Act (P.L. 94-588). The ESA requires federal agencies to ensure that all actions, which they "authorize, fund, or carry out," are not likely to jeopardize the continued existence of any threatened and endangered species.

The only federally threatened species where suitable habitat exists on the Preserve is the Mexican spotted owl (Mexican spotted owl) (*Strix occidentalis lucida*) (USDI Fish and Wildlife Service, 2008). The bald eagle was delisted as threatened on August 8, 2007. Consultation with the USFWS regarding the proposed MUSY of forage on the Preserve was initiated June 8, 2008.

Mexican Spotted Owl (*Strix occidentalis lucida*)

Figure 27 – Mexican spotted owl

Existing Condition

The Mexican spotted owl (Figure 27) can be found in the forested mountains and canyons of central Colorado and southern Utah south through Arizona and New Mexico into Central Mexico. The owl's distribution in this range is not contiguous but occurs in patches of suitable habitat. Mexican spotted owls commonly use mixed-conifer forests throughout most of their range (USDOI Fish and Wildlfie Service 1995). Mixed conifer forests are generally dominated by Douglas-fir and/or white fir, with co-dominant species, including southwestern white pine, limber pine, and ponderosa pine. The understory often consists of the species above as well as broadleaved species such as Gamble oak, maples, boxelder, and New Mexico locust. Habitat-use patterns vary throughout the range and with respect to owl activity. Much of this variation in habitat could be contributed to differences in regional patterns of habitat and prey availability (USDOI Fish and Wildlfie Service 1995). In the Jemez Mountains, most nests are on cliff ledges or cavities in narrow steep-walled canyons (Wargo 2006).

Forests used for nesting and roosting usually contain mature or old-growth stands with complex structure. In addition, the stands are typically uneven-aged, multistoried, and have high canopy closure (USDOI Fish and Wildlfie Service 1995). Nest trees are typically large and mature. Douglas-fir is the most common species of nest tree; however, tree species used for nesting vary somewhat among areas and habitat types. Douglas-fir is also the most commonly used species for roosting.

Mexican spotted owls are nocturnal and hunt primarily at night. Their diet consists of a variety of prey, but they most commonly eat small-and medium-sized rodents such as wood rats, peromyscid mice, and microtine voles (USDOI Fish and Wildlfie Service 1995). They may also consume bats, birds, reptiles, and arthropods.

Ward and Block (1995) indicate that under heavy livestock grazing in meadows, populations of voles would be expected to decrease, and this would improve conditions for deer mice. Deer mice are associated with areas of little herbaceous cover and extensive exposed soil. Long-tailed and Mexican voles use sites with less exposed ground and greater herbaceous cover. Increases in deer mouse abundance in meadows would not offset decreases in vole numbers because voles provide greater biomass per individual and per unit area (Ward and Block 1995). Such decreases

could negatively influence owls where voles are common prey or used as alternative food sources when other prey species are diminished (Ward and Block 1995).

The recovery plan for the Mexican spotted owl determined that grazing affects the owl in the following ways (USDA-USFS 1995):

1) Altered owl availability,
2) Altered susceptibility to fire by limiting the ability of ground fires to occur,
3) Degeneration of riparian plant communities, and
4) Impaired ability of plant communities to develop into spotted owl habitat.

To accommodate the needs of the owl and its prey species, "key grazing areas" are to be maintained in good to excellent range conditions (USDA-USFS 1996). Key grazing areas will normally be ¼ to 1 mile from water, located on productive soils on level to intermediate slopes, and be readily accessible for grazing. Size of key forage monitoring areas could be 20 to 500 acres. In some situations such as high mountain meadows with perennial streams, key areas may be closer than ¼ mile from water and less than 20 acres. There are approximately 54,078 acres (60 percent) of "key grazing areas" within the grasslands and forests of the Preserve.

The Preserve uses a 40 percent utilization threshold as a firm guide to signal when grazing may become detrimental to grassland health. Drops in livestock numbers and recent good moisture years have led to a drop in utilization below 20 percent for years 2005 through 2007 (T.E.A.M.S., 2007).

There are approximately 53,609 acres of mixed conifer habitat within the Preserve that could provide nesting/roosting/foraging habitat for Mexican spotted owls. Formal surveys following Regional protocol methodologies for the presence of this species have been conducted in 2005 and 2006 (both survey reports are located at the Preserve office). No Mexican spotted owls have been located on the Preserve. Even though surveys have been conducted and yielded negative results, for this analysis the assumption is made that Mexican spotted owls could occupy the Preserve based on presence of suitable habitat.

The wildlife report prepared in support of the EA completed for the interim grazing program noted that habitat considered suitable based on forest structure was at the upper threshold in elevation and not supported by associated cliff structure (Valles Caldera Trust, 2002).

No Protected Activity Centers[19] (PACs) for Mexican spotted owl are located within the Preserve.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. Therefore, it is anticipated that there would be an increase in density of the vegetative species

[19] Protected Activity Center is defined as area of suitable habitat (based on vegetation and topography) surrounding an area known or suitable for nesting or breeding. The protected area is at least 600 acres consolidated as close to the activity center as possible.

such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments. None of the proposed rangeland improvements are being proposed in PACs. Therefore, there would be no disturbance to nesting resulting from construction activities.

Alternatives C, D

Implementation of these alternatives would allocate forage for domestic livestock grazing at a scale similar to the interim grazing program. Current management prescriptions include Annual Operating Instructions (AOIs), adjustments to the AUMs based on climate and productivity, entry and exit dates of June 1 through September 30, and a rotational grazing system. These adjustments reflect annual resource or climatic conditions and assist in making progress toward meeting the desired condition for the Mexican spotted owl. Desired conditions include maintaining forage utilization at conservative use levels of (30-40 percent) and managing for good to excellent range condition within key areas during the growing season.

The construction of temporary fences, along with range riders would assist in improving and maintaining livestock distribution between pastures. The improvement in livestock distribution would ultimately lead to adequate forage utilization levels and range condition to support Mexican spotted owl habitat.

The implementation of either alternative would not remove the structural habitat characteristics required for the Mexican spotted owl within the Preserve. The overall canopy cover and forest structure would not change due to grazing, since livestock would not affect tree composition.

The implementation of the proposed activities and monitoring plan would assist in meeting adequate range conditions. Production utilization monitoring in riparian areas will be evaluated both spring and fall. Monitoring would continue to be conducted annually to evaluate if riparian habitat is maintained and is in good condition. Metric are described in Chapter One. Ensuring adequate residual cover during the growing season provides cover for Mexican spotted owl prey base. Ecological goals being proposed for adoption would sustain habitat into the future. Achieving the stated objectives would be especially important in pastures that are grazed during the late spring and early summer months when avian species are rearing young and require a higher level of prey species.

Alternative C_2 or D_2

The activities being proposed to manage facilities would not occur in any PAC, therefore there would be no effect to nesting. Nor would the proposed activities change or effect foraging areas or the habitat for prey species.

Cumulative Effects

Action Alternatives

As previously described in the watershed section, past activities especially timber harvest, associated road building and livestock grazing have combined to create the current condition of habitat in the Preserve (Valles Caldera Trust, 2007).

Past activities have reduced fuel loadings on localized areas of the Preserve; however, there is still a chance that the area could experience a stand replacing wildfire (Valles Caldera Trust, 2007). A stand replacing wildfire would incrementally result in the loss of Mexican spotted owl and prey species habitat. Livestock grazing as proposed in the action alternatives would not combine with other activities to affect fuel loadings or fire behavior.

The proposed action combined with cumulative actions such as livestock grazing on adjacent allotments could incrementally decrease prey base cover habitat for the Mexican spotted owl. However, having the ability in the proposed activities to implement adaptive management strategies to manage the AOIs to adjust the AUMs, livestock numbers, entry and exit dates, number of days and grazing system would assist in incrementally improving prey base habitat for these species.

Determination

Alternatives A, B

Impacts to Mexican spotted owl habitat as a result of the alternatives would be negligible; therefore, there will be **no impact (NI)** to this species.

Alternatives C, D

The Wildlife Report prepared for this analysis (Moser 2008) determined that the proposed activities associated with grazing on the Preserve **may affect, not likely to adversely affect (MANLAA)** the Mexican spotted owl or its habitat. This determination was based, in part, on a comparison of the grazing criteria being proposed, with the criteria found in the *Framework* for Streamlining Informal Consultation for Livestock Grazing Activities (USDA-USFS 2005). The grazing criteria are consistent with the proposed adaptive management strategies for livestock grazing and livestock management activities. The grazing activities as proposed and guided by the performance requirements in Chapter One.

No Protected Activity Centers (PACs) or CHUs for Mexican spotted owl are located within the Preserve. Therefore, there would be no potential disturbance from construction activities to nesting.

These alternatives have the greatest potential to impact prey species overall in the riparian sections. Vegetation along streams have been impacted to the point where cover for prey species is lacking in some areas. This is a combination of livestock and elk use. Mexican spotted owl pellet studies in the Jemez Mountains from 1982 through 2000 show that voles were about 7 percent of prey items overall; wood rats and insects were in the highest percentages (>30 percent and >20 percent, respectively) of the prey items (Johnson and Williams III 2004). Although impacts on riparian vegetation may affect Mexican spotted owl foraging in the Preserve, because of the large foraging range of the Mexican spotted owl and their use of varied prey items, with

indications that wood rats and insects are used in higher percentages, it would not be expected that any impacts on foraging in the Preserve riparian areas would limit their ability to find food.

There could be some temporary and localized vegetation impacts where cattle tend to concentrate. With construction of temporary fences, use of range riders and by following monitoring requirements, cattle could be rotated before any impacts would be widely distributed. Because these impacts would be localized and temporary, there would not be expected to be any widescale reductions in available habitat for Mexican spotted owl prey species. The proposed management of larger capacity permanent water sources would provide more water in the upland area, and reduce need for cattle to visit riparian area for water. It is anticipated that dividing the pastures that will be used on a rotational basis will reduce impacts on riparian corridor, maintaining grasses and vegetation at a level that will maintain Mexican spotted owl prey species.

Alternative C_2 , D_2

Facilities management being considered, would not measurable increase the effects to the Mexican spotted owl or its habitat beyond what is described for Alternatives C and D. The determination is a **May Affect, Not Likely to Adversely Affect the Mexican spotted owl or its habitat.**

Sensitive Species

There are 31 terrestrial species on the Regional Forester's Sensitive Species list (USDA-USFS 2007) that potentially occur on the Preserve. Table 19 lists species that do not occur on the Preserve, have no likelihood of occurring on the Preserve, and have no key habitat occurring on the Preserve. These species will be eliminated from further consideration in this analysis.

Table 19 – Sensitive species eliminated from further analysis

Common Name	*Scientific Name*
White-Tailed Ptarmigan	*Lagopus leucurus*
Western Yellow Billed Cuckoo	Coccyzus americanus occidentalis
Burrowing Owl (Western)	*Athene cunicularia hypugaea*
Boreal Owl	*Aegolius funereus*
Gray Vireo	*Vireo vicinior*
Cinereus (Masked) Shrew	*Sorex cinereus cinereus*
Preble's Shrew	*Sorex preblei*
Spotted Bat	*Euderma maculatum*
Pale Townsend's Big-Eared Bat	*Corynorhinus townsendii pallescens*
Pika	*Ochotona princeps*
Snowshoe Hare	*Lepus americanus*
Botta's Pocket Gopher	*Thomomys bottae aureus*
NM Banner Tailed Kangaroo Rat	*Dipodomys spectabilis clarenci (baileyi)*

Western Heather Vole	*Phenacomys intermedius intermedius*
Yellow-Bellied Marmot	*Marmota flaviventris*
Mink	*Mustela vison energumenos*
Rocky Mountain Bighorn Sheep	*Ovis canadensis Canadensis*

Table 20 identifies Sensitive species (USDA-USFS 2007) with a likelihood of occurrence on the Preserve or potential habitat for the species occurs within or adjacent to the Preserve. These species and the potential consequences that could result from implementation of the action alternatives or taking no action at all have been analyzed.

Table 20 – Sensitive Species Requiring Analysis

Common Name	***Scientific Name***
Bald Eagle	*Haliaeetus leucocephalus*
New Mexico Meadow Jumping Mouse	*Zapus hudsonius luteus*
Northern Goshawk	*Accipiter gentiles*
Peregrine Falcon	*Falco peregrinus anatum*
Jemez Mountains Salamander	*Plethodon neomexicanus*
Northern Leopard Frog	*Rana pipiens*
White-Tailed Ptarmigan	*Lagopus leucurus*
Dwarf Shrew	*Sorex nanus*
Water Shrew	*Sorex palustris navigator*
Goat Peak Pika	*Ochotona princeps nigrescens*
Gunnison's Prairie Dog	*Cynomys gunnisoni*
Southern Red-Backed Vole	*Clethrionomys gapperi*
Long-Tailed Vole	*Microtus longicaudus*
American Marten	*Martes americana origenes*
Ermine	*Mustela erminea muricus*

Bald Eagle (*Haliaeetus leucocephalus)*

Figure 28 – Bald eagle

Existing Condition

Wintering bald eagles (Figure 28) begin to arrive on the Preserve in October and leave by May, with peak numbers only during the coldest period of January (Johnson 2003). The location and abundance of wintering eagles is dependent on food, availability of appropriate roosting and foraging habitat, and human disturbance. Location and abundance can vary from year to year. This seasonal use by bald eagles occurs mainly along the San Antonio creek, although individuals can be observed during the day at numerous locations throughout the Preserve. Most individuals seen away from water are feeding on elk carcasses as a result of hunting activities on the Preserve. Eagles typically use the trees near the creek as overnight roosts (Parmenter 2003).

Parmenter noted that hikers and vehicle traffic from two roads near the roost sites along San Antonio creek were the main causes of disturbance for bald eagles in that area.

In general, eagle concentrations occur around reservoirs and along rivers, with a scattering of birds in terrestrial habitat (Johnson 2003). There are no large water bodies to provide breeding/foraging habitat within or near the Preserve. Breeding habitat for bald eagles is limited in New Mexico and none is known to occur in the Jemez Mountains.

Nest trees are usually larger than those trees in the surrounding stands (Smith and Weston 1990), primarily conifer, and have thick, stout limbs. Bald eagles often construct alternate nests within a territory and vary use between them from year to year (USDOI 1986). Eagles roost but do not nest on the Preserve (Johnson 2003).

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these

increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Administrative activities, including infrastructure maintenance, are currently curtailed or minimized when the eagles are present (Parmenter 2003) where those activities are likely to disturb the eagles. These administrative procedures would continue under these alternatives.

Alternatives C, D

No management activities are proposed that would affect roosting, or perch habitat in the Preserve. Eagle interaction with domestic livestock grazing activities would be unlikely. Livestock have generally left the Preserve prior to the arrival of the eagles. Roosting or perch sites would usually be high in trees or on cliff ledges, not in grazing areas. Indirectly impacts or changes in the Preserve's riparian condition could affect fish populations, thus affecting the eagles' diet, which consists primarily of fish from the Preserve's streams and carrion. The intensity of grazing as proposed is not expected to negatively affect riparian condition (see 3.1 Watershed section)

Administrative activities, including infrastructure maintenance, are currently curtailed or minimized when the eagles are present (Parmenter 2003) where those activities are likely to disturb the eagles. These administrative procedures would continue under these alternatives.

Alternative C_2 or D_2

Facility management proposed under these alternatives would have **NI** to bald eagle or their habitat.

Cumulative Effects

All Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the action alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for bald eagle.

Determinations

All Alternatives

These alternatives would not be expected to measurably change bald eagle habitat or propose activities that would otherwise affect the integrity of potential nesting habitat; therefore, there will be **NI** to bald eagle or their habitat.

New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus)*

Figure 29 – New Mexico meadow jumping mouse

Existing Condition

The New Mexico meadow jumping mouse (Figure 29) is considered to be an extreme habitat specialist that relies on riparian areas that have tall, dense herbaceous vegetation, especially sedges, on perennially moist soil (Frey 2006)). Frey (Frey 2006) only found the New Mexico meadow jumping mouse in areas with 2 to 3 feet of vertical cover types. Montane populations use both persistent emergent herbaceous wetland (i.e., beaked sedge and reed canary grass) and scrub-shrub wetland (i.e., willow and alder) riparian communities, specific capture sites in scrub-shrub wetlands were nearly always restricted to small patches and narrow strips of herbaceous, usually sedge-dominated, microhabitats found between the water's edge and the shrubs. Tall dense sedge on moist soil appears to be the key microhabitat utilized by New Mexico meadow jumping mouse, regardless of the community type. Preferred habitat in the Jemez Mountains contains permanent streams, moderate to high soil moisture, and dense, diverse streamside vegetation of grasses, sedges, and forbs (Morrison 1985, State of New Mexico 2008). Some recent studies have noted possible declines in populations where jumping mice have historically been found. (J. Frey 2005).

Zwank Najera, and Cardenas (1997) found that the breeding period for this mouse is June thru August, nesting on the surface or beneath brush, logs or stumps. It has a home range of .5 to 2 acres. It feeds on seeds, insects, and fruits and when seeds are unavailable or limited, insects may compose of up to half of its diet.

The New Mexico meadow jumping mouse is not dependent on the beaver for suitable habitat but Frey (Frey 2006) has found that the loss of beaver and beaver dams in areas could have a negative impact on the mouse habitat in two ways. The dams create the moist soils need for the microhabitat and can provide barriers to people and livestock in using the habitats favored by the New Mexico meadow jumping mouse. The Preserve has historically had beavers in Sulphur and Indios creeks, and personnel have recently observed an individual beaver moving through the area, but currently there are no beaver populations located on the Preserve. A beaver restoration project in Indios Creek is ongoing to restore beaver to the area within the next 3 to 4 years (Parmenter 2008).

The meadow jumping mouse apparently requires dense vegetation for population persistence, and its scarcity may be related to livestock overgrazing in streamside habitats (State of New Mexico 2008). Periodic severe flooding may also contribute to its rarity. In more mesic areas the

subspecies may be favored by the opening up of forests and similar ecological changes (State of New Mexico 2008).

Proper herding of livestock and reducing cattle use of streamside habitat for extended periods could increase the quality of riparian zones by increasing cover and ensuring good stream bank stability.

No formal surveys have been completed within the Preserve although wildlife data received from the adjoining Santa Fe National Forest show two locations of this species along the San Antonio Creek within the Preserve. Inventories are proposed for summer 2009 (Parmenter 2008)

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

These alternatives would be expected to benefit potential habitat for jumping mice. Any livestock grazing impacts to jumping mice or their habitat would be eliminated or negligible. Without impacts of livestock grazing, suitable habitat could expand and provide better potential habitat, although there will still be elk grazing impacts within the Preserve.

Alternatives C, D

Under both these alternatives, forage would be allocated to domestic livestock grazing at levels similar to the current allocation. Pasture rotation, range riders moving cattle around and an increase in upland water storage capacity would reduce riparian impacts and increase range distribution of cattle; riparian conditions could continue to improve somewhat under these alternatives. Any suitable habitat present would continue to be grazed, with no potential for improvement/expansion of potential habitat. Surface nests are susceptible to trampling by livestock.

Recreational development and range management activities in montane areas have the potential to affect isolated populations of the New Mexico meadow jumping mouse (Morrison 1992, Frey 2006). Grazing of tall dense sedge habitat by either wild or domestic ungulates remove habitat components for the mouse.

Alternative C_2 or D_2

The proposed facility maintenance activities would have no impact to New Mexico meadow jumping mouse or its habitat.

Cumulative Effects

All Alternatives

Other cumulative use includes wildlife use of grassy vegetation, i.e., elk, rabbits, other small rodents, and insects such as grasshoppers. This cumulative use could reduce vegetation below standards needed for cover habitat in localized areas. Also, use by elk and recreation activity could also contribute to trampling effects of stream banks, nests, and reduction of riparian vegetation. Because jumping mice have been found in the Jemez Mountains. In areas of moderate grazing (Morrison 1992), it is not expected that these cumulative effects would lead to declines in overall populations.

The loss of beaver and beaver dams in areas could have had a negative impact on the mouse habitat. As previously noted the dams created the moist soils need for the microhabitat and can provide barriers to people and livestock in using the habitats favored by the New Mexico meadow jumping mouse (Frey 2006). The proposed reintroduction of beaver could combine with the proposed improvements in range infrastructure to improve habitat.

The distribution of anglers is controlled by assigning fishing areas to each angler and limiting the size of fishing parties. Even as visitation increases on the Preserve as a whole, the number and distribution of anglers is not anticipated to change in the planning horizon. Any proposed change in the fishing program that would result in a change in the density of anglers should consider the potential effect to the New Mexico meadow jumping mouse in combination with any domestic livestock grazing and document such considerations in the appropriate environmental document.

Inventories and monitoring may indicate a need for additional performance requirements to protect this extreme habitat specialist.

Determinations

Alternatives A, B

These alternatives would be expected to benefit jumping mice by improving or increasing potential habitat. Any livestock grazing impacts to jumping mice or their habitat would be eliminated or negligible. Without impacts of livestock grazing, suitable habitat could expand and provide better potential habitat, although there will still be elk grazing impacts within the Preserve. Alternative B could further improve habitat by affecting the distribution of elk and reducing erosion in riparian areas. These alternatives are not expected to measurably change New Mexico meadow jumping mouse habitat; therefore, there will be **NI** to this species.

Alternative C, D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Alternative C_2 or D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Northern Goshawk *(Accipiter gentiles)*

Figure 30 – Northern goshawk

Existing Condition

The northern goshawk (Figure 30) is a forest generalist that uses a variety of forest types, forest ages, structural conditions, and succession stages (Reynolds et al. 1992). The principal forest types occupied by goshawks in the southwest are ponderosa pine, mixed conifer, and spruce-fir. Goshawks seem to prefer mature forests with large trees on moderate slopes with open understories (Squires and Reynolds 1997). The northern goshawk reaches the southern limits of its breeding range in the highlands of Arizona, New Mexico, and possibly western Texas southward to at least Jalisco, Mexico. The small New Mexico population occurs locally in mature coniferous forests of mountains and high mesas. The goshawk is a predator of small birds and mammals. Snags, downed logs, woody debris, openings, large trees, herbaceous and shrubby understories, and interspersion of vegetation structure are important features contributing to the presence of prey populations (State of New Mexico 2008).

Northern goshawks nest in coniferous, deciduous, or mixed-pine forests, depending on availability. A nest area is composed of the nest tree and stand(s) surrounding the nest that contain prey handling areas, perches, and roosts. Reynolds et al. (1992) stated that nest areas are often on mesic sites (northerly facing slopes, along streams). However, La Sorte et al. (2004) found that aspect was not a factor in nest location; rather the average nest site was centered in a forested area with small nonforested areas dispersed around the perimeter of the territory (La Sorte et al. 2004). The forested area around the nest site corresponded well with the size of a post-fledgling family area (Reynolds et al. 1992). Numerous studies have documented that goshawk nest sites are associated with characteristics of mature forest structure such as high canopy closure, mature trees, and open understories (Reynolds et al. 1992),(Squires and Reynolds 1997); (La Sorte et al. 2004).

A goshawk's nesting home range is about 6,000 acres (Reynolds et al. 1992). A breeding pair usually occupies its nest area from early March until late September. The nest area is the center for all activity associated with breeding from courtship through fledging of young (Reynolds et al.

1992). Nest trees are usually one of the largest trees in the nest area. Most territories contain several alternative nest trees. Most goshawks have two to four alternate nest areas within their home range. Alternate nest areas may be used in different years, and some may be used for decades.

No formal surveys have been conducted and no known nests occur on the Preserve but several designated foraging areas overlap onto the Preserve from the Santa Fe N.F. These areas are located on the east, west and northwest edges of the Preserve. Goshawk have been observed foraging on the Preserve. Breeding, roosting, and foraging habitat is available on the Preserve within the mixed conifer and Ponderosa pine forests.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

With rotation of grazing pastures, range riders and maintenance, repair, or construction of range improvements to better distribute cattle grazing, there would be improvement of riparian vegetation within the Preserve thereby providing potential to improve prey diversity for goshawk. The forage range of the goshawk is approximately 6,000 acres, any localized impacts to vegetation and prey species, would not be expected to impact the ability of goshawks to find prey within and adjacent to the Preserve. Goshawks typically nest high in larger trees. Cattle grazing through an area would be unlikely to create disturbance to nest sites. Herding activity (movement and noise), depending on distance from nest site, duration and intensity of disturbance, could disturb nesting behavior. This disturbance would have a greater impact earlier in the breeding season. Once goshawks are incubating eggs and feeding young (usually after May 1), it is more likely that they will retain the nest. Because grazing season in the Preserve normally will not begin until June 1, disturbance during the early vulnerable breeding period is unlikely.

Grazing effects on vegetation structure and composition could reduce abundance or variety of prey species in localized areas, but would not have impacts over large areas. Grazing would have no effect on canopy cover levels, and thus, there would be no change in existing vegetation structural stages. There are no grazing improvements proposed in a known goshawk territory.

Construction of range developments would create noise and activity there would be potential for disturbance from this activity if this activity occurred within potential or suitable habitat or near a goshawk nest. Performance requirements include goshawk surveys for any projects in potential or suitable habitat planned during the breeding season (March 1 to September 30) would eliminate potential for impacts to nest sites.

Alternative C_2 or D_2

Construction of facility developments would create noise and activity there would be potential for disturbance from this activity if this activity occurred within potential or suitable habitat or near a goshawk nest. Mitigation to do goshawk surveys for any projects in potential or suitable habitat done during the breeding season (March 1 to September 30) would eliminate potential for impacts to nest sites.

Cumulative Effects

All Alternatives

Effects considered would be those that would combine with other past, present, or reasonable foreseeable future actions to contribute to direct effects of disturbance to nesting sites, and indirect effects from impacts to vegetation that could contribute to impacts on prey species. Management activities associated with the management of livestock or connected management of range infrastructure could cause a minimal amount of disturbance, dependent on frequency and distance from nest sites. The forage range of the goshawk is approximately 6,000 acres, any cumulative effects of localized impacts to vegetation and prey species, would not be expected to impact the ability of goshawks to find prey within and adjacent to the Preserve.

Determination

Alternatives A, B

These alternatives are not expected to measurably change Northern goshawk habitat; therefore, there will be **NI** to this species.

Alternatives C, D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. Construction of range developments would create noise and activity disturbance. Mitigation to do goshawk surveys for any projects in potential or suitable habitat done during the breeding season (March 1 to September 30) would eliminate potential for impacts to nest sites.

Alternative C_2 or D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. Construction of facility developments would create noise and activity disturbance. Mitigation to do goshawk surveys for any projects in potential or suitable habitat done during the breeding season (March 1 to September 30) would eliminate potential for impacts to nest sites.

American Peregrine falcon (*Falco peregrinus anatum)*

Figure 31 – American Peregrine falcon

Existing Condition

American Peregrine falcon (Figure 31) usually inhabit open country, preferably where there are rocky cliffs with ledges overlooking rivers, lakes or other open water and an abundance of birds. Nesting habitat includes cliffs or platforms near water and an abundance of prey. Peregrines are primarily aerial hunters; small to medium sized birds are usually captured in flight; birds too large to be carried are knocked to the ground. Peregrines feed on a wide variety of birds but they occasionally also take mammals, insects and fish.

In New Mexico, breeding habitat is provided locally by cliffs in forested habitats in mountain and river canyons statewide. They prefer elevations from 6,500-8,600' but may be found from 3,500-9,000'. Data from NMDGF show that although productivity in the state had recovered from historic lows by the 1980s, it began trending lower after 1984. The goal for recovery is sustained occupancy of 85 percent of known territories. In New Mexico, pairs occupied 81 percent of known falcon territories in 2004. Occupancy increased; however, productivity was slightly below recent averages and below historic levels (Johnson and Williams III 2004).

There is no suitable peregrine nesting habitat within the Preserve. Peregrines do nest on the cliffs just to the west and use areas within the Preserve as foraging habitat (Parmenter 2008).

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of

additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

With rotation of grazing pastures, range riders and maintenance, repair, or construction of range improvements to better distribute cattle grazing, there would be improvement of riparian vegetation within the Preserve thereby providing potential to improve prey diversity for Peregrine falcon. Grazing effects on vegetation structure and composition could reduce abundance or variety of prey species in localized areas, but would not have impacts over large areas.

No management activities are proposed that would affect nesting, roosting, or perch habitat in the Preserve. Domestic livestock movement or associated management through the area would not be expected to cause a disturbance.

Falcons nest in cavities high on cliffs where cattle would have no access; therefore, there is no potential for direct impacts to nests. Visual or noise stimuli during the early breeding season (March 1 to May 15) would have the greatest potential for short-term and localized effects to breeding birds. Grazing will not normally begin until June 1 in the Preserve; therefore, there would usually be no disturbance during the early breeding season. As previously stated, suitable breeding habitat is not present on the Preserve.

Indirect effects to falcons would include impacts on prey species caused by temporary and localized impacts on grassy vegetation. The proposed allocation and use of forage would result in only minor effects Preserve wide with moderate effects possible, limited in time and space. Because prey includes songbirds, which forage over a wide range, any temporary impacts on vegetation would not be expected to cause a decline in songbird populations. Falcons also range over a several mile territory; therefore, it is not anticipated that that there would be any impacts to the falcons ability to find food. Placement of water developments would be expected to distribute cattle better throughout the Preserve, resulting in more even forage use and reduced impacts to riparian areas, providing improved habitat for prey species.

Alternative C_2 or D_2

Facility improvements proposed in conjunction with Alternatives C or D would not impact the Peregrine falcon or its habitat.

Cumulative Effects

Action Alternatives

Effects considered would be those that would contribute to direct effects of disturbance to nesting sites, and indirect effects from impacts to vegetation, which could contribute to impacts on prey species. As noted above, because of the location of falcon nests high on cliff sites, there is little potential for direct effects to nesting from cattle grazing; therefore, there would be no contribution to cumulative effects from grazing disturbance.

Determinations

All Alternatives

These alternatives would not be expected to measurably change peregrine falcon habitat or propose activities that would otherwise affect the integrity of potential nesting habitat; therefore, there will be **No Impact (NI)** to peregrine falcon or their habitat.

Jemez Mountains Salamander (*Plethodon neomexicanus)*

Figure 32 – Jemez Mountain Salamander

Existing Condition

Jemez Mountains salamanders (Figure 32) are primarily found in habitats between 7,200-9,600 feet in specific microhabitat conditions. Preferred microhabitat is characterized by relatively high humidity and soils that contain deep, igneous, subsurface rock that is fractured vertically and horizontally to allow the species to retreat underground to below the frost line. Habitats where pumice is the dominant subsurface structure are generally not occupied. Jemez Mountains salamanders are rarely encountered on the surface or under bark, litter, or in aspen logs. Much of the life cycle occurs underground, with surface activity occurring inside rotted coniferous logs or under rocks during a brief period of the summer (typically June through August) when conditions are warm and wet. Individuals are rarely found exposed on the surface. The macrohabitat is coniferous forest dominated by Douglas-fir, blue spruce, Engelmann spruce, ponderosa pine, or white fir. Other trees in the area may include aspen, Rocky Mountain maple, New Mexico locust, oceanspray, and various shrubby oaks.

Breeding likely occurs in the spring, with eggs laid beneath the soil surface in interstitial spaces between fractured rocks, in rotted root channels, or in the burrows of rodents or large invertebrates. Ants of at least three species make up approximately 74 percent of the diet. Other important prey items for the Jemez Mountains Salamander include beetles, mites, spiders, earthworms, and other small invertebrates found in rotting logs and under rocks.

Forest management practices that lead to drier habitat conditions are thought to negatively affect JMS abundance and limit detection. These woodland salamanders lack lungs and gills, and exchange gases almost entirely through cutaneous respiration. Thus, Jemez Mountains salamanders, as well as other plethodontids, seek moist micro-environments and are sensitive to silvicultural treatments that modify the prevailing temperature, humidity, soil moisture, soil surface cover, and soil porosity.

Threats to the species include activities that may impact individuals or populations and or alter habitat conditions in the following manner:

1) ground disturbance such as excavation, churning, compaction, or any activity that reduces interspaces and subsurface channels;

2) vegetation modification to the extent that ground surface microclimate is made drier or otherwise altered through increased exposure to sun and wind; and
3) suppression of populations of ants and other surface-dwelling invertebrates, which are the primary prey of the Jemez Mountains salamander.

Current levels of livestock grazing are not believed to be a direct or indirect threat to the viability of Jemez Mountains salamander populations. The majority of this species' habitat is poorly suited (too rocky or steep) to support livestock grazing. The habitat/microclimate found in grazing lands (small soil pore spaces and fibrous root texture) is not considered suitable for the salamander.

Livestock may trail through habitat, but no impacts to Jemez Mountains salamander habitat are expected. Water developments and facilities that concentrate animals and could result in soil compaction would not normally be constructed on forested rocky sites that are the preferred habitat of Jemez Mountains salamanders.

Individual Jemez Mountains salamanders are very difficult to detect at a site because of their fossorial habits and intimate dependency upon exacting moisture conditions. Even when environmental conditions are ideal for surface activity, it is believed that only a small percentage of the individuals that occur at a site are surface active and therefore detectable using high-grade survey protocol. Therefore, data collected during high-grade surveys are believed to significantly underestimate the actual numbers of Jemez Mountains salamanders present at a site.

Surveys were conducted on the Preserve from July to September of 2002. Three out of ten locations revealed positive results. Approximately 41,500 acres of potential habitat has been initially identified on the Preserve. The majority of the suitable habitat is in denser mixed conifer, where forage is sparse, and on steeper slopes where livestock would not tend to graze.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Construction of range improvements in potential or suitable habitat could cause some impacts, either directly from project activities. Removal of fences could indirect improve or protect

conditions of the JMS by reducing trailing. The primary period in which salamanders are on the surface is during the seasonal rains (typically July 1 through October 15). Mitigation to do JMS surveys for any project in potential or suitable habitat done during the wet periods from July 1 through October 15 would eliminate potential for direct impact to individuals on the soil surface.

Alternatives C, D

Grazing within the Preserve would not be likely to cause a trend to federal listing or cause a decrease in overall species populations. If salamanders are present while cattle are moving through an area there could be some localized impacts to individuals. Any localized concentrations of cattle could cause soil compaction that could deter salamander movement underground. A Cooperative Management Plan (New Mexico Endemic Salamander Team 2000) developed in 2000, notes that only a small percentage of individuals that occur at a site are surface active; therefore, only a small number of the population would have potential to be impacted at any one time. According to the Cooperative Management Plan, current levels of livestock grazing are not believed to be a direct threat to the viability of JMS populations because the majority of salamander habitat is too rocky or steep to support livestock grazing (New Mexico Endemic Salamander Team 2000).

Construction of range improvements in potential or suitable habitat could cause some impacts, either directly from project activities or indirectly from soil compaction from cattle use. The primary period in which salamanders are on the surface is during the seasonal rains (typically July 1 through October 15). Mitigation to do JMS surveys for any project in potential or suitable habitat done during the wet periods from July 1 through October 15 would eliminate potential for direct impact to individuals on the soil surface. Typically, construction of fences creates trailing of cattle along those fences with resultant soil compaction along fences. These trails are usually less than about two feet wide so soil compaction would not limit surface access for the salamander over a wide area. The proposed removal and relocation of some fences would reduced this effect locally

Alternative C_2 or D_2

Construction of facility developments could create a potential disturbance activity, if this activity occurred within potential or suitable habitat. Mitigation to do JMS surveys for any projects in potential or suitable habitat done during the wet periods from July 1 through October 15 would eliminate potential for direct impacts to individuals on the soil surface.

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. Mitigation to do JMS surveys for any projects in potential or suitable habitat done during the wet periods from July 1 through October 15 would eliminate potential for impacts to individuals.

Cumulative Effects

Action Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for Jemez Mountains salamander.

Those projects that would contribute to direct effects of disturbance to on-surface salamanders, or indirect effects of soil compaction are considered for cumulative effects. The Cooperative Management Plan for the JMS (2000) notes that cattle grazing does not usually occur on the steep rocky areas necessary for salamander habitat; therefore, grazing would be a minor contribution to these cumulative effects.

Determination

Alternatives A, B

These alternatives are not expected to measurably change JMS habitat; therefore, there will be **NI** to this species.

Alternatives C,D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. Mitigation to do JMS surveys for any projects in potential or suitable habitat done during the wet periods from July 1 through October 15 would eliminate potential for impacts to individuals.

Northern Leopard Frog (*Rana pipiens)*

Figure 33 – Northern leopard frog

Existing Condition

The northern leopard frog (Figure 33) is typically associated with streams and rivers, although lakes, marshes and irrigation ditches are also occupied. Much of the river valley habitat of these frogs has been modified by human activities, including draining of wetlands, channelization and damming of rivers, and the development of irrigation systems (Degenhart 1996). In New Mexico, they occur at elevations of about 3,500 to 11,000'. Their habitats include cattail marshes, beaver ponds and other water sources with aquatic vegetation. Breeding can occur at any time of year following heavy rainfall or in higher elevations later in the season. Egg masses are attached to emergent vegetation or lie on the bottom of the pond in shallow slow moving or still water (Amphibia Web 2008). In New Mexico, Scott and Jennings (1985) reported eggs and small tadpoles of this species from April through July and September through October.

It will be important for breeding habitat to maintain water in most areas from July to October.

Initial breeding activity is related more to temperature than precipitation (Degenhart 1996). Threats to local populations include alterations in wet areas, stocking of predatory fish; local extinctions as water dries up during years of low precipitation, and predation and competition by bullfrogs.

Food habits of northern leopard frogs are unknown but undoubtedly feed on a wide variety of invertebrate prey (Degenhart 1996). The frog may forage long distances from water in upland habitat during wet periods (Degenhart 1996).

No formal surveys have been completed within the Preserve although wildlife data received from the adjoining Santa Fe National Forest show four locations of this species within the Preserve. Three historic locations are also recorded within the Preserve. Potential habitat is present along riparian corridors within the Preserve.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Performance requirements previously described would require any water development to provide for the escape of small animals.

Alternatives C, D

There could be some direct localized impacts to individuals, young or eggs with cattle moving through wet areas and entering streams or other water sources. These impacts would not be expected to cause a decline in populations or a trend to federal listing.

Leopard frogs have been found in water developments (Britton 2005, Painter 2005), so proposed maintenance, repair, and construction of earthen tanks and water developments would provide some additional habitat. With a performance requirements to provide escape ramps from water developments, there would be no potential for frogs to get trapped in these developments; earthen tanks would require no escape ramps. Other impacts from grazing could include effects on water quality from waste products, and sedimentation from stream bank trampling (Smith 2003).

Alternative C_2 or D_2

Construction of facility developments would create potential disturbance activity, if this activity occurred within potential or suitable habitat.

Cumulative Effects

Action Alternatives

Other uses that would be considered for cumulative effects when combined with grazing would be those that would impact springs, streams and wet areas. Any roads or hiking trails that cross streams have a point of impact in a constant area; therefore potential for impacts would be limited. Anglers walking through side pools, would also be a factor in impacts to eggs and young. Current angling pressure is limited.

Determination

Alternatives A, B

These alternatives are not expected to measurably change NLF habitat; therefore, there will be **NI** to this species.

Alternatives C,D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. A mitigation that all water developments should be designed with exit ramps so that any small wildlife can escape would benefit individuals.

Alternatives C_2,D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Dwarf shrew (*Sorex nanus)*

Figure 34 – Dwarf shrew

Existing Condition

This shrew (Figure 34) lives in white fir-Douglas-fir zone from about 7,000 to 9,000 feet. The preferred habitat is talus and other rocky areas primarily in subalpine coniferous forest. Various other habitats, including sedge marsh, subalpine meadow, dry brushy slopes, arid shortgrass prairie, dry stubble fields, and piñon-juniper woodland (State of New Mexico 2008).

At higher elevations breeding begins in late June – early July. Two litters are produced with the second one occurring in early September. At lower elevations breeding may begin earlier (NatureServe 2008).

The dwarf shrew feeds primarily on insects, spiders, and other small invertebrates such as worms, mollusks, and centipedes, but may also consume vegetable matter as well as some small vertebrates, including salamanders (NatureServe 2008).

Although no formal surveys have been conducted, dwarf shrew has been found within the Preserve (Hope 2008).

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

Management practices in BISON-M (State of New Mexico 2008) note that dwarf shrew is tolerant to grazing activities. Grazing on the edge of the talus slopes keeps down vegetation that would potentially encroach. These activities would not be expected to have an impact on this species or habitat. Grazing would not take place among talus slopes and therefore would have no impact on dwarf shrew.

Alternative C_2 or D_2

Facility improvements proposed in conjunction with Alternatives C or D would not impact the dwarf shrew or its habitat.

Cumulative Effects

Action Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for dwarf shrew.

Determination

Alternatives A,B

These alternatives are not expected to measurably change dwarf shrew habitat; therefore, there will be **NI** to this species.

Alternatives C,D

These alternatives are not expected to measurably change dwarf shrew habitat; therefore, there will be **NI** to this species.

Alternatives C_2,D_2

These alternatives are not expected to measurably change dwarf shrew habitat; therefore, there will be **NI** to this species.

Water shrew (*Sorex palustris navigator)*

Figure 35 – Water shrew

Existing Condition

As the name suggests, water shrews (Figure 35) are closely associated with water often found around streams and other aquatic habitats; areas of high humidity surrounded by heavy vegetation, logs and rocks are preferred. Stream banks often provide favorable cover, including boulders, large stones, tree roots, overhanging ledges, willow, alder thickets, and spruce. Also found in lakes, bogs, and other lentic habitats (NatureServe 2008).

In New Mexico, water shrews are confined, so far as known at present, to the Sangre de Cristo, San Juan, and Jemez Mountains where they occur in the vicinity of permanent streams, seldom descending below 8,000 feet in altitude. Findley observed one foraging in July of 1961 on the Rio Las Vacas in the Jemez Mountains (State of New Mexico 2008).

Both terrestrial and aquatic invertebrates are consumed by water shrews (Orrock et al. 2000). The primary aquatic organisms consumed by shrews, including stoneflies, mayflies, and cadisflies are most abundant in streams with fast current and cobble substrate (Orrock et al. 2000).

The water shrew breeds from February through August. Nest sites are near water in underground burrows, rafted logs, beaver lodges, and other areas providing shelter (NatureServe 2008).

Common predators include fish such as trout, bass and pickerels, monks, otters, weasels, snakes and occasionally hawks and owls (NatureServe 2008).

Although no formal surveys have been conducted, water shrew have been found within the Preserve (Hope 2008).

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

Forage allocation and use would occur as described in the proposed action; there would be range maintenance, repair, construction, or obliteration of earthen tanks, water developments and removal of interior fences to increase range distribution of cattle. Any suitable habitat present would continue to be grazed, with no potential for improvement/expansion of potential habitat.

Pasture rotation, range riders moving cattle around and an increase in upland water storage capacity would reduce riparian impacts; riparian vegetation would be expected to increase somewhat under these alternatives.

Threats include destruction of habitat through heavy grazing. When an isolated population disappears for any reason, it is unlikely to be restored by natural dispersal; therefore, isolated populations may be especially vulnerable to extirpation from human activities or long-term climate change (NatureServe 2008).

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the water shrew or its habitat.

Cumulative Effects

Action Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for water shrew.

Determination

Alternatives A,B

These alternatives are not expected to measurably change water shrew habitat; therefore, there will be **NI** to this species.

Alternatives C,D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. A mitigation that all water developments should be designed with exit ramps so that any small wildlife can escape would benefit individuals.

Alternatives C_2, D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Goat Peak Pika (*Ochotona princeps nigrescens)*

Figure 36 – Goat Peak pika

Existing Condition

In New Mexico, Goat Peak pika (Figure 36) are confined to talus slides and boulder fields in Alpine and subAlpine areas. In the Jemez Mountains, goat peak pikas have been taken on Goat, Santa Clara, and Pelado peaks, where they live in lava rocks as low as 9,000 feet (State of New Mexico 2008)

Pikas do not hibernate, but are active beneath the snow all winter, foraging out from talus in snow burrows (Smith and Weston 1990).

They breed late April – early July. They nest under rocks and rock outcrops use grasses, forbs, sticks, and leaves for nest material.

Loss of appropriate Goat Peak pika habitat can occur by increasing moisture in dry areas, which promotes invasion of vegetation that fills the talus slopes (NatureServe 2008).

Environmental Consequences

Alternatives A, B

Under these alternatives, there will be no new grazing activities. Livestock would not utilize the available forage. Therefore, it is anticipated that there would be an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

Grazing would be maintained at current level; there would be range maintenance, repair, construction, or obliteration of earthen tanks, water developments and removal of interior fences to increase range distribution of cattle. Grazing will not occur on talus slopes and boulder fields. **Therefore, there would be no direct, indirect, or cumulative effects to Goat Peak pika or their habitat.**

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the Goat Peak pika or its habitat.

Cumulative Effects

Action Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for Goat Peak pika.

Determination

Alternatives A,B

These alternatives are not expected to measurably change Goat Peak pika habitat; therefore, there will be **NI** to this species.

Alternatives C, D

These alternatives are not expected to measurably change Goat Peak pika habitat; therefore, there will be **NI** to this species.

Alternatives C_2, D_2

These alternatives are not expected to measurably change GP pika habitat; therefore, there will be **NI** to this species.

Gunnison's Prairie Dog (*Cynomys gunnisoni)*

Figure 37 –Gunnison's prairie dog

Existing Condition

Populations of Gunnison's prairie dog (Figure 37) can be considered to occur in two separate range portions – higher elevations referred to as montane populations and lower elevations referred to as prairie populations. The montane habitat found in the northeastern portion of the range (central and south-central Colorado and north-central New Mexico) consists primarily of higher elevation, cooler, and moister plateaus, benches, and intermountain valleys. This habitat comprises 35-40 percent of the species' total current range. (USDI Fish and Wildlife Service, 2008). Gunnison's prairie dogs occupy grass and shrub vegetation types in low valleys and mountain meadows within this habitat. Gunnison's prairie dogs feed most extensively on grasses, forbs, and sedges, but they will also eat insects, probably when necessary (State of New Mexico 2008).

Diseases such as plague have been known to devastate prairie dog colonies. Prairie dog populations have declined since the settlement period due to poisoning and habitat loss (State of New Mexico 2008, USDOI Fish and Wildlife Service 2008).

In Arizona, they are perceived as being in direct competition with livestock for grazing forage though some of the literature shows bias and lack data supportive of specific claims about the degree of competition (State of New Mexico 2008).

This species is common on the Preserve (Parmenter 2008)

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian

vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

Grazing would be maintained at current level; there would be range maintenance, repair, construction or obliteration of earthen tanks, water developments and removal of interior fences to increase range distribution of cattle.

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the Gunnison's prairie dog or its habitat.

Cumulative Effects

All Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for GP dog.

Determination

All Alternatives

These alternatives are not expected to measurably change GP dog habitat; therefore, there will be **NI** to this species.

Southern Red-backed Vole (*Clethriomomys gapperi*)

Figure 38 – Southern red-backed vole

Existing Condition

The southern red-backed vole (Figure 38) are common in mature lodgepole pine stands or in mixed spruce-fir forests with good cone production and an abundance of surface litter, including stumps, logs, and exposed roots of fallen trees. In such habitats, chickarees are often abundant and red-backed voles frequently use the middens of the squirrels for cover and as a food source. Other habitats include grassy meadows, willow riparian areas, talus, and krummholz (Fitzgerald

1994, Frey 1995). Grass communities are generally unsuitable habitat for southern red-backed voles, probably due to lack of food and cover.

These voles forage by grazing or browsing on the ground, in herbaceous vegetation, snags, stumps, rocks, or logs feeding upon the ectomycorrhizal fungi found in older coniferous stands and also need the woody debris for cover (Buskirk 2002).

They breed late winter to early fall. The nest sites can be a secondary cavity in a live or dying tree, hole in the ground, stumps, logs, or under rocks. They use nests of other animals. The nests are made from grass, sticks, leaves, and moss and are close to ground level.

Grazing is not likely to negatively impact this species (J. Frey 1995).

No surveys have been conducted for this species within the Preserve. Swickard, Haas, and Martin (Swickard, Haas and Martin 1971 (1972)) found them around the Valles Caldera in association with rocks and blue spruce.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternative C, D

Grazing by both livestock and wildlife can alter function and composition of moist areas through trampling and reduction in height and density of vegetation. Excessive grazing can reduce height and density of vegetation limiting the amount of cover for this species against predators and for their prey (insects) (Delong 2000).

Grazing would be maintained at current level; there would be range maintenance, repair, construction, or obliteration of earthen tanks, water developments, and removal of interior fences to increase range distribution of cattle. Any suitable habitat present would continue to be grazed, with no potential for improvement/expansion of potential habitat.

Pasture rotation, range riders moving cattle around and an increase in upland water storage capacity would reduce riparian impacts; riparian vegetation would be expected to increase somewhat under these alternatives.

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the southern red backed vole or its habitat.

Cumulative Effects

All Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for Southern red-backed vole.

Determination

Alternatives A, B

These alternatives are not expected to measurably change Southern red-backed vole habitat; therefore, there will be **NI** to this species.

Alternatives C, D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. A mitigation that all water developments should be designed with exit ramps so that any small wildlife can escape would benefit individuals.

Alternative C_2 or D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Long-tailed Vole (*Microtus longicaudus*)

Figure 39 – Long-tailed Vole

Existing Condition

The long-tailed vole (Figure 39) can be found in coniferous forests, but are most abundant where there is at least some grassy vegetation present on the forest floor. They are also found from time to time in rockslides (J. Frey 1995).

Long-tailed voles in Arizona live in the meadows, grassy valleys, grassy clearings in forests, sagebrush flats, and rocky slopes near or in coniferous forests. Elsewhere in the Southwest where

long-tailed voles live with or near montane voles, the former species occupies somewhat drier situations. Long-tailed voles are usually taken near or along the banks of streams where there was grass or brush, in meadows, on hillsides covered with chaparral or grass, in rock slides, willow thickets, or sometimes in sagebrush within a half mile from water. The relationship of long-tailed voles to water is not known precisely, whereas in New Mexico long-tailed voles required water for daily sustenance (Frey 1995, State of New Mexico 2008).

Long-tailed voles feed mostly on green vegetation, as well as on fruits and seeds. During winter, bark buds, and twigs of most locally common trees and shrubs, including spruce, aspen, oak, and snowberry are also consumed. Fescues, sedges, yarrow, and Oregon-grape are also commonly used (Fitzgerald 1994) (J. Frey 1995).

Nests are typically in underground burrows or under logs/rocks, and young are born from late April through September.

Frey (1995) reported that this species is largely dependent on well-developed mesic meadows and that grazing will negatively impact this species.

No formal surveys have been completed within the Preserve although wildlife data received from the adjoining Santa Fe National Forest show fourteen locations of this species within the Preserve.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternative C, D

Grazing by domestic livestock would continue at a scale similar to the interim grazing program; there would be range maintenance, repair, construction or obliteration of earthen tanks, water developments and removal of interior fences to increase range distribution of cattle. Any suitable habitat present would continue to be grazed, with no potential for improvement/expansion of potential habitat.

Pasture rotation, range riders moving cattle around and an increase in upland water storage capacity would reduce riparian impacts; riparian vegetation would be expected to increase somewhat under these alternatives.

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the long-tailed vole or its habitat.

Cumulative Effects

All Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under the Action Alternatives, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for long-tailed vole.

Determination

Alternatives A, B

These alternatives are not expected to measurably change the long-tailed vole habitat; therefore, there will be **NI** to this species.

Alternatives C, D

These action alternatives **may impact individuals or habitat but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Alternative C_2 or D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**. The performance requirement that all water developments should be designed with exit ramps so that any small wildlife can escape would benefit individuals.

American Marten (*Martes Americana origenes*)

Figure 40 – American marten

Existing Condition

American martens (Figure 39) inhabit forest of spruce (*Picea* spp.), fir (*Abies* spp.), Douglas-fir, and associated trees in northern New Mexico. Optimum habitat appears to be mature, old-growth spruce-fir communities with more than 30 percent canopy cover, well-established understory of fallen logs and stumps, and lush shrub and forb vegetation supporting microtine and sciurid prey (State of New Mexico 2008). Martens occur in spruce-fir forests and marginal alpine habitat in the San Juan and Sangre de Cristo Mountains. Objects on the forest floor, including

logs, rock piles, stumps, windthrow trees, and slash are thought to be important in providing winter access to subnivean (under the snow) rodent populations.

Martens breed in late summer/early fall, and bear offspring in the spring. The birthing site is usually under the snow or in old squirrel nests.

Martens eat insects, mice, voles, red squirrels (*Tamiasciurus hudsonicus*), pikas, and snowshoe hares. They also feed on carrion. During certain times of the year (mostly in the fall), a significant portion of their diet is comprised of berries.

Martens typically will utilize (hunt) the edge of meadows surrounded by forests w/in 10 -23 meters (32 – 75 ft.) of the forest edge (Buskirk 2002). Beyond the 10 – 23 meter distance, martens stop hunting and will cross open meadows up to 100 meter (328 ft.) wide. It is possible that marten prey species are not abundant and do not provide for energetic efficiencies to hunt beyond the ecotone of the forested edge and meadow openings. Hadley and Wilson (Hadley and Wilson 2004) found cleared ski runs had low densities of the prey species red-backed voles and that captures of red-backed voles only occurred in or near the forested edges.

Home range for martens range from .4 sq. mi. to 5 sq. mi. and are influenced by home ranges that are negatively correlated to the fluctuation of small mammal prey base abundance (Buskirk 2002). Marten populations may fluctuate by a factor of more than 10 in response to fluctuations of prey populations (Buskirk 2002). Current research indicates martens are adaptable to human presence. Marten attraction to human structures has been observed due to the presence of mice and voles taking advantage of created habitat and forage found in and adjacent manmade structures.

Bennett and Samson (Bennett and Sampson 1994) found marten population size and condition, and dispersal rates are correlated to small mammal populations. Microtine rodents, particularly red-backed voles (C*lethrionomys spp*.), other voles (*Microtus spp*.), red squirrels (*Tamiasciurus spp*.), snowshoe hare (*Lepus americanus*), birds, insects and berries comprise the most common foods for marten (Buskirk 2002). Red-backed voles are often associated with habitat that includes high basal areas of Engelmann spruce, large diameter woody debris in older coniferous forests (Ruggiero et al. 1994). Red squirrels are also important food source and provide important resting and denning habitat for marten; 40 – 50 percent of marten resting/den areas contained red squirrel middens (Henry and Ruggiero 1996). Snowshoe hare are an important large bodied prey in winter and energetically important to martens during winter metabolic stress (Buskirk 2002). Red squirrels share a unique relationship with marten since middens provide resting sites, natal/den sites and subnivean access (Ruggiero et al. 1994).

Surveys were conducted August-September 2002 within the Preserve, fourteen sites were surveyed with negative results.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The

reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

Grazing by domestic livestock would continue at a scale similar to the interim grazing program; there would be range maintenance, repair, construction or obliteration of earthen tanks, water developments and removal of interior fences to increase range distribution of cattle. Any suitable habitat present would continue to be grazed, with no potential for improvement/expansion of potential habitat.

Pasture rotation, range riders moving cattle around, and an increase in upland water storage capacity would reduce riparian impacts; riparian vegetation would be expected to increase somewhat under these alternatives.

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the American marten or its habitat.

Cumulative Effects

All Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under either Action Alternative, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for American marten.

Determination

All Alternatives

The No Action or action alternatives are not expected to measurably change the American marten habitat; therefore, there will be **NI** to this species.

Ermine (*Mustela erminea murices*)

Figure 41 – Ermine

Existing Condition

The ermine (Figure 40) is a weasel of high altitudes (7,800-11,000 feet) in northern New Mexico in association with small rodent populations in montane meadows, and avoids dense forest. Habitat includes forest-edge, grassland, shrub, wet meadows, and riparian areas. Dens in hollow log or under log, stump, roots, brushpile, or rocks (NatureServe 2008).

Swickard, Haas, and Martin (Swickard, Haas and Martin 1971 (1972)) took five specimens in the Valles Grande in the Jemez Mountains, four of which came from a meadow and one from a rock slide. All were surrounded by mixed coniferous forest at altitudes of 8,100-8,550'. No formal surveys have been completed within the Preserve although wildlife data received from the adjoining Santa Fe National Forest show eleven locations of this species within the Preserve.

Encroachment of trees into meadows, due to fire suppression or changes in climate, may also reduce ermine habitat (Buskirk 2002).

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities. It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments.

Alternatives C, D

Because they associate with meadows in forests, ermines probably are vulnerable to the effects of livestock grazing on vegetation; small mammal prey may be secondarily affected. Objectives proposed for grasslands would sustain habitat for ermine and their prey.

Alternative C_2 or D_2

Facility management proposed under these alternatives would have no effect on the ermine or its habitat.

Cumulative Effects

All Alternatives

Beyond the direct/indirect effects addressed associated with proposed activities under either Action Alternative, there are no activities that are reasonably certain to occur within the Preserve that would result in cumulative effects to habitat for ermine.

Determination

Alternatives A, B

These alternatives are not expected to measurably change the ermine habitat; therefore, there will be **NI** to this species.

Alternatives C, D

These action alternatives **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Alternative C_2 or D_2

This alternative is to be incorporated into Alternative C or D, the determination **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or cause a loss of viability to the population (MIIH)**.

Species of Interest

Rocky Mountain Elk (*Cervis elaphus nelsoni*)

Figure 42 – Rocky Mountain elk

Existing Condition

Rocky Mountain elk (Figure 41) inhabit most forest types with good forage and cover. They utilize a variety of habitats during the course of their lives. Certain vegetation types are of limited value to elk due to aspect, elevation, snow depth, lack of water availability and/or vegetation components.

The amount of grazing animals than an area can support depends not only on the amount of forage produced, but the access to that forage and availability of water. Approximately 31 percent of the Preserve was found suitable for allocating forage to grazing (Teams 2007). The remaining 69 percent is not suitable for allocation due to limited forage and to a lesser degree because of steep slopes and a lack of nearby water sources. Data from radio collared elk (Rupp 2005) and monitoring sites (T.E.A.M.S., 2007) indicate that the proposed allocation of forage is consistent with the actual use by elk. Vegetation management in forested areas may increase forage production slightly, but limited gains would be realized from limiting soil factors (T.E.A.M.S., 2007).

Only an estimated 10 percent of forested acres, primarily in the ponderosa pine type, have the potential to meet or exceed production levels considered suitable for sustainable allocate of forage to grazing.

Across the Preserve, the highest potential herbaceous productivity is located in the broad grassy valles. As discussed in the watershed section, climate, especially moisture, is the limiting factor of forage production on the majority of sites and rates vary widely depending on the timing and form of annual precipitation. As a result, average biomass production can change significantly in relatively short timeframes. For example, forage production doubled between a dry year in 2002 and a wet year in 2007.

Another climate related condition involved the lack of snow in 2004 and 2005, which led to higher use by elk. Elk overwintered in 2005 and only were gone a short time in winter 2004. This overwintering may explain the higher usage measured in riparian areas. Riparian utilization was 45 percent and 34 percent for years 2004 and 2005, respectively.

A decision was made in 2002 for an interim grazing program that would allow livestock stocking rates not to exceed 2,000 AUs over a 4-month period. Actual stocking would be based on estimated forage production and adaptive monitoring for all herbivores not to exceed 40 percent utilization of grasses for the following four ecological sites:

- Grazeable Woodland – forests located on the mid-slopes surrounding the valles.
- Mountain Valley – the upland dry grasslands between the woodlands and the wet bottomlands.
- Mountain Meadow – wet meadow grasslands adjacent to the riparian areas.
- Riparian – grasslands within 150 feet on either side of the perennial streams.

The proposed allocation of forage was based on the results of monitoring during the interim grazing program.

The population trend for the Rocky Mountain elk is stable to increasing (Liley 2008). Since 1995, the New Mexico Department of Game and Fish has conducted aerial elk counts over the Jemez Mountains. The most recent population estimate in the Jemez Mountains, which includes Game Management Units 6A, 6B and 6C, and a small portion of Unit 7 is 5,500 to 8,400 with an estimate of 3,500 animals that reside seasonally on the Preserve (Liley 2008). Historically elk utilized the west side of the Preserve and wintered to the south and west, but elk now concentrate on the east and north sections of the Preserve, which are in or associated with the large grassland valles, and winter to the north and east (T.E.A.M.S., 2007).

To date the Trust has taken a conservative approach, stocking less than 700 head of livestock in addition to the existing elk numbers. The Trust has also herded animals daily to assure that utilization was not excessive in any one area. Herding was shown to be effective by distributing and restricting the location and duration of use to achieve a sustainable level of use. Monitoring indicates the interim grazing program has achieved greater capacity than traditional rest rotation or rest deferred grazing systems that rely on fences to achieve distribution. Based on the monitoring data, which are supported by modeling, the Preserve is close to the maximum number of livestock considering the existing number of elk (T.E.A.M.S., 2007).

The Trust uses a 40 percent utilization threshold as a firm indicator when grazing could adversely affect grassland health. For perennial herbaceous rangeland species, approximately 60 percent of the aboveground biomass is needed to sustain production and ecosystem services (Crider 1954, Dietz 1989, Frank 1993). Mountain meadow and mountain valley grasslands ranged from 20 to 40 percent utilization for years 2002 through 2004. Drops in livestock numbers and recent good moisture years have led to a drop in utilization below 20 percent for years 2005 through 2007.

Carrying capacity was estimated both by analysis of actual monitoring and livestock use data from the interim grazing program, and by modeling forage production during a typical year. During a typical precipitation year, the grazing of 9,470 to 11,270 AUMs in combination with herding achieved the goal of staying below 40 percent utilization when averaged over a 4-year period. When analyzed by year, use for all areas during a typical year (with 14 inches of precipitation) was between 30 percent and 40 percent, except in riparian areas where use slightly exceeded 40 percent. Capacity is severely reduced during dry years; and the current number of elk may exceed capacity when they remain on the Preserve all year. During years with abundant rainfall, the amount of forage will not limit capacity of either elk or livestock. Actual use by elk will increase during dry years because more elk remain on the Preserve during the winter; but a decrease in available forage as a result of climate may account for higher utilization rates (T.E.A.M.S., 2007).

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no grazing by domestic livestock; Alternative B would allocate only 5 percent of the available forage in support of domestic livestock grazing. The reduction or elimination of grazing by domestic livestock would remove or minimize any potential for impacts of noise and disturbance from grazing and connected management activities.

It is anticipated that eliminating or minimizing domestic livestock grazing would lead to an increase in density of the vegetative species such as shrubs, forbs, and grasses and meadow encroachment would continue to occur as described in the watershed section. Riparian vegetation would also be expected to increase. In addition, cattle would not be present to compete with the elk for the site or the forage.

Eliminating or minimizing the level of grazing would not likely create a change in the number of elk that use the Preserve. Elk may be less mobile throughout the Preserve and be less likely to range off the Preserve.

There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments sustaining and potentially expanding suitable elk habitat. Removing or replacing mesh fencing would benefit elk. Besides the hazard to mature elk described and illustrated in Chapter One, "Purpose and Need – Forage Allocation" (Section 1.2.3), it also increase the mortality of elk calves. Predators take advantage of this barrier to prey on younger less agile elk calves that get separated from the herd by the mesh fencing.

By adopting wildlife friendly standards described in the performance requirements, habitat for elk as well as other wildlife would be improved.

Alternatives C, D

Allocating forage to domestic livestock grazing at the level proposed is not likely to cause a change in elk use on the Preserve. Elk may move in response to cattle but as long as adequate forage in areas typically used by the elk remain allocated for their use, changes are likely to be minor to negligible. Any attempt to increase stocking rate by allocating more of the grasslands for livestock, and expecting elk to move to other habitat would likely fail, resulting in overgrazing (T.E.A.M.S. 2007, Moser 2008). In the past, it has been suggested that forage outside of the areas where livestock were to be stocked was available for elk (i.e., in the forested mountains) (Valles Caldera Trust, 2002); therefore, the capacity existed to increase stocking rates. This is not necessarily true. Elk preference is for the same habitat targeted by livestock grazing—primarily the grasslands associated with the valles and the surrounding woodlands. A program of vegetation management may result in a minor increase of the dispersal of elk into areas that have experienced recent conifer encroachment; however, livestock utilization may increase in those areas too. The same efforts would not significantly increase the dispersal of elk into more forested areas of the Preserve, because forage preference for elk would remain in the more productive grasslands where high quality forage is more abundant (TEAMS 2007).

Continuing a rotational grazing system using range riders, temporary fences and repair, maintenance and construction of earthen tanks and water developments in the uplands will help spread livestock and elk foraging more evenly over the Preserve, reducing overgrazing impacts. Temporary fences would create travel barriers; unless constructed to wildlife standards that would allow migration and passage.

Alternative C_2 or D_2

Under this alternative, the existing horse barn would be remodeled within 20 percent of the existing footprint; therefore, there would be no direct, indirect, or cumulative effects to elk or their habitat.

Cumulative Effects

All Alternatives

The cumulative effect of grazing livestock in conjunction with elk use appears reduced compared to historic conditions. However, public recreation is a new and increasing activity on the Preserve. Most of the recreation activities occur in the valles, the area preferred by elk. During the interim recreation program visitation as increased from a few hundred visitors to thousands of visitors annually (Valles Caldera Trust, 2007).

Planning for the development of facilities and transportation infrastructure within the Preserve is ongoing. Such development may have a detrimental effect on the Preserve's elk population. During the planning and analysis for that activity, performance requirements may be developed that could include a reduction in domestic livestock grazing or other adjustment to the proposed MUSY of forage.

Since federal acquisition, the activities occurring on the Preserve have cumulatively led to an upward trend in overall ecological condition (Valles Caldera Trust, 2007). The uplands and streams, have shown upward trends. Actual use has remained low since government acquisition of the Preserve in 2000 as shown in the watershed section. Monitoring and surveys conducted by NMDGF indicate that the population is stable to increasing on the Preserve(Liley 2008).

Neo-Tropical Migratory Birds

Existing Condition

Neotropical migratory birds are Western Hemisphere species in which the majority of individuals breeds north of the Tropic of Cancer and winters south of that same latitude. (The Tropic of Cancer is a line of latitude 23 degrees north of the equator, which marks the northern extent of the tropics). These species can be found using a wide variety of habitat during their breeding and migration, including forest canopies, snags, understories, ground vegetation/structure, existing openings and a wide variety of structural types and successional stages.

Environmental Consequences

Alternatives A, B

Under Alternative A, there would be no impacts on migratory birds from livestock grazing. Tall grass habitat and riparian vegetation would be expected to increase; however, because of elk grazing in this area, these increases would not be as extensive in the riparian zone. There would be no benefits of additional water sources under Alternative A whereas Alternative B would provide the benefits of additional water resources with the maintenance, repair, or construction of earthen tanks and water developments. Under Alternative B, in localized areas, individual birds could be negatively impacted by repair or construction operations of earthen tanks or water developments; however, these losses would not be expected to cause declines in overall species population and indirectly would improve habitat by creating riparian communities distributed throughout the preserve and by supporting improved distribution of elk.

Alternatives C, D

Individuals of some species could be impacted, but there would be no declines in species populations. According to the Existing Rangeland Condition Report (T.E.A.M.S., 2007) approximately 31 percent of the Preserve is suitable allocating forage in support of a sustainable domestic livestock grazing program. Continued current impacts on vegetation from grazing will maintain or decrease habitat for some species while increasing habitat for others. The main impacts would occur in the riparian zones where cattle and elk tend to concentrate. Impacts would be greater in the breeding season, when cattle moving through an area could impact individual nests, there is potential for nesting disruption or harm to young of the year. However, due to the small number of individuals that might be impacted, negative impacts to local populations of land birds within the Preserve are not expected. Prior to federal acquisition, cattle entered the Preserve the first of May. Since federal acquisition, cattle entry has been delayed until the first of June based on range readiness conditions. Later entry serves to reduce effects to NTMB during the breeding season. No intentional take of migratory birds would occur under this project.

Pasture rotation, range riders moving cattle around and an increase in upland water storage capacity would reduce riparian impacts. Because birds have a large foraging range, any local impacts on vegetation would not limit their ability to find food.

Development of more water sources would provide both positive and negative impacts. Birds would benefit from more distributed water sources for drinking, bathing, and emerging insect sources. Livestock and other ungulate use around the water could reduce vegetation, impacting individual nests and reducing forage and cover. Water sources could attract more predators to the site, increasing avian predation (Finch et al. 1997).

Overall, the rotation grazing system, following appropriate allowable use standards, should provide protection to birds and their habitat, resulting in only minor effects. In localized areas, individual birds could be negatively impacted by grazing, connected livestock management activities, repair or construction of earthen tanks, or water developments; however, these losses would not be expected to cause declines in overall species population. While both alternatives

allocate the same amount of forage to domestic livestock grazing, Alternative D would likely result in a higher level of use (within the allowable range) in the effort to maximize economic return.

Alternative C_2 or D_2

Under this alternative, the existing horse barn would be remodeled within 20 percent of the existing footprint; therefore, there would be no direct, indirect, or cumulative effects to migratory birds or their habitat. In localized areas, individual birds could be negatively impacted by repair or construction operations of facility developments; however, these losses would not be expected to cause declines in overall species population.

Cumulative Effects

Past management actions related to timber harvest and grazing activity are generally responsible for the defining the current condition of habitat throughout the Preserve relative to suitability for land birds/neotropical migrants. These actions have affected the overall amount and seral stage distribution of forested habitat largely by reducing the amount of old-growth habitat and increasing the amount of mid-late seral habitat. There are no foreseeable actions that would affect seral stage habitat in this area and influence future suitability for this group of species.

The goals, objectives and performance requirements being proposed to guide or constrain the MUSY of forage, should ensure the long-term maintenance of amount and distribution of suitable habitat for native resident and migratory land bird species.

3.3.2. Wildlife – Environmental Consequences – Summary

In general, the implementation of any action alternative or the no action alternative is not anticipated to cause any adverse direct, indirect, or cumulative effects, significant in context or intensity to any ETS species; species of interest; or migratory birds (Moser 2008).

Potential effects to wildlife from grazing include those caused by cattle foraging and moving through areas, and those from connected activities for livestock operations. Movement of cattle could impact ground-nesting birds; litter and burrowing species such as small rodents, amphibians, and reptiles; and birds that nest in shrubs or low tree branches. There could be competition for forage with other ungulates, such as elk and mule deer, and other forb/shrub users, such as rabbits and other small rodents. In localized areas of heavier cattle concentration, such as near water sources, soil could become compacted, thereby deterring movement of salamanders, voles, insects, and other subsoil species. Connected activities for care and maintenance of livestock and livestock facilities, depending on frequency and intensity, would create noise and movement disturbance. The potential response by wildlife to this disturbance would be greater during the breeding season. Disturbances associated with livestock activity and grazing would generally not extend beyond ¼ mile of the activity because topography and vegetation would buffer sounds and visual disturbances.

Grazing by domestic livestock as proposed could create localized changes in vegetation structure and composition. Depending on duration and intensity of use by domestic animals, short-term

loss of cover/food can occur and could lead to more long-term shifts in vegetation cover, changing animal species occurrence (i.e., could change prey base and have localized impacts on predator populations, necessitating increased hunting range distances).

Minor or localized moderate effects to vegetation and associated habitats could occur without the connected improvements in range infrastructure being considered. Even with the proposed improvements, herding in combination with proposed infrastructure management will continue to be necessary to reduce the concentration of use in riparian areas and wet meadows under Alternatives C and D. Depending on the alternative selected, the improvements in ecological condition made since federal acquisition could either be maintained or improve.

Rotation grazing, maintenance, repair, or construction of earthen tanks and water developments would result in better distribution of grazing of livestock and wildlife ungulates. The proposed maintenance of upland water sources would support better distribution of livestock under Alternatives C and D and improve elk distribution under Alternative B. Under any of these alternatives, the proposed improvements in infrastructure will reduce erosion and improve habitat conditions. Infrastructure management could have localized effects from noise and ground disturbance. Performance requirements that guide and constrain infrastructure development would minimize and adverse effect resulting from the improvement and connected activities.

Many species would benefit from an additional water source during dry periods of the year. Predators, such as snakes, hawks, predatory mammals, could benefit from the concentration of prey near the water source – to the detriment of the prey species. Livestock could reduce the vegetation around the water source possibly reducing cover and forage sites. Expanding livestock distribution would result in additional grazing in upland areas that formerly were grazed less or not grazed. It would be expected that broader livestock distribution and additional grazing in upland areas would have minor impacts to wildlife as long the appropriate allowable use standards for grazing are maintained. Expanding distribution would be beneficial in that foraging will be more evenly spread over the Preserve, and reduce impacts on riparian areas. Rotational grazing would also help maintain adequate forage/cover for wildlife.

It is possible that some localized areas could receive concentrated grazing that could impact stream bank vegetation resulting in limited willow/other shrub growth with resultant decreased cover/forage/nesting sites for wildlife in the riparian corridor. Trampling, especially be the shorter legs and larger hooves of domestic cattle, can physically modify stream banks and remove vegetation. Sedimentation and lack of stream bank vegetation can cause streams to become shallower and lack adequate woody debris cover. Resulting decrease in water quality and aquatic habitat can impact habitat diversity. Using a systematic approach to adaptive management, which consists of goals, objectives and monitored outcomes, such impacts can detected and ameliorated.

Based on climate and productivity, forage was allocated to support 1,950 yearlings (1,365 AUs) grazing on the Preserve in 2008. Measuring the actual use and effects of season long use by this herd will help the Trust further refine capacities and effects.

From a wildlife standpoint, Alternative B would provide the greatest benefit to wildlife. The level of grazing proposed under Alternatives C and D is similar in scale to the level allowed under the interim grazing program. Measurable improvements have occurred during the interim grazing period. However, actual use has varied and stocking has usually been below capacity. Under Alternative C, where monetary as well as relative benefits of domestic livestock grazing programs would be considered, a similar level of use relative to capacity is likely (based on the interim grazing program). Under Alternative D, where economic return was emphasized it would be likely that numbers would be at or near capacity on an annual basis.

While the effects analysis presented in the wildlife report (J. Moser 2008) was based on grazing at full capacity, the actual use that is likely under Alternative C, and the inherent flexibility under that alternative, would likely benefit wildlife directly and indirectly to a level similar to the interim grazing program.

Alternative D as guided and constrained by the proposed goals, objectives and performance requirements would sustain the current condition of the Preserve's habitats and, over time permit progress toward both ecological goal attainment.

3.4 Wildlife – Aquatic Species

This section addresses potential effects of the project to TES aquatic species (including those species proposed for such listing) (USDA-USFS 2007) that have been documented or have suspected occurrences on in within the aquatic habitats on the Preserve. This evaluation is required by the Interagency Cooperative Regulations (Federal Register 1978), to be compliant with the provisions of the ESA of 1973 (P.L. 93-205) (87 Stat. 884), as amended.

The existing condition is described for each species, group of species, or habitat. Direct, indirect, and cumulative effects of alternatives are identified and discussed.

Fish surveys were completed in the two major streams/rivers of the Preserve have been completed annualy. These two streams, the East Fork Jemez River and San Antonio Creek, contained a mixture of the following species:

- Rio Grande chub (*Gila pandora*)
- Fathead minnow (*Pimephales promelas*)
- Longnose dace (*Rhinicthys cataractae*)
- Rainbow trout (*Oncorynchus mykiss*)
- Brown trout (*Salmo trutta*)
- Rio Grande sucker (*Catostomus plebeius*)
- White sucker (*Catostomus commersoni*) – One individual found

The Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*) was found historically within the Valles Caldera but has been since extirpated.

Of these species, those listed in Table 21 are considered in this analysis based on their listing or potential listing as TES (USDA-USFS 2007).

Table 21 – Threatened, endangered, or sensitive (TES) aquatic species and their status on the Preserve

Common Name	Scientific Name	Known to occur?	Potential to Occur?
Rio Grande sucker	*Catostomus plebeius*	Yes	Yes
Rio Grande chub	*Gila pandora*	Yes	Yes
Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*	No	Yes

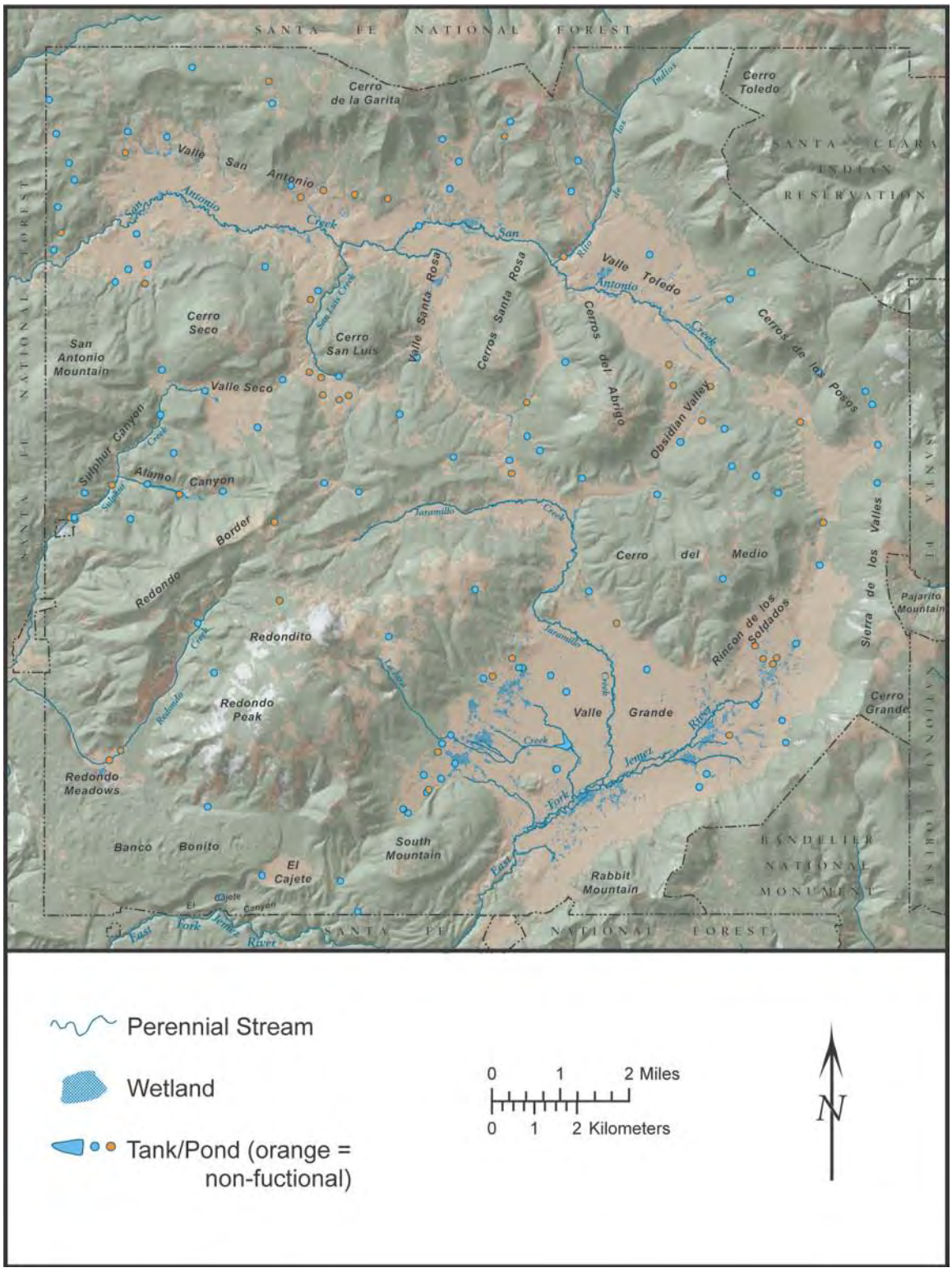

Figure 43 – Aquatic Habitats

Rio Grande Sucker (*Catostomus plebeius*)

Figure 44 – Rio Grande sucker

Existing Condition

The Rio Grande sucker (Figure 44) is a member of the Castomid family. This sucker is characterized by its small size, soft ray fins, and a fleshy, subterminal mouth (Rees and Miller 2005). The Rio Grande sucker is usually found in low gradient, low velocity streams (Calamusso, Rinne and Turner 2002). Specimens have been collected in pool, riffle, and glide habitat types.

The historic range of the Rio Grande sucker included the Rio Grande Basin of Colorado and New Mexico, the Mimbres River and six rivers in Mexico (Calamusso, Rinne and Turner 2002). This fish has been introduced and populations have established in the Rio Honde, the Gila River basin, and the San Francisco River drainage (Calamusso, Rinne and Turner 2002). Currently, the Rio Grande sucker is listed as endangered in the Colorado portion of its distribution. Within its northern New Mexico range the Rio Grande sucker appears to be in decline. A recent survey of the Carson and Santa Fe National Forests also found a decline in range and abundance of Rio Grande sucker (Calamusso, Rinne, and Turner 2002).

Rio Grande sucker abundance and condition can be negatively impacted by the deposition of fine sediments (Swift-Miller, Johnson and Muth 1999); this fish usually favors larger, coarse substrate. Competition from introduced fish has been a major factor in the decline in abundance of the Rio Grande sucker. The white sucker has especially contributed to the decline of the Rio Grande sucker (Rees and Miller 2005). Other factors contributing to the decline of the Rio Grande sucker include habitat destruction and alteration, decreased water flow and increased water temperature (Rees and Miller 2005).

The Rio Grande sucker is native to the streams of the Vales Caldera (Rees and Miller 2005) and is currently found within several streams of the Valles Caldera. A 2001 survey of the East Fork Jemez River found Rio Grande sucker present in all reaches (Simino 2002). A 2002 snorkel survey of San Antonio Creek found Rio Grande suckers present in the lower reaches of San Antonio Creek (Goodman 2003). Electro-fishing surveys in 2003, 2004, and 2005 conducted by Aquatic Consultants Inc. found Rio Grande sucker present in the East Fork Jemez River but not in San Antonio Creek (Aquatic Consultants Inc. 2003, 2004, and 2005). The Rio Grande sucker's absence in the later surveys does not necessarily mean that it is now absent from the San Antonio. Declines were observed following drought events in 2002 and 2006.

In the past, the San Antonio was stocked with rainbow trout twice a year by the State of New Mexico, Department of Game and Fish (NMDGF) in two locations (Goodman 2003). The East Fork Jemez River has also been routinely stocked with rainbow trout (Simino 2002). Stocking of

brown trout began in the 1930s, if not before (Simino 2002). Currently, stocking of rainbow trout and brown trout does not take place, and these species are naturally reproducing (Parmenter, Valles Caldera Trust, Chief Scientist 2008). As part of an effort to increase the assemblage of native fish, Rio Grande sucker, along with other native species, were moved from the East Fork Jemez River to San Antonio Creek in 2007. The fish dispersed from the release site but the success of introduction is not yet known (Parmenter, Valles Caldera Trust, Chief Scientist 2008).

Riparian conditions along the East Fork Jemez River have improved, since federal acquisition and during the implementation of the Interim Grazing Program. Improvements have been measured in the perennial reaches below the spring to the Preserve's southern boundary (T.E.A.M.S., 2007). In the intermittent reaches above this point, riparian conditions have not improved and are classified as "functioning–at-risk" (T.E.A.M.S., 2007). Water quality in the East Jemez was found to have a high degree of exceedence of turbidity standards for samples taken for East Fork Jemez River. Water temperature exceeded standards to some extent on all streams but particularly, in terms of total duration of record, on East Fork Jemez River (Moser 2008). A 2001 USFS stream inventory found that pool quantity was properly functioning but pool quality was found to be not properly functioning. From the 2002 USFS report: "Sediment input from the entire bank and upland erosion occurring in the VCNP has greatly diminished pool volume in the East Fork Jemez River (Simino 2002). The lack of large woody debris is also contributing to the lack of pool quality (Simino 2002)."

San Antonio Creek has showed some improvement in riparian conditions since the implementation of the interim grazing program according to PFC surveys (T.E.A.M.S., 2007). Water temperature at several locations in San Antonio Creek exceeds USFS and NMED (NMED) standards for salmonid development. From the 2003 USFS report: "The water temperature data were compared to both Forest and NMED standards. The Forest standards classified San Antonio Creek as not properly functioning for salmonid development at all sites except station 5 located near the headwaters. The NMED standards classified two of the five sites as not properly functioning for water quality (State of New Mexico 2002). Other water quality factors that were found to be not properly functioning: the pH of the stream was neutral to basic and often exceeds 8.8, and ammonia and aluminum levels can occasionally exceed water quality standards (Goodman 2003). According to the 2002 survey other physical parameters that were not properly functioning included relative sediment content in riffles, the density of large woody debris, pool development, and width-to-depth ratio (Goodman 2003).

Environmental Consequences

Alternative A

Direct, Indirect, and Cumulative Effects

Under this alternative, none of the Preserve's forage would be allocated to grazing by domestic livestock. No infrastructure maintenance other than necessary fence maintenance would occur. There would be no direct effects to the Rio Grande sucker with this alternative since in stream

activities are not proposed. Indirect effects could come from roads and failing earthen tanks inputting sediment; however, with routine maintenance, the effects of roads are probably not a major contributor of sediment into these streams (E. Moser 2008). Indirect effects could also come in the form of stream bank improvement because of no cattle grazing. Indirect effects could come from the continued grazing of elk and other wildlife in the riparian area.

Cumulative effects would include the indirect effects as well as the legacy effects of the grazing that has taken place within the Valles Caldera for the last 100+ years. Stream banks and associated riparian areas have been impacted by cattle grazing. Grazing has lead to bank slumping, which alters habitat and increases instream sediment (E. Moser 2008). The Rio Grande sucker favors coarse substrate for spawning and resides in a variety of habitats. Sediment inputs into the stream would decrease the amount of available coarse substrate. Sediment could also alter habitat, decreasing pool depth and changing pools into glides or riffles. This Alternative could add these effects to the overall cumulative effect if structures were to fail because of a lack of maintenance. However, these effects would likely be localized and minor to moderate and without grazing by domestic livestock, overall stream conditions should improve. Riparian conditions have been shown to be improving (T.E.A.M.S., 2007) with a decrease in cattle grazing (McWillams 2006) so a complete cessation of cattle grazing would likely lead to an improvement in stream conditions.

Determination

Implementation of this no-action alternative would have ***no effect on the Rio Grande sucker***. This determination is made because (1) cattle grazing would cease and stream habitat would likely improve, and (2) the impact of failing structures and elk grazing would likely be minor and localized.

Alternative B

Direct, Indirect, and Cumulative Effects

Under this alternative, 95 percent of the available forage would be allocated toward elk and other wildlife. Most of the interior fencing would be removed and tanks would be maintained. Forage could be allocated to incidental livestock programs and to scientific study or native seed programs. There would be no direct effects to Rio Grande sucker under this alternative since no activities are proposed within the actual streams. Indirect effects could come in the form of sediment flowing into the stream from maintenance activities along roads and at tanks and incidental use by livestock. Maintenance activities would also have positive indirect effects. The potential for failure of these structures and potential sediment input would be reduced by continued maintenance. Elk and other wildlife grazing in the riparian would also impact the stream banks and add some sediment because of banks slumping. The majority of sediment that has entered the stream probably has come from cattle grazing along the banks rather than from road activities (E. Moser 2008). With only incidental use by cattle, conditions would be expected to improve.

Cumulative effects to the Rio Grande sucker would come from the historic effects of cattle grazing on the streams as well as the indirect effects from proposed maintenance and wildlife grazing. The Valles Caldera has been grazed for over 100 years, much of the grazing without conservative management (A. Jackson 2008). This Alternative would not greatly add to the overall cumulative effects because of the minor allocation of forage to cattle and the continued maintenance and improvement of infrastructure.

Determination

Implementation of Alternative B would have ***no effect on Rio Grande sucker***. This determination is based on a prediction of negligible to minor direct, indirect, and cumulative effects resulting from this action.

Alternative C

Direct, Indirect, and Cumulative Effects

Under this alternative, forage would be allocated based on the 2007 Existing Condition Report. The Trust would continue annual programs for domestic livestock grazing, allocating forage to such programs based on estimated production, climate, and specific areas to be grazed as provided in the 2007 Existing Condition Report. Interior fencing would be maintained, removed, relocated, or replaced with temporary/semi-permanent barriers. Earthen tanks would be managed as described in Chapter One. Direct effects to Rio Grande sucker would come from cows moving through the stream and directly causing damage to individual fish or habitat. Indirect effects could come from cattle along stream banks. In the past, cattle movement along banks has caused slumping, which leads to the alteration of habitat and increased sediment in the streams (E. Moser 2008). The Rio Grande sucker favors coarse substrate and is sensitive to increased sedimentation, which could result from grazing in the riparian. Additional indirect effects could come from maintenance of roads, tanks, and fences. Maintenance activities could add some sediment to streams but this continued maintenance will prevent larger sediment inputs from structure collapses.

Cumulative effects would include the direct and indirect effects of historic sheep and cattle grazing as well as the above indirect effects. The historic grazing largely contributed to the nonproper functioning conditions of the streams that existed before the implementation of the interim grazing program. The reduction of cattle grazing that occurred with the interim program resulted in an improvement in stream conditions (USDA-USFS 2007). Ongoing effects of the historic grazing include nonfunctioning stream temperature, turbidity, and pool quality. Alternative C would include adaptive management guided by the goals and objectives and measured using the monitored outcomes described in Chapter One. The adaptive management would alter gazing in relation to indicators of rangeland health as well as techniques such as herding and barriers (A. Jackson 2008). This management should maintain or improve current stream conditions.

Determination

Implementing Alternative C ***may effect, but is not likely to contribute to a trend toward federal listing or cause a loss of viability to the population or species, the Rio Grande sucker***. This determination is made because 1) cattle impact stream banks leading to sediment inputs into the stream. 2) The interim grazing program has lead to an upward trend in stream health that would likely continue with this Alternative.

Alternative D

Direct, Indirect, and Cumulative Effects

Under this alternative, forage would be allocated for use by domestic livestock grazing at the same level as under Alternative C. Infrastructure management is also proposed at the same level as Alternative C. While it is likely that actual use may be somewhat more variable under Alternative C, the analysis of that alternative assumed use at the maximum level permitted. The effects to Rio Grande sucker would be the same as Alternative C.

Determination

Implementing Alternative D ***may effect, but is not likely contribute to a trend toward federal listing or cause a loss of viability to the population or species, the Rio Grande sucker***. This determination was made for the same reason as Alternative C.

Alternative C_2 and D_2

Direct, Indirect, and Cumulative Effects

This Alternative would be folded into Alternative C or D. This alternative would improve an existing barn and outbuildings for staff and educational facilities. Implementation of this Alternative in conjunction with Alternative C or D would have the same effects as Alternative C and D.

Determination

Implementing Alternative C_2 and D_2 ***may effect, but is not likely contribute to a trend toward federal listing or cause a loss of viability to the population or species, the Rio Grande sucker***. This determination was made for the same reason as Alternative C.

Rio Grande Chub (*Gila pandora)*

Figure 45 – Rio Grande chub

Existing Condition

The Rio Grande chub (see Figure 45) is a small fish averaging 5½ inches in length that is found in both rivers and lakes. This species is often confused with other members of the *Gila* genus. The Gila chub's two dark lateral stripes with occasional dark spots and a silvery color overall (Sublette, Hatch and Sublette 1990) differentiate it from other members of this genus. There is limited information on the habitat preferences of the Rio Grande chub; they have been found in pools with overhanging banks and brush and seem to prefer sand over cobble substrate. Spawning takes place in riffles with breeding likely taking place March through June (Rees, Carr and Miller 2005). During a survey of streams in the Santa Fe and Carson national forests, Rio Grande chub were found in many streams but were only present in reaches with a gradient of less than two percent at elevations between 5,600 and 9,200 feet (Calamusso and Rinne 1996).

Historically the Rio Grande chub was abundant and widespread throughout the Rio Grande basin, the Pecos River basin, and the San Luis Closed basin (Rees, Carr and Miller 2005).

Currently, the Rio Grande chub is likely expatriated form the main stem of the Rio Grande but still found in the Rio Grande tributaries. This fish is considered to be widespread throughout suitable habitat in the Rio Grande basin of New Mexico (Rees, Carr and Miller 2005).

A number of factors have lead to the decline of the Rio Grande chub, including competition and predation from introduced species such as brook trout (*Salvelinus fontinalis*); habitat fragmentation caused by impoundments and water diversions; habitat destruction from grazing, mining and other land use practices; and changes in the thermal regime caused by water impoundment releases (Rees, Carr and Miller 2005).

The Rio Grande chub has been found within several streams of the Valles Caldera. A 2001 survey of the East Fork of Jemez River (Placeholder24) found Rio Grande chub present in all reaches (Simino 2002). A 2002 snorkel survey of San Antonio Creek (Placeholder25) found Rio Grande chub present in all reaches (Goodman 2003). Electro-fishing surveys in 2003, 2004, and 2005 conducted by Aquatic Consultants Inc. (ACI) found Rio Grande chub present in the East Fork Jemez River but not in San Antonio Creek (Aquatic Consultants Inc. 2003, 2004, 2005). The Rio Grande chub's absence in the later surveys does not indicate that it is now absent from the San Antonio. Rio Grande chub, along with other native species, were moved from the East Fork Jemez River to San Antonio Creek in 2007 in an effort to increase the native fish assemblage. The fish dispersed from the release site but the success of the reintroduction is not yet known (Parmenter, Valles Caldera Trust, Chief Scientist 2008).

For the existing stream conditions of East Fork Jemez River and San Antonio Creek stream see Rio Grande sucker affected environment/existing condition section.

Environmental Consequences

Alternative A

Direct, Indirect, and Cumulative Effects

Under this alternative, none of the Preserve's forage would be allocated to grazing by domestic livestock. No infrastructure maintenance other than necessary fence maintenance would occur. There would be no direct effects to the Rio Grande chub with this alternative since in stream activities are not proposed. Indirect effects could come from roads and failing earthen tanks inputting sediment; however, with routine maintenance, the effects of roads are probably not a major contributor of sediment into these streams (E. Moser 2008). Indirect effects could also come in the form of stream bank improvement because of no cattle grazing, which would benefit the Rio Grande chub, which favors pools with bank overhang. Indirect effects could come from the continued grazing of elk and other wildlife in the riparian area.

Cumulative effects would include the indirect effects as well as the legacy effects of the grazing that has taken place within the Valles Caldera for the last 100+ years. Stream banks and associated riparian areas have been impacted by cattle grazing. Grazing has lead to bank slumping, which alters habitat and increases instream sediment (E. Moser 2008). Sediment could also alter habitat, decreasing pool depth and changing pools into glides or riffles. This Alternative could add these effects to the overall cumulative effect if structures were to fail because of a lack of maintenance. However, these effects would likely be localized and minor to moderate and without grazing by domestic livestock, overall stream conditions should improve. Riparian conditions have been shown to be improving ((T.E.A.M.S., 2007) with a decrease in cattle grazing (McWillams, 2006)so a complete cessation of cattle grazing would likely lead to an improvement in stream conditions.

Determination

Implementation of Alternative A would have ***no impact to Rio Grande chub***. This determination was made because 1) no cattle grazing would reduce impacts on stream banks. Overhanging streams banks are a part of Rio Grande chub habitat. 2) Short-term effects from failing infrastructure would likely not be great enough to impact this chub.

Alternative B

Direct, Indirect, and Cumulative Effects

Under this alternative, there would be no direct impacts to the Rio Grande chub, no in stream activities are planned with this Alternative. Indirect effects could come from elk trampling the stream banks causing stream bank failure. Indirect effects could also come in the form of stream bank improvement because of no cattle grazing.

Cumulative effects in the form of legacy effects from past grazing would continue to impact the chub but no new cattle grazing effects would be added. Recent surveys comparing the riparian conditions from before and after the implementation of the interim grazing program, which has

restricted the number of cattle grazing on the Preserve showed an improvement in riparian condition. With only incidental cattle grazing and continued structure maintenance stream health would be expected to continue to improve. Improved stream health would provide suitable habitat for the Rio Grande chub

Determination

Implementation of Alternative B would have ***no impact to Rio Grande chub.*** This determination was made because 1) no cattle grazing would reduce impacts on stream banks. Overhanging streams banks are a part of Rio Grande chub habitat. 2) Infrastructure maintenance would continue; no added effects from failing infrastructure would be added.

Alternative C_1, C_2

Direct, Indirect, and Cumulative Effects

There would be minimal direct effects to the Rio Grande chub with this Alternative. Direct effects could come from cattle moving through streams and directly damaging individual chub. Indirect effects to the Rio Grande chub could come in the form of slumping stream banks from cattle movement in the riparian zone. Rio Grande chub have been found in pools with overhanging banks. While these fish seem to prefer sand to coarser substrate, slumping banks would result in less available habitat for this species. The allocation of adequate forage to wildlife and ecosystem services and the system of adaptive management as guided by goals and objectives and measured through monitored outcomes should help to minimize this effect.

Cumulative effects would include these indirect effects as well as the legacy effects of sheep and cattle grazing that have taken place in the Valles Caldera for over 100 years.

These past effects have lead to decreased stream bank habitat, decreased pool quality, and increased stream temperatures. All of these factors affect the Rio Grande chub. These legacy effects will continue and the indirect effects of this action will be added. However, with the implementation of the interim grazing program stream conditions have improved. With the management proposed with this Alternative stream conditions should remain the same or continue on an upward trend.

Determination

Implementation of Alternative C ***may effect, but is not likely to contribute to a trend toward federal listing or cause a loss of viability to the population or species, the Rio Grande chub***. This determination was made because 1) cattle grazing impacts the stream banks that are part of the Rio Grande chub's habitat. 2) Management will be implemented with this that will lessen the impact to the riparian and adjust grazing for changes in the environment.

Alternative D_1, D_2

Direct, Indirect, and Cumulative Effects

The effects of this Alternative on the Rio Grande Chub would be the same as Alternative C.

Determination

Implementation of Alternative D ***may effect, but is not likely to contribute to a trend toward federal listing or cause a loss of viability to the population or species, the Rio Grande chub***. This determination was made for the same reason as Alternative C.

Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*)

Figure 46 – Rio Grande cutthroat trout

Existing Condition

Rio Grande cutthroat trout (Figure 46) is a member of the *Oncorhynchus clarkii* polytypic species is composed of 14 subspecies and several distinct racial forms (Pritchard and Cowley 2006). Rio Grande cutthroat trout possess the bright slashes on the underside of the maxillaries and are brightly colored on the sides and belly but differ from the most closest related cutthroat, the greenback and Colorado cutthroat trout, by the fewer scales in the lateral line and more pyrolic caecae (Behnke 1992).

Rio Grande cutthroat trout have been found in a variety of habitat types from mainstems to small, first-order streams. The Rio Grande cutthroat trout species requires a variety of habitat types for different life stages. Suitable gravel is required for spawning and juvenile trout need slower waters for development. As adults increase in size they tend to move into the faster moving waters of the main stem while also relying on pools and woody debris for refugia (Pritchard and Cowley 2006)

Historically the range of Rio Grande cutthroat trout is thought to have included the Rio Grande drainage of Colorado, New Mexico and Texas; the Pecos River drainage of Colorado, New Mexico and Texas; and the Canadian River drainage of Colorado and New Mexico. The historic range may also have included the headwaters of the Rio Conchos in Mexico (Hendrickson et al. 2002). Currently, the Rio Grande Cutthroat Trout is found in tributaries of the Rio Grande in Colorado and New Mexico; the Carnero and Sanguache drainages in Colorado; tributaries of the Canadian River in Colorado and New Mexico; and tributaries of the Pecos River in New Mexico (Pritchard and Cowley 2006).

The Rio Grande cutthroat trout has been extirpated from its historic range by a number of factors. Currently, the greatest threat to the Rio Grande cutthroat trout comes from nonnative trout such as brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout

(*Oncorhynchus mykiss*), and other forms of cutthroat trout. These introduced species can lead to increased competition and predation as well as interbreeding with rainbow trout and nonnative cutthroat trout (Pritchard and Cowley 2006). Other threats to the Rio Grande cutthroat trout include migration barriers, overfishing, habitat disturbance, and disease.

Rio Grande cutthroat trout are not currently found within the Preserve. Historically Rio Grande cutthroat trout was found in streams throughout the Preserve. The stocking of nonnative trout in the late 1800s and early 1900s was probably the main cause of the extirpation of Rio Grande cutthroat trout from the streams of the Valles Caldera.

From the 2002 East Fork Jemez River stream inventory report: A cultural report from 1892 states that the mountain streams fed "*Los Valles*" [the Valles Caldera] and that the streams "*teem with mountain trout.*" This report predates fish stocking in the Jemez Mountains. The first recorded stocking in New Mexico occurred in 1896 (Sublette, Hatch and Sublette 1990). The mountain trout that this report talks about can only be Rio Grande cutthroat trout. During 1936, a creel census was conducted throughout the state in NFS waters. Included in this report is a stocking history for the East Branch (Fork) Jemez River. During the years 1932 through 1936, 88,300 rainbow trout and 13,500 Yellowstone cutthroats were stocked. During 1936, the creel census recorded that 30 percent of the fish caught were rainbow, 50 percent were Yellowstone cutthroat, and 20 percent were brown trout. No Rio Grande cutthroat trout were caught in the East Fork Jemez River. Unfortunately, this report does not say where the creel census was conducted or where the fish were caught or stocked. One can conclude that brown trout were stocked prior to 1932 (Simino 2002).

From the 2003 San Antonio Creek stream inventory report: Rio Grande cutthroat trout has been extirpated from San Antonio Creek since the 1950s by exotic trout introductions through competition, hybridization and predation (Sublette, Hatch and Sublette 1990). German brown trout is a piscivore, consuming fish like Rio Grande cutthroat trout. Brown trout also compete with native fish for food and living space in the river (Goodman 2003).

Environmental Consequences

Alternative A

Direct, Indirect, and Cumulative Effects

Under this alternative, there would be no direct impacts to the Rio Grande cutthroat trout since no activities are planned within the actual streams. Indirect effects to the cutthroat trout habitat could come in the form of failing tanks inputting sediment into streams. Rio Grande cutthroat need gravel for spawning, which could be covered by additional sediment.

The cumulative effect of 100+ years of sheep and cattle grazing in the Valles Caldera would still be present even without continued cattle grazing. Stream bank condition would improve but pool to riffle ratios may take longer to improve as well as stream temperature and turbidity. The cumulative effects that this Alternative would add would come from failure of structures due to lack of maintenance. However, these effects would be short-term and localized. The lack of

structure maintenance may cause an increase in sedimentation but because of the lack of cattle grazing, overall stream conditions will likely improve.

Determination

Implementation of Alternative A would have ***no impact on Rio Grande cutthroat trout.*** This determination was made because 1) Rio Grande cutthroat trout have been extirpated from the project/action area. 2) The effects of failing infrastructure could have short-term, minor and localized effects but because of a lack of cattle grazing overall riparian conditions should improve.

Alternative B

Direct, Indirect, and Cumulative Effects

Under this alternative, there would be no direct impacts to the Rio Grande cutthroat trout since this Alternative does not propose any activities within the actual streams. Indirect effects could come from elk continuing to use the riparian area causing stream bank slumping, changing habitat and increasing sediment into the stream. Indirect effects could also come in the form of stream bank improvement because of the limited grazing by domestic livestock that is being considered. Since the reduction in cattle on the Valles there has been an improvement in riparian health. If forage even further reductions were implemented, stream bank health would likely to continue to improve.

Cumulative effects would include the indirect effects of elk grazing and improving stream conditions as well as the legacy effects of past grazing and stocking of nonnative fish. Riparian health would continue to improve but the effects of past grazing would continue in the form of high stream temperatures and sediment. This Alternative would contribute a minimal amount to the overall cumulative effects. Continued improvement in habitat for the Rio Grande cutthroat trout would contribute to the success of any future proposal to reintroduce the native fish.

Determination

Implementation of Alternative B would have ***no impact on Rio Grande cutthroat trout.*** This determination was made because 1) Rio Grande cutthroat trout have been extirpated from the Valles Caldera. 2) The effects of Alternative B would be minimal.

Alternative C_1, C_2

Direct, Indirect, and Cumulative Effects

Under this alternative, there would be no direct impact to Rio Grande cutthroat trout because Rio Grande cutthroat trout has been extirpated from the Preserve. Indirect effects could come in the form of impact by cattle and elk to the stream banks. Use of the riparian in the past by cattle has lead to banks slumping and additional sediment being added to the streams. Habitat has also been altered by impacted stream banks; the Rio Grande cutthroat trout needs a variety of habitats for its life stages, including slow backwaters and cover.

Cumulative effects include the above indirect effects as well as the legacy effects of past grazing and fisheries management (stocking of nonnative fish) in the Valles Caldera. Past grazing has lead to altered habitat, impacted stream banks increased stream temperature. This Alternative includes adaptive management and techniques such as herding and appropriate fencing should help to minimize the effects to the riparian. Impacts also come from the introduced rainbow and brown trout inhabiting the Valles Caldera streams. These nonnative trout displace and prey upon the Rio Grande cutthroat trout. Continued improvements in Rio Grande cutthroat trout habitat could contribute to the success of any proposal to reintroduce the Rio Grande cutthroat trout in the future.

Determination

Implementation of Alternative C would have ***no impact on Rio Grande cutthroat trout.*** This determination was made because Rio Grande cutthroat trout have been extirpated from the Valles Caldera.

Alternative D_1, D_2

Direct, Indirect and Cumulative Effects

The effects of this Alternative would be the same as Alternative C.

Determination

Implementation of Alternative D would have ***no impact on Rio Grande cutthroat trout.*** This determination was made for the same reason as Alternative C.

3.5 Cultural Resources

3.5.1. Affected Environment/Existing Condition

Prehistoric Era

The rich animal, botanical, and mineral resources of the Valles Caldera have provided materials and food for human use throughout prehistory. Through their occupation and use of the Preserve people left behind traces of their passing. These artifacts along with their setting in context with the natural landscape create the cultural resources of the Preserve. This cultural landscape (Page, Gilbert and Dolan 1998) reflects the history, cultural richness, developmental patterns, and changing relationships between people and the environment. The cultural resources of the Preserve are diverse and include prehistoric archaeological sites, historic structures and artifacts (e.g., corrals, fences, and roads), the landscapes vistas and view sheds through which we experience our connection with the land, and the various cultural traditions still in place today that connect surrounding Puebloan communities to the caldera landscape.

The earliest occupation of the Southwest began during the Paleoindian period, dated from over 12,000 years ago to about 7,500 years ago (5,500 B.C.). Ideal locations for Paleoindian sites are the grasslands and river terraces within broad valleys, as well as high-elevation saddles and ridges used as prehistoric transportation routes. These early sites can be difficult to find because deposits in which they occur are buried or have eroded over time, or because artifacts from the early period are mixed in with those from subsequent human use at the same locations. Paleoindian spear points and other flaked stone tools are notable because they often are made from high quality lithic material such as chert and obsidian that has been transported over long distances. The most distinctive of these early artifacts, the finely-made Clovis and Folsom points, have been found as isolated artifacts at a dozen or more locations in and around the Jemez Mountains. Within the Preserve, there are no known Paleoindian campsites but the several isolated Late Paleoindian spear points found here confirm human use of the caldera for at least 10,000 years.

Figure 47 – Obsidian and chert arrow and spear points from the Preserve

During the Archaic period (5500 B.C. through A.D. 500), the subsistence base for human groups witnessed a shift from wide-ranging hunting of large game animals and gathering of botanical resources, toward a focus on harvesting and processing of region-specific plant resources such as seeds and nuts. For the first time, artifact assemblages commonly include ground stone artifacts used in processing of vegetal resources. Flaked stone artifacts often were made only of locally available materials and distinctive tool types include a variety of dart points as shown in Figure 47.

Numerous archaeological sites on the Preserve are dated to the Middle and Late Archaic, suggesting that human use of the Preserve progressively increased throughout the Archaic. The numerous large and small scatters of stone tools and debris found throughout the caldera represent a wide range of types of use: from locations used briefly to make stone tools or prepare specific resources such as game or fish, to small seasonal camp sites, to expansive habitation sites that were occupied repeatedly over centuries.

While domesticated maize (corn) entered the Southwest late in the Archaic period, dependence on cultivated plants and horticultural practices did not occur until the Ancestral Puebloan period (A.D. 500-1650). Pottery first appears during this period, initially as plain ceramics and then in a diverse range of decorated types, including the black-on-white ceramics common all over the Jemez Mountains. Small chipped stone points suitable for use on arrows also first appear. The characteristic round subsurface "pithouses" distinctive to the period before A.D. 1000 are not known within the Preserve.

After A.D. 1000, a shift to aboveground habitation structures appears to coincide with the beginning of agricultural intensification and increased permanence in settlement that continued throughout the period and characterizes the historic pueblos across the Southwest. Small one- and two-room masonry structures called "fieldhouses" are ubiquitous on the Jemez and Pajarito Plateaus, but in the Preserve occur only on Banco Bonito. It is likely that the south facing, gently sloping landforms on Banco Bonito (below 8,500 feet elevation) offer the only conditions within the Preserve suitable for maize agriculture. The rest of the Preserve ranges from 8,500 to 11,250 feet. This high elevation also explains why there are no pueblos within the caldera. Plant foods may have been cultivated or encouraged at other locations on the Preserve outside the Banco Bonito, but the types of plants would have been quite different from those that supported the Puebloan populations that relied on maize-beans-squash horticulture.

The absence of pueblos and restricted distribution of fieldhouses and does not indicate diminishing use of the caldera by Puebloan people. Rather, the sedentary agricultural people in late prehistory probably used the caldera much as it is used today – as an area without large or permanent habitation, but visited or occupied briefly by all the people of the region. Thus, while ceramic sherds compose only a small fraction of the total artifacts present on the Preserve, the decorated sherds that have been recovered are diverse and represent the distinctive ceramic types characteristic of the cultural groups in all of the surrounding region.

One of the challenges in understanding the Valles Caldera archaeological record is interpreting the function and age of the numerous obsidian artifact scatters found widely within the Preserve.

The sites could represent complex habitation activities or simpler specialized or brief activities. The artifact assemblages at these sites were created while tool makers knapped obsidian collected at geological deposits located on Cerro del Medio, San Antonio Creek and Rabbit Mountain. People throughout prehistory valued and exploited the abundance, high-quality and large nodule size of this volcanic glass. While obsidian scatter sites can be associated with any cultural group, they often lack artifacts that are distinctive to one or another of the cultural periods and thus may represent use 500 years ago, or 10,000 years ago, or everything in between,

The obsidian quarries pose additional interpretive challenges because they cover large areas and contain vast quantities of obsidian artifacts accumulated over several millennia of continuous use. Intensive and extensive field investigations at large and small sites will be needed to accurately detect patterns of changing prehistoric obsidian procurement and use over time. Less than 10 percent of the Preserve has been surveyed for cultural resources. As inventory progresses, knowledge of the distribution and diversity of sites will increase considerably.

Historic Period

The historic period in the Jemez region begins after 1540 when Spaniards first explored the Jemez Mountains. In 1598, Spaniards under the leadership of Juan de Oñate entered and conquered several of the pueblos. Hispanic missions were established in the pueblos around New Mexico (including Jemez Pueblo) in the 1600s. After the Pueblo Revolt and reconquest by De Vargas (1680-1692), missions and settlements started anew in the Jemez region and a land-grant system was set up to encourage settlement. Settlers brought domesticated livestock and horses with them and, by the late 1700s, Hispanic settlers and Puebloan Indians were herding cattle and sheep in the valles of the caldera. Pastoral use of the land initiated a change in the cultural landscape of the Preserve; initiating a change in developmental patterns and a changing relationship between people and the environment.

Anglo-American trappers also hunted and trapped in the caldera in the 1800s, but the first detailed record of Anglo-Americans in the caldera occurred in 1851 when a route between Santa Fe and a camp on the northeast portion of the Valle Grande was created. Hay was cut in the Valle Grande to send back to Santa Fe to feed livestock owned by the U.S. Army, which had moved into New Mexico territory in 1846 at the beginning of the war with Mexico for control of the territory (the area became a U.S. Territory in 1848). The camp was used seasonally until Navajo raiders attacked it in 1851, forcing its abandonment.

A legal claim to the caldera occurred in 1860 when the heirs of Luis Maria Cabeza de Baca (who had died in 1827) gave up their land grant around Las Vegas, New Mexico, in exchange for five tracts of land elsewhere in New Mexico Territory as part of a land dispute settlement arranged by the U.S. Congress. The first area the family selected was a square of 99,289 acres around the caldera, which subsequently became known as the "Baca Location No. 1." The Baca family began using the land in 1876 when the property boundaries were finalized. The numerous heirs divided the land for raising sheep and stock, but most sold their land claims.

By 1881, only a handful of Baca family members still held claims while other land entrepreneurs who had purchased claims on unclear terms bickered over boundary rights. Legal battles (and

occasional violent disputes) continued until 1899 when the New Mexico Supreme Court tried to settle the matter by ordering that Baca Location No. 1 be sold at public auction and the proceeds divided among the claimants. Attorney Frank Clancey purchased the land for $16,548 and immediately sold it again to the "Valles Land Company" run by businessmen Mariano and Fredrico Otero, two of the former claimants.

The Oteros continued cattle ranching and sheep herding, and began mining sulphur at Sulphur Springs on the west side of the property. They opened a hot spring resort that continued operating until 1977. They also built the first roads and cabins for office and living quarters. In 1909, they sold Baca Location No. 1 to the Pennsylvania-based Redondo Development Company, but retained grazing rights on the property. Redondo Development began logging operations, but completed only small-scale cutting due to transportation difficulties. The company continued leasing land for grazing until two Española businessmen, Frank and George Bond, purchased the land in 1918. Redondo Development Company retained the timber rights. The Bonds grazed thousands of sheep on the property and built more cabins for their families and hired help. They produced millions of tons of wool and dominated the market in New Mexico until World War II when the market for wool weakened.

Meanwhile, Redondo Development Co. sold its timber rights in 1935 to Firesteel Lumber, who immediately sold the rights to the New Mexico Land and Timber (later named New Mexico Timber Company). The company began logging operations in Banco Bonito in 1935, just after a road was constructed by the Civilian Conservation Corps (now NM Highway 4) making transportation of logs much easier. They set up a logging camp in Redondo Meadow and later in the north portion of the property. They continued logging until the early 1970s, cutting trees on 50 percent of the property and created over a thousand miles of logging roads.

When Frank Bond died in 1945, his son Franklin began running more cattle than sheep; by 1960 sheep had been replaced by cattle. By this time, the Bond family was looking to sell the property, expressing interest in the federal government as a potential buyer—an idea that many conservationists and legislators had hoped for since the late 1800s. The plan was disrupted; however, when the property was sold for $2.5 million in 1962 to the Baca Land and Cattle Company, run by wealthy Texas oilman, Patrick Dunigan. Dunigan built more buildings and a guest lodge at the north edge of the Valle Grande, and continued to maintain the land as a cattle ranch and popular elk hunting location.

In 1964, Dunigan filed a lawsuit against New Mexico Timber Company, seeking damages for destructive logging practices, which eventually resulted in the transfer of timber rights to him by 1972. In 1973, he made a deal with Union Geothermal Company to drill several locations on the west side in hopes of harnessing geothermal steam for a power plant—a plan that never came to fruition because of Native Americans' concerns for potential effects downstream water and possible disturbance of sacred land around Redondo Peak, and (ultimately) the lack of enough steam to generate the desired power.

By the late 1970s, Dunigan desired to preserve the land for the public and began negotiations with the U. S. USFS and National Park Service for sale of the land. His death in 1980 disrupted

the process, and his sons maintained the property, primarily as a cattle ranch until 2000, when they finally sold the property to the federal government, after which approximately 89,000 acres became the Valles Caldera National Preserve.

Preservation and Management of Cultural Resources

The Trust is working to develop and implement a cultural landscape approach to preservation that recognizes multiple layered landscapes. Each cultural landscape encompasses a variety of cultural and natural resources that are linked through their connection to historical and ecological patterns and events, and that express and inform on human uses of the area during the continuum of prehistory, history, and the contemporary present. Cultural landscapes represent several historic contexts in the Preserve, the history of ranching is one such historic theme. Components of historic ranching found throughout the Preserve include corrals, fences, roads and routes, and water improvements. Many of these same constructions are in use today as part of contemporary ranching infrastructure. Of particular interest are the corrals and cabins located in the north end of the Valle Grande known as the Ranch Headquarters. This area and the buildings and features within it will be nominated to the National Register of Historic Places as a historic district. Other historic features are hidden throughout the landscape, including crosses carved in old growth pine (Figure 48) and the flourished signatures carved in aspen trees that represent early 20th century Hispanic sheepherding.

Figure 48 – Cross carved into Ponderosa pine tree

In the context of MUSY of forage, cultural resources must be considered from a somewhat different perspective than natural resources. Natural resource characteristics and overall health contribute directly to the sustainability of forage utilization on the Preserve; therefore, the quality of their condition can be considered as closely linked with the overall goal of sustainability. Cultural resources require consideration from a different set of values that acknowledge preservation and interpretation of the human past as an objective of the Trust, distinct from the overall health and condition of the landscape. However, because most archaeological resources are soil deposits containing the remnants of prehistoric cultural activities, their condition tracks with the on-going recovery of vegetation communities, stream health and reduced erosion. Actions by the Trust that enhance these values will maintain and enhance the condition of intact prehistoric cultural deposits. Actions that lead to loss of ground-cover vegetation, soil compaction, soil erosion, or sediment transport will diminish or potential threaten intact cultural deposits. The intertwining of soil, vegetation, and hydrologic health with preservation of archaeological resources calls for integrating the management of these resources.

While integrated management has the potential to increase the complexity of planning and implementation at the Preserve, this approach also affords increased efficiencies gained from merging treatments and considerations into fewer tasks and components. This integration of

natural and cultural resource protection and assessment is further enhanced by the cultural landscape approach adopted by the Preserve. The overall health of the contemporary landscape is viewed in concert with consideration of past human use, associated impacts and enhancements, and potential opportunities or limitations that have resulted. Thus, historic built features are part of the in-use infrastructure, and repair and maintenance also offers opportunities to achieve preservation. Likewise, viewsheds, fence systems, erosion control features and archaeological deposits can all be considered as part of cohesive decision making regarding operations, preservation, and restoration. This integration reflects and expresses the importance of the working ranch concept in the philosophy of the Trust for management of the Preserve.

3.5.2. Environmental Consequences

Alternative A

Direct/Indirect Effects

No direct effect to cultural resources would be likely to occur as a result of taking no action. Indirectly, it is likely that erosion occurring because of the current condition of ranch infrastructure (primarily roads, fences, and tanks) would continue. Erosion resulting from grazing by elk and other wildlife would continue. Erosion can cut into intact subsurface cultural deposits, exposing artifacts and shifting their location, removing them from the context of their surroundings and diminishing the information potential of previously undisturbed deposits. Removal of livestock grazing from the Preserve would be a change from historic use, would de-emphasize the cultural value of the working ranch concept as an expression of continuity with past human use, and would put the livestock-grazing cultural landscape in nonactive status. The obligation for minimal maintenance of ranching infrastructure (e.g., corrals, fences, tanks) to avoid deterioration through dis-use and neglect continues whether or not these facilities are in use.

Alternative B

Direct/Indirect Effects

This alternative includes activities that are ground disturbing (e.g., management of earthen tanks and fences) and thus have the potential to impact surface artifacts and subsurface deposits that may be present. Most such ground disturbing activities are considered an "undertaking" under NHPA and require the completion of the VCT Cultural Resources Compliance Process and an interdisciplinary review prior to implementation. These processes include determining if any cultural resources are present, whether those resources could be adversely impacted by the activity, and identifying measures to avoid or otherwise protect the resource. If this site specific inventory indicates that adverse effects to historic properties cannot be avoided, then the activity would be outside the scope of this analysis and would require a separate analysis and decision under the appropriate NEPA document based on the significance of the impact. Activities included under this analysis and decision include only those that will have no adverse effects to historic properties.

Based on the outcomes of the interim grazing program, cattle grazing at the intensity proposed under this alternative has little potential to adversely affect cultural resources. The concentration of animals would be insufficient to disturb artifacts protected by litter and vegetation. Rockshelters can be protected by the placement of natural barriers such as logs or rocks. This type of protection has been successful during the interim grazing program.

Activities such as the harvesting of grass seed are not ground disturbing even when using mechanical harvesters. Educational and other activities would occur under the performance requirements that currently guide visitor activities and include protections for cultural resources. Opportunities for monitoring potential effects to surface and buried archaeological resources will enhance future planning and management of these cultural resources.

This alternative retains continuity with past ranching uses of the Preserve. By minimizing the presence of livestock, a shift in the relationship of people and the environment would occur. It is likely that recreation, education and other uses would have a more dominant role in the present cultural landscape. The physical features that define the historic landscape would not be affected; however, the cultural landscape of the working ranch with fences and cross-fences and domestic livestock throughout the Preserve would be less visually conspicuous. The obligation for minimal maintenance of ranching infrastructure (e.g., corrals, fences, tanks) to avoid deterioration through dis-use and neglect continues whether or not these facilities are in use.

Alternative C

Direct/Indirect Effects

Under this alternative, grazing would be permitted at a scale similar to the interim grazing program depending on conditions. Infrastructure management is also being proposed as part of this alternative. The potential to impact cultural resources would depend on the number of animals grazing annually and the amount and types of infrastructure repair and use (Dennison et al. 2007). Up until 2008, less than 750 animals grazed annually on the Preserve. There was little evidence of the presence of cattle measurable at the end of the season. Herding had reduced trailing and the careful placement of supplements and moving of supplements reduced any localized disturbance that occurs from the use of lures. In 2008, 1,950 head of yearlings grazed on the Preserve. Localized ground disturbance in the form of trailing along fences and concentration around supplements as well as additional trailing occurred. These localized disturbances may have exposed artifacts and churned otherwise intact soils, and have the potential to adversely affect otherwise intact subsurface cultural deposits. Performance requirements proposed for domestic livestock grazing include a requirement to place supplements and lures in old road beds or otherwise disturbed areas and to consult with cultural resources specialist before otherwise locating supplements.

The effects as a result of infrastructure management as mitigated by the application of performance requirements would be similar to the effects described under Alternative B. Alternative C emphasizes the development of grazing programs that provide relative as well as monetary benefits, including benefits to local communities and enhancing the objectives on surrounding NFS land. Under this alternative, there is an increased likelihood that collaborative

programs, which include grazing by local producers, would occur. The cultural landscape of the working ranch would continue similar to present. The past cultural landscape could be connected to the current with grazing by local producers.

Alternative D

Direct/Indirect Effects

Under this alternative, the effects to cultural resources would be similar to what was described under Alternative C, although with potential for increased effects as the total number of livestock is increased. Under Alternative C, the cultural landscape would connect the past when local families grazed small herds of sheep on the Preserve to a current landscape where the Preserve continues to play a role in the cultural landscape of the Jemez Mountains. Under Alternative D, the Preserve would likely continue the more recent mode prior to federal acquisition with larger operators bringing in steers and yearlings for summer grazing. The interaction with the surrounding communities would be more similar to past ranch management under the Dunigan family than prior management under the Bond owners. Nonetheless, the physical features of the ranching cultural landscape would be retained and protected.

Alternative C_2 and D_2

Direct/Indirect Effects

The Dunigan family, who owned the ranch from 1963-2000, constructed the horse paddocks and barn in the 1970s. The Dunigans raised race horses at the ranch in order to benefit from the high-altitude conditions of the Jemez Mountains, transporting the horses to Texas to compete in sea-level races. The attached apartment was occupied by caretakers. The building is of recent (ca. 1977) construction, and does not have sufficient historical or associative significance to be considered eligible for the National Register of Historic Places (Dennison et al. 2007). As such, the proposed maintenance and improvements would have no measurable change to the cultural or historic landscape or to any historic properties.

However, there are prehistoric archaeological sites throughout the historic Ranch Headquarters area and a large prehistoric archaeological site near the horse paddocks barn that could be affected by the proposed improvements and subsequent use of the area. These archaeological sites would be fully documented and protected from any adverse effects prior to the proposed use of the buildings and surrounding areas. Activities would be cleared through the Cultural Resources Compliance Process and reviewed by the State Historic Preservation Office (SHPO) prior to any ground disturbance or contractual commitments.

All Alternatives

Cumulative Effects

Monitored outcomes, including the integrity of biotic characteristics (vegetative cover, cover by litter or bareground) and abiotic characteristics (erosion) are also good indicators of possible indirect and cumulative effects to subsurface archaeological resources.

3.6 Socioeconomic

This section presents a summary of the direct, indirect and cumulative effects of taking no action, implementing the proposed action or action alternatives on a combination of social and economic factors. For the purpose of this analysis the effects will be presented relative to significance in the two-county socioeconomic impact area, which includes Sandoval and Rio Arriba counties (Figure 49) as well as the relative to importance in the overall management of the Preserve. To aid in decision making, the analysis will also consider effects, which may be negligible within the socioeconomic impact area, but may be meaningful in the context of individuals, communities, or the management of the Preserve. While the action Alternatives, C and D, do not either limit or guarantee participation based on residency or individual socioeconomic situations, Alternative C is *more likely* to provide grazing opportunities to smaller producers within the socioeconomic area. For the purpose of this analysis, this likelihood is considered both to assess the significance of such participation within the socioeconomic area and to aid in decision making.

3.6.1. Affected Environment – Socioeconomic Impact Area

The socioeconomic impact area was delineation based on the physical and economic setting of the Preserve in the context of the Jemez Mountains and surrounding communities, as well as feedback and participation in the interim grazing program and public meetings.

The socioeconomic area is mostly rural but not immune from the pressures of modern real estate markets and population growth. Population growth, urbanization, water rights, and ownership/management of neighboring lands, including public lands providing valuable grazing permits, are just a few of the complicating factors faced by ranchers in Sandoval and Rio Arriba Counties. In a profession so dependent on land and livestock ownership, ranchers in northern New Mexico are increasingly faced with the challenges of working on both private and public lands and the possibility of losing grazing permits (Raish and McSweeney 2003). Thus, the proposed management activities being considered by the Trust are meaningful to individuals and communities within the socioeconomic impact area, without regard to the level of impact these activities would be likely to have.

Another source of economic activity in rural communities is natural resource based recreation. As agricultural markets become more complex and less conducive to the survival of small operations, some farmers and ranchers are searching for secondary revenue streams to help sustain traditional agricultural operations. In some cases, farm and ranch based recreation may serve as an outlet for struggling agricultural operations (Rimbey, Gardner, and Makus 1992). Supplementing agricultural operations with recreational services does not appear to be as prevalent in northern New Mexico as in other regions of the country. However, natural resource based recreation is an increasingly popular activity in the area, and the unique environment of the Preserve is increasingly drawing visitors from nearby cities and towns, as well as from afar, to participate in the variety of recreational activities offered (Valles Caldera Trust, 2007). Recreational activities may serve to provide economic stimulus in rural communities in the form of visitor spending (Bergstrom et al. 1990). It is apparent that residents with agricultural ties in Sandoval and Rio Arriba Counties place a greater importance on the availability of public lands

for grazing than for recreational opportunities, but the potential economic influence of travel and tourism must not be overlooked.

The following paragraphs provide brief descriptions of each county in the socioeconomic impact area, including historical information as well as a list of the communities in each county:

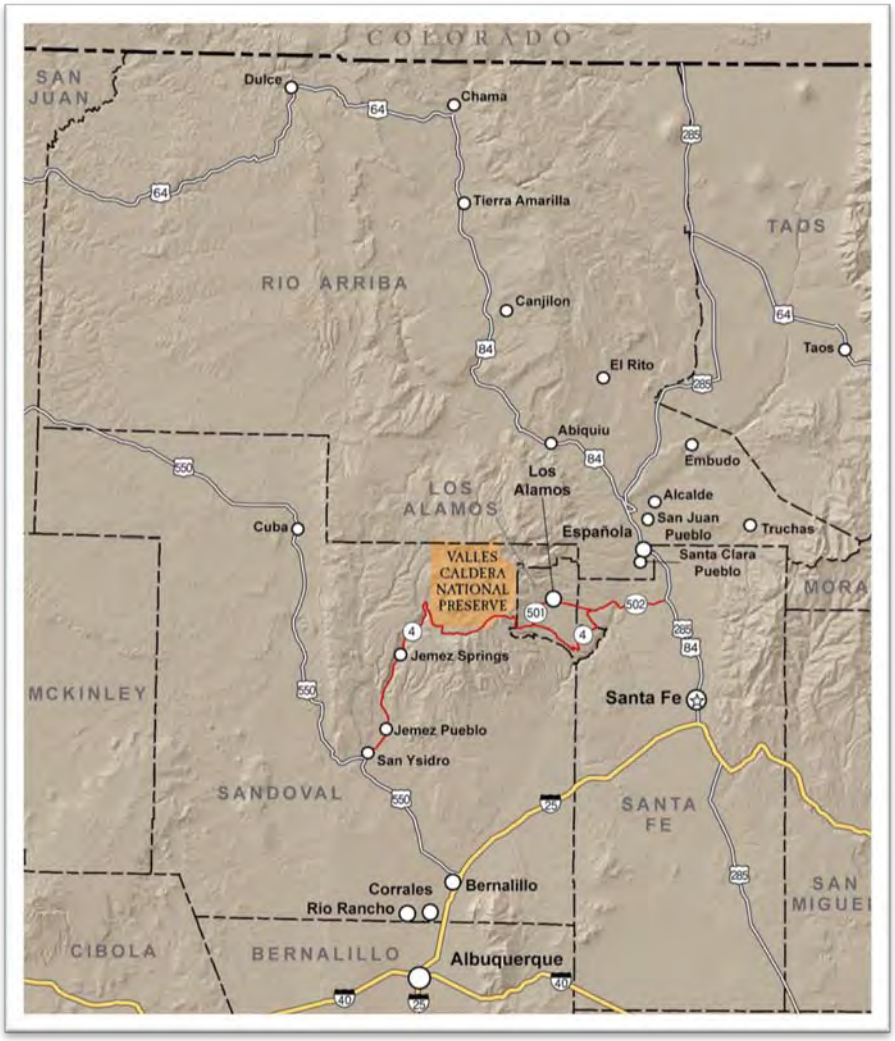

Figure 49 – Socioeconomic Impact Area

Sandoval County

The majority of the Preserve falls within the boundaries of Sandoval County. Located in north-central New Mexico, Sandoval County is an economically and culturally diverse region. The region consisting of modern day Sandoval County was one of two districts created in the New Mexico territory, and became part of Santa Ana County in 1852. Sandoval County was first established as its own entity in 1903, 9 years prior to New Mexico's statehood, and was separated from what is currently Los Alamos County in 1949 (Sandoval County 2008). With its strong agricultural ties, many county residents rely heavily on ranching operations for both income generation and to maintain historical and cultural activities associated with the ranching way of life. In addition, like many rural areas across the United States, natural resource based recreation

is becoming an increasingly popular source of economic stimulus. The unique landscape and climate of northern New Mexico draws visitors to participate in a variety of outdoor recreation activities. The recreational and agricultural opportunities supported by the Preserve are likely to generate minor but measurable levels of economic stimulus for Sandoval County. In addition to economic ties, the Preserve supports a variety of cultural and heritage symbols for local residents. Sandoval County currently encompasses 3,716 square miles and includes six incorporated communities: Bernalillo, Cuba, Corrales, Jemez Springs, Rio Rancho, and San Ysidro (Figure 49) (www.sandovalcounty.com).

Rio Arriba County

Rio Arriba County is located in north-central New Mexico and borders Colorado to the north. Similar to Sandoval County, Rio Arriba County has a rich history of Native American and Spanish influence. Ranching in Rio Arriba County began in the 1890s with the Chama grazing country becoming prominent and supporting large spreads throughout the county (www.rio-arriba.org). In modern times, cattle ranching remains an important income source for many families in Rio Arriba County, and is also important for maintaining cultural ties to Native American and Spanish heritage. Only a small portion of the Preserve lies within the boundaries of Rio Arriba County; however, management activities on the Preserve affect the economic condition of local communities. Many cattle ranchers, who could potentially benefit from opportunities to graze on the Preserve, reside in that county, and visitors traveling to the Preserve may pass through the area, purchasing goods and services from local businesses. In addition to economic ties, the Preserve supports a variety of cultural and heritage symbols for local residents. Communities in Rio Arriba County include: Abiquiu, Alcalde, Canjilon, Chama, Dulce, El Rito, Embudo, Espanola, San Juan Pueblo, Santa Clara Pueblo, Tierra Amarilla, and Truchas (Figure 49) (http://www.epodunk.com).

Demographics, Employment, and Income

This section provides a comprehensive evaluation of the existing conditions in the two-county socioeconomic impact area, including basic demographics, employment, and personal income. The demographics section includes a variety of human factors affecting the overall state of the local workforce; those factors include population, age, education level, and ethnicity.

Employment and income are reported by economic sector, which are a set of local businesses by industry, grouped together according to similarities in the goods and services offered. Economic sectors are reported according to 2-digit North American Industry Classification System (NAICS) codes. NAICS is a system developed by the U.S. government for grouping establishments into industries based on the primary activity with which they are engaged (Bureau of Labor 2008). Assessing employment and income by sector will aid in the identification of those industries important to the economic sustainability of the region, and those potentially dependent on the activities taking place on Preserve.

Demographics

According to the 2000 census, the total population in the two county area is 131,098. The U.S. Census Bureau conducts a survey every 10 years; however, the Census Bureau does provide more

recent estimates of population. Table 22 reports the estimated 2006 population as well as the population reported under the 2000 Census. Interestingly, Sandoval County is experiencing significant population growth while Rio Arriba County is experiencing a slight decline in population. The growth rate of Sandoval County's population is 26.5 percent; which is much greater than that of New Mexico and the United States, which are 7.5 and 6.4 percent, respectively. The negative population growth of Rio Arriba County suggests that it is dominantly rural, and could be most influenced by agricultural industries. Given the considerable growth in Sandoval County, it likely that the overall influence of the agriculture sector, in terms of employment and income, has declined in recent years. Such influences of specific industries are addressed in the employment and income sections below.

Table 22 – Population and Growth Rate (U.S. Census Bureau, 2007)

Population and Growth Rate			
	2000	**2006**	**% Change**
Sandoval County	89,908	113,772	26.5%
Rio Arriba County	41,190	40,949	-0.6%
Two County Area Total	131,098	154,721	18.0%
New Mexico	1,819,046	1,954,599	7.5%
United States	281,421,906	299,398,484	6.4%

The age distribution across counties is dominantly middle aged. Figure 50 summarizes the age distribution for each county. Most individuals in each county lie within the 25- to 54-year-old age group; suggesting the majority of residents in the study area are of working age and likely dependent on their employment status to support themselves. Those areas with an older population typically have a higher percentage of retirees, and are thus less dependent on local employment conditions due to the influence of transfer payments from outside the local region. There are no significant differences in the age distribution between the counties and the state; the largest difference lies in Sandoval County and its slightly higher percentage of individuals in the 35- to 44-year-old age group.

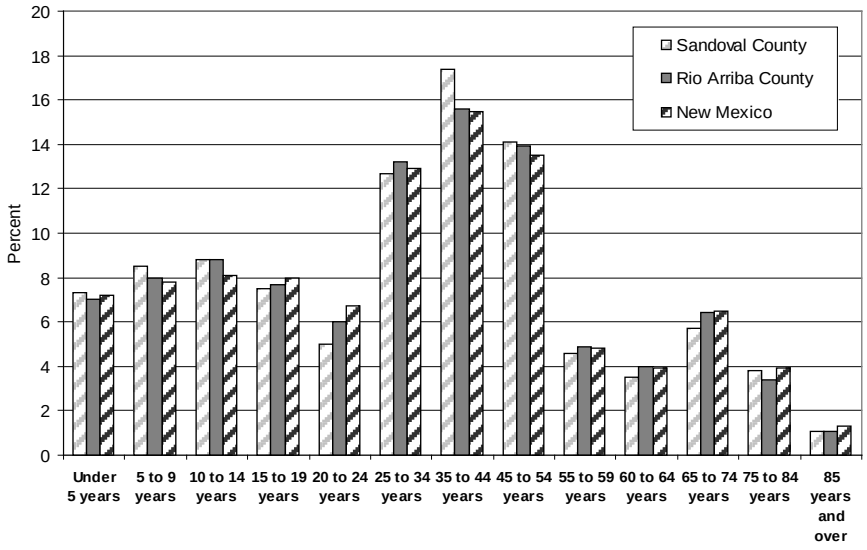

Figure 50 – Age Distribution **(U.S. Census Bureau, 2007)**

Table 23 reports the ethnic distribution for the socioeconomic impact area and for New Mexico. According to Census definitions, Hispanic or Latino may be of any race. As defined by the U.S. Census Bureau, race and Hispanic origin are two different concepts; thus, people in each race group may be either Hispanic or not Hispanic (U.S. Census Bureau, 2008). Coinciding to the race and Hispanic origin issue, individuals may report more than one race; this further complicates the manifestation of overlapping groups. Because of this, summing the ethnic distribution in an area often results in a sum of greater than 100 percent; this is the case Table 23. The majority of the individuals in the two-county region are Caucasian; however, a dominant percentage (43.1 percent) of the population is Latino. Table 23 reports ethnicity figures for the counties and state individually. At the county level, Rio Arriba County has a very high proportion of Latino (72.9 percent). The state of New Mexico overall has a large proportion of individuals from Latino and Native American decent, 42.1 percent and 10.5 percent, respectively. Sandoval and Rio Arriba Counties have a higher percentage of Native Americans than the state at 17.2 percent and 14.7 percent, respectively.

Table 23 – Resident Ethnicity (U.S. Census Bureau 2007)

Ethnic Background of County Residents			
	Sandoval County	**Rio Arriba County**	**New Mexico**
Caucasian	68.1 %	59.5 %	69.9 %
African American	2.2 %	0.5 %	2.3 %
Latino	29.4 %	72.9 %	42.1 %
American Indian	17.2 %	14.7 %	10.5 %
Asian	1.5 %	0.3%	1.5 %
Pacific Islander	0.2 %	0.2 %	0.2 %
Other	14.4 %	28.2 %	19.4 %

In terms of livestock producers in the socioeconomic impact area, the vast majority of owner/operators are of Hispanic origin. A subsection of this group was surveyed by Raish and McSweeney for their 2003 study, Economic, Social, and Cultural Aspects of Livestock Ranching on the Espanola and Canjilon Ranger Districts of the Santa Fe and Carson National Forests: A Pilot Study. This study focused on "*…gathering information on both the economic and noneconomic contributions of livestock ownership to local families and communities*". Of this subsection 85.6 percent reported a family residence within the community of four generations or more, 51.6 percent reported speaking Spanish as their primary language, and 33.9 percent reported a bilingual household (Raish and McSweeney 2003). Of this subsection, 48.4 percent reported being from 50-65 years of age; with 25.8 percent falling into the age bracket between 36-49 years and 24.2 percent reporting that they were over 65 (Raish and McSweeney 2003).

Employment

The most recent US Census data for employment in the socioeconomic impact area is for the year 2000. Given the changes in population, and possible changes to industry composition, a secondary data source is used to report employment and income for the local region. Minnesota IMPLAN Group (MIG) reports annual economic data for all counties in the United States. The most current IMPLAN data available is 2006, which is the data utilized throughout this analysis. MIG utilizes national, state, and local data sources to report county level employment, and includes full-time, part-time, seasonal, and self-employment. Thus, IMPLAN reports employment data simply as jobs, not full-time equivalents (FTEs), thus one person with multiple jobs will show up more than once in the data. This prohibits the comparison to local population data provided by the US Census.

According to the 2006 IMPLAN data, total employment in the 2-county area is 53,680 jobs; 68 percent of that employment is in Sandoval County (36,758 jobs). Table 24 reports total employment by industry at the 2-digit NAICS code level. The largest employing sector in each county is the government with 7,063 and 5,453 jobs in Sandoval and Rio Arriba counties, respectively. In proportional terms, the government is a much larger employer in Rio Arriba County with 32 percent of total employment, versus 19 percent in Sandoval County. Manufacturing at 19 percent, construction at 9 percent, and retail trade at 9 percent are also important sectors for overall employment in Sandoval County. The four sectors mentioned (government, manufacturing, construction, and retail trade) account for 57 percent of total employment in Sandoval County. Large employing sectors in Rio Arriba County are health and social services at 16 percent, retail trade at 10 percent and construction at 7 percent; those three sectors, along with government, account for 65 percent of the total employment in Rio Arriba county.

Proportionally, the agriculture, forestry, fishing and hunting (i.e., "agriculture") sector is a much larger sector in terms of employment in Rio Arriba County at 6 percent than it is in Sandoval County at only 1 percent of total employment. This sector accounts for a variety of agricultural and natural resource based activities, including cattle grazing. Although neither county's employment is exceptionally supported by the agricultural sector, the relative importance of agriculture is much greater in Rio Arriba County than it is Sandoval County. Thus, any economic

implications of the proposed Stewardship Action may be of greater importance to the overall health of the economy in Rio Arriba County, than it would be in Sandoval County

In terms of the entire two-county socioeconomic impact area, grazing (as an activity within the agricultural sector) is an even smaller component of total economic activity as measured by employment. Figure 53 reports the proportions of total employment by economic sector. The agricultural sector is further broken down into four specific components to better assess the industries supported by Preserve management actions: wood products and processing; grazing; mining; and all other agriculture, forestry, fishing and hunting activities. Overall, grazing in Sandoval and Rio Arriba Counties only supports 0.1 percent of total employment.

In surveys conducted by Raish and McSweeney for their 2003 study, only 8.1 percent of the respondents reported ranching as their full time employment, although 41.9 percent reported that they were retired from full time jobs outside of ranching and were now ranching full time. A significant number, 27.4 percent, worked full time outside the ranch.

This suggests that cattle ranching is only a small portion of total economic stimulus, and programs for domestic livestock grazing on the Preserve would have a negligible effect on total employment in the region. Other agriculture, forestry, fishing and hunting activities accounts for a somewhat larger proportion of total employment in comparison to cattle grazing (2.2 percent vs. 0.1 percent); thus, any Preserve management activities affecting fishing and hunting opportunities may have a larger effect on local employment conditions relative to those affecting the grazing program. However, in both counties it is likely more meaningful in the context of some individual communities then in the context of either county overall.

Table 24 – County Employment (Minnesota IMPLAN Group 2006)

County Employment by 2 Digit NAICS Code			
	Sandoval	**Rio Arriba**	**Total**
Ag, Forestry, Fish & Hunting	283	939	1,222
Mining	145	176	321
Utilities	79	109	188
Construction	3,442	1,149	4,591
Manufacturing	6,958	323	7,281
Wholesale Trade	704	193	897
Transportation & Warehousing	526	332	858
Retail trade	3,492	1,666	5,158
Information	930	88	1,018
Finance & insurance	1,228	275	1,503
Real estate & rental	1,110	157	1,267
Professional, scientific, & technical services	1,190	364	1,555

Management of companies	104	106	210
Administrative & waste services	2,138	519	2,656
Educational services	696	582	1,279
Health & social services	1,810	2,777	4,588
Arts, entertainment & recreation	752	147	899
Accommodation & food services	2,364	1,098	3,462
Other services	1,742	469	2,211
Government	7,063	5,453	12,516
Total	36,758	16,922	53,680

Income

Another indicator of the overall health of the local economy is household income. Figure 51 reports the average household income for each county in the socioeconomic impact area and the state of New Mexico for 2006. Interestingly, the two counties have very different average annual household incomes. Sandoval County has a very strong average household income compared to the state average ($83,285 versus $77,778, respectively), whereas average household income in Rio Arriba County is considerably less than the state average ($63,543 versus $77,778, respectively).

Average Household Income within the Socioeconomic Impact Area

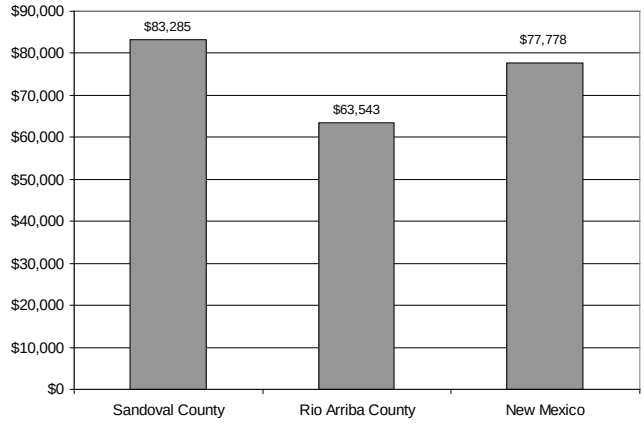

Figure 51 – Average Household Income (Minnesota IMPLAN Group 2006)

Also of relevance is the aggregate income reported for each economic sector. Table 25 reports the total income by two-digit NAICS sector for each county. Total income is the sum of employee compensation, proprietors' income, and other property income. Similar to the distribution of employment, Sandoval County generates the majority of income (77 percent) in the socioeconomic impact area. In terms of total income by sector, the government generates 28 percent of total income in the entire region; at the county level, income from the government sector represents 23 percent of total income in Sandoval and 45 percent in Rio Arriba. Thus, employment by the government generates nearly half of the total income in Rio Arriba County,

even though government jobs are less than one-third of total employment in the county. This suggests that relative to other employment opportunities in Rio Arriba County, government sector jobs are high paying. Government employers in Rio Arriba County include the USFS and Los Alamos Laboratory. The sector responsible for generating the most income in Sandoval County is manufacturing; manufacturing generates 30 percent of total income, but only 19 percent of total jobs. One of the larger manufacturing employers in the county is Intel Corporation. The agriculture sector is a relatively small part of total income for both counties generating just 2 percent of total income in Rio Arriba County, and less than 1 percent of total income in Sandoval County.

Table 25 – Total Income by Sector (Minnesota IMPLAN Group 2006)

Total Income by 2 Digit NAICS Code ($ Millions)			
	Sandoval	**Rio Arriba**	**Total**
Ag, Forestry, Fish & Hunting	7.057	10.431	17.488
Mining	17.690	30.225	47.915
Utilities	15.382	18.907	34.289
Construction	185.695	43.352	229.047
Manufacturing	674.585	18.447	693.032
Wholesale Trade	37.652	6.767	44.418
Transportation & Warehousing	20.159	14.684	34.842
Retail trade	140.718	54.428	195.146
Information	98.110	2.873	100.984
Finance & insurance	110.634	22.866	133.500
Real estate & rental	61.096	4.330	65.426
Professional, scientific & technical services	53.311	12.403	65.714
Management of companies	4.370	4.998	9.368
Administrative & waste services	110.068	7.688	117.755
Educational services	11.681	3.520	15.201
Health & social services	57.513	82.815	140.328
Arts, entertainment & recreation	12.670	3.312	15.982
Accommodation & food services	41.732	22.122	63.854
Other services	53.961	10.805	64.766
Government	526.297	303.679	829.976
Total	2240.381	678.652	2919.031

Figure 52 reports the proportions of total labor income by economic sector. As reported in Figure 53, the agriculture sector is further broken down into wood products and processing; grazing; mining; and all other agriculture, forestry, fishing and hunting activities. In terms of total income in the two-county region, income from grazing operations account for a very small proportion

(0.1 percent). Thus, any changes to grazing allotments on the Preserve would be negligible within the context of total income in the region.

In the surveys conducted by Raish and McSweeney for their 2003 study, 46.9 percent of the respondents reported that income from livestock accounted for less than half of their annual income; 20.9 percent reported that proceeds went back into operations or toward paying loans that were taken out in support of operations. Only 3.2 percent reported earning 91 to 100 percent of their income through ranching (Raish and McSweeney 2003). It is important to note that more than half – 58 percent – responded that income from livestock was spent on living expenses and 33.9 percent responded that they were retired and counted on income from livestock for part of their income (Raish and McSweeney 2003).

Unintended consequences of the management of one resource may adversely affect the conditions of other resources. For example, an unintended consequence of cattle grazing may be increased competition for forage between cattle and elk, and a reduction in the size of the elk herd on the Preserve. This may limit the recreational hunting occurring locally, which may decrease economic activity in the agriculture, forestry, fishing and hunting sector. Thus, increases in income to cattle ranchers may be offset by decreases in income for employees in other sectors.

Proportional Income Within the Socioeconomic Impact Area by Sector

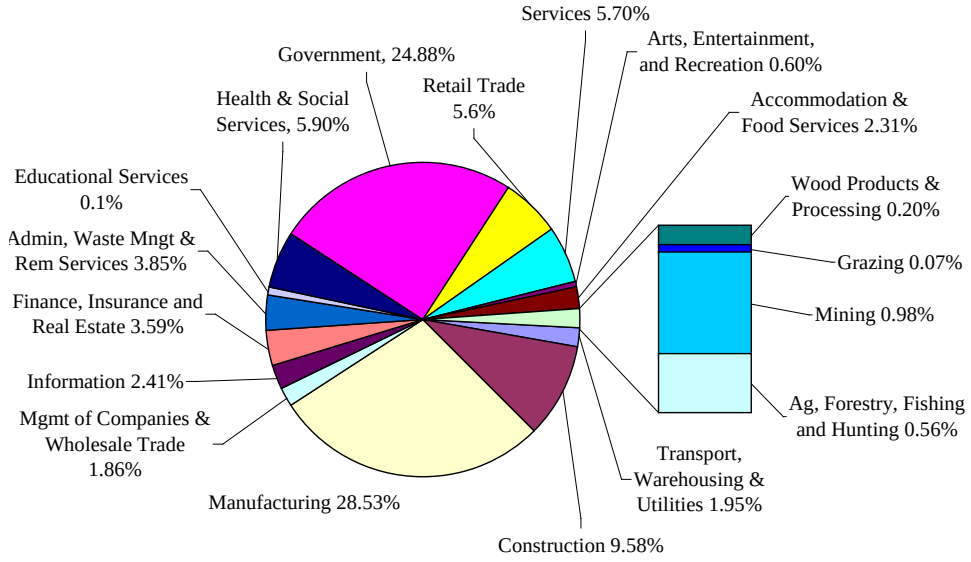

Figure 52 – Proportional Income (Minnesota IMPLAN Group)

Proportional Employment within the Socioeconomic Impact Area by Sector

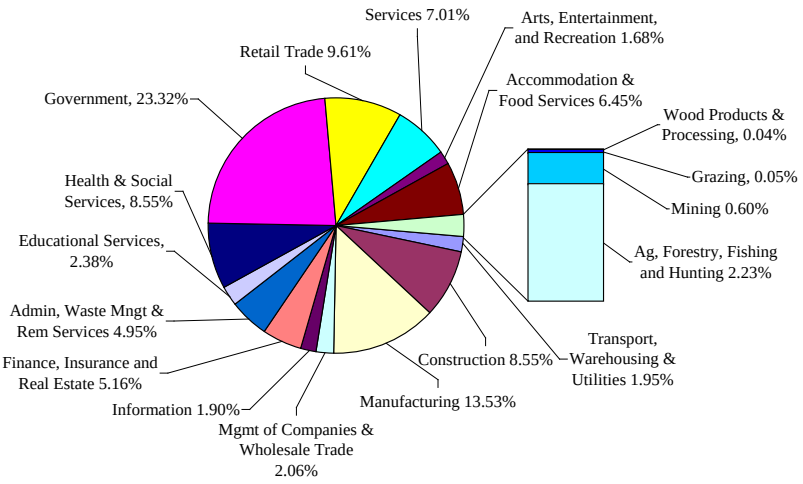

Figure 53 – Proportional Employment (Minnesota IMPLAN Group)

Table 26 reports the 2006 unemployment rates for Sandoval County, Rio Arriba County, New Mexico, and the United States. Although unemployment rates vary slightly in the socioeconomic impact area, the rates are not at alarming levels. Unemployment in Sandoval County is slightly higher than the state and slightly lower than the national levels whereas unemployment in Rio Arriba County is slightly higher than both the state and national levels. As jobs are created in a region, labor comes from two primary sources: local unemployment and in-migration of households. With unemployment rates near the national average in the socioeconomic impact area, new jobs will likely be filled by a combination of local unemployed residents and new households to the area. Since Rio Arriba County has a slightly higher unemployment rate than Sandoval County, it is more likely that new jobs in Rio Arriba County will be filled by local sources of labor.

Table 26 – Unemployment Statistics

Unemployment Statistics	
Sandoval County	4.4%
Rio Arriba County	4.9%
New Mexico	4.2%
United States	4.6%
Source: US Bureau of Labor Statistics	

Valles Caldera National Preserve

As defined in the Act, and guided by the Multiple Use Sustained Yield Act of 1960, the Preserve is to be managed by the Trust to ensure a wide range of recreational and commercial activities,

and ecological conditions, including: operation as a working ranch (where consistent with other purposes); preservation of the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural and recreational values; multiple use and sustained yield of renewable resources; and public recreation. Furthermore, the Act states that renewable resource utilization and management alternatives should provide, to the extent practicable, benefits to local communities and enhanced coordination of management objectives with surrounding NFS land. The Act also establishes a benchmark for the Trust to be financially self-sustaining by 2015.

While quantitative data necessary to predict the consequences of the alternatives to the management of the Preserve and generation of income from activities does not exist, discussion of the competing uses of Preserve resources from a socioeconomic perspective is warranted. Such a qualitative analysis may bring to light certain social and economic issues not specifically addressed in the assessment of the available quantitative data. Potential repercussions of management alternatives will be discussed further in the assessment of the direct, indirect and cumulative effects below.

As defined in the *State of the Preserve* report, understanding the condition of the Preserve is a key component of comprehensive management (Valles Caldera Trust, 2007). Both the ecological state of the Preserve and the condition of facilities and infrastructure are key criteria the Trust considered in the development of a comprehensive plan for the multiple use and sustained yield of the forage resources. While the ecological impacts are reserved for other resource reports, there may be financial and economic implications coinciding with changes in the condition of the ecological environment. Along with acquiring the ranch as federally owned public land, the government also inherited the out of date and deteriorating facilities and infrastructure on the property.

The majority of facilities on the Preserve were in place when the property was acquired in 2000. Many were built in the early 20th century and are eligible to be considered as historic properties under the National Historic Preservation Act (Valles Caldera Trust 2005). In 2006, a group of engineers from the USFS evaluated 38 structures on the Preserve (USDA-USFS Gila National Forest 2006). The engineers appraised the total replacement value of the structures at approximately $5.5 million. The annual cost to operate and maintain the facilities is likely to exceed $30,000, and deferred maintenance needs are in excess of $1.22 million.

Management of a viable grazing program on the Preserve could be supported by ancillary facilities providing storage, office and meeting space, classrooms as well as stalls and corrals. Connected to grazing programs is the management of ranch infrastructure (fences and other barriers; earthen tanks and other watering systems.) In addition to the deferred maintenance costs associated with the facilities, there are substantial costs to repair and maintain fences, earthen tanks, and other infrastructure required to operate the Preserve as a working ranch. A total of 136 earthen tanks exist on the Preserve, approximately 43 of which are not functioning and causing damage to the natural resources surrounding them (Valles Caldera Trust, 2007). The alternatives developed address this issue of maintenance, repair, and development of existing and future infrastructure. A certain level of maintenance is required in support of livestock management and distribution while other repairs and maintenance are needed to protect and preserve natural as well as cultural

resources. In the financial efficiency analysis presented below, grazing alternatives are assessed with the necessary and connected management of infrastructure and with and without the desired development of facilities. Such costs may make it difficult to implement livestock management with full cost recovery.

Since the Valles Caldera National Preserve was acquired in 2000, only a small number of cattle, relative to the total volume of animals in the local area, have been permitted to graze. Table 27 compares the number of head on the Preserve to the number of head in Sandoval and Rio Arriba Counties. Table 28 reports the volume of cattle on the Preserve as a percentage of total cattle in the two-county analysis area. Of the total volume of cattle in socioeconomic impact area, total cattle supported by the Preserve ranged from 0.7 percent to 2.5 percent in the years 2002 through 2007. Thus, in recent years, the Preserve has only supported a small percentage of local area cattle production. In a smaller subsection of USFS allotments either adjacent to, or in proximity of the Preserve, the permitted number of AUMs is 42,649. Use by the Trust is representative of about 6 percent of the USFS-permitted number. At 1500 AU for four months, use on the Preserve would be about 14 percent of the number permitted on that smaller subsection. While not significant, use on the Preserve becomes more meaningful when considered in a local context.

Table 27 – Relative Grazing Use in Volume (Valles Caldera Trust 2007, USDA 2008)

Volume of Cattle on the VCNP and Surrounding Counties, 2002 – 2007			
Year	**VCNP**	**Sandoval County**	**Rio Arriba County**
2002	1,021	19,000	23,000
2003	673	10,000	20,000
2004	611	11,000	19,000
2005	611	10,000	20,000
2006	200	10,000	18,000
2007	500	9,000	19,000

Table 28 – Relative Grazing Use as a Percent (Valles Caldera Trust 2007, USDA 2008)

Percent of Cattle on the Preserve and Surrounding Counties, 2002 – 2007			
Year	**VCNP**	**2 County Area**	**% on VCNP**
2002	1,021	41,000	2.5
2003	673	30,000	2.2
2004	611	30,000	2.0
2005	611	30,000	2.0
2006	200	28,000	0.7
2007	500	28,000	1.8

In terms of the financial returns to the Trust, the cattle program has supported a minor proportion of total revenues generated from public programs. Table 29 reports the total revenues generated by program for the years 2004 through 2007; Table 30 reports those revenues as a percent of total revenue; and Table 31 reports operating costs and revenues of grazing programs. Grazing accounted for 0-8 percent of total program revenues during the years reported. The most important programs on the Preserve in terms of total revenue are hunting, accounting for nearly half of all revenues generated from all public programs, followed by fishing and special events. Thus, from a financial efficiency standpoint, any effects of grazing on these programs should be carefully considered prior to the adoption of a specific grazing plan.

Table 29 – Annual Revenues in Dollars **(Valles Caldera Trust, 2007)**

VCNP Revenues by Resource Program, 2004 – 2007				
	2004	**2005**	**2006**	**2007**
Hunting	$210,850	$285,625	$317,365	$350,556
Fishing	$62,793	$71,645	$60,415	$67,392
Other Events	$129,562	$109,449	$76,656	$93,828
Concession Sales	$13,256	$9,558	$48,496	$42,513
Commercial Rental	$8,000	$5,000	$45,095	$6,810
Grazing	$42,110	$39,654	$0	$5,800
Miscellaneous	$50,890	$131,288	$246,817	$183,058
Total	$517,461	$652,219	$794,844	$749,957

*(annual operating cost for other revenue programs (recreation and other guest services) is approximately $500,000)

Table 30 – Annual Program Revenues as a Percent **(Valles Caldera Trust, 2007)**

Revenues as a Percent of Total by Resource Program, 2004 – 2007				
	2004	**2005**	**2006**	**2007**
Hunting	41%	44%	40%	47%
Fishing	12%	11%	8%	9%
Other Events	25%	17%	10%	13%
Concession Sales	3%	1%	6%	6%
Commercial Rental	2%	1%	6%	1%
Grazing	**8%**	**6%**	**0%**	**1%**
Miscellaneous	10%	20%	31%	24%
Total	100%	100%	100%	100%

Table 31 – Interim Livestock Program – Operating Costs and Revenues[20] **(Valles Caldera Trust, 2007)**

Operating Costs and Revenues for Interim Livestock Programs 2002 – 2005				
	2002	**2003**	**2004**	**2005**
Operating Costs	$41,200	$116,000	$145,561	$148,000
Revenues	$8,790	$28,450	$42,110	$39,654

In addition to the quantifiable costs and revenues associated with the action alternatives, a variety of nonmonetized social values exist. Such values may be cultural, ecological, recreational, and/or any other value not directly accounted for in the market place; they may be positively or negatively affected under the alternative management scenarios. For example, as reported in Raish and McSweeney (Raish and McSweeney 2003), grazing by local cattle ranchers may increase the traditional values and connections to ancestral lands and heritage in local communities. However, cattle grazing by producers from outside the socioeconomic impact area are not likely to support such cultural values. The Preserve is operating in a social atmosphere highly entrenched in the traditional ways of life for long time residents of northern New Mexico. Local attitudes toward lands use in the area are unique in the sense that many resident cattle ranchers feel a cultural tie to the land and the agricultural opportunities supported by the Preserve. Many local ranchers "*consider the ranching way of life vital to maintaining their cultural heritage and traditional values, as well as to passing those values on to future generations*" (Raish and McSweeney 2003). Domestic livestock grazing programs on the Preserve that do not benefit local producers are not likely to decrease such values in the area, as other grazing opportunities will not be affected. However, the Preserve has the ability to increase cultural values in the local region by supporting traditional programs.

Similarly, domestic livestock programs on the Preserve may have implications for ecological and recreational values. The biological consequences of the proposed management alternatives are assessed in other resource sections in this EA; however, such consequences may negatively affect the ecological environment and the recreational opportunities supported by the Preserve. It is important to retain awareness that the Preserve is a tract of federal land; and as such, must consider the potential values for individuals outside the local area.

Influences of the grazing program on recreation may have additional economic impacts not directly accounted for in the quantitative analysis due to limitations in data availability. If recreational visits to the Preserve decrease, then there will likely be less consumer spending in the area. Stynes and White (Stynes and White 2005) developed national average spending profiles for visitors to national forests. Profiles were developed from responses to economic questions on the National Visitor Use Monitoring (NVUM) survey administered at 119 national forests between the years 2000 and 2003. Table 32 reports the expenditures per party per trip for locals and nonlocals by trip type, where "Day" is day trips, "OVN-NF" is overnight trips on a national

[20] From 2002-2005 the Trust managed the livestock program through contract or employee labor. The costs included fencing and assistance with security and hunt management. 2006-2008 the livestock program was managed by the producers through a single contract. The Trust incurred all costs of fencing and other connected activities.

forest, "OVN" is overnight trips off a national forest, and "Non-Primary" are those visits where recreation was not the primary purpose of the trip. Although these expenditure profiles are not specific to visits to the Preserve, evidence suggests that a decrease in recreational visits to the Preserve will likely result in decreased spending in the area. Thus, any proposed management activities potentially affecting recreation levels on the Preserve should be considered with respect to the potential economic implications of decreased recreational spending in the area. In the case of a healthy grazing program on the Preserve, it is not likely that substantial changes in visitor spending to the area would occur.

Table 32 – National Forest Visitor Spending Profile

National Forest Visitor Spending Profiles by Trip Type Segment and Spending Category, $ per Party per Trip[a]								
	Nonlocal Segments			***Local Segments***				
	Day	**OVN-NF**	**OVN**	**Day**	**OVN-NF**	**OVN**	**Non-Primary**	**All Visits[b]**
Lodging	0	25.3	64.85	0	16.24	17.62	48.78	19.71
Restaurant	13.6	25.26	58.91	6.12	13.61	21.49	44.8	22.32
Groceries	7.61	36.55	31.28	5.41	41.15	23.46	21.04	17.18
Gas and Oil	15.99	37.28	35.79	11.67	27.7	25.93	28.52	21.53
Other Transportation	0.98	3	7.54	0.21	0.21	1.09	5.1	2.26
Activities	3.87	8.04	15.49	1.82	3.8	6.76	9.67	6.03
Admissions/Fees	5.24	10.23	9.02	3.42	10.54	8.37	6.97	6.13
Souvenirs/Other	4.31	15.59	22.37	4.2	11.24	11.42	18.64	10.4
Total	51.6	161.25	245.25	32.85	124.49	116.14	183.52	105.57
[a] Outliers are excluded and exposure weights are applied in estimating spending averages. All figures expressed in 2003 dollars.								
[b] The all visit averages are computed as a weighted average of the columns using the national trip segment shares as weights								
Source: Spending Profiles of National Forest Visitors, NVUM Four Year Report (Stynes and White 2005).								

Although specific data representing the values discussed above does not exist for the Preserve, it is important to acknowledge that such values are relevant in the socioeconomic impact area. More detail will be provided in the effects analysis of the specific management alternatives below. However, such detail will be provided in the form of a qualitative assessment of potential effects, as quantitative data on the secondary effects of the proposed alternatives do not exist.

3.6.2. Environmental Consequences

Methodology

According to Forest Service Manual 1970.62, the analysis should implement "techniques to develop the most efficient combination of activities for each decision unit within each alternative." Given the information provided, financial efficiency measures are calculated in this analysis to provide a means of comparing the economic feasibility across alternatives.

The alternatives are analyzed and compared using the Quicksilver program to estimate the benefit-cost ratios and the net present values (NPVs) of project alternatives. Quicksilver is a financial analysis tool developed by the USFS to generate measures of financial efficiency. A 4-year planning horizon is used in this analysis; activities would begin in fiscal year 2009 and end in fiscal year 2012. This planning horizon is consistent with the use of the model and the planning horizon of the Trust.[21]

Table 33 summarizes the activities expected to take place each year for each alternative. Information regarding the management activities for each alternative, as well as the timeline for project implementation, were collected from local sources. Since potential implementation scenarios are still under investigation, the estimated costs and benefits across alternatives are reported together. Thus, the NPVs calculated are simply the discounted revenues associated with the proposed activities minus, the discounted cost in aggregate, reported in 2008 dollars. The NPV begins at zero, not reflecting deferred maintenance needs as a debt, but as a new cost.

Revenues are based on revenues either received or offered during the interim grazing program. Increases in revenues are estimated based on expected increase in efficiencies and decreases in risk over time.

Table 33 – Activities across alternatives

Project Activities Across Alternatives							
Fiscal Year	Fence Removal	Fence Maint.	Fence Construction	Fence Repair	Deferred Maintenance (Facilities)	Maintenance and Repair of Earthen Tanks	Grazing
2009	B,C,D	B,C,D	C,D	B,C,D	C_2, D_2	B,C,D	B*,C,D
2010	B,C,D	B,C,D	C,D	C,D	C_2, D_2	B,C,D	B*,C,D
2011	B,C,D	B,C,D	C,D	C,D	C_2, D_2	B,C,D	B*,C,D
2012	B,C,D	B,C,D	C,D	C,D	C_2, D_2	B,C,D	B*,C,D
$_1$ Alternative is conducted without deferred maintenance for outbuildings.							
$_2$Alternative is conducted with deferred maintenance for outbuildings.							
*Under Alternative B, less than 5% of the available forage would be allocated to grazing; annual programs may or							

[21] The next *State of the Preserve* is due in 2012. In addition the Trust is developing a comprehensive plan for public use and access to the Preserve which will propose the development and management of facilities and programs that support public use. and access for recreation, education and other purposes (Valles Caldera Trust 2006), based on a strategic business plan. These benchmarks will provide logical points for evaluating MUSY-Forage consistent with adaptive management.

may not occur.

This analysis is based on the likely development scenarios outlined in the alternatives, where Alternative A is the "No Action" alternative. To remain consistent with the terminology and labeling throughout the analysis, financial efficiency measures are reported for Alternatives A, B, C without deferred maintenance of facilities (C_1), C with deferred maintenance of facilities (C_2), D without deferred maintenance of facilities (D_1), and D with deferred maintenance of facilities (D_2). The data used for this analysis represents the best available estimate of the quantities, costs, and benefits associated with each development scenario.

According to Office of Management and Budget (OMB) Circular A-94, NPV is the standard criterion for deciding whether a project is economically justifiable. NPV is a way of comparing all monetarily valued costs and benefits, and is calculated by subtracting the discounted sum of total costs from the discounted sum of total benefits. Economic principles associated with the time value of money suggest that money now is worth more than money in the future. Thus, benefits and costs occurring in the future must be discounted back to represent their current value. A federally prescribed discount rate of 4 percent is used in this analysis (FSM 1971.21). A positive NPV means that the discounted sum of benefits is greater than the discounted sum of costs, and vice versa. Inflation is also a variable that can affect the NPVs associated with each alternative. However, due to the uncertainty of future inflation, OMB Circular A-94 recommends the avoidance of making assumptions about the inflation rate whenever possible. Thus, for the purposes of this project, inflation will be left at zero.

The computation of Benefit-Cost ratios further assesses the relationship between monetary benefits and costs. The Benefit-Cost ratio is simply the discounted sum of benefits divided by the discounted sum of costs. A ratio greater than one suggests that the benefits associated with a project are greater than the costs. One caveat of Benefit-Cost ratios is that they do not allow the analyst to assess the aggregate value of benefits associated with an alternative. The alternative with the highest Benefit-Cost ratio has the highest value of benefits compared to the associated costs, but does not necessarily have the greatest value of benefits at the aggregate level. Benefit-Cost ratios are often used as a decision criterion in situations when a budget constraint is present (i.e., choose the alternative with the highest ratio up to a certain level of total costs). NPV provides a better measure of the overall level of benefits and costs as it reports the difference between benefits and costs at the aggregate level, rather than being a ratio of the two.

Economic Impact Analysis investigates the effects of the alternatives on employment and income in the socioeconomic impact area. The relative size of the local communities plays an important role in the assessment of job and income impacts to the economy. Broader, more diverse, economies will likely be more resilient to changes in jobs and income than smaller, more rural communities. For example, a loss of ten jobs in a large metropolitan area will likely have little to no impact on the overall health of the economy. However, the same loss in jobs in a small rural community may severely affect local economic conditions. Thus, when assessing the magnitude of impacts to employment and income across alternatives, it is important to keep in mind the relative importance of those economic factors to the specified analysis area.

Models of the local economy were built using IMPLAN Professional 2.0 software and 2006 data. IMPLAN models were then imported into the Forest Economic Analysis Spreadsheet Tool (FEAST), which is a Microsoft Excel-based workbook designed to describe the impacts to employment and income by resource program, major industry and planning alternative (http://fsweb_col.ewz.r6.fs.fed.us/epm/imisupplement/PEIA.htm).

A change in economic stimulus to a region (e.g., increased production of a natural resource) will likely have both direct and indirect outcomes to the region. Direct outcomes would include change in employment caused specifically by the change in the sector. In this case, an example would be additional workers to manage the increase in production.

"Indirect" effects are the changes in inter-industry purchases as they respond to the new demands of the directly affected industries. These may include increased business at facilities that process the resource and increases in service industries such as gas stations, grocery stores. Another type of indirect effect would be an "induced" effect where additional prosperity would lead to a change in spending habitats and a demand for new products or industries

Similar to the employment impacts, the total income in the study area will be affected according to the activities associated with each alternative. Total income is the sum of employee compensation, proprietors' income and other property income. Total income changes along with local employment levels. As reported in the case of employment impacts, income is generated through direct, indirect, and induced effects. Definitions for these effects remain the same as was stated in the employment impacts section above.

In the case of the alternatives being considered, both Alternatives C and D would allow for the same level of cattle grazing on the Preserve. Table 34 reports the forage allocated to cattle grazing in AUMs, as well as the expected return per AUM to the Trust. An AUM is the amount of forage required to feed a cow, or its equivalent, for 1 month (http://www.nv.blm.gov/range/AUMs/aums.htm). The financial returns to the Trust would come from payments received to graze cattle.

Recalling that under Alternative C the evaluation of programs for the multiple use of forage (primarily domestic livestock grazing) would consider relative benefits (see Chapter Two, 2.2 "Alternatives Analyzed in Detail") of a program as equitable to monetary return. Under Alternative D, the emphasis is on optimizing the market value of the forage. In 2007 and 2008, the Trust weighted the economic return from the forage over support to local communities and enhancing objectives on surrounding NFS land by a weighting factor of 30 percent versus 5 percent. Both seasons resulted in grazing by a single producer outside the socioeconomic impact area.

Traditionally cattle ranching operations in northern New Mexico are small family owned businesses(Raish and McSweeney 2003). In contrast, the returns to scale qualities of the larger operation allow them to bid a higher price for the forage. This was reflected in the response to the various programs offered under the interim grazing program and was used to estimate the price per AUM reported in Table 34.

Table 34 – Estimated Annual Returns

Estimated Annual Returns to the Trust for Domestic Livestock Grazing[22,23]			
Alternative C_1, C_2			
Fiscal Year	AUMs	$ per AUM	Total Return ($)
2009	6000	3	18,000
2010	6000	5	30,000
2011	6000	7	42,000
2012	6000	7	42,000
Alternative D_1, D_2			
Fiscal Year	AUMs	$ per AUM	Total Return ($)
2009	6000	13	78,000
2010	6000	17	102,000
2011	6000	23	138,000
2012	6000	23	138,000

As previously reported, economic impacts to the local economy originate from the circular flow of currency, and are reported as direct, indirect, and induced effects. How money is introduced into the economy alters the total economic impact of policy decisions. The economic stimulus generated by additional grazing would vary based on whether the stimulus was retained locally or returned to a community or region outside the socioeconomic impact area. For example, any profits earned by the nonlocal producer will likely leave the local area; whereas any profits earned by local producers will likely remain locally in the form of household income. That income may then be respent in the local economy creating additional economic stimulus. A nonlocal producer will likely purchase inputs to production (i.e., fuel) in the local area, thus there will likely still be some direct effects of program implementation whether or not forage is used by local producers. However, the resulting change in the structure of profits incurred locally is likely to produce differences in total economic impacts across the alternatives due to changes in the indirect and induced effects.

Income is generated from three different sources: employee compensation, proprietary income and other property income. Proprietary income is earnings from self employment, and would account for the profits earned by cattle producers grazing on the Preserve. In the case of local producers grazing on the Preserve, proprietary income would remain local and further generate indirect and induced effects as it circulates through the economy. However, if forage were to be used by a nonlocal producer, then that proprietary income would likely be lost. To account for

[22] Table 12 estimates the return 1,500 AUs grazing for 4 months (6,000 AUMs) actual capacity and duration of grazing season could vary.
[23] While Alternative 'B' allows up to 5% of the available forage to be utilized for domestic livestock grazing, use would emphasize research, education or recreation and may or may not occur annually.

the differences in economic impacts as a result of nonlocal versus local forage allocations, two regional economic models were built using IMPLAN software. Both models were constructed using 2006 data for Sandoval and Rio Arriba Counties. The first model utilizes the standard levels of income reported by IMPLAN for the ranching and farming sector, and accounts for spending by local producers. This model is used to estimate the economic impacts of Alternative C, under which grazing would likely to include a majority of local producers. To account for the lost proprietary income under Alternative D, where forage would likely be purchased by nonlocal producers, a second model is developed in which proprietary income is set to zero. Thus, any profits to the cattle rancher would not be included in the local economy. Model 2 is used to estimate the economic impact of Alternative D. Both models are imported into the FEAST spreadsheet, and regional economic impacts are estimated accordingly.

The results of the financial efficiency and jobs and income analyses are reported for each alternative in the direct and indirect outcomes sections below. A summary of the effects will be included to allow for easy comparison across alternatives.

Alternative A

Direct and Indirect Effects

There would be no direct effects on the economy in the two-county socioeconomic impact area if no action were to take place.

In terms of indirect effects on the local economy under the No Action Alternative, no estimate exists that allows for determination of changes in the local economic conditions. There would be no direct, indirect, and induced effects to local employment and income as measured by IMPLAN and FEAST. However, any change in environmental conditions as a consequence of implementing the No Action Alternative that alters the use patterns of the area may potentially affect total employment and income in the area. For example, changes in recreational expenditures occurring from a change in environmental conditions may affect the jobs and income. Current trends associated with recreational programs on the Preserve are likely to continue.

In addition, the debt present in the deferred maintenance needs of the ranch infrastructure and facilities would be retained.

Cumulative Effects

Given that there are no measurable direct and indirect socioeconomic effects that would occur under the No Action Alternative, there would also be no measurable cumulative effects.

Alternative B

Direct and Indirect Outcomes

As outlined in Chapter 2, Alternative B emphasizes the protection and preservation of natural resource and recreational and other relative values. Under this alternative, 95 percent of forage resources would be allocated to elk, other wildlife and ecosystem services; therefore, there would

no longer be commitments to annual programs for multiple use beyond those commitments made prior to this decision. It is assumed that livestock grazing and other uses of forage would be incidental and likely to support education, research or short-term drought relief or other purposes.

Alternative B addresses the deferred maintenance and other ranch infrastructure needs but does not address the deferred maintenance needs of facilities (Table 33). This alternative has a cost to benefit ratio of .10 and a NPV of -$387,431. The negative NPV reflects the deferred maintenance needs for ranch infrastructure assumed through federal acquisition. A negative NPV does not imply that the alternative is economically inefficient. In determining economic efficiency, all costs and benefits associated with the management activities should be taken into account. This includes those that may not directly be monetized or may increase future revenues in other resource programs; those of which are outside the scope of this analysis. Nonmarket benefits may include improved ecosystem health, increase in wildlife, improvement in recreation experiences, and a variety other effects not accounted for in the market place. Thus, the financial measures reported in this document should be considered along with any other social and ecological impacts associated with the management activities proposed under Alternative B.

The activities associated with Alternative B would require human power in the socioeconomic impact area. This would occur in the form of employment in the area. A detailed description of the direct and indirect impacts to employment and income is provided in the methodology section above. Overall, it is estimated that the activities associated with Alternative B would support 3.8 jobs and generate $86,686 in income within the socioeconomic impact area; a negligible effect overall. It is expected that the direct and indirect outcomes to employment under this alternative would be in the agriculture, construction, and retail sectors of the local economy. Table 41 and Table 42 in the summary section below reports the levels of income generated by sector for all proposed management alternatives.

While jobs and income generated are negligible within the socioeconomic impact area, the contribution may be meaningful in the context of an individual or community.

Cumulative Effects

Through the planning horizon, the Trust will be developing a comprehensive plan for public use and access as informed by a strategic business plan as well as a long-term plan for the management of forests and grassland ecosystems as informed by forest inventory and assessment. Until such plans are approved and implemented, other activities on the Preserve will likely to continue at a scale similar to the current level.

The reduction in livestock numbers could affect recreation management indirectly, by reducing negative impacts that can occur between livestock and recreation, and by reducing logistical issues associated with coordinating both livestock and recreation programs. Cumulatively, this could result in a simpler, more flexible, and more efficient recreation program, and increased visitor satisfaction.

Fishing, hunting, and wildlife viewing are some of the recreation activities that can be improved by reductions in grazing. In an article by Smith (2001) analyzing the effects of winter feeding of

elk, the economic benefits of maintaining more elk than diminished habitat could support is discussed. Smith states that one of the benefits of an increased elk herd are enhanced economic opportunities for outfitter/guides and other businesses benefiting from the consumptive and nonconsumptive use of wildlife. Thus, any additional increase in recreational visitation, such as elk hunting, is likely to provide economic stimulus to the local area in the form of visitor spending, and may generate more jobs and income for local residents. As stated above, recreational revenues are a substantial contributor to the self-sufficiency of the Preserve, and far exceed the revenues generated by the grazing program. It is likely that an emphasis on the recreational values would lead to increased revenues for the Preserve in the future.

Under Alternative B, maintenance and repair of infrastructure is limited, as that required to sustain a viable grazing program would no longer be required. Thus, beyond the planning horizon it is likely that annul operation and maintenance costs would be reduced. Grazing opportunities on land surrounding the Preserve are assumed to be unaffected by the alternative chosen. The alternatives analyzed in this report include actions on the Preserve only, thus assessing any forage allocations on adjacent public or private lands is outside the scope of this analysis. Under this alternative, only minimal and incidental additional grazing in the area would be supported on the Preserve, thus there would not likely be any change in the form of either benefits or costs to local cattle producers.

As reported in the Affected Environment section above, Sandoval and Rio Arriba counties have a large proportion of individuals in the working age group. Furthermore, both counties have an unemployment rate slightly higher than the state average. Any additional employment supported by the activities proposed under this alternative is likely to be filled by local residents and may serve to increase income in the area. Such increases are negligible in the context of the socioeconomic impact area; however, they can be meaningful in the context of individuals and individual communities.

Alternative C (C_1, C_2)

Direct and Indirect Effects

Under this alternative, programs for the multiple use of forage would be developed that balance, as practicable, the management goals from Section 108 of the Act. Relative, nonmonetary benefits and values would be given equitable consideration to that given to direct monetary returns. A total of 6,000 AUMs are considered per year for the 4-year planning horizon[24]. Under Alternative C_1 there is no deferred maintenance on outbuildings proposed; however, maintenance, repair, removal, and construction of fences and earthen tanks would occur as described in Chapter One, "Proposed Action," and listed in Table 33 above. The financial efficiency analysis conducted modeled a benefit-cost ratio of .29 and a NPV of negative $398,398. This value reflects the deferred maintenance on the ranch infrastructure.

[24] The actual number would depend on the annual program, current conditions, and balancing livestock grazing with other activities on the Preserve.

Alternative C_2 includes all the activities in Alternative C_1as well as improving and maintaining several out buildings in support of the program. Thus, as expected, the NPV becomes more negative, and the benefit-cost ratio becomes smaller in Alternative C_2. The NPV and Benefit-Cost ratio for all activities associated with Alternative C_2 is negative $-563,362 and 0.23, respectively as more of the deferred maintenance debt, acquired with the Preserve is addressed.

However, a negative NPV and/or a benefit-cost ratio less than one do not imply that the alternative is economically inefficient. In determining economic efficiency, all costs and benefits associated with the management activities should be taken into account. This includes those that may not directly be monetized or may change future revenues in other resource programs; those of which are outside the scope of this analysis. Nonmarket costs not accounted for in the financial efficiency measures may include deteriorated ecosystem health, reduction in wildlife, and a variety other effects not accounted for in the market place. Similarly, there may be benefits to local producers in the form of cultural values that are not reflected in the financial analysis conducted. Thus, the financial measures reported in this document should be considered along with any other social and ecological impacts associated with the management activities proposed under Alternative C.

Investments in infrastructure and facilities could also increase opportunities for future revenue generation. For example, the larger earthen tanks, once stabilized could be used in support of the Trust's recreation program by supporting picnicking or even flat-water fisheries. Improved facilities could contribute to the development of ranch oriented recreation activities, including horseback riding, educational activities, or other special events.

The activities associated with Alternative C_1 would require human power in the socioeconomic impact area. This would occur in the form of employment in the area. Overall, it is estimated that the activities associated with Alternative C_1 would affect 11.1, jobs in the socioeconomic impact area and add $170,215 into the local economy.

In addition to the activities associated with C_1, activities under Alternative C_2 include maintenance and improvement to facilities as described in Chapter One. These activities are modeled to add an additional $20,288 into the local economy with a total contribution modeled at $190,503.

Table 42 and Table 43 below show the expected distribution of direct, indirect, and induced income through all sectors of the economy across all alternatives. To put the numbers in perspective, the additions to the local economy need to be compared to the existing income as previously presented in Table 25. Such a comparison is made in Table

Table 35 – Estimated Change in Income

Estimated change in income under Alternative C relative to current.				
Current	C_1	% Change	C_2	% Change
$0,000	$170,215	.00005	$190,503	.00007
Source: IMPLAN (Minnesota IMPLAN Group, 2006);FEAST (USDA-Forest Service, 2008)				

Alternative C_1 or C_2 would be expected to have a negligible effect to the income in the context of the socioeconomic impact area. Programs developed under this alternative could have a meaningful effect in the context of individuals and possibly communities. This would be especially true for programs that benefited livestock producers within the socioeconomic impact area as indicated in the surveys conducted by Raish and McSweeney(2003).

Cumulative Effects

Management activities on the Valles Caldera National Preserve have impacts on the economic conditions of local communities through changes in employment and income. Such modifications to local employment and income may be stimulated directly by the labor required to accomplish the management activities, as well as indirectly through changes in inter-industry and household purchases in response to any direct change in the composition of an industry. It is likely, however, that other projects occurring in the region will also affect local employment and income conditions. The cumulative impact on the economic environment is the total effect resulting from the incremental impact of the actions considered in the proposed Stewardship Action when added to other past, present and reasonably foreseeable future actions in the area regardless of the party undertaking the actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over the planning horizon (40 CFR 1508.7).

In the case of Alternative C, forage on the Preserve would be more likely to benefit local producers and could enhance the management objectives on surrounding NFS land. Given that the majority of cattle ranchers in Sandoval and Rio Arriba Counties manage small operations, it is likely that multiple producers will be allowed to graze on the Preserve. The activities associated with this alternative stimulate both employment and income in the local area through the direct, indirect, and induced effects as described above. The impacts to employment and income associated with Alternative C of the proposed Stewardship Action would be in addition to those impacts created by other projects occurring in the same region during the planning horizon. Management of the Preserve and surrounding lands requires actions in a variety of resource programs.

Through the planning horizon, the Trust will be developing a comprehensive plan for public use and access as informed by a strategic business plan as well as a long-term plan for the management of forests and grassland ecosystems as informed by forest inventory and assessment. Until such plans are approved and implemented, other activities on the Preserve will likely to continue at a scale similar to the current level.

Present and reasonably foreseeable actions in addition to the proposed action would include: facilities and infrastructure management, water systems management, communications systems development, and maintenance of existing roads and trails. Traffic on New Mexico Highway 4 (NM 4) is expected to increase by 2 percent to 5 percent annually (Mid-Region Council of Governments of New Mexico n.d.). Given the additional traffic in the area, the Preserve may experience an increase in demand for visitation. This may initiate future projects on the Preserve to accommodate a change in the allowable visitation rate. In addition, fishing along the East Fork Jemez River is expected to become a core activity on the Preserve, increasing the need for

management of the fisheries resource. In addition to the activities occurring on the Preserve, the Santa Fe National Forest has ongoing and future projects occurring in the local area. Projects on the Santa Fe National Forest include environmental analyses for various range allotments and travel management; however, there is not a substantial change in the number of people or animals proposed.

The previously mentioned projects and programs would have implications for the condition of the local economic environment. The actions discussed would likely support additional jobs and income in the local region. Any estimated change in economic conditions associated with Alternative C would be in addition to those created by projects occurring simultaneously in the region. Thus, cumulatively there is likely to be additional employment and income supported in the area. It is unlikely, however, that the cumulative impacts of such projects would result in an adverse effect on the local economy since additional jobs and income in the region are typically viewed as economic benefits.

Not accounted for in this analysis are any additional changes in revenues and/or nonmarket benefits or costs associated with changes in any of the other resource programs supported by the Trust. Cattle grazing on the Preserve can conflict with other programs such as wildlife and recreation; especially fishing. As stated above, recreational revenues are a substantial contributor to the self sufficiency of the Preserve, and far exceed the revenues generated by the grazing program.

The linkage between the grazing and recreation programs on the Preserve is not yet quantified. Some reasonable assumptions can be made based on feedback received from anglers during the interim grazing program. From 2003 through 2007, the numbers of livestock ranged from 200 to a maximum of 703. When grazing the pastures near the designated fishing areas, a few of the animals would stray into the fishing beats, prompting occasional phone calls and complaints. In 2008, the Trust supported 1,960 head of cattle on the Preserve. Range riders were generally only successful in controlling the distribution of about ¾ of the herd with several hundred cattle impacting the fishing program on a daily basis for about a one month period. This prompted at least a dozen heated complaints in writing, as well as general dissatisfaction reported by returning anglers (Larry Sellers, personal communication, recreation staff, July 2008) and numerous phone calls. Many anglers stated they would not return to fish on the Preserve. One complaint in writing was copied to various tackle specialty shops and fishing organizations. While the optimum balance between livestock and recreation cannot be quantified at this time, it can be assumed that the distribution and intensity of cattle grazing needs to be carefully managed to avoid adversely affecting the value of recreation in the valles.

Under Alternative C_1, a certain level of maintenance and repair of infrastructure is required to sustain a viable grazing program, and Alternative C_2 includes additional maintenance and repairs on facilities. These improvements will need to be maintained beyond the planning horizon. Grazing opportunities on lands surrounding the Preserve are assumed to be unaffected by the alternative chosen. The Santa Fe National Forest is a major contributor to forage allocated to grazing in the area. In 2007, the total permitted commercial cattle grazing on the Forest was 93,663 AUMs. Any change in grazing on the Santa Fe National Forest would be assumed to be

independent of the actions being proposed. If this alternative lead to a redistribution of a small percent of the AUMs currently being grazed in the socioeconomic impact area, it could result in improvements to surrounding USFS allotments that could in turn, could indirectly benefit individual local producers.

Also difficult to quantify is the cumulative effect that potential benefits to local communities and enhancing the management objectives on surrounding NFS land could have on the local support for the Trust and management of the Preserve. The analysis estimates the economic contributions that activities on the Preserve could provide to local economies. Less quantifiable is the economic return to the Trust resulting from support from local communities.

As reported in the "Existing Conditions" section above, Sandoval and Rio Arriba counties have a large proportion of individuals in the working age group. Furthermore, both counties have an unemployment rate slightly higher than the state average. Any additional employment supported by the activities proposed under this alternative would likely be filled by local residents and may serve to increase income in the area.

Alternative D (D_1, D_2)

Direct and Indirect Effects

Under this alternative, opportunities to graze would be awarded based optimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the MUSY capability of the land.

As under Alternative C, a total of 6,000 AUMs are estimated per year for the 4-year planning horizon under Alternative D, recognizing that this number could vary based on actual conditions. Although not a large amount of forage is allocated to multiple uses under this alternative, it is substantial enough that if it was allocated to one producer, it would take a large scale operation, relative to local producers, to consume all the forage. Managing a single large herd of yearlings is the program that is assumed to best optimize the market value of the Preserve's forage. Both prior to and following federal acquisition, this type of program has brought in producers from outside the two-county analysis area. It is unlikely that local producers would play a significant role, in this high market program. Both the scale of operation and geographic constraints (lack of winter range) are limiting to producers within the socioeconomic impact area.

Under Alternative D_1 there is no deferred maintenance on outbuildings scheduled; however, there is maintenance, repair, removal, and construction of fencing, as well as maintenance of earthen tanks proposed. Table 33 above reports the schedule of activities to occur under each alternative during the 4-year planning horizon. The financial efficiency analysis conducted accounts for the monetarily valued benefits and costs associated with the alternative. Typical benefits accounted for in the financial efficiency analysis include the returns to the Trust in the form of revenues generated in exchange for the use of forage. Thus, the NPV is the discounted sum of all monetarily valued benefits and costs associated with Alternative D_1 activities.

Given the economies of scale of a large cattle operation, the Trust would expect receive more per AUM for the grazing permits than they would receive from smaller producers. This allows for

the maximum financial return to the Trust for the grazing program to be generated. A second financial efficiency measure estimated for this alternative is a benefit-cost ratio, which is the discounted sum of benefits divided by the discounted sum of costs. The NPV and Benefit-Cost ratio for all activities associated with Alternative D_1 for the 4-year planning horizon, is $48,716 and 1.09, respectively. While not a significant measure of efficiency, it reflects not only income to the Trust but reflects a positive measure of efficiency after addressing the deferred maintenance needs of the connected ranch infrastructure.

The NPV and cost-benefit ratio return to the negative under Alternative D_2 – negative $116,248 and .84, respectively – as investments are made to address the deferred maintenance needs and improvements to facilities.

In determining economic efficiency, all costs and benefits associated with the management activities should be taken into account. This includes those that may not directly be monetized or may change future revenues in other resource programs; those of which are outside the scope of this analysis. Nonmarket costs not accounted for in the financial efficiency measures may include deteriorated ecosystem health, reduction in wildlife, and a variety other effects not accounted for in the market place. Thus, the financial measures reported in this document should be considered along with any other social and ecological impacts associated with the management activities proposed under Alternatives D_1 and D_2.

The activities associated with Alternative D would require human power in the socio-economic analysis area. This would occur in the form of employment in the area. A detailed description of the direct and indirect impacts to employment and income is provided in the methodology section above. Overall, it is estimated that the activities associated with Alternative D_1 would have a similar negligible impact to the socio-economic impact areas as reported for Alternative C_1, supporting 11 jobs in the two-county analysis area, and $170,208 in income. Alternative D_2 is modeled to have a slight increase in income at $190,326 and a slight increase in employment at 11.5. As displayed in Table 40, most of the employment supported by this alternative would be in the agriculture sector with smaller impacts to the construction, retail, real estate, and science and technology sectors.

The effects to overall employment and income within the context of the socioeconomic impact area would be negligible and similar in scale to Alternative C. While contributions under Alternative C could be meaningful in the context of individuals or communities, such contributions are unlikely under Alternative D.

Implementation of Alternative D could stimulate spending in a variety of economic sectors to purchase the goods and services necessary to conduct the proposed activities and facilitate the additional cattle grazing in the area; this would result in additional direct income in the area. Given the likely engagement with a single producer from outside the two-county area, under this alternative, any profits earned by the producer would leave the local area and become part of household income in the producer's county of residence. Thus, that money no longer would be able to contribute to the economic growth of the socio-economic analysis area. However, inputs to production would likely be purchased from within the local area, and additional spending would then occur in response to the direct activity in the local economy as firms purchase the

inputs required to meet increased demand. This would result in additional income generation through the indirect effects. Income would be generated in a variety of economic sectors; most affected would be the construction sector, followed by the agriculture, government and retail trade sectors. Table 41 and Table 42 in the summary section below reports the levels of income generated by sector for all proposed management alternatives.

Cumulative Effects

Cumulative effects within the socio-economic impact area under this alternative would be similar in context and intensity to those described under Alternative C. Benefits that would be meaningful at the individual or community level are not likely to be realized. No cumulative effect or change to the existing condition in the context of the individual or community is likely to result from the implementation of this alternative.

As conditions in the surrounding region continue to be affected by elk, climate, competition from increasing recreational pressures and other factors; lack of grazing opportunities available on the Preserve my contribute to an overall decrease in support for the Preserve and Trust. While difficult to quantify, it is reasonable based on a review of public comment.

Comparison across Alternatives

Tables 36 through 44 summarize the financial efficiency measures and impacts to jobs and income across all alternatives.

Financial Efficiency

The financial efficiency measures reported in the description of effects for each alternative include NPVs and benefit-cost ratios. Table 36 reports the results for each alternative side by side for easy comparison.

Table 36 – Economic Measures

Comparable Economic Measures Across Alternatives						
Economic Measure	**A**	**B**	**C_1**	**C_2**	**. D_1**	**D_2**
Benefit Cost Ratio	N/A	0.10	0.29	0.23	1.09	0.84
Net Present Value ($)	N/A	-387,431	-398,398	-563,362	48,716	-116,248
Source: Quicksilver (USDA-Forest Service, 2008)						

The figures provided in Table 36 serve as measures of the financial efficiency of the proposed alternatives. Specific welfare criteria may affect the determination of the preferred alternative. The decision maker should assess the results of each alternative separately and take into account any secondary ecological and social impacts associated with the alternatives. The Benefit-Cost ratios and NPVs presented above are based on the financial information provided by the Valles Caldera Trust. The data provided does not allow for the quantitative valuing of secondary

impacts. Thus, the financial measures provided here should be balanced with any expected ecological and social impacts associated with the alternatives.

Concerning financial efficiency, quantitative indicators are measured in terms of the monetarily valued costs and benefits associated with the proposed management activities. A variety of costs are associated with the proposed Stewardship Action; those costs include: fence removal, fence maintenance, fence repair, fence construction, deferred maintenance for outbuildings, and maintenance and repair of earthen tanks. The benefits associated with the project are in the form of revenues from the fees paid for grazing. In terms of the financial efficiency of alternatives, Alternatives B, C^1, C^2, and D^2 report negative NPVs. Negative NPV do not imply that they are economically inefficient. In determining economic efficiency, all costs and benefits associated with the management activities need to be considered. This includes those that may not directly be monetized; quantitative analysis of such values is outside the scope of this analysis. Nonmarket costs and benefits may include the ecological, recreational, and social values qualitatively discussed above or in other sections of this EA. Thus, the financial measures reported in this document should be considered along with any other social and ecological impacts associated with the management activities.

In addition, the negative NPVs result from the deferred maintenance costs associated with infrastructure and facilities; rather than the inefficiency of any domestic livestock grazing program. All programs for domestic livestock grazing would be required to return income to the Trust greater than or equal to operational costs. Deferred maintenance activities could be supported through grants (Youth Conservation Corps, Clean Water Act and others), in exchange for grazing opportunities, through volunteer projects, or means other than direct payment.

Employment and Income

The following analysis summarizes the effects across on employment and income in the socioeconomic impact area. Modeled impacts to employment and income are direct, indirect, and induced effects as defined above. The total impact to employment or income is the sum of the direct, indirect, and induced effects. Table 37 reports the total employment impacts by alternative. Interestingly, all the grazing alternatives would support the similar level of jobs in the local area if implemented. Thus, the any additional economic stimulus provided by the grazing scenarios with infrastructure (Alternatives C_2 and D_2) would not likely increase local employment more than the case of no infrastructure (Alternatives C_1 and D_1). Similarly, the nonlocal and local grazing allocations are likely to support the same levels of employment in the local economy. Total AUMs allocated to cattle are the same under all grazing alternatives, the inputs to production are likely to be similar, thus creating similar levels of economic stimulus in the local economy. The local circulation of money under Alternative C is offset by the greater amount of money in Alternative D. Forage allocations are likely not enough to ignite the migration of new ranching operations into the local economy under the local grazing alternatives; existing producers may expand their operations to consume the additional forage in the area. Similarly, under the nonlocal grazing alternatives, the operator would not be considered as a new employee in the local economy since his/her place of residence would still be elsewhere. However, nonlocal producers would still be likely to purchase inputs to production locally, and may hire additional

help from the local labor market as needed. All modeled outcomes are negligible in the context of total income and employment within the socioeconomic impact area.

Table 37 – Influence on Total Employment

Impact to Total Employment by Alternative					
A	B	C_1	C_2	D_1	D_2
0	3.8	11.1	11.5	11.1	11.5
Source: IMPLAN (Minnesota IMPLAN Group, 2006) and FEAST (USDA-Forest Service, 2008)					

Table 38 and Table 39 report the direct and indirect employment impacts in the local area that would be stimulated by implementation of each of the alternatives. The sum of the direct and indirect effects is the total impact to employment reported above. Nearly all jobs supported by the management alternatives analyzed are in either the agriculture or construction sector. Even though the actions stimulate spending in a variety of other economic sectors, the spending may not be enough for firms in those sectors to increase employment. However, that spending will be reflected in the impacts to income reported Table 42 and Table 43 below.

Table 38 – Employment Impacts

Direct and Indirect Employment Impacts Across Alternatives A, B, and C						
	A		B		C	
Sector	Direct	Indirect & Induced	Direct	Indirect & Induced	Direct	Indirect & Induced
Agriculture	0	0	1.6	0.6	6.3	2.3
Mining	0	0	0.0	0.0	0.0	0.0
Utilities	0	0	0.0	0.0	0.0	0.0
Construction	0	0	0.9	0.3	1.2	0.4
Manufacturing	0	0	0.0	0.0	0.0	0.0
Wholesale Trade	0	0	0.0	0.0	0.0	0.0
Transportation & Warehousing	0	0	0.0	0.0	0.0	0.0
Retail Trade	0	0	0.1	0.0	0.1	0.1
Information	0	0	0.0	0.0	0.0	0.0
Finance & Insurance	0	0	0.0	0.0	0.0	0.0
Real Estate & Rental & Leasing	0	0	0.0	0.0	0.0	0.1
Prof, Scientific, & Tech Services	0	0	0.0	0.0	0.0	0.1
Management of Companies	0	0	0.0	0.0	0.0	0.0
Admin, Waste Mngt & Removal Services	0	0	0.0	0.0	0.0	0.0
Educational Services	0	0	0.0	0.0	0.0	0.0

Health Care & Social Assistance	0	0	0.0	0.0	0.1	0.1
Arts, Entertainment, and Recreation	0	0	0.0	0.0	0.0	0.0
Accommodation & Food Services	0	0	0.0	0.0	0.0	0.0
Other Services	0	0	0.0	0.0	0.0	0.0
Government	0	0	0.0	0.0	0.0	0.0
Total	0	0	2.7	1.0	7.8	3.3
Source: IMPLAN (Minnesota IMPLAN Group, 2006) and FEAST (USDA-Forest Service, 2008)						

Table 39 – Direct and indirect employment impacts across alternatives C_2, D_1, and D_2

Direct and Indirect Employment Impacts Across Alternatives C_2, D_1, and D_2						
	C_2		**D_1**		**D_2**	
Sector	**Direct**	**Indirect & Induced**	**Direct**	**Indirect & Induced**	**Direct**	**Indirect & Induced**
Agriculture	6.3	2.3	6.3	2.3	6.3	2.3
Mining	0.0	0.0	0.0	0.0	0.0	0.0
Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Construction	1.4	0.5	1.2	0.4	1.4	0.5
Manufacturing	0.0	0.0	0.0	0.0	0.0	0.0
Wholesale Trade	0.0	0.0	0.0	0.0	0.0	0.0
Transportation & Warehousing	0.0	0.0	0.0	0.0	0.0	0.0
Retail Trade	0.1	0.1	0.1	0.1	0.1	0.1
Information	0.0	0.0	0.0	0.0	0.0	0.0
Finance & Insurance	0.0	0.0	0.0	0.0	0.0	0.0
Real Estate & Rental & Leasing	0.0	0.1	0.0	0.1	0.0	0.1
Professional, Scientific, & Technical Services	0.0	0.1	0.0	0.1	0.0	0.1
Management of Companies	0.0	0.0	0.0	0.0	0.0	0.0
Administrative, Waste Management & Removal Services	0.0	0.0	0.0	0.0	0.0	0.0
Educational Services	0.0	0.0	0.0	0.0	0.0	0.0
Health Care & Social Assistance	0.1	0.1	0.1	0.1	0.1	0.1
Arts, Entertainment, and	0.0	0.0	0.0	0.0	0.0	0.0

Recreation						
Accommodation & Food Services	0.0	0.1	0.0	0.0	0.0	0.1
Other Services	0.0	0.0	0.0	0.0	0.0	0.0
Government	0.0	0.0	0.0	0.0	0.0	0.0
Total	8.1	3.4	7.8	3.3	8.1	3.4
Source: IMPLAN (Minnesota IMPLAN Group, 2006) and FEAST (USDA-Forest Service, 2008)						

Table 41 summarizes the estimated change in total income in the analysis area across alternatives. An increase in income would occur under all action alternatives. The total estimated impact on local income ranges from $86,686 under Alternative B, to $190,503 under Alternative C_2. The alternatives with infrastructure would generate more income than those alternatives without infrastructure due to the additional economic stimulus provided by the deferred maintenance for outbuildings. Also, the impact on total income would be less under Alternatives D_1 and D_2 where it would be expected that income would quickly leave the socio-economic analysis area. This is due to the treatment of profits as explained in the methodologies section above. Profits for the ranching operations appear as proprietor's income in the models constructed of the local economy. In the case of grazing by a nonlocal producer, those profits would leave the area and not be accounted for in local household income. Alternative C is likely to include greater participation by producers from within the socioeconomic impact area. Any profits so earned would remain in the local economy, and may be respent on local goods and services. Thus, as expected, the impacts to income associated Alternative C are greater than the impacts to income under the same management activities under Alternative D. The differences in income between the two scenarios are very small, likely due to the fact that margins in the cattle ranching business are small, and profitability is low. The difference in the models used to estimate the economic impact for Alternatives D is that proprietor's income was set to zero (i.e., it would not stay in the local economy). Given the difference in models, the impact to local income is estimated to be slightly different. All impacts are negligible in the context of income within the socioeconomic impact area.

Table 40 – Impact to Total Income (Minnesota IMPLAN Group 2006)

Impact to Total Income by Alternative					
A	**B**	**C_1**	**C_2**	**D_1**	**D_2**
0	$86,686	$170,215	$190,503	$170,038	$190,326
Source: IMPLAN (Minnesota IMPLAN Group, 2006) and FEAST (USDA-Forest Service, 2008)					

Table 41 and Table 42 report the direct and indirect impacts to income in the socioeconomic impact area that would be stimulated by implementation of the alternatives. Although the primary activities associated with the grazing and repair/maintenance of infrastructure lie within the Agriculture and Construction sectors, they also stimulate direct and indirect spending in a variety of other sectors, which affects total income in the area. For example, activities associated

with Alternative C are estimated to directly increase income in the Accommodation and Food Services industry by $710. In addition to that $710, another $933 is generated in the Accommodation and Food Services sector in response to the increased inter-industry purchasing resulting from the increased demand for the output of the directly affected industries, as well as the increased expenditures from households due to the increase in local income (i.e., the indirect and induced effects). Thus, the estimated total income supported in the Accommodation and Food Services industry as a result of the activities proposed under Alternative C is the sum of the direct, indirect and induced effects, or $1,643. Similar impacts are estimated to occur in many of the other sectors in the local economy.

Table 41 – Impacts to Direct and Indirect Income (Alternatives A, B, and C_1)

Direct and Indirect Income Impacts Across Alternatives						
	A		**B**		**C_1**	
Sector	Direct	Indirect/ Induced	Direct	Indirect/ Induced	Direct	Indirect/ Induced
Agriculture	$0	$0	$4,969	$7,549	$19,614	$30,107
Mining	$0	$0	$104	$214	$140	$768
Utilities	$0	$0	$195	$364	$266	$1,296
Construction	$0	$0	$38,561	$12,641	$51,497	$18,525
Manufacturing	$0	$0	$651	$339	$1,423	$904
Wholesale Trade	$0	$0	$268	$355	$433	$1,210
Transportation & Warehousing	$0	$0	$292	$286	$435	$907
Retail Trade	$0	$0	$2,222	$1,170	$3,297	$2,888
Information	$0	$0	$299	$245	$408	$732
Finance & Insurance	$0	$0	$807	$893	$1,115	$2,908
Real Estate & Rental & Leasing	$0	$0	$588	$1,846	$794	$6,895
Prof, Scientific, & Tech Services	$0	$0	$412	$654	$571	$2,278
Management of Companies	$0	$0	$15	$8	$22	$22
Admin, Waste Mngt & Removal Services	$0	$0	$385	$350	$531	$1,085
Educational Services	$0	$0	$140	$84	$187	$218
Health Care & Social Assistance	$0	$0	$1,265	$754	$1,680	$1,964
Arts, Entertainment, and Recreation	$0	$0	$114	$72	$164	$193
Accommodation & Food Services	$0	$0	$529	$343	$710	$933
Other Services	$0	$0	$471	$411	$626	$1,253

Government	$0	$0	$3,453	$2,369	$4,607	$6,607
Total	$0	$0	$55,739	$30,946	$88,522	$81,692
Source: IMPLAN (Minnesota IMPLAN Group, 2006) and FEAST (USDA-Forest Service, 2008)						

Table 42 – Impacts to Direct and Indirect Income (Alternatives C_2, D_1, and D_2)

Direct and Indirect Income Impacts Across Alternatives						
	C_2		**D_1**		**D_2**	
Sector	Direct	Indirect /Induced	Direct	Indirect /Induced	Direct	Indirect /Induced
Agriculture	$19,677	$30,133	$19,569	$30,038	$19,632	$30,064
Mining	$169	$780	$140	$767	$169	$779
Utilities	$322	$1,319	$266	$1,293	$322	$1,317
Construction	$61,697	$22,731	$51,497	$18,523	$61,697	$22,730
Manufacturing	$2,032	$1,155	$1,423	$903	$2,032	$1,154
Wholesale Trade	$564	$1,264	$433	$1,207	$564	$1,261
Transportation & Warehousing	$548	$953	$435	$905	$548	$952
Retail Trade	$4,146	$3,238	$3,297	$2,884	$4,146	$3,234
Information	$494	$768	$408	$731	$494	$766
Finance & Insurance	$1,359	$3,008	$1,115	$2,902	$1,359	$3,002
Real Estate & Rental & Leasing	$957	$6,962	$794	$6,880	$957	$6,947
Prof, Scientific, & Tech Services	$697	$2,330	$571	$2,273	$697	$2,325
Management of Companies	$28	$24	$22	$22	$28	$24
Admin, Waste Mngt & Removal Services	$647	$1,132	$531	$1,083	$647	$1,130
Educational Services	$223	$233	$187	$218	$223	$233
Health Care & Social Assistance	$2,008	$2,099	$1,680	$1,961	$2,008	$2,096
Arts, Entertainment, and Recreation	$202	$209	$164	$193	$202	$209
Accommodation & Food Services	$853	$992	$710	$931	$853	$990
Other Services	$749	$1,304	$626	$1,251	$749	$1,301
Government	$5,517	$6,983	$4,607	$6,596	$5,517	$6,971
Total	$102,887	$87,616	$88,478	$81,560	$102,842	$87,484
Source: IMPLAN (Minnesota IMPLAN Group, 2006) and FEAST (USDA-Forest Service, 2008)						

Overall, the activities associated with the proposed Stewardship Action are not likely to have major economic implications for local communities. Even relative to the small, rural communities in Sandoval and Rio Arriba Counties, the estimated changes in employment and income would be considered negligible in the context of the economic environment of the analysis area. Given the higher unemployment rates in the local region, relative to the state of New Mexico, new jobs created from the management activities would likely be filled by local residents; thus, household migration patterns should not experience any changes. Any impacts to local communities should be positive in the form of lower unemployment and greater local income. However, the direct and indirect effects on employment and income, as well as the financial efficiency measures estimated in this analysis should be carefully considered along with any social and ecological impacts and the overall objectives of the policy.

3.6.3. Environmental Justice

As stated in Executive Order 12898, it is required that an analysis of federal actions consider the potential of disproportionate effects on minority and low-income populations in the local region. The principals of Environmental Justice require agencies to address the equity and fairness implications associated with federal actions. The Council on Environmental Quality (CEQ) (1997) provides the following definition to provide guidance with the compliance of Environmental Justice requirements:

- "Minority population: Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.."

According to the US Census data reported in Table 23 above, 72.9 percent of the population in Rio Arriba County identifies themselves as Hispanic or Latino. Thus, according to CEQ (1997), minority populations in the socioeconomic impact area should be identified and considered under the Environmental Justice criterion.

Table 43 reports the proportion of families below the poverty level by county in the Valles Caldera Economic Analysis Area.

Table 43 – Poverty Levels

Poverty Levels by County	
Location	**Percent Below Poverty Level**
Sandoval County	9.0%
Rio Arriba County	16.6%
New Mexico	14.5%
US Census 2000	

The Environmental Justice principles set forth in Executive Order 12898 and CEQ (1997) were considered in regards to the proposed Stewardship Action. Alternatives were reviewed to determine whether or not the proposed actions adversely impact minority and low-income populations. The alternatives do not differ from one another in terms of adverse impacts, and it is has been determined that there should not be any disproportionate impacts to minority or low income groups as a result of the proposed Stewardship Action decision. Impacts to local communities are expected to be negligible, and there is no reason to suspect that any impacts will disproportionately affect minority and low income populations. The actions associated with the alternatives are not expected to yield a negative impact to jobs and income, and may support additional employment and income in the region; from which, minority and low-income populations may benefit. Any grazing allowed under the grazing plan will either be in addition to or a redistribution of that currently permitted on federal lands in the local area; therefore, there should be no adverse effects to minority and low-income populations relative to the existing conditions. Given the proportion of Hispanic or Latino population in the area, it is likely that they would benefit from any job and income creation under the chosen alternative.

3.7 Sensory Resources

3.7.1 Affected Environment/Existing Condition

Sensory resources (the sight, sounds, and the sense of place experienced on the Preserve) are what the public values most about the Preserve (The Mary Orton Company 2007). Sensory resources have a direct relationship with the natural and cultural resources of the Preserve. They are the values and significance of personal experience realized through vision, sound, touch, smell, taste, and feelings about a particular landscape or setting. It is the human senses that solidify the memories of life-changing and emotionally stirring events and experiences. The real value of the experience grows in post-experience recollection. Interpretation plays an important role with sensory resources – the promotion and awareness of the resource message, the natural and built setting for the promotion and awareness of these resources to visitors, and how the message about these resources are conveyed to the visitors. This concept, first quantified in the 1970s, is now recognized as a critical concept in managing and marketing leisure activities (Crompton 2008).

Visual Resources

The Valles Caldera sits atop the Jemez Mountain in north-central New Mexico. The Jemez Mountains are surrounded by a high desert of sagebrush, rabbit brush, juniper, and pinion pine. This high desert landscape is accentuated by leveled mesas and the dramatic canyons of the Rio Grande. The Jemez Mountains rise out of this landscape (Figure 54) to a height of 11,254 at Redondo Peak. As the elevation increases, the vegetation changes to ponderosa pine, mixed conifers, aspen, and spruce-fir forests. The mountains are a different visual experience than the more arid landscape of the lower elevations. The valles of the Preserve are extensive, naturally subirrigated meadows and lush grasslands framed by soft rolling hills covered with evergreens, which creates a visually attractive landscape somewhat unique to the region.


STS090-755-75

Figure 54 – The Valles Caldera (Image courtesy of the Image Science & Analysis Laboratory, NASA Johnson Space Center, http://eol.jsc.nasa.gov)

This landscape also incorporates the human footprint. Historically, this is a working landscape; it experienced various resource extraction and ranching activities that resulted in unnatural visual elements that are now part of this place. Arrow-straight fence lines shooting across the grasslands and cabins, huddled together along the edges of evergreen forests and grasslands, create subtle foci. Stock tanks dot the landscape, and flattened well drilling pads sit on canyon slopes. Roads cutting across the valles and spiraling up the forested domes occupy 12 to 14 linear miles per square mile of land.

Since federal acquisition, the scenery of the Preserve has begun to change. There have been temporary negative effects by the concentration of portable buildings and vehicles in the Valle Grande Staging Area. However, this contact station is temporary while the Trust completes planning to determine where facilities should be located for long-term management of the Preserve. There have also been positive effects as ecological conditions improve. Roads have been improved to provide safe access and to reduce the impacts to natural resources, especially hydrology (Valles Caldera Trust, 2007). However, such improvements have increased the degree to which the roads stand out from the existing landscape.

Cleanup of accumulated ranch debris has been undertaken around the headquarters area while landscaping surrounding the historic cabins has been allowed to "go natural" as the Trust defines the linkages between the cultural and natural landscape to ensure that maintenance activities do not inadvertently affect the cultural values, now protected by law.

Overall, the changes, both positive and negative, have not significantly changed the visual characteristic of the Preserve.

Sense of Sound

Most people remark on the natural soundscape of the Preserve and consistently identify it as a value to be protected (Valles Caldera Trust, 2002). The valles absorb sound, and the quiet is palatable. The sound of NM 4 is not audible beyond 200 to 300 feet from the highway.

The natural soundscape of the Preserve includes the sound of nature, unusually discernable from the changing song of the wind to the single call of bird or animal. Sound in the Preserve is carried and absorbed in a notable way.

Sense of Place

While not readily quantified, there is no doubt in the collective mind of the Trust that the physical landscape of the Valles Caldera evokes an intense emotion and sense of place among stakeholders. Some identify it as "the other side of the fence," a place from which they have been long excluded, the Bali Ha'i of the Jemez.

While people share the history of exclusion, what they desire to do on the Preserve varies greatly. The Preserve is a Mecca for learning about geology, history, and archaeology. Some visitors simply want to stand either in the middle of the Valle Grande or on top of Redondo Peak. People have purchased from $200,000 to over $400,000 in lottery tickets annually since federal acquisition, hoping for a chance to hunt elk, turkey, or to fish on the Preserve.

Local livestock producers have long eyed the grasses of the Preserve, wanting to share in the history of their parents, grandparents, or even great grandparents who grazed their own livestock in the days of the Partido.

To the people of Jemez Pueblo, federal acquisition has marked their return to traditional sites and their own unique sense of place in the landscape.

The natural, historic, and cultural aspects of landscape all combine provocatively, affecting the hearts and minds of people in varying ways.

3.7.2 Environmental Consequences

Alternative A

Visual Resources

Implementation of the No Action Alternative would not have a direct measurable effect on the visual resources of the Preserve. Routine maintenance, categorically excluded from documentation under NEPA, would continue. Without a coordinated effort to remove, relocate, replace, and maintain the fences of the Preserve, much of the interior fences would continue in a state of disrepair. Poorly located fences and tanks would continue to cause resource damage with evidence of erosion creating localized adverse effects.

Some visitors would miss the sight of cattle on the ranch; most would not notice the loss judging from the feedback obtained through public workshops (The Mary Orton Company 2007). During these workshops people identified the "natural" scenery as their most valued aspect of the Preserve. Many also cited the historic landscape as very important. Several historic tours are currently being offered on the Preserve. The continued presence of cattle was not identified as important or desirable to the degree that the "pristine" or "natural" beauty was mentioned.

Prior to 2008, the conservative grazing programs were occasionally visible to visitors but were not a dominant feature of the landscape. In 2008, the Trust, for the first time, approached cattle numbers identified at the upper limit of the interim grazing program. Under this more intensive operation, cattle were a dominant characteristic in the upper and lower San Antonio Creek. Most visitors responded negatively to this intensity of grazing (Valles Caldera Trust, 2008).

Sense of Sound

Changes to the sounds of the Preserve would be negligible.

Sense of Place

By selecting the No Action Alternative the Trust would bring a de facto ending to the operation of ranching activities as they have occurred on the Preserve for over a century and a half. This would bring about a change to the "sense of place" for many people, leaving the working ranch as a part of the Preserve's history and not its future. The intensity of the change would vary from negligible to some to a more intense effect to others. Whether this change was positive or negative would also depend on the individual.

Local livestock producers and members of their community would likely develop a negative "sense of place" regarding the Preserve inferred by a review of comments received at various public meetings (The Mary Orton Company 2007, Moreno 2007).

Alternative B

Visual Resources

While the no action alternative would allow working ranch infrastructure (fences and earthen tanks) to fall into disrepair, under this alternative infrastructure that does not serve the overall protection of resources and security of the Preserve would be removed and rehabilitated. These activities would create localized, short-term visual impacts, which would fade into the natural setting over time. Fences that bisect the valles, as well as gates and cattle guards would be removed creating a more natural viewscape as compared to the working ranch viewscape. In the long term, such change would not be apparent to most observers. The working ranch history represented in the buildings and cabins of the historic Headquarters District (Figure 55) and San Antonio cabin would be retained in the visual landscape.

Figure 55 – Historic "Salt Barn" and Corral located in the Headquarters District

Sense of Sound

Changes to the sounds of the Preserve would be minor, short-term, and localized.

Sense of Place

By selecting this alternative, the Trust would minimize ranching activities as they have occurred on the Preserve for over a century and a half. This may bring about a change to the "sense of place" for many people, as the working ranch becomes less dominant and more of a historic activity than contributing to the present character.

Under this alternative, the working ranch infrastructure would be removed and maintained in a considered manner, in keeping with the perceived ethic of a well-maintained ranch. A small portion of the available forage could be allocated for domestic livestock grazing programs for scientific, educational, recreational, or other public or commercial purposes. While such programs do not constitute the continuation of a working ranch in the historic sense, they can serve to continue the "sense of place" connection to the Preserve's working ranch history.

Alternative C

Visual Resources

Under this alternative, there would not be any measurable change to the visual resources of the Preserve. Annual programs for domestic livestock grazing would continue similar in scale as under the interim grazing program.

Improvements to the ranching infrastructure would be likely to have short-term and localized effects. Fences, gates, cattle guards, and other infrastructure would continue to contribute to the visual theme of the Preserve as a working ranch.

Indirectly, the Preserve would become a "part" of the surrounding NFS landscape through consideration of the objectives on surrounding NFS land.

Sense of Sound

Changes to the sounds of the Preserve would be minor and localized.

Sense of Place

For visitors to the Preserve, the "sense of place" would continue to represent a working ranch. Provided cattle and angler interactions were minimized, and ecological conditions were maintained, this would not be a negative connotation.

By selecting this alternative, the Trust would bring a decided return to the "sense of place" that many local producers affix to the Preserve. Even though local producers had not grazed livestock on the Preserve since the early 20th century up until federal acquisition, this alternative restores the sense of communal responsibility to the land and connection to their forbearers.

While local producers brought their livestock to graze on the Preserve from 2002 to 2005, the access did not extend to the producers themselves. Access would continue to be limited under this alternative. Limiting access limits the opportunity to gain the type of attachment possible when one is living or working on the land.

The types of programs that could occur under this alternative (conservation stewardship, replacement heifer, grant-funded restoration activities) that provide values other than monetary return for grazing can affect the sense of place. Stakeholders that do not necessarily support grazing on public land sometimes view grazing programs that contribute toward educational or societal values in a more positive light.

Alternative D

Visual Resources

Under this alternative, there would not be any measurable change to the visual resources of the Preserve, and the upper limit for capacity would be based on annual productivity. With an emphasis on optimizing the economic return, it would be likely that annual numbers would be at or near capacity for most years, depending on market conditions.

Under the interim grazing program, only operations for the 2008 season approached capacity, bringing 1,950 yearlings onto the Preserve. These higher numbers emphasized ranching as a central feature on the visual landscape of the Preserve. Complaints increased, and, for the first time, the Trust received requests for refunds from visitors who found their recreational experience to be not worth the price of admission due to the dominance of cattle on the landscape.

Improved distribution of the cattle can mitigate the negative effects of cattle interacting with anglers; however, under this alternative, the working ranch aspect of the Preserve would dominate the visual landscape.

Improvements to the ranching infrastructure would be likely to have short-term and localized effects to the visual resources as discussed under Alternative C.

Sense of Sound

Changes to the sounds of the Preserve would be minor and localized.

Sense of Place

For visitors to the Preserve, the "sense of place" would continue to represent a working ranch. Provided cattle and angler interactions were minimized and ecological conditions were maintained, this would not be a negative connotation.

By selecting this alternative, the Trust could change the "sense of place" to local producers, who would feel excluded from the Preserve. Based on comments from public meetings and workshops, they would perceive this exclusion as a deliberate choice by the Trust similar as to Alternatives A. However, under Alternatives A, no one would be grazing the Preserve, whereas under Alternative D, there would be a deliberate selection made by the Trust to favor a larger producer who would typically be from outside the local area rather than distributing the benefit among local communities (the types of programs that provide the greatest economic return generally exclude local producers based on the scale of economic efficiency that can be realized by larger producers). Based on responses received at public meetings and comments regarding the proposed Stewardship Action ((Valles Caldera Trust, 2007), (Moreno, 2007), (The Mary Orton Company, 2007), (Valles Caldera Trust, 2008), local producers and their communities would be likely to build a negative "sense of place" concerning the Preserve.

Alternative C_2 and D_2

Visual Resources

The facilities proposed for deferred maintenance are not historic buildings; there would be no measurable change to the visual resources of the Preserve by repairing these facilities or

improving their overall serviceability and condition. It would be expected that the visual impact of restored and maintained facilities would be positive.

Sense of Sound

Changes to the sounds of the Preserve would be minor and localized.

Sense of Place

While in general the overall improvement to these facilities would be in keeping with a well-maintained working ranch, it would only add a minor element to the sense of place that would be dominated by the program emphasis.

3.8 Recreation

3.8.1. Affected Environment/Existing Condition

Currently, *backcountry recreation* (recreation not supported by developed day-use or overnight facilities) occurs on the Preserve. In lieu of developed facilities, the Trust uses a system of reservations and lottery drawings to manage popular recreation activities (hiking, fishing, hunting, horseback riding, and tours). Opportunities to enjoy spontaneous recreation activities are limited to trails available from NM 4 and short excursions from the Valle Grande Staging Area, a temporary visitor facility situated in the Valle Grande. Winter recreation events usually do not require a reservation but are only available on limited days and during specified times. Besides core activities previously listed, the Trust hosts a variety of special events and workshops, including marathons and mountain biking events; photography, painting, and other artistic workshops; fishing, hunting, and other outdoor skill clinics, as well as accommodating requests for weddings, meetings, and other personal or professional events.

This combination of core events and special events constitutes the Trust's "Interim" recreation program. It was developed to meet the mandate of the Act to provide reasonable access to the Preserve for recreation within 2 years of federal acquisition. The program is also serving to inform the Trust in planning for the comprehensive management of the Preserve for use and access for recreation as well as education, science and research, and other public or commercial purposes.

The Trust budgets about $500,000 to manage use and access to the Preserve and grosses about $750,000 annually (Valles Caldera Trust 2006 budget, Valles Caldera Trust 2007).

The Interim grazing program and existing ranch infrastructure has a moderate effect on the interim recreation activities. Recreation activities are coordinated in time and space to reduce potential conflicts between cattle and recreation. Wildlife viewing and fishing are two activities that can be negatively affected by the presence of cattle, based on comment forms received from the public.

3.8.2. Environmental Consequences

Alternative A

Under this alternative, there would be no change to the current interim recreation program. Without domestic livestock grazing, planning and logistics for recreation would be simplified (one less activity to consider).

Alternative B

Direct and Indirect Effects

Under this alternative, there would be no direct effects to recreation activities on the Preserve. Indirectly, removing interior fences could increase opportunities for any program involving cross-country access through the valles (e.g., fishing, horseback riding, orienteering, etc.). Commercial and recreation photography and filming could also be enhanced by the removal of interior fences. Restoration and maintenance of the larger tanks could provide opportunities to introduce game fish and develop flat-water fisheries activities.

The incidental grazing by domestic livestock proposed under this alternative would not be likely to negatively impact recreational activities, based on years during the interim grazing program when small numbers of cattle grazed. Under this alternative, domestic livestock could be incorporated into recreational and education programs on the Preserve.

Alternative C and D

Direct and Indirect Effects

Under this alternative, there would be no direct effect or change in recreation programs on the Preserve. Indirectly, the management of infrastructure, including the construction of gates to allow cross-country access through the valles could improve opportunities to increase or improve activities that require or benefit from this type of access.

This alternative includes the repair and maintenance of larger tanks that could be developed for recreation as described under Alternative B. Under this alternative, the tanks would be important tools for distributing cattle away from sensitive areas and recreational opportunities associated with the improvement of tanks may be limited.

During the interim grazing program conflicts between recreation and livestock grazing primarily involved anglers and increased as the number of cattle grazing on the Preserve increased. The year 2008 saw the greatest number of complaints and conflicts. During this season, 1,950 yearlings (1,365 AUs) grazed on the Preserve. Better distribution and management of the livestock as proposed in Chapter One, would reduce such conflicts.

Indirectly grazing at this intensity is not likely to adversely impact recreation activities provided livestock has proper oversight and logistics for recreation consider the presence of livestock. Under Alternative C, interpretive messages can be used to create a positive perception regarding domestic livestock programs, which are providing for social or environmental services. Under

Alternative D, interpretive messages can be developed that emphasize the contribution of grazing fees in support of Preserve Management.

Alternative C_2 and D_2

Direct and Indirect Effects

The additional facility development proposed under these alternatives could increase recreation opportunities by providing classrooms and meetings spaces that could support a variety of public programs.

Cumulative Effects across Action Alternatives

Cumulative Effects

Programs for the multiple use of forage are unlikely to combine with the current level of visitation and types of programs to create cumulative, adverse effects. However, comprehensive planning for public use and access to the Preserve for recreation as well as education, scientific, commercial, and other purposes is ongoing. It is foreseeable that some level of program implementation, including facility development may occur during the planning horizon. Decisions regarding the types of programs offered and facilities developed would consider other programs and activities, including the multiple use of forage. These analyses will consider cumulative effects based on an analysis of a range of reasonable alternatives and could result in adjustments to the MUSY of forage resources, including new performance requirements to guide or constrain activities.

3.9 Elements of Significance

The CEQ identified 10 elements to consider at a minimum when evaluating the potential intensity of effects from a proposed federal action.

3.9.1 Beneficial and Adverse Effects

A significant effect may exist even if the agency believes that on balance the effect will be beneficial. The analysis identifies both adverse and beneficial effects. Both effects are described in context and intensity.

3.9.2 Public Health or Safety

Based on the previous sections, no direct, indirect, or cumulative effects to public health and safety are expected to occur as a result of the selection and subsequent implementation of any of the alternatives.

3.9.3 Unique Characteristic of the Geographical Area

These effects are addressed in the socioeconomic section (3.5), sensory resource section (3.6), and cultural resources section (3.4).

3.9.4 Controversy

The degree to which the effects are likely to be controversial was explored through scoping and public involvement. While the grazing of domestic livestock on public land is generally controversial, the controversy surrounding the proposed action is mitigated by the Act that directs the management of the Preserve as a working ranch, consistent with other goals and purposes. In addition, the intensity of livestock grazing being proposed on the Preserve is minor relative to the grazing currently occurring on surrounding forest system land and is negligible compared to grazing in the two-county area as discussed in the socioeconomic section (3.5).

3.9.5 Uncertain, Unique, or Unknown Risks

The proposed action has a foundation of goals, objectives, and monitored outcomes based on industry standards, 5 years of monitoring and field sampled data as described in the watershed section (3.1). This management system mitigates risk and uncertainty through early detection of downwards trends. Economic uncertainties are mitigated through performance requirements that limit long-term commitments and require economic sustainability for programs as described in Chapter One, "Proposed Action – Multiple Use of Forage" (Section 1.3.5).

3.9.6 Setting Precedent

The actions being proposed (forage allocation, use of forage and infrastructure management) are common activities on public land. The approach proposed by the Trust is specific to meeting the purposes of the Act and would not establish precedence for managing or utilizing forage on other public lands.

3.9.7 Connected Actions, Cumulative Effects

The proposed action considers connected actions (actions that could not occur independently of each other), including the allocation of forage, use of forage, and management of infrastructure. The direct, indirect, and cumulative effects of the proposed action (or alternative actions) and connected and reasonably foreseeable future actions are discussed. Cumulative effects are monitored through a synthesis of monitored outcomes. This assessment would be presented every 5 years in the *State of the Preserve*.

3.9.8 Cultural Resources

The potential effects to cultural resources are presented in a detailed discussion in the cultural resources section (3.4)

3.9.9 Threatened or Endangered Species and Habitats

The potential effects to TSE species are presented in a detailed analysis in the wildlife section (3.3) and the aquatic species section (3.4).

3.9.10 Compliance

The proposed action and alternatives as described are in compliance with all federal, state, and local laws imposed for the protection of the environment. Opportunities for producers to use forage will be awarded through legal instruments, including contracts awarded and administered in a manner consistent with federal contracting procedures and applicable procurement and

acquisition regulations. Other legal instruments include Memorandums of Understanding, Interagency Agreements, and either awarding or applying for grants.

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