THE BOARD OF COUNTY COMMISSIONERS OF THE COUNTY OF SANTA FE RESOLUTION NO. 2019-

A RESOLUTION ADOPTING THE ORTIZ MOUNTAINS OPEN SPACE MANAGEMENT PLAN AND DIRECTING STAFF TO IMPLEMENT THE PLAN

WHEREAS, Santa Fe County (County) owns and maintains a network of over 6,600 acres of open space and parks, and 46 miles of trails, including the Santa Fe Rail Trail; and

WHEREAS, the 2015 Sustainable Growth Management Plan and the Open Land and Trails Plan call for developing management plans for open space properties; and

WHEREAS, the 2019 Open Space, Trails and Parks Strategic Management Plan identified the Ortiz Mountains Open Space Management Plan (Management Plan) as year 1 priority project; and

WHEREAS, the Santa Fe County Board of County Commissioners and the County Open Land, Trails and Parks Advisory Committee (COLTPAC) support the development of management plans for open space properties; and

WHEREAS, management principles were developed with community input to guide the development, management, and maintenance of Santa Fe County Open Space and Trail properties; and

WHEREAS, specific management principles were developed for the Ortiz Mountains Open Space which include providing safe public access for educational programming, focus on managing and maintaining the unique biological assets of the property, protection of resources, and increased youth and community participation in site stewardship; and

WHEREAS, the Management Plan prioritizes projects for implementation in the short-term, mid-term, and long-term; and

WHEREAS, the Management Plan includes implementation phasing timelines and preliminary estimated implementation costs; and

WHEREAS, COLTPAC has reviewed and recommends approval of the Management Plan (Exhibit A).

NOW, THEREFORE, BE IT RESOLVED by the Board of County Commissioners that:

1. The Ortiz Mountains Open Space Management Plan attached hereto as Exhibits A is hereby adopted; and

- 2. Staff is directed to implement the Management Plan to the extent possible with available resources and to request amendment of the plans as needed; and
- 3. Staff is directed to request necessary budget for staffing, training, planning, maintenance, and capital funding for implementation of the Management Plan; and
- 4. Staff is directed to involve community members and the public in the outlined management projects and activities contained within the Management Plan when appropriate.

PASSED, APPROVED, AND ADOPTED this 24th day of September, 2019.

BOARD OF COUNTY COMMISSIONERS

By: War Chair

O3/X SWING S

Attest:

Geraldine Salazar Santa Fe County Clerk Date: 9-24-2019

Approved As To Form:

Rachel Brown.

Interim Santa Fe County Attorney

COUNTY OF SANTA FE STATE OF NEW MEXICO BCC RESOLUTIONS PAGES: 149

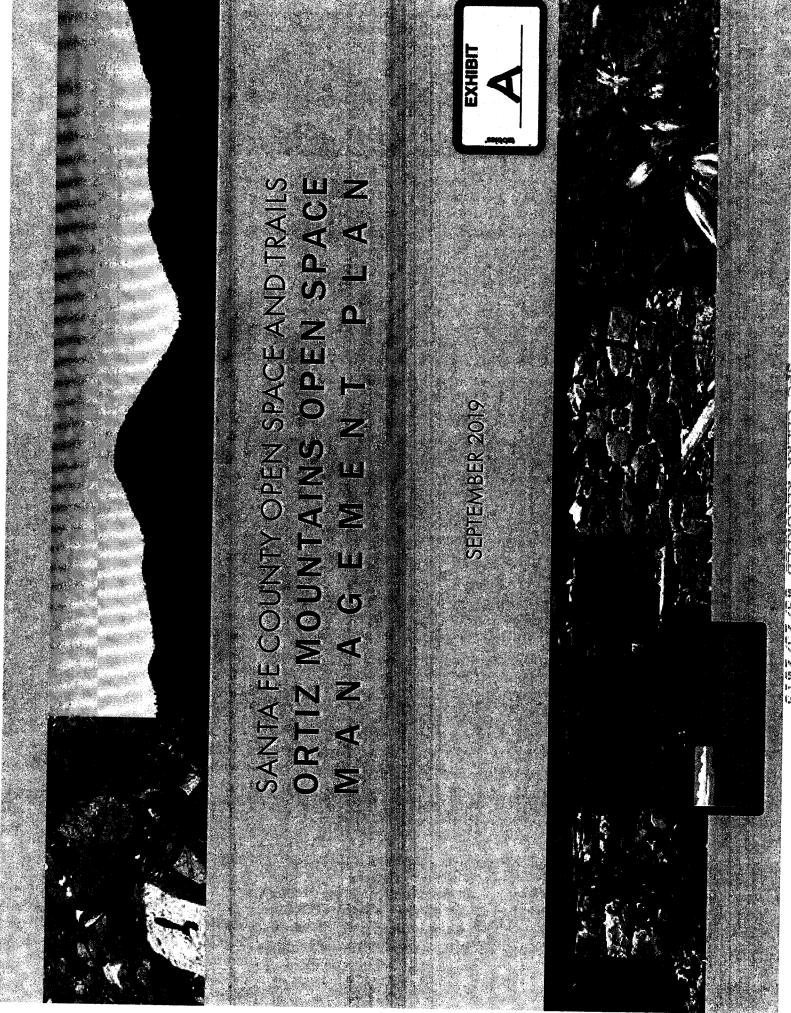
I Hereby Certify That This Instrument Was Filed for Record On The 25TH Day Of September, 2019 at 02:28:23 PM And Was Duly Recorded as Instrument # 1897621 Of The Records Of Santa Fe County

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ness My Hand And Seal Of Office Geraldine Salazar

County Clerk, Santa Fe, NM

Page 2 of 2



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ACKNOWLEDGEMENTS

Santa Fe County Board of County	'n.
Commissioners.	ĸ
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Henry Roybal – District 1	៥
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Anna Hansen – District 2	٥
Budy Carris - District 3	-
Nata Sales District	>
Anna Hamilton – District 4	•
Ed Morerto - District 3	•
The County Open Lands, Trails, and Parks Advisory	

Special appreciation to the stakeholders and local, state and federal agency representatives, who provided the time, local wistom and sense of the community needed to achieve this Management Plan and the related Ortiz Mountains Interpretive Docent Kit.

The planning team obtained stakeholder input in a variety of ways.

- Interviews with key information resource people.
 Iwo day intensive work session with stakeholder representatives from adjacent stakeholder representatives from adjacent landowners, the conservancy holders, the landowners, the conservancy holders, the representatives from County. State and Federal groups.
 Field walk with prior docents and County OSTP staff.

 A specific thank you for date and documents that added to the research efforts for this Management Plan and the related Ortiz Mountains linterpretive Docent Kit.

Dave Wykoff, Cunningham Hill Mine Reclamation Project

Paul Olafson, Planning Project Manager

Stephen Maynard, Ortiz Mountains Geology Phil Young, Docent materials

TABLE OF CONTENTS

1.0	BACKG	BACKGROUND AND EXISTING CONDITIONS			4
	1.1	Plan Purpose and Need	1	100	
	1.2	Plan Process	2	-	
	1.3	Property Description + Existing Conditions Assessment	æ		
2.0	ISSUE	ISSUES / CHALLENGES		, d	
	2.1.	Access	7	4. ·	
	2.2	Environmental Resources	6		
	2.3.	Historical Resources	10	,	
3.0	ORTIZ	ORTIZ MOUNTAIN OPEN SPACE MANAGEMENT PLAN		· • • • • • • • • • • • • • • • • • • •	
	3.1.	Vision	11	e de la companya de l	
	3.2	Management Goals	11		
	3.3.	Ortiz Mountain Open Space Management Plan	13		
	3.4.	Monitoring + Maintenance Approach	16		
	3.5	Policies	19		
	3.6	Plan Implementation	20		
ORT	IIZ MOU!	ORTIZ MOUNTAINS OPEN SPACE APPENDICES			
-	APPENDIX A:	X.A. Overall Management Activities Matrix for Ortiz Mountains Open Space, May 2019	pace,		
	APPENDI	APPENDIX B: Least-Cost Alternate Road Analysis, June 2016			
	APPENDIX C:	IX C: Ortiz Mountains Docent Tool Kit, Working Draft September 2016			8
	APPENDIX D:	IX D: Ortiz Mountains Open Space, Existing Habitat and Wildlife Summary	≥		
	APPEND	APPENDIX E: Forest Management Plan for Ortiz Mountains Open Space			
Santo	, Fe County /	Santa fe Courty / Oritz Mountains Open Space Management Plan			



EXECUTIVE SUMMARY

The Ortiz Mountains Open Space includes the highest peaks in the Ortiz Mountain range, and is visible throughout Santa Fe County. This property is biologically diverse, contains many wildfife species of conservation need, and is part of the Gallsteo Basin wildfile corridor. It also contains many historic milling resources, including the Old Ortiz Mine which is one of the earliest hard-rock mines in the western United States.

Management challenges and opportunities for the Oritz Mountains Open Space include maintaining safe public access to and on the site, managing educational visits, and managing estiting environmental and cultural resources on the step and rugged property. Access to the site is difficult due to the poor condition and legal restrictions of the access road that is provided through the neighboring gold mine property. Management challenges also include balancing wildlife habitat needs with fuels reduction facilities prevention, loss of cultural resources from environmental and user impack, and long-term habitat consequences related to climate change. This management plan outlines strategies to protect the Oritx Mountains Open Space by improving to consever the ties it sturial and cultural resources, administrating existing into exercise the ties it should and cultural resources, and management and monitioning to consever the ties it should and cultural resources, and maintaining existing introverments. The Plan outlines a vision, management goals, project and assessment priorities, site maintenance activities, and community stewardship opportunities.

The Ortiz Mountains Open Space Management Plan identifies short, mid, and long-term management priorities for the property. The short-term priorities include providing safe access to the site by continuing limited educational visits, martialing existing improvements, and conducting science-based management and monitoring of the natural and cultural resources on the site. In the mid-to-long term, Santa Fe County will work to enhance interpretive educational opportunities at the Ortiz Mountains Open Space and develop a Master Plan for the property.

A Docent Tool Kit is contained in the appendix to this plan which describes the interpretive approach for guided visits and hikes on the Ortiz Mountains Open Space. This Tool Kit also provides a thorough overview of the wonderful and interesting history of the property and the area.

This Management Plan for the Ortiz Mountains Open Space provides the long-term vision and goals for how to manage this remarkable open space and its unique cultural and environmental resources. The Plan's vision and goals reflect the desires of stakeholders and the County to create an exceptional Santa Fe County Open Space and Trails experience.



itally simulated view from North Peak looking southeast toward adjacent open mine on i



Santa Fe County / Ortiz Mountains Open Space Management Plan

1. BACKGROUND AND EXISTING CONDITIONS

1.1. PLAN PURPOSE AND NEED

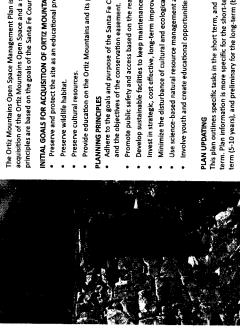
The Orfiz Mountains Open Space Management Plan was developed in order to prioritize management activities in a way that best protects and manages the cultural and natural resources of the property. This plan also carefully considers and examines the feasibility of providing safe experiences on this remote and difficult to access property. The Ortix Mountains Open Space Management Plan provides direction and specific action priorities for short-term, mill term, and long-term phases. The purpose of the Ortiz Mountains Open Space Management Plan is to:

- help understand existing environmental conditions,
- clarify priorities for maintenance and resource management,
 - identify projects for future investments,
- describe an approach to planning, implementation and maintenance activities, and
 - identify stewardship and community educational opportunities.

This management plan will help county staff, volunteers and county residents understand the conditions of the property, and establish the County management vision, goals and strategies for the Ortiz Mountains Open Space.



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1.2 PLAN PROCESS

The Ortiz Mountains Open Space Management Plan is informed by the County's initial goals for acquisition of the Ortiz Mountains Open Space and a set of planning principles. The planning principles are based on the goals of the Santa Fe County Open Space and Trails Program.

INITIAL GOALS FOR ACQUISITION OF ORTIZ MOUNTAINS OPEN SPACE

- Preserve and protect the site as an educational preserve.

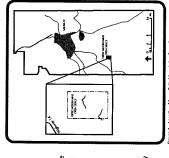
- Provide education on the Ortiz Mountains and its past mining history.

PLANNING PRINCIPLES

- Adhere to the goals and purpose of the Santa Fe County Open Space and Trails program,
- Promote public safety and access based on the reasons for acquiring the property. Develop sustainable facilities to keep maintenance needs to a minimum.
 - Invest in strategic, cost effective, long-term improvements.
- Minimize the disturbance of cultural and ecological resources.
- Use science-based natural resource management and monitoring principles.
 - Involve youth and create educational opportunities.

PLAN UPDATING
This plan outlines specific tasks in the short term, and indicates planning goals in the long term. Plan information is more specific for the short-term (1-5 years), descriptive for the midterm (5-10 years), and preliminary for the long-term (beyond 10 years).

lead to the need for adjustments to the plan. After the mid-term span of 10 years, this plan will need updating. This plan should be evaluated annually for benchmarks and annual goals and Changing community needs, environmental conditions, and County management capacity will to update property maintenance and management needs.



1.3 PROPERTY DESCRIPTION + EXISTING CONDITIONS ASSESSMENT

chosen as the beneficiary of the 1350 acres in the western part of the Ortiz Mountains because of their ability to provide an educational experience for visitors while focusing on conservation mineral rights were not part of the County's acquisition. Presently, there are limited regulatory part of a court settlement between LAC Minerals USA, Inc. and the Friends of Santa Fe County to address cleanup of the Cunningham Hill gold mine. The Santa Fe Botanical Gardens was property to the Preserve. A conservation easement was granted to the Santa Fe Conservation Trust in 2001. In 2007, Santa Fe County purchased the property, now the Ortiz Mountains The Santa Fe Botanical Garden acquired the Ortiz Mountains Educational Preserve in 1995 as operate the property as an educational preserve with limited guided visits until 2015, when full management of the property was handed over to the County. The property's underlying Open Space, from the Botanical Gardens which included the encumbrances outlined in the Conservation Easement and the access easement. The Botanical Gardens continued to values. An access easement was granted to the Botanical Garden through LAC Minerals restrictions to excavation of the underlying minerals on the property.

1.3.2. Geology and Mine History

The Ortiz Mountains Open Space is a 1350 acre property that includes the highest peaks in the Ortiz Mountains—Placer Peak and North Mountain. The Ortiz Mountains sit at the southwestern edge of the Galisteo Basin and are an important landscape feature in central Santa Fe County.

catching stormwater and improving drainage on the Ortiz Mountains Open Space is important Pecos River. The Ortiz Mountains formation is the head-waters of three small catchment basins. Managing all activities-including hiking--particularly with a view to reducing erosion, The Ortiz Mountains form part of the watershed boundary between the Rio Grande and the to the health of the Galisteo Watershed and the site. The Ortiz Mountains are geologically part of the Ortiz Porphyry Belt of Santa Fe County which also includes the Cerrillos Hills and the San Pedro Mountains. The precious metals in the Ortiz porphyry belt attracted mining activity. Native Americans and Spanish likely did some limited mining for precious metals in the Ortiz Mountains, but the first significant placer workings began in 1821. The underground Ortiz Mine was opened in 1822. By 1832, several gold-

Sanla Fe County / Ortiz Mountains Open Space Management Plan



Ortiz Mountains Open Space - Existing Conditions Map

bearing veins had been discovered. But following World War I, rising mining costs, the low grade of the ores, and the relative lack of water resulted in the closure of the mines. In the 1970s and 1980s, Gold Fields Corporation worked an open pit mine within a half mile of the Old Ortiz Mine. After a joint venture between Pegasus Gold Corporation and LAC Minerals in the late 1980s, LAC Minerals was left with the job of remediation and reclamation of the mine site.

Much more information relating to the history of the Ortiz Mountains and mining can be found in the Docent Tool Kit, Appendix C.

1.3.3. Cultural Significance

Because of the prominence of the mountains surrounding the Galisteo Basin, this property has cultural significance to the area pueblos and tribes. A preliminary cultural resources survey has identified sites that will require cultural consultation as the property is developed and opened to the public. A full survey may be required as future access, development, and management

1.3.4. Improvements and Existing Infrastructure

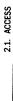
activities of the property are explored.

1.3.4.1. Existing infrastructure

Facility improvements at the Ortiz Mountains Open Space include a large covered shelter Pacility improvements at the Ortiz Mountains Open Space include a large covered shelter with picnic tables, benches and a vault tollet built in 2002 as part of the Botanical Gardens development of the property. New Mexico Abandoned Mine Lands Program (AML) designed and installed safety improvements to mines and mining relics, including shafts, adits, pits and open stops including backfilling, plugging with polyurethane foam, and fecing of features. A large steel cupols structure was placed over the old Ortiz Mine entrannee to keep people out but allow the bats that live in the mine easy access for daily flights.

2.3.4.2. Trails
Several trail routes were developed by the Santa Fe Botanical Garden. Directional signs for
those trails exist on the property. Many of the trails have not been maintained and may
not be usable without significant assessment, including the Eagle Canyon Trail and the Skid
Trail. North Peak Trail only exists as a route, and no physical trail has been constructed. The Loop Trail was well used for the less strenuous history tours on the property and follows an old road. Placer Peak Trail is in need of re-routing to make it sustainable and less susceptible to erosion, and also to avoid cultural sites.

Santa Fe County / Ortiz Mountains Open Space Management Plan



The condition of the road and the nature of the environment make road maintenance difficult. The combination of the road access restrictions and the existing conservation on the property do not allow for free, open access. The neighboring gold mine has locked gates that restrict access to the public on the access road for the Orit's Mountains Open Space. As a result, County staff are required to accompany visitors on site which requires significant staff time in coordinating guided events. Safety and access for emergency responders is an on-going concern. An emergency access plan was developed in coordination with the Santa Fe County Office of Emergency Anaagement in 2015. This plan should be evaluated annually as guided tours are scheduled.



Current access to the Oritis Mountains Open Space is through LAC Minerals property. The 2.5 mile drit access road starts at the controlled entry gate to the LAC Minerals property. The road is very narrow, rocky, and steep and requires four-wheel drive vehicles, and is unsuited for normal emregency vehicle use. The agreement with LAC Minerals allows only for County escorted access, temporary parking in a designated area, and placement of portable restroom facilities on a seasonab basis. The agreement specifically excludes overnight parking, camping, hunting, recreational basis. The agreement specifically excludes overnight parking, camping, hunting, recreational use of motoroycles, ATVs, snow mobiles, and equestim use except pack animal sused for maintenance. The current condition of the access road, the County escort requirement, and limits on use make access to the site difficult to manage. The poor road condition also affects site maintenance, as it is difficult to get to the site and complete tasks within a day, Road improvements and maintenance may not be feasible due to the existing conditions of the road. The access and conservation agreements together do not allow equipment, vehicles or people to stay overnight on the property including maintenance equipment, tucks or crews which creates substantial time and operational constraints on site management activities.

A preliminary GIS analysis was conducted to see if there were other viable off-site access routes to the Ortiz Mountains Open Space. Based on the summary analysis, no other routes from the west, north or south of the site were parcified at this time based on cost, construction difficulty, and environmental impacts. Additional routes should be analyzed and explored. There are viable alternate routes on the LAC Minerals site, but use of these alternate routes would require renegotiating the access agreement with LAC Minerals.



2. ISSUES/CHALLENGES

The Santa Fe Conservation Trust holds the Ortiz Mountains Open Space Conservation fasement. The purpose of the conservation easement is to ensure that the property will be retained forever in its natural, scenic, forested and open space condition and prevent any use that will significantly impair or interfere with the conservation values. Activities that cause significant soil erosion, such as the use of motor vehicles on the site (except on existing roads or for limited emergency access), open fires, building and dumping are prohibited uses. Camping is also a prohibited activity.

2.1.3. Guided Trips and Staff Capacity Due to the limiting factors of the access agre

Due to the limiting factors of the access agreement and the conservation easement in combination, all visitors to the property must be accompanied by County staff. Past trips have ranged from less strenuous tours along the Loop Tall to very strenuous hikes to Placer Peak or North Mountiain. Trips to the property last at least half a day but hikes to Placer Peak and North Mountain regularly take 6 hours or more from start to finish. Staff time for organizing and planning events, and leading these hikes and tours is significant.

In 2015, the County took over active management of the Ortiz Mountains educational visits. County Open Space & Irralis staff food on all tasks related to marketing, scheduling and leading visits and hikes, visits and hikes were limited to three in 2015. The limited schedule heavity strained the small staff and highlighted liability issues.

Issues relating to scheduling tours are:

- Due to the road conditions Santa Fe County policy states only County vehicles can be used to transport visitors through the LAC property;
- Risks of liability coverage for visit and hike participants due to the remote location and road condition;
 - Wear and tear on County vehicles that are exacerbated by the poor access road conditions, as well as wear and tear on the road itself;
- Slow emergency services response due to the access road conditions and unreliable cellular phone service on site.
- Nature of trails on the property only allow for experienced and well-equipped wilderness hikers



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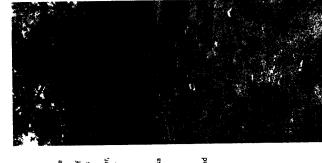
2.2. ENVIRONMENTAL RESOURCES

An important resource on the property is the soil, which is highly susceptible to erosion due to the area's physical features and the long history of mining. Exploratory trenches and pits exist throughout the property. Externeby testep, rough, and erodible soils make up most of the site. Soils on the property are shallow and very rocky and endure high runoff and erosion rates. The steepness of the slopes is an important, determining factor in the growth form and density of

2.2.2. Fire Danger/ Forest Health vegetation at the property.

Fire danger in the Ortiz Mountains Open Space is moderately high due to a high density of trees in some areas, as well as fuel buildup on the forest floor in some areas. A forest health evaluation is in progress to determine appropriate thinning and monitoring of the forest ecosystem in coordination with the County's Wildland Fire crew.





southern ecoregions, such as the Black-chimned Sparrow, sharing the open space with species more typical of northern ecoregions, such as the Olive-sided Flycatcher. Species of high conservation concern using the property include Pinyon Jay, Grace's Warbler, Virgina's Warbler, Juniper Titmouse, Black-chimned Sparrow, and Townsend's Big-eared Bat. Additional baseline conservation need, and is part of a regional critical wildlife corridor(as identified by the New Mexico Department of Game and Fish Critical Habitat Assessment Tool) connecting the Sangre represent a convergence of species found in different ecoregions, with species more typical of de Cristo and Sandia-Manzano Mountains. Wildlife at the Ortiz Mountains Open Space 2.2.3. Ecosystem and Wildlife
The Ortiz Mountains Open Space is biologically diverse, contains numerous species of assessments are needed to document wildlife species using the property.

an important habitat component for numerous wildlife species, exists throughout numerous habitat types, including ponderosa pine forest and mixed-confier forest. Patches of pinon pine mortality, due to drought and bark beetle infestations, exist throughout the property, and serve as important habitat for species such as mule deer and black-chinned sparrow. woodlands on slopes at numerous elevations, 2.) ponderosa pine forests in higher elevation valletys, and 3.) mixed-confler forests, containing primarily Douglas fir, white fir, and ponderosa pine, in valletys and shaded north and east-facing slopes at higher elevations. Small clusters of aspen and white pine exist in cool and moist locations at higher elevations. Gambel oak, There are numerous vegetation communities on the preserve, including: 1.) piñon-juniper



2.3. HISTORICAL RESOURCES

2.3.1. Archaeological Survey

will require an update to the initial survey and a survey of the entire property may need to be conducted as the property is developed and opened to visitors. An archaeological survey of a limited area near the developed area of the property has been initiated in 2019. was performed in 2016. Cultural sites have been identified in these preliminary surveys that An archaeological survey was initially conducted as part of the Abandoned Mine Lands Program (AML) project in the early 1990s. Another survey of a trail reroute to Placer Peak

2.3.2. Mine History

The Ortiz Mountains have a long history of mining going back to 1822, and relics of that past remain a Visible part of the property. Several historic mining structures including mine pits, shafts and trenches exist, and were safeguarded by AML in 2003. The AML project included backfilling of adits, shafts, pits and open stopes; construction of bat cupolas; fencing and netting of pits and other open structures; and revegetating disturbed areas.

Preservation and stabilization of these features will be important in the development of this property, interpretation of the mine history of the area is an opportunity to be explored and developed further.



The vision for the Ortiz Mountains Open Space is based on the existing conservation easement that establishes habitat preservation and education as the primary uses for this site.

3. ORTIZ MOUNTAINS OPEN SPACE MANAGEMENT PLAN

County Open Space system. The site is a preserve for wildlife and the natural systems they rely on. The fauna and flora that share this land remain the fundamental element of the In 2025, the Ortiz Mountains Open Space is the "wild-ness" component of the Santa Fe preserve in the future.

Guided groups visit the site to learn about and appreciate these rugged mountains, and, about the specific details of this place and how it affects the lands around it. Participants learn about the site's importance for wildlife species, including species of conservation need. The site educates about the history of mining on Ortiz Mountains and how land restoration continues. The property is an example of science-based land restoration practices, and the community and County are engaged together in maintenance and stewardship of the land including trails and educational improvements.

3.2. MANAGEMENT GOALS

The Ortiz Mountains Open Space management goal states the vision in terms of actions that can be implemented and monitored.

and habitat at the Ortiz Mountains Open Space. The management goal is to encourage community stewardship, involve citizens in monitoring, and protect the habitat and cultural resources on the site. Public access to the site is limited for educational purposes and to Santa Fe County will maintain educational opportunities and support the existing wildlife allow the natural processes to thrive.



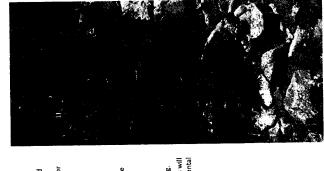


3.2.1 Specific Management Goals

Specific management goals in support of the Ortiz Mountains Open Space Vision are:

- A. Holistic & Inclusive. The Ortiz Mountains Open Space is managed in a transparent manner
 through on-going communication with the community about planning, implementation
 and management activities for the site.
- Education and Research. Education and research is supported to understand in depth the Ortiz Mountains Open Space, the historic context of the site, and its environment.
- C. Ecological Health. The ecological health and resilience of the Ortz Mountains Open Space is maintained through minimizing new impacts and science-based management and
- Natural Appearance. The Ortiz Mountains Open Space appearance and mining history are complemented by using natural design principles and materials that reflect the history and environment of the site.
 - . Cultural Resources. The cultural resources on the Oritz Mountains Open Space are conserved through monitoring of the resources and in-situ protection.
- Access. Management policies for the Ortiz Mountains Open Space balance desires for increased dongementy visitation and the goal to protect the site.
- G. Infrastructure. Infrastructure on the Ortiz Mountains Open Space will be limited while being appropriately designed and maintained to allow emergency access and minimize impacts on the property.

Sonio fe County / Orfiz Mountains Open Space Management Plan



3.3. ORTIZ MOUNTAINS OPEN SPACE MANAGEMENT PLAN

The Plan for Ortiz Mountains Open Space describes proposed management strategies, projects and associated investments to support the Ortix Mountains Open Space Vision and Management Goal. The Plan recommends planning actions; projects with their purposes Management Goal. The Plan recommently standing actions; projects with their purposes implementation.

Plan actions are focused on:

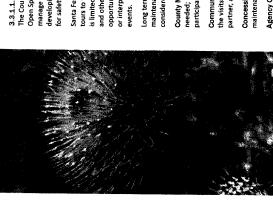
- achieving safe access to the site;
- activiting safe access to the site;
 continuing limited scheduled educational visits and hikes;
- resolving constraints both legal and physical to make access and maintenance of the
- maintaining the existing trails and improvements on site,

site more practical;

- managing ecosystem health on the property, and
- building staff capacity with stewardship and community outreach and programming.

Any long-term expansion of interpretive education improvements, trails, and public access will be evaluated based on conducting a property-wide cultural survey and detailed environmental assessment.





3.3.1. Visitor Management

3.3.1.1. Guided trips

Open Space visitors. In the short-term the Plan anticipates that the County will continue to manage the visits and hikes. This will mean establishing a tour schedule with limited visits, developing a robust docent training and interpretive program, and managing the facilities The County needs to establish short- and long-term management for Ortiz Mountains for safety and visitor impacts.

opportunities at the property. Partnerships in the short term could include organized hikes or interpretive tours in which the partner organization takes the lead in organizing the Santa Fe County recognizes the opportunity for educational programming and guided tours to the Ortiz Mountains Open Space. Currently, County resources and staff capacity is limited for these activities. The County has identified that partnerships with non-profits and other entities could be a cost-effective method to provide for public educational

Long term options should be evaluated to assess implications for staffing, operations, maintenance, liability and financial arrangements. Long-term options that should be considered include:

needed, process to allocate County vehicles with appropriately licensed drivers to escort participants; tour and hike management protocols and liability issues. County Management. Identify any permanent increase in County staff and staff hours

Community Partner. The County either helps form or finds a capable partner to conduct the visits and hikes. Clear criteria on the organizational, financial and longevity of the partner, and service agreement requirements should be identified. Concessionaire. The County would need to determine the types of activities; operational, maintenance and insurance requirements; and assignment of liabilities...

Agency Cohort. This approach could be similar to the arrangements the County has with New Mexico State Parks for management of Cerrillos Hills State Park.

Sarta Fe County / Orliz Mountains Open Space Management Plan

3.3.1.2. Docents

property since the time of the Botanical Garden management. This group has special and intimate knowledge of the property and the County should utilize this asset in developing tour material and schedules. There is already a contingent of dedicated docents who have been involved with the

consistent with the County's interpretive goals for the property, as outlined in the Docent Toolkit (Appendix C). Educational material should also be consistent with the Docent A training protocol needs to be developed for these and additional docents that is Toolkit. Docents should be actively recruited to support tour operations. In the long term, dedicated staff may be considered at this property. An interpretive ranger, with the ability to organize, lead and provide interpretive tours may be needed to provide

3.3.1.3. Staff capacity

3.3.2. Partnerships

access to the public.

- education for and access at the Ortiz Mountains Open Space. Partnership opportunities A. LAC Minerals (Barrick Gold) should continue to be an important partner in developing with LAC Minerals include:
- Interpretive opportunities include current mining, reclamation, revegetation, water monitoring, etc.
- Developing additional or improved access to the site, either through moving or improving the current access easement.
- As their planning effort moves forward, the County is interested in continuing a dialogue to help develop appropriate use of the neighboring property.

B. Santa Fe Conservation Trust (SFCT)

- The County will work with SFCT to amend the Conservation Easement to streamline management of environmental conditions of property.
- Explore docent recruitment, training

3.4. MONITORING AND MAINTENANCE

Explore options with the Sierra Club and similar groups to provide hike leaders with safety and backcountry experience training. Determine interpretive capacity.

C. Sierra Club, and similar groups

Explore using Sierra Club leader training for OSTP docent training.

 D. Abandoned Mine Lands Program (AML) Explore docent recruitment, training.

A maintenance schedule will be developed which includes seasonal tasks to open and close the property. The County will lead the organization of maintenance activities and maintain the existing on-site improvements. Strategies to optimize maintenance effort include:

- collaboration with civic organizations, other agencies and community stewards to
 - invest in smaller, consistent well-planned maintenance activities; leverage the efficiency of working together;
- conduct maintenance activities at the optimum time based on monitoring or a regular

3.4.1. Terrain Management Units schedule.

Work with AMI. to determine any remaining mine hazards and to safeguard those
hazards if they exist. Santa Fe County intends to develop and maintain productive,
collaborative relations with the community and other stakeholders as a critical activity
of the Ortiz Mountains Open Space Management Plan.

A Baseline natural resources assessment was conducted in 2018 and 2019. As part of this assessment, active natural resource management areas were identified, and serve as the basis for the terrain management units which are described below and mapped on the next page.

Maintenance tasks will be identified in the future from regular monitoring activities.

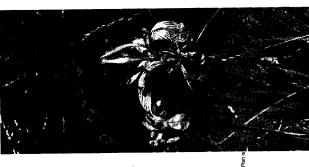
OMOS-ACS: Access easement corridor

OMOS-TRL: Trail corridors

OMOS-PRSV: Preserve

OMOS-AMGT: Active Management Area*

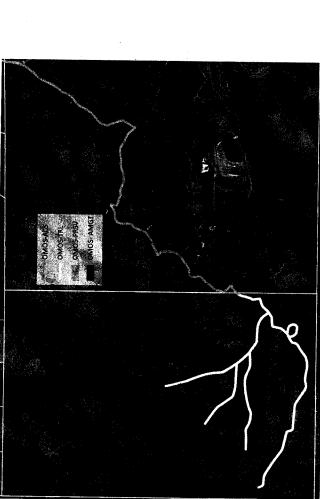




Sonia Fe County / Ortiz Mountains Open Space Management Plan



Monitoring will be an important aspect of maintaining the health of the property. This will include assessment and monitoring of ecological health; erosion—especially at the used trails and trailhead area and the areas disturbed by previous mining activity, cultural and historical resources; and wildlife. Additional monitoring will focus on the safety of the site and will include condition of the access road; the built elements including the shade structure and picnic tables, signs, restroom facility, and mine safeguard features and fences at mine entries.



Annually in the spring early summer Once every 2-3 years

Ecological Health

trait condition Evological Hearth?

Public Sartery
Proble Sartery
Proble Sartery
Proble Sartery
Proble Sartery
Proble Sartery
Proble Sartery

Picture posts and Bullseye surveys

Ecological Health/Public

Visual observation; monitoring will be per plan based on cultural resources

GMOS-PRSV ... OMOSTRI

Santa Fe County / Orliz Mountains Open Space Management Plan



3.4.3. Needed Assessments and Studies A number of assessments are necessary to inform management, master planning and operations in the short and long term. Some necessary assessments have been conducted, while others still need to be completed.

In process assessments:

Wildlife baseline assessments, including rare, threatened, and endangered species.

A forest health analysis, including fuel loads and trees per acre.

Needed assessments:

A trail assessment needs to be completed in order to determine the current safety and
sustainability of existing trails. Trails maintenance and repair/recoutes will then be done
on a priority basis depending on staff approved educational programming schedules, staff
capacity, and allocated budget.

- A monitoring plan needs to be developed in order to manage the environmental and
 cultural resources on the property and to guide property restoration activities including forest health and thinning, and soil stabilization.
 - A property wide cultural resources survey may need to be conducted as a master plan
 is developed to guide how the property can be developed for recreation and education
 is developed.

The assessments will better characterize and document resources on the Ortiz Mountains Open Space and help identify specific areas that need protection to support habitat health and protect facilities.

3.5. POLICIES in order to protect and manage the property resources in a way that is consistent with the in order to protect and manage the property reason for purchase, policies have been developed to guide staff specific to this property:

Staff will only drive on existing roads, as per the Conservation Easement, in order to limit

- erosion and impacts.
- No tours will be scheduled to Placer Peak until a trail reroute is complete.
- Guided tours will be scheduled on a limited basis, and will only access the property by hiking up the road. Vehicles will not be used to access the site for guided tours.
 - All natural resource management will be grounded in the best available science
- Monitoring and adaptive management will be used when managing all natural resources
 - Property improvements will only proceed after conducting natural and cultural resource

Santa Fe County / Ortiz Mountains Open Space Management Plan

3.6. PLAN IMPLEMENTATION

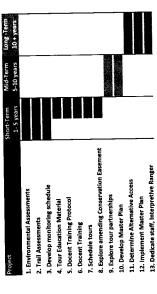
regarding maintenance, planning, project preparation, community outreach and stewardship. Prioritization will be based on balancing the tasks at hand, the staff and funds available to Plan implementation will start by identifying priorities and timelines among staff for activities accomplish the tasks. A matrix of recommended management activities over the short, mid, and long term phases is contained in Overall Management Activities Matrix for Ortiz Mountains Open Space (see Appendix A). This Plan will be updated after the short term projects have been completed.

Short Term Implementation

Implementation of this plan will begin upon approval of the Ortiz Mountains Open Space Management Plan by the Santa Fe County Board of Commissioners. Recommended Year-I implementation activities include:

- Environmental Assessments Trail Assessments

- Developing monitoring schedule Developing Tour Educational Material
- Developing a Docent Training Protocol Tour schedule and programming





Docent Training Protocol needs to be developed to determine appropriate training and scheduling of tours. This will determine the capacity of interested volunteers to run tours as well as the interpretive focus and schedule for tours.

While continued visitation of the property is a goal of the County for Ortiz Mountains Open Space, it will require careful consideration of staff and operational resources needed to regularly provide tour opportunities either through the County ow with partnering groups. Additionally, while tour and docent planning is underway, work on the access and uses permitted will be required to allow for a functioning tour option at the site. Environmental Assessments need to be conducted to determine what impacts, if any, tours will have on the property, and how to best mitigate those impacts. A trail assessment is a priority to determine what the maintenance and safety status is of each trail in order to determine the appropriateness of fours in that location. In the short term, this will help to determine the best way to manage and schedule tours. Additionally, these analyses will help to develop the maintenance as Arledule tours. Additionally and access easement, and inform the development of a master plan.

ORTIZ MOUNTAINS OPEN SPACE APPENDICES (Separate Document)

APPENDIX A: Overall Management Activities Matrix for Ortiz Mountains Open Space, May 2019

APPENDIX B: Least-Cost Alternate Road Analysis, June 2016

APPENDIX C: Ortiz Mountains Docent Tool Kit, Draft August 2016

APPENDIX D: Ortiz Mountains Open Space, Existing Habitat and Wildlife Summary

APPENDIX E: Draft Forest Management Plan for Ortiz Mountains Open Space

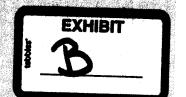
Santa Fe County / Ontiz Mountains Open Space Management Plan



SANTA FE COUNTY OPEN SPACE AND TRAILS PROGRAM ORTIZ MOUNTAINS OPEN SPACE MANAGEMENT PLAN APPENDICES

September 2019







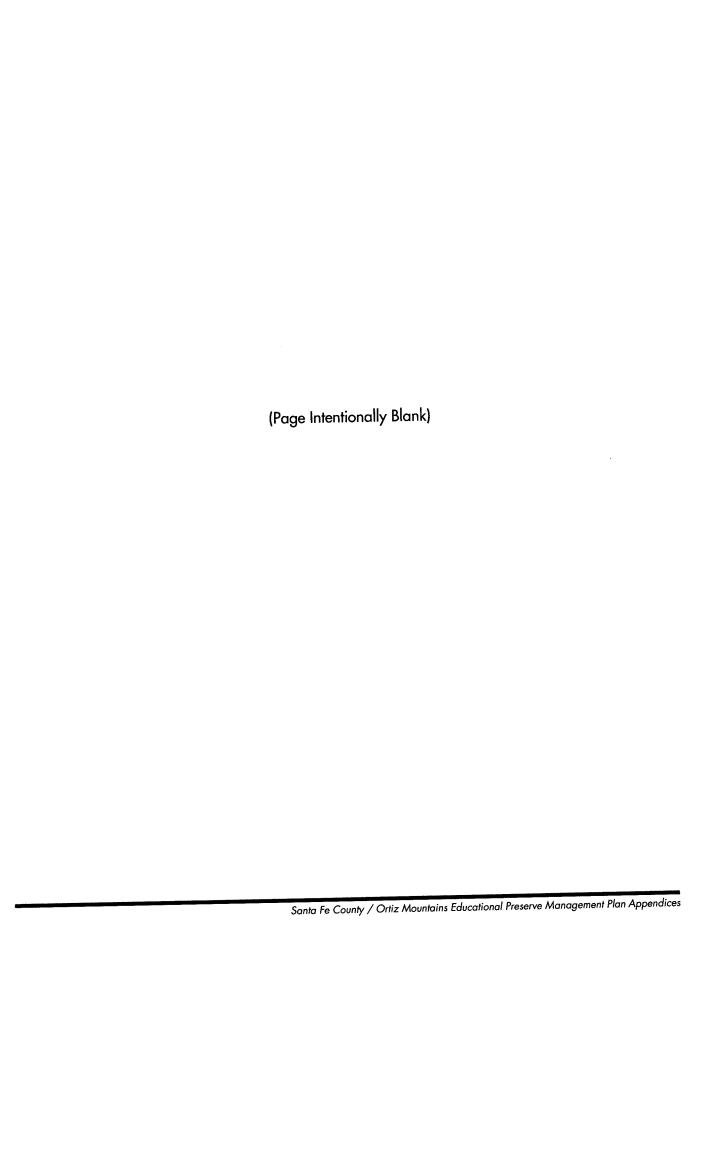
APPENDICES / TABLE OF CONTENTS

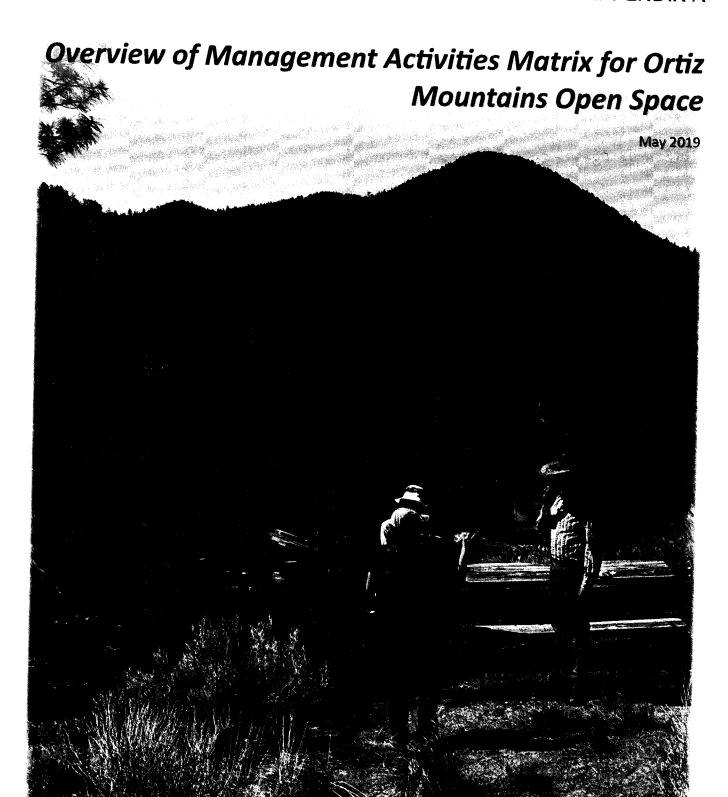
ORTIZ MOUNTAINS OPEN SPACE APPENDICES

APPENDIX A: Overview of Management Activities Matrix for Ortiz Mountains Open Space, May 2019

APPENDIX B: Ortiz Mountains Educational Preserve Docent Tool Kit, August 2016
APPENDIX C: Ortiz Mountains Educational Preserve Least-Cost Analysis, July 2016
APPENDIX D: Ortiz Mountains Educational Preserve Environmental Research Summary

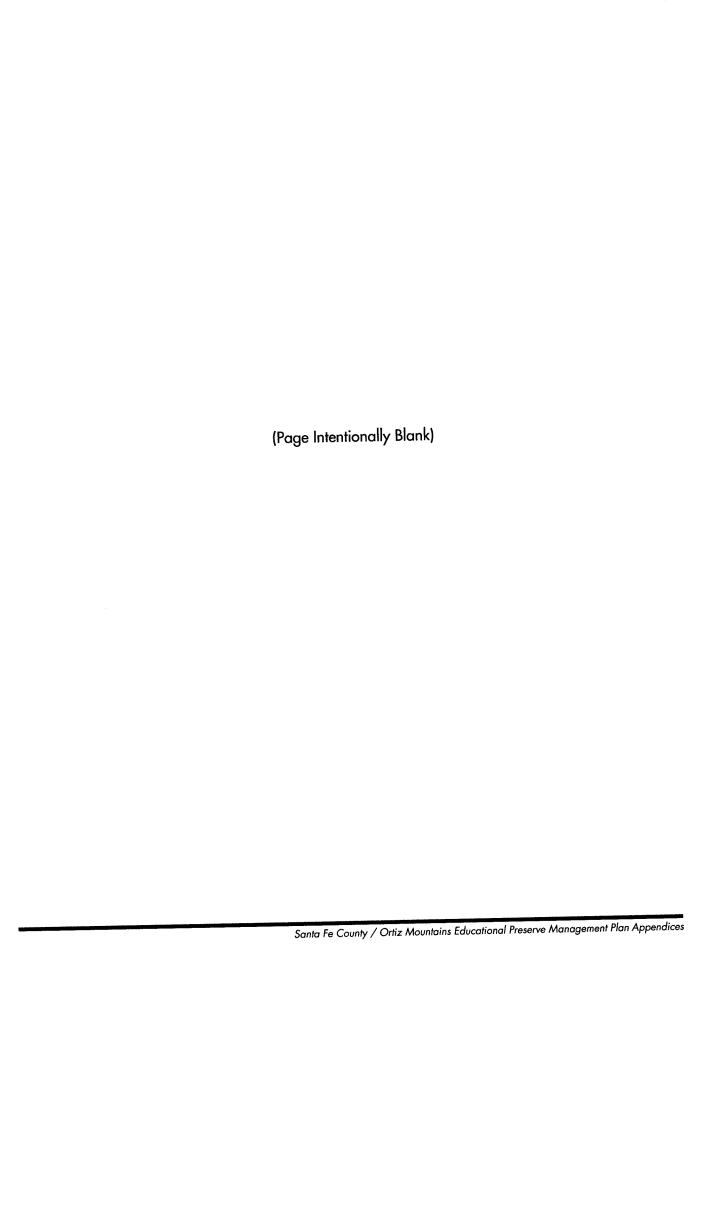
APPENDIX E: Draft Forest Management Plan for Ortiz Mountains Open Space



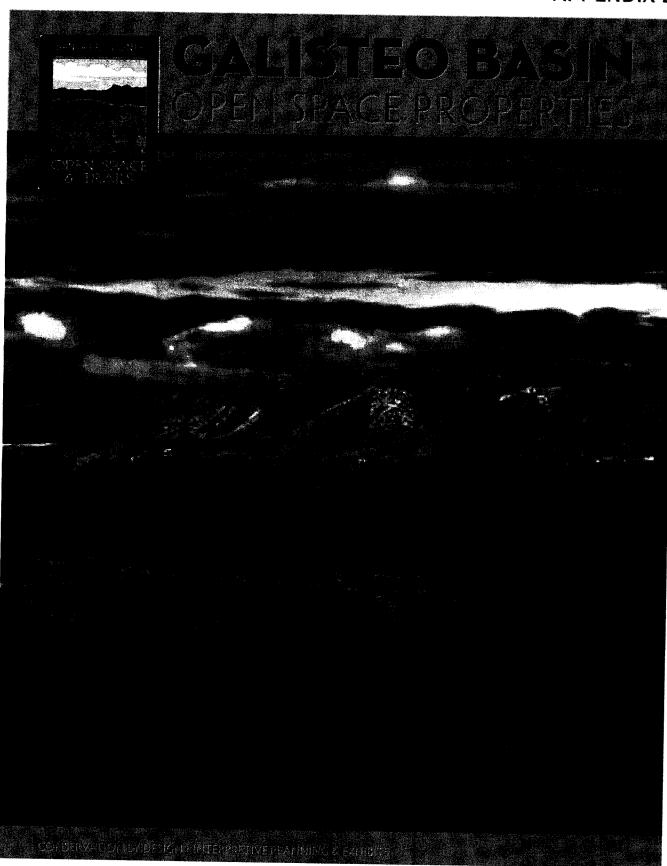


Santa Fe County / Ortiz Mountains Educational Preserve Management Plan Appendices

OMOS	Priority	Project or Management Activity							
		בארכים יישושפפוופון ארוואולא	Objective or Purpose	Location Code	Actor	Timeline ST=Short MT=Mid LT=Long	Recurring (R) or Not Recurring (NR)	Labor and Cost Estimates	Funding Source
Maintenance	1.2	Maintain site signs and bulletin board	Public Access M	Entry gate	SFC-M (Crew)	ST-MT-LT	×	Annually, up to haif day for 2 beople (8 h/v) + sumplies TRD	GF
	3	Maintain entry gates	Public Safety / Ecological Health	Entry gates	SFC-M (Crew)	ST-MT-LT	ď	Annually, up to half day for 2 people (approx. 8 h/y)	GF
	4	Inspect and repair surface, drainage and erosion on access road	id Public Safety / Access Management	Off-Site Access Road	SFC-M (Crew) or contractor	ST-MT-LT	4	Annually: 2 times for 4 people (64 h/y)) + supplies TBD	GF, CIP
	15	Inspect and repair shade shelter and picnic tables, porta-potty, and restock emergency kit		Shelter Area	SFG-M (Crew) or contractor or	ST-MT-LT	R	Annually: 2 times/ 1 day for 2 people (32 h/y) + supplies TBD	GF, CIP, VOL
	7.0	Inspect and repair trails and related trail markers and trails signage	ill Public Safety / Ecological Health	Trails	SFC-M (Crew) or contractor or	ST-MT-LT	Я	Annually: 2 times for 4 people (64 h/y)) + supplies TBD	GF, CIP, VOL
		Menther seeleghal theath based on montering plan	Ecological Nacility / Education	און site (אַפּוּפְּטּינּפָּטְ פונפּפּצָּ)	ກວ່ານກ່ອນ ກວ່ານກ່ອນກ່ອນ ກວ່ານກ່ອນກ່ອນ	SPEKATELY	T	Sveer TED time and personnel bases on monitoring plan	JON-415
		(venire) cultural rescurces based on menirening plan	Extragration	Coloural resource sites	Connecio: et	SERVINE	2	Svear 180 time and personnel based on monitoring plan	JON AID
		ואכווונים הוא ופאבוו צבופא ופכועוכה כא ומוות פונעופג מוס סוופרונובניוטא	Public Salety Evolugical Freath	כהותום והיסחורה צוניי	Sic-in (Crew) or contracting voluments	STEWNEGT	X	ant saudins + ((Vhat)) added टाका १६० र :श्राहमामर	GIS CIP VOL
Improvements	1.1	Implement access roads improvements plan	Public Safety / Access Management / Ecological Health	Off-Site Access Road	SFC-M (Crew) or contractor	ST-MT	œ	Every 3-5 years: Based on assessment and bid	CIP, Grant
76	1.2	Install site signage and bulletin board		Entry Gate	SFC-M (Crew) or contractor	TS.	NR	TBD, based on plan and bid	GF, CIP
	2,	Install education interpretive signs and improvements	ŭ)	Selected locations on property	SFC-M (Crew) or Contractor	L _W	N.	TBD, based on plan and bid	CIP, grant
	;	irali development and implementation and related facilities	A S		Contractor	WIT-LT	NR	TBD, based on plan and bid	CIP, grant
		Celluar connectivity	Public Safety	Select sites	SFC-M (Grew) or contractor	MT	Æ	TBD, based on plan and bid	CIP, grant



APPENDIX B



Santa Fe County / Ortiz Mountains Educational Preserve Management Plan Appendices

GALISTEO BASIN OPENSPACE PROPERTIES





Thank you for participating as a volunteer docent. Without volunteers, Santa Fe County would not be able to offer access to the Ortiz Mountains Educational Preserve.

As a docent, you will be the primary contact and the person who will interact with tour participants at the Ortiz Mountains Educational Preserve. You will be accompanied by at least one County staff member who will provide access to the site. This County staff member will unlock the gate and will remain with you during the entire time spent on site.

While you are not expected to be an expert, it is your responsibility to become familiar with the history and significance of the Ortiz Mountains, and to convey that information to tour participants in a friendly and professional manner.

Please direct any questions to the current Docent Program Leader:

NAME	
PHONE	
E-MAIL	

INTRODUCTION TO THE PROPERTY

The Ortiz Mountains Educational Preserve is a 1,350-acre property located in the Ortiz Mountains adjacent to an active gold mine reclamation site owned by LAC Minerals. This Open Space parcel encompasses the upper reaches of the Ortiz Mountains, including Placer Peak, the highest peak in the range at 8,897 feet. The property was originally donated to the Santa Fe Botanical Garden (SFBG) to manage the site as an educational preserve, and was later acquired by the County in 2007. SFBG continued to provide management of the property and guided tours through 2015, with approximately 300 participants annually.

Access to the property is by 2.5 unmaintained miles of road easement through the LAC Mineral property. The road is a concern due to its primitive, unmaintained status. Although volunteer docents have used the road in the past to lead guided tours and hikes, safety and liability concerns caused the SFBG to relinquish involvement. In 2015, County staff took over site tours, using County vehicles only. A management plan is currently underway for the property, and is considering access alternatives.

The property features a picnic area, kiosk, parking area, portable restroom, and several interpretive signs. Interpretive opportunities here include the high-elevation. "Sky Island" ecology, geology, Native American, and mining history. Numerous historic mining artifacts are present on the property, and the visitor is rewarded with outstanding views of the entire Galisteo Basin. Also within the viewshed is the historic mining community of Dolores, home to the first stamp mill¹ in New Mexico.

¹ A stamp mill is a piece of mining equipment that crushes rock.

MEDERALE

HOW TO USE THIS TOOLKIT

This toolkit contains important information that will help increase your familiarity with the site and its resources, whether you are new to the Ortiz Mountains or know it well.

It includes information on the important stories to know about the Galisteo Basin as a whole, and how the Ortiz Mountains fit in to the Basin's history and significance. This document addresses why the County conducts interpretation, and provides an outline of a sample tour that addresses the key points of the site's history and significance. Additional program ideas are also provided, as well as tips and tricks for interpretive presentations.

Evaluation is an important part of any interpretive presentation. Evaluation forms are included in this document, as well.

ROLES AND RESPONSIBILITIES

Access to the Ortiz Mountains Educational Preserve will occur through the following individuals:

County Staff Person

This individual oversees the guided tour program for the year on behalf of the County and provides access to the locked property per the agreed-to tour schedule. This person will lead the safety discussion and oversee the distribution and collection of participant waivers and evaluation forms at each tour. This individual will also work with the Docent Program Leader to arrange for the appropriate number of County vehicles and drivers to accommodate all tour participants.

Docent Program Leader

This individual will serve as the primary liaison between the County representative and the cadre of volunteer docents. He or she will monitor training and orientation meetings; establish and maintain the tour schedule and tour participant lists; and keep the County staff person informed about the size of each upcoming tour in aid of arranging County transportation.

Docent

Docent requirements include attending orientation meetings and an annual County-sponsored training, and committing to two years of participation as a docent. Before leading their first tour, all new docents must observe at least three guided tours led by trained and seasoned docents.

Successful docent candidates will be able to demonstrate their knowledge of the subjects, interpretive storylines, and protocols described by the OMEP, including the natural and cultural significance of the Ortiz Mountains and its place (historically and ecologically) in the larger Galisteo Basin. Additionally, they will be able to demonstrate their understanding of basic interpretive principles and techniques.

Interpretive program outlines are useful tools to help ensure that quality interpretive (not just informative) experiences are offered. At least two weeks before giving a tour program, each docent must submit an interpretive program outline to the Docent Program Leader for review and approval. This need be submitted only once, regardless of the number of times an individual offers a certain program. However, when and if the docent later modifies the program, he or she must submit a new outline for approval. Tweaking and modifications are encouraged as over time, docents find new ways to make the visitor experience increasingly meaningful and impactful.

Tour Participants

Individuals interested in participating in a guided tour to the Ortiz Mountains Educational Preserve must review the required safety disclosures and agree to the participant behavior expectations before securing their spot. In addition, the County representative should explain at the start of a tour that the County is interested in ensuring quality visitor experiences. Hearing this, participants may be more willing to offer useful feedback via the post-tour evaluation forms.

OVERVIEW OF ORTHZ MOUNTAINS EDUCATIONAL BRESERY



What Is Interpretation?

"a mission-based communication process that forges intellectual and emotional connections between the interests of the audience and the inherent meanings of the resource."

-National Association for Interpretation

STORIES OF THE ORTIZ MOUNTAINS

A multilayered and nuanced story can be told of the many different ways people have responded to the Ortiz Mountains and the riches they offer. The Ortiz Mountains hold within their ridges and drainages intertwining stories of cycles and change, growth and contraction. At the heart of it all is a grand geologic story of mountain building and erosion. Later came many waves of treasure seekers, whose grinding work rarely paid off and whose settlements bloomed and disappeared within a few years. The most recent chapter tells of industrial mining, the scars left behind, and the remarkable community engagement that achieved remediation and reclamation for environmental damage.

In the Ortiz Mountains Educational Preserve's stunning outdoor classroom, we have an opportunity to reflect on what we value for the long term, the costs and benefits of resource extraction, and the stewardship of the natural processes that sustain us.

There are a number of intertwining stories to tell about the Ortiz Mountains. As a docent, you have the chance to tell them all. You must be well-versed in geology, history, mining methods and remediation, and ecology.

Reminder: The road into the property is hazardous and there are significant liabilities associated with its use. At this time, a County representative must escort any visitors to the property.

¹ It is the intention of the County that stories related to spiritual connections and tribal histories in the Galisteo Basin are best told by tribal members. Archaeological history and evidence are topics that the County will include in interpretive programs and products throughout the Basin, as appropriate at each of the various Open Space locations.

(SVIERVIEW/SESSREVENIS) PRITAINS EDUCATIONAL PRESERVE

WHO ARE OUR VISITORS?

The site is currently closed to general public access; only supervised visitation is allowed. Docent-led hikes of the property occur periodically summer through fall. Through docent-led hikes, the site will continue to welcome:

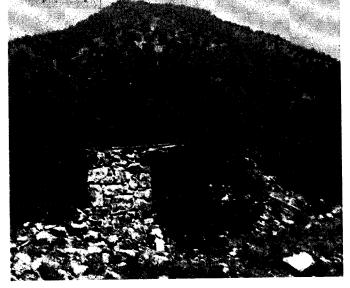
- Destination Travelers interested in historic sites, who will be attracted to the property if marketed well
- Day-trippers, who may make a special trip to experience an exclusive Open Space asset
- Mining and Geology Buffs, who will continue to attend guided tours of the historic mining area

Why Conduct Interpretation at the Ortiz Mountains?

The overall purpose of interpretation at the Ortiz Mountains Educational Preserve (and throughout the Galisteo Basin) is to broaden awareness of human connection and interdependence within this landscape, so that people come to understand, care about, and help care for its irreplaceable natural, cultural, and archaeological resources.

We do this by telling the many individual stories of the Ortiz Mountains in a unified and compelling way, and by using interpretive principles and techniques to ensure the experience is enjoyable, engaging, relevant to visitors, and helps fulfill the mission of the County's Open Space programs. In this way, we help our visitors develop a deeper sense of place, and invite them into a stewardship relationship with the many resources that make the Galisteo Basin exceptional.

Skillful interpretation will help to preserve cultural resources, scenic vistas and diverse ecosystems by inspiring people about the significance of the Ortiz site through time, and the ongoing relevance of the Ortiz Mountains and Galisteo Basin region to their day-to-day lives.



OVERWEY, OF ORTIZINOUNTAINS EDUCATIONAL PRESERVE

The Six Core Principles of Interpretation

Purposeful

We interpret the Ortiz Mountains for several reasons, among them to provide a quality visitor experience and to help the organization fulfill its stewardship mission.

Organized

Good interpretation isn't haphazard, but instead wellplanned and easy for the visitor to enjoy and follow.

Enjoyable

Interpretation isn't school. It's a voluntary experience, so it must be inviting, engaging, stimulating to the imagination, interactive, and multi-sensory (it's not just talking).

Thematic

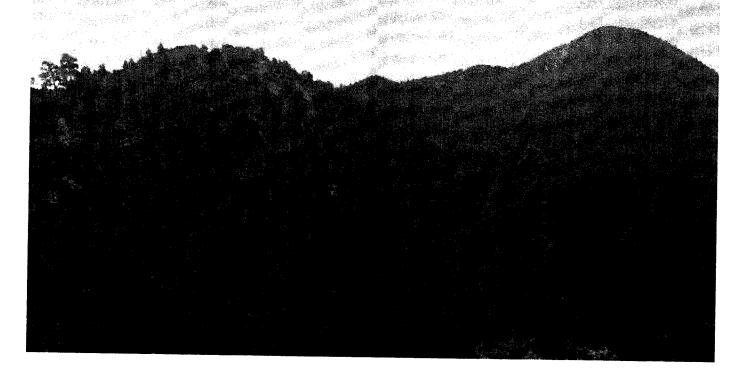
Interpretation is not the same as information.
Interpretation involves facts, yes—but it uses them in ways that always illustrates a bigger story—that of the Galisteo Basin and its precious heritage resources.

Relevant

Interpretation should be a personal experience for your audience members. We make our stories relevant to the visitor's interests, not just our own, As interpreters, we strive to understand our visitors so we can relate our story to what they already care about.

You

You are the key ingredient that makes programs successful. Follow the themes and remember the goals—and always be yourself. Let your enthusiasm shine through—it's infectious! And keep growing your skills. Many docents say there's nothing quite as satisfying as becoming a master interpreter.



LOOM SEOR NEEDER HEISZTION AT ORTIZ MOUNTAINS EP

As discussed on the prior page, interpretation is purposeful.

The County has developed an interpretive master plan encompassing all its properties across the Galisteo Basin—including the Ortiz Mountains Educational Preserve. The plan identifies specific interpretive goals for the Basin. Several of them (below) have particular significance for the Ortiz Mountains property. As you give programs and lead tours, you'll want to keep these goals in mind.

You'll notice that each goal is accompanied by one or more objectives—what visitors should be able to do as a result of their interpretive experience. Don't worry, you aren't going to be quizzing visitors! The objectives are provided here only to help you better understand some of the hoped-for outcomes for each goal. Keeping them in mind helps you keep your presentations focused and successful.

INTERPRETIVE GOAL 1: Increase public knowledge and appreciation of the natural and cultural resources of the Galisteo Basin.

Objective A. Visitors will understand the basic geography of the Galisteo Basin, and its main physical features, including the geology of the Ortiz Mountains.

Objective B. Visitors will be able to cite something new they've learned about the natural and cultural resources of the Galisteo Basin.

INTERPRETIVE GOAL 2: Increase awareness of and appreciation for the significance of the Galisteo Basin to American Indian cultures over time.

Objective A: Visitors will understand that prior to Spanish-contact, more than 10,000 native people lived and farmed in several Basin pueblos, and the Basin served as a regional trade route.

Objective B: Visitors will be able to describe, in general terms, why the mountains surrounding the Basin are sacred to American Indian tribes throughout the region.

Objective C: Visitors will be able to describe at least one Galisteo Basin mineral so valuable it was used as a trade good by native peoples (turquoise, malachite, lead).

Objective D: Visitors will be able to describe one or more inter-cultural conflict(s) experienced by the native people of the Basin (Apache and Navajo raids; Spanish colonization).

INTERPRETIVE GOAL 3: Increase understanding of the dynamic relationship between humans and the environment, and the impacts of human activity on the highly sensitive natural and cultural resources of the Galisteo Basin Open Space properties.

Objective A. Visitors will be able to cite how the gold mining economy was related to the development and decline of nearby towns.

Objective B. Visitors will know that the early gold from the Ortiz Mountains was transported around the world via the Santa Fe Trail.

Objective C. Visitors will understand that mining has longlasting environmental impacts and will be able to describe reclamation efforts.

Objective D. Visitors will understand in general terms the role of water in various mining activities, and the impacts of mining on water conservation and quality.

Objective E. Visitors will understand and respect that certain areas of the OMEP (and other OS properties) are culturally sensitive and therefore closed to visitor use.

INTERPRETIVE GOAL 4: Develop and strengthen support for the conservation, management, and restoration of open space lands in the Galisteo Basin, including the protection and restoration of biodiversity, native habitats, wildlife corridors, and soil resources.

Objective A. Visitors will understand the unique qualities of a Sky Island, the significance of dramatic elevation change to plant and animal life, and the importance of Sky Islands to migrating animals as well as the biodiversity of the region.

Objective B. Visitors will be able to give several examples of the concept of life zones.

Objective C. Visitors will express appreciation of and/ or support for the County's conservation of key Open Space properties such as the OMEP.

GOALS FOR INTERPRETATION AT ORTIZ MOUNTAINS ED

INTERPRETIVE GOAL 5: Increase public knowledge and appreciation of Santa Fe County's leadership in community-based resource conservation and sustainable design.

INTERPRETIVE GOAL 6: Provide an improved visitor experience by strengthening the bonds between Galisteo Basin residents and visitors and the past that surrounds them.

INTERPRETIVE GOAL 7: Promote respect by strengthening stewardship values and increasing compliance with regulations.

NITER PRETIMENTHEMES FOR GALISTEOBASINES PROPERTIES

A COMPELLING STORY

Picture the Galisteo Basin properties protected by the Santa Fe County Open Space, Trails and Parks Program as embodying a compelling story, and the process of interpretation as a storytelling art. Interpretive goals describe what we want these stories to do—both for the resource and the visitor—and interpretive objectives help us gauge how well our storytelling is working to achieve those goals.

Themes are where the "art" part comes in. Themes can be thought of as the core messages behind a story's facts. Their job is to highlight the deeper meanings of the Basin's heritage resources. Themes help the visitor not only to understand the Basin's importance, but to see him or herself as part of its ongoing story.

A good interpretive theme is expressible in a single, powerful sentence that contains only one idea—an idea that weaves the tangible aspects of the resource (the facts) with their intangible meaning(s). Themes are compelling and memorable. Themes answer the all-important question, "Why would our visitors want to know this—why would they care?" Note that a theme isn't necessarily repeated verbatim in any particular story; instead, it forms the framework around which a story is built. Think of a theme as the "take-away" that you want visitors to remember, absorb, care about, and incorporate—not only into their store of knowledge, but their lives.

A landscape as vast and old as the Galisteo Basin holds many stories and carries several strong themes. Varied as they are, these themes have been organized into a unified message hierarchy that works as a system: one central, overarching theme capturing the significance of the Galisteo Basin as a whole, and three supporting sub-themes. Sub-themes are just like themes—single, compelling statements of meaning—but their job is to expand on and illustrate the central theme. Sub-themes also organize the Basin's various stories into meaningful categories. We limit ourselves to three sub-themes because of the way the human mind uses memory and assigns meaning.

Every story told on behalf of the County's Galisteo Basin properties, therefore, should illustrate one or more subthemes (see illustration, page 10). This is how interpretation works its magic. By using smaller stories to illustrate a bigger one, you're ensuring that each interpretive experience in the Basin will, in the visitor's mind, add to his or her growing and very personal understanding of—and appreciation for—this special place. Every story you tell is, ultimately, telling one big story—the central theme of the Galisteo Basin.

Over time, interpretation in the Basin will build toward a stronger stewardship ethic for the resource, grow respect for the Open Space program's conservation mission, and strengthen advocacy for natural land protection in general. By using themes, you're helping visitors and residents understand, care about, and care for these incredible heritage resources, which in turn give our region its remarkable depth and flavor.

The central theme and sub-themes below were developed with the entire Galisteo Basin in mind. Naturally, not every sub-theme is equally relevant to every OS property. Some stories are more suited to certain sub-themes than others. As you read, think about which of these Basin sub-themes and storylines have particular relevance to the Ortiz Mountains Educational Preserve.

INTERBRET VERTHEMEN FOR BANGER FOR BASIN OF PROPERTIE

The Santa Fe County Open Space & Trails Program has established the following theme structure for interpretive programs and products throughout the Galisteo Basin. The interpretive stories told at the Ortiz Mountains Educational Preserve contribute to the Basin-wide theme structure below. Preserve-specific storylines that illustrate these themes appear on the following page.

GALISTEO BASIN CENTRAL THEME

The Galisteo Basin is an inspirational and fragile landscape, shaped by many processes and cultures, and imbued with a deep sense of time and place.

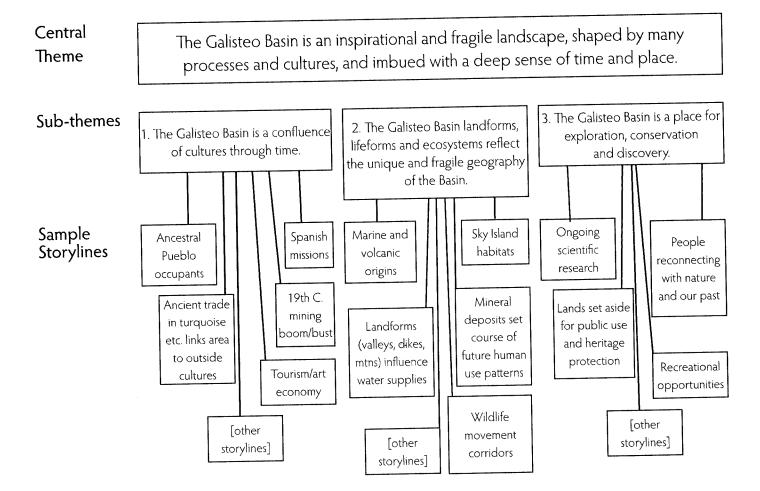
GALISTEO BASIN SUB-THEMES & STORYLINES¹

- The Galisteo Basin is a confluence of cultures through time.
 - a. Archaeological evidence indicates human presence in the greater Galisteo Basin for more than 7,000 years.
 - b. Spanish exploration and missions in the Basin had a profound impact on ancestral pueblo cultures.
 - c. Active trade routes in the region attracted European exploration of the Basin.
 - d. Evidence of historic ranching and mining efforts can be seen throughout the Basin today.
 - e. The railroad created new opportunities for trade and transportation beyond the Basin.
 - f. The Galisteo Basin is a landscape sacred to more than a dozen American Indian tribes—including those in the Rio Grande valley, the southern Plains, and as far away as Hopi.
 - g. Prehistoric, historic, and sacred sites and artifacts are fragile, valuable, irreplaceable, and worthy of our respect and protection.
- 1 Think of a storyline as the thread or plot of a story.

- 2. The Galisteo Basin landforms, lifeforms and ecosystems reflect the unique and fragile geography of the Basin.
 - a. Ancient seas and swamps once covered this landscape, leaving behind many traces of life .
 - b. Geological uplifts, faulting and volcanic eruptions formed much of the terrain we see in and around the Basin. Erosion continues to shape the landscape today.
 - c. The Galisteo Basin is important habitat and a migration corridor for hundreds of wildlife species of regional, national and international significance, including top predators, threatened and endangered species, and migratory birds.
- 3. The Galisteo Basin is a place for exploration, conservation and discovery.
 - a. Archaeological research in the Galisteo Basin has helped define the profession and knowledge of archaeology in the Southwest, and many research opportunities remain.
 - b. People today value the Galisteo Basin for open spaces, scenic vistas, spiritual reflection, recreation, archaeology, and continued traditional use by native peoples.
 - c. Recreation opportunities in the Basin promote exploration, learning, stewardship and reflection.
 - d. Because people care, important areas throughout the Galisteo Basin are being protected for future generations.

INTERPRÉTIVÉ THEMES FOR ORTIZ MOUNTAINS ER

THEME MAP



SAMPLE TOURS AT ORTIZ MOUNTAINS E

Narratives of the geology, human history, and ecology of the Ortiz mountains are deeply intertwined, and interpretation of the Ortiz Mountains will always be interestingly cross-disciplinary. Note that all the sample programs illustrate one or more Galisteo Basin sub-themes.

The Mountain of Life program is the most comprehensive, covering all three Galisteo Basin sub-themes.

These program ideas are meant to serve as a springboard from which to develop your own personal style of tour. Creativity is welcome!

Mountain of Life: The varied riches of the Ortiz Mountains continue to draw both people and wildlife. (illustrates all three Galisteo Basin Interpretive Sub-themes)

Origins of the Ortiz: Geology sets the stage for future activity

- Ancient seas set down sedimentary layers
- Periods of uplift create massive mountains
- Volcanic activity forces magma through cracks, creating igneous intrusions laced with precious metals
- Eons of erosion bring gold deposits close to the surface, leaving clues in the gravel.
- The shape of the mountains (elevation) and the gold hidden within both play a role in what's to come.

1828 gold discovery triggers a century of gold rushes

- Although people have lived in the Galisteo Basin for at least 7,000 years, no mining on the mountain itself took place until the 19th century.
- Placer mining (cheap, quick, and easy, but hit-or-miss)
- Lode mining (more industrial and expensive, but more productive; water intensive); Dolores
- Mining industry boosted with arrival of railroad (ore transportation and processing)
- In all, gold lured more than __ people to this area—in search of great wealth, or just a living
- Mine shafts now stabilized and/or closed for safety and wildlife protection (Townsend's big-eared bat)

Modern techniques increased mining production—but at a heavy cost

- 1971 brings open pit mining, heap leaching; intensive operation, doubling previous yields. Cunningham Mine.
- Gold has its price: environmental impacts to water quality, wildlife and human health, scenic values
- · Activism and resulting mitigation projects (Friends of

Santa Fe challenge Goldfields Corp, work with LAC and conservation partners to create a reclamation plan); OMEP is born.

The mountains are home to a more lasting wealth: a rich ecosystem (at highest point of climb, with view of Galisteo Basin)

- The mountain provides another form of wealth: a wealth
 of biodiversity due to four life zones; supports a range of
 habitats, plants and wildlife
- Some species spend entire lifespan here, others use seasonally (breeding sites, migration stops, seasonal food supplies, resting areas); others as conditions change (due to drought, fire, human development elsewhere, etc.).
- Sky Island concept—isolation above the arid plain makes it a critical haven for sensitive and/or vanishing species; one of several sky islands in NM-AZ-Mexico border area.
- Part of the Galisteo Basin you see below us is a critical wildlife corridor linking to other sky islands, mountain and forest habitats.

Because people care, this mountain lives forever

- For nearly 200 years, the riches of the Ortiz attracted intense human activity in the form of mining—so much so, that it nearly destroyed this sky island forever.
- But love of this place led to creation of the OMEP. Now the mountain—and its life zones, species, and movement corridors linking to other natural lands—are protected in perpetuity.
- In the same way, the OMEP and other protected natural lands are here for you, and will be for your children's children.

OTHER PROGRAMIDEAS FOR ORTIZ MOUNTAINS EP

What Happens When We Go Up — Life Zones and Habitats of the Ortiz Mountains

The program takes an ecological focus, highlighting the links between elevation, climate, plant diversity, and wildlife diversity in the Ortiz Mountains. The Preserve includes four vegetation communities—and plant diversity is matched by diversity of wildlife. Discussions include C. Hart Merriam's Life Zones concept; the Sky Island concept, with the Ortiz ecologically significant as habitat for cougar, black bear, bobcat, mule deer, and dozens of bird species; and the Galisteo Basin as a wildlife corridor.

Even if no large wildlife are seen on tour, tracks, scat, and other sign will be present to illustrate the presence of rich biodiversity. The preservation of the ecological integrity will be linked to community involvement, including LAC Minerals, citizens, SFBG, and Santa Fe County.

When and if appropriate, the role of fire in maintaining wildlife habitat may also be discussed. Visitors will have the opportunity to learn to read the land for signs of wildfire and fire recovery.

Tracks and Trails in the Ortiz Mountains

This tour connects animal tracking with the concept of the Galisteo Basin as a wildlife corridor, the role of the Ortiz Mountains as wildlife habitat, and the importance of sky islands.

Participants will learn to identify animals by their tracks and other signs. Why would this particular animal come this way? What was it seeking, and where did it end up? Discussion will focus on the reasons different species might move vertically, or from the mountains to the valley, whether annually, seasonally, or daily.

This tour includes a demonstration of an easy way to cast tracks in plaster. Visitors will be encouraged to consider collecting tracks of several species as they explore other natural areas. This is an especially fun activity for families with children, and a good way to illustrate the theme of stewardship: we can enjoy wildlife and collect memorabilia without harming either animals or their habitats.

When and if appropriate, the role of fire in maintaining wildlife habitat may also be discussed. Visitors will have the opportunity to learn to read the land for signs of wildfire and fire recovery.

A Bird Walk Through Time

This tour explains C. Hart Merriam's Life Zones concept as it relates to habitat for animals, particularly birds, the importance of sky islands as stopovers for migrating birds. Discussion explores how these movement patterns may have originated and changed over the course of millennia.

As our climate continues to warm, what future changes will we see in bird populations? Discussion will explore the possibility of some species disappearing from this area and other, new species extending their range to the Ortiz in response to changing conditions. Visitors will be encouraged to keep phenological records of their own sightings over time. Refer interested individuals to citizen science programs run by the Audubon Society, the Cornell Laboratory of Ornithology, the Field Museum, etc.

Legacy of the Rock — The History-making Geology of the Ortiz Mountains

The geology of the Ortiz Mountains is the story of an eonslong cycle: rock layers laid down from the erosion of distant mountains, episodes of dramatic mountain building, then millennia of yet more erosion. With the most recent erosion, the interior "plumbing" of ancient volcanoes was finally exposed, along with tantalizing bits and flakes that sparked a rush for riches, and the inevitable bust that followed.

This tour focuses on the following features:

- Oldest sedimentary layers
- · Igneous activity, veins of gold
- Erosion/ deposition of gold bearing gravel
- Remnants of miner's camps, lifeways of miners
- · Placer mining process and water use
- Lode mining process and water use (mina Santo Niño, mina Santa Rosalia),
- Remnants of New Mexico's first railroad (1867); other relics of Mexican and Territorial Eras
- The town of Dolores (importance for processing ore in arrastras, boom and bust).

OTHER PROGRAM IDEAS FOR ORTIZINOUNTAINSE

Life of a Miner — Dirt and Gold, Water and Hope

Miners working to extract gold from the Ortiz Mountains in the early days endured, for the most part, a hardscrabble life with only the occasional reward. How heavy is that bag of gravel on the first trip up the ladder? The tenth trip? Do your arms feel stronger when it is your own end-of-the-day pepena? What do you sleep on in the hills; where do you wash your clothes; is it canned beans again for dinner?

By hearing accounts of day-to-day life in the placer fields and the dusty town, hefting their tools, and looking at old pictures and documents, we can imagine the details of mining life as it was lived here, and consider the ways that our contemporary struggles and joys may be the same or different.

A number of hands-on elements add dimension to the experience:

- · Barea (the wooden gold pan)
- Bag of sandy gravel to lift and carry
- Picture of deep placer mine, pictures of mining with pica and cuna
- Replicas of lode mining tools (cached at a tour stop) to heft
- Map/ diagram of the Old Ortiz Mine
- Information on the various artifacts found at different sites on the mountain
- Readings from Baxter: what/how/where miners ate, slept, recreated, spent their money.

The group will inspect the mina Santo Niño and the site of the nearby mina Santa Rosalia, as well as remnants of New Mexico's first railroad (1867) and other relics of the Mexican and Territorial Eras.

BROKRAM OUTBING TEMPLATE

Submit to Docent Program Leader within two weeks of scheduled tour

Program Title:	Audience:
Program Theme:	
Illustrates which Galisteo Basin Sub-theme(s):	
Goal(s):	
Objective(s):	
Resources/materials needed:	
Flair - How will you personalize your tour, involve guests, and make it	enjoyable?
Presentation Outline	
Introduction (after welcome, introducing self, SFC Open Space progra	am, housekeeping info, etc)
Body (storylines):	
Conclusion:	
•	

TOUR OUTLINE — EXAMPL

Submit to Docent Program Leader within two weeks of scheduled tour

Program Title: Mountain of Life

Audience: Mixed ages from Santa Fe region

Program Theme:

The many riches of the Ortiz Mountains continue to draw both people and wildlife.

Illustrates which Galisteo Basin Sub-theme(s): All three

Goal(s): To inspire guests to respect and value the OMEP.

Objective(s): 1.50% of guests will be able to restate my theme. 2. Guests will take only photos as mementos. 3.25% of guests will indicate interest in returning for other programs.

Resources/materials needed: Native American artifact; sedimentary and igneous rock samples; photos of gold nugget, 1800s miners, Cunningham mine activity/impacts, wildlife; map of Galisteo Basin w/ OS properties; field guides for natural history questions.

Flair - How will you personalize your tour, involve guests, and make it enjoyable? Pass around photos and artifacts to bring history to life; invite people to spot/report wildlife, smell ponderosa bark, track the number of flower species, etc.; ask questions so people can participate/offer their own observations/stories.

Presentation Outline

Introduction (after welcome, introducing self, SFC Open Space program, housekeeping info, etc)

I'm glad to be with you at the OMEP today. As you know from the signup process, a visit here is a rare opportunity, and not everyone gets to do it. But did you know that this particular mountain range has been a tremendous attraction for thousands of years—not only for people, but for wildlife as well? Why would that be? What's so special about the Ortiz Mountains? Let's load into the van, and we'll start exploring what makes this place such a big deal, for people and for wildlife.

Body (storylines):

- Geology is what set the stage for future activity.
- In 1828, the discovery of gold triggered more than a century of gold rushes.
- In the late 20th c, modern techniques increased production—but at a heavy environmental cost.
- The mountain is home to a more lasting wealth: a rich ecosystem.

Conclusion:

So we discovered today that these mountains have been attracting attention for thousands of years. More recently, the riches of the Ortiz attracted intense mining activity, nearly destroying this fragile sky island. But because people cared about this place, the OMEP was created. Now the land, its species, and its critical function as a haven along migration corridors are all protected in perpetuity. And in the same way, this preserve is here for you—and will be for your children's children. Because people care, this mountain will live forever (finish up with thanks, invite to fill out form, available for questions, etc.).

DECOM MENDED RESOURCES FOR INDER BREEFES

- Galisteo Basin Open Space Properties Interpretive Plan, 2016
- Personal Interpretation: Connecting your Audience to Heritage Resources by Lisa Brochu and Tim Merriman, InterpPress, 2002
- The Interpreter's Guidebook: Techniques for Programs and Presentations by Regnier, Gross, and Zimmerman.
 Interpreter's Handbook Series, University of Wisconsin-Stevens Point Foundation Press, 1994.
- Sharing Nature with Children by Joseph Cornell, DAWN Publications, 1998
- Interpreting Our Heritage by Freeman Tilden, University of North Carolina Press, 1977

- Interpretive Writing by Alan Leftridge, InterpPress, 2006
- Project Learning Tree: Environmental Education Pre K-8 Activity Guide, by Project Learning Tree (Amazon has copies)
- Project WET Curriculum and Activity Guide 2.0, by Project Wet (Amazon has copies)
- Project WILD K-12 Curriculum and Activity Guide, by Project WILD (Amazon has copies)
- WIll include Ortiz-specific resources in next draft of document

KEY CONCEPTS IN INTERPRETATION—A GLOSSARY

Topic

The subject matter of a presentation. Western tanagers, tanager nesting habits, migration, birds of New Mexico, and raptor-songbird relationships are all topics. Topics are not the same as themes.

Program Theme

The principle message or story about your topic. A theme is the "big idea" that connects a presentation's facts and concepts into a meaningful whole. Think of your theme as the one "take-home message" you want your visitors to grasp and remember forever. Effective themes link a tangible with an intangible; they are specific and interesting. Themes express a complete thought, so always think of your themes as a complete sentence.

Good examples: The Mexican gray wolf is a keystone of our Southwestern ecosystems; Desert plant structures help them survive the world's harshest environments; Volcanoes set the stage for the "good life" for early Jemez residents.

Bad examples: The Mexican gray wolf; Plant structures; Southwestern ecosystems; Prehistoric life in the Jemez Mountains. These are topics, not themes. What <u>about</u> wolves? How do plant structures <u>matter</u>? What was <u>significant</u> about prehistoric life in the Jemez?

Program Sub-Themes

Subordinate messages that support and illustrate your theme. Subthemes form the body of your presentation, and facts support the subthemes (see diagram on page 8). Like themes, subthemes are complete sentences. Ideally, use three subthemes (up to five if absolutely necessary). Sample subthemes for Volcanoes set the stage for the "good life" for early Jemez residents:

- 1) Rich volcanic soils yielded abundant crops
- 2) Naturally-occurring volcanic caves offered convenient shelter
- 3) As a valuable trading commodity, high-quality obsidian brought wealth and influence

P.O.E.T.R.Y.

A useful acronym for the six essential qualities of interpretation:

- Purposeful: serves the visitor as well as your mission
- Organized: well-planned and easy to follow
- Enjoyable: entertaining, stimulating, interactive, multi-sensory
- Thematic: has a central "take-home" message
- · Relevant: meaningful and personal
- You: Be yourself--and let your enthusiasm shine through. Your passion is infectious!

KEY CONCEPTS IN INTERPRETATION—A GLOSSARY

Relevant

Information is relevant when it's both meaningful & personal: linked to something your visitor already knows, and linked to something your visitor already cares about.

Self-Referencing

A technique to help visitors put themselves into your story (when was the last time you...what do you suppose he felt when...why do we...?)

Tangibles

The objects, features, or events we interpret, e.g. projectile points, black bears, battlefields, endangered species, forest fires, plant communities, ceremonial dances.

Intangibles

The larger ideas that lie behind tangibles and give them meaning, e.g. craftsmanship, adaptation, struggle, recovery, innovation, interdependence, shared heritage.

Universal Concepts

Extra-powerful intangibles that reach across boundaries of culture, gender, etc.; e.g., healing, family, support, security, hope, courage, fear, love. Use universal concepts in every program.

Program Goal

The "big-picture," ultimate result of your interpretive program. Goals help advance your agency's mission, so they should tier to the Galisteo Basin Open Space Interpretive Plan (Interpretive Plan). Because people must both learn something and feel something before they will be interested in making behavioral changes, interpretive goals should address the cognitive, emotional, and behavioral realms. Try to think about what you want your visitors to learn, feel, and DO as a result of your program. Programs can have more than one goal. Example: If your theme is Gophers are beneficial animals, a reasonable set of goals might be:

 Visitors will understand the importance of gophers, better appreciate gophers, and become active supporters of gopher habitat restoration.

Examples of unreasonable program goals:

- Visitors will understand the complete life history of the gopher. (Why would your visitor want to know this? And how does this goal serve your mission?)
- Visitors who have strong convictions that all rodents are vermin will experience a complete reversal of attitude. (a. Come on, this is real life. b. Good interpreters always respect divergent viewpoints-speak your truth, but acknowledge that there are multiple points of view. Let visitors make their own decisions)

Program Objective

A specific and measurable way to track success. As a good interpreter, you should try to track your effectiveness (in an informal way). Set at least one objective for every goal you create. Make objectives worthy but realistic, and something you can actually observe.

Realistic objectives for the gopher program

- 70% of visitors will be able to recall at least two benefits of gophers, if asked
- More than one visitor will express surprise at the importance of gophers, or make a similar remark
- 50% of visitors will take the brochure on non-toxic and humane pest control methods

KEY CONCEPTS INDIFFERENCE ATTONIA OF OCCUR

Program Objective (continued)

Unrealistic objectives

- 100% of visitors will be able to name all the benefits of gophers that were discussed on tour (rarely will you achieve 100% on any objective; if you do, perhaps your sights are set too low)
- 90% of visitors will volunteer for the gopher habitat recovery team (we can't change everyone's lives with one program. Our job is to plant seeds of stewardship and encourage them to grow.)

HELPEUL HINTS FOR BETTER PROGRAMS

The Theme's the Thing. People forget facts but remember themes. Make sure every program has a theme, and select only facts that illustrate that theme. Practice non-attachment; if a fact doesn't support that "larger concept", leave it out.

Remember that the interpreter is not the program. Command people's attention, but don't make yourself the center of attention. Our job is to connect people to the resource and its meanings. The very best interpreters are "transparent." They act as facilitators to the visitor experience.

Do your research. Make sure your facts are verified and that you can quote your sources. The internet is a terrific tool, but be cautious. Anyone can write a Wikipedia entry. Doublecheck your sources, and rely on your qualified expert contacts when in doubt.

Keep it brief. Who loves a long speech? Give enough to create a satisfactory experience, but always leave them wanting to know more. This helps empower others to become more involved. Think of yourself not as planting trees, but planting seeds.

Always try to involve your audience physically and emotionally, not just intellectually. People retain up to 90% of what they do. That's a powerful teaching concept! Emotional connections are vital, too: a stewardship ethic develops over a long period, but it always starts with some connecting experience, a revelation that occurs on a very personal level.

Teachable moments: If something unscripted but spectacular occurs—for example, a hawk dives for prey right in front of your group, stop and let everyone enjoy the moment. After the excitement is over, work the event into your presentation if possible (without forcing it). For example, the hawk may fit into your discussion of forest ecosystems: "This grassland is an important source of seeds and other plant foods, which support small animals, and, as we've just seen, their predators."

Go for it! Great theme-based programs are a work in progress. Don't wait for perfection before trying out the theme-and-subthemes approach. Instead, create and adjust. Over time, as you discover what works and what doesn't, you'll come up with new and better ways of using theme structure to make your presentations relevant, interesting, and memorable.

Feel shy? Test your new program in a safe environment. Practice in front of a mirror. Videotape yourself. Try things out on friends, and ask for their feedback.

Did we mention that the Theme's the Thing?

Do a stealth evaluation. Now and then, try to overhear what visitors say after a tour, or unobtrusively watch their behavior at your site. Are they "getting" your theme? Are you meeting your objectives? Let their reactions help you to adjust and refine your program over time.

Always be working on a new presentation. It keeps you and your programs fresh, and your job interesting. And the positive feedback you'll get from your visitors is the best kind of high!

Get certified. The National Association for Interpretation provides training and certification for people who deliver interpretive programs to the public. It combines the theoretical foundations of the profession with practical skills in delivering quality programming. To find a course near you, visit www.interpnet.com/certification.

BACKGROUND INFORMATION ORTIZMOUNTAINS EP

Summary Information/Overview

The Ortiz Mountains Educational Preserve (OMEP), located approximately 30 miles southwest of Santa Fe off the scenic Turquoise Trail, incorporates 1,350 acres in the upper reaches of the Ortiz Mountains, including Placer Peak, the highest peak in the Ortiz range at 8,897 feet (2712 meters).

Geology

The geologic story of the Ortiz Mountains begins with massive deposits of sedimentary rock laid down from 360 million years to 40 million years ago in a subsiding trough. During two periods of volcanic activity, igneous rock (crystallized from magma) pushed into and through the sedimentary layers – horizontally in the first eruption, then vertically in the second. The base and precious metals that sparked the New Mexico's gold rush and decades of fascinating and lucrative mining, formed during the second period of igneous activity around 32 million years ago as dikes pushed vertically up through the sedimentary layers. A massive Fuji – sized mountain arose from all this activity before millennia of wind and rain of wore away much of the massif to expose the interior plumbing – the veins, dikes and vents of volcanic rock, which are the ultimate source of all the gold. Today visitors can see outcrops of pyroclastic rocks that formed in the Dolores Gulch volcanic vent (31.3-31.9 MA) and gold-bearing quartzite at the Florencio prospect along its edges. These have also eroded over time, producing the wide shelves of gently sloping gravel around the bases of all the Ortiz belt mountains. (Baxter) (Maynard)

Mining (Placer, Lode, Open Pit/Heap Leach)

Beginnings of Gold Mining

Archeological evidence demonstrates that people were in and around the Ortiz mountains for centuries before the 1820s. In the 200 years before the arrival of Coronado, likely many thousands lived within a dozen miles of what was to become the town of Dolores. There was even seasonal habitation at the town site itself, because of the natural spring, but it had very little lasting impact on the area. (TRC Mariah Associates)

The story of gold mining in the Ortiz Mountains begins in 1821 with two colorful legends: in one, a rush erupted after an unfortunate ox trying to slake its thirst at a spring, ate a gold nugget and died. In the second, a sheepherder or muleteer

picked up a rock while searching for a lost animal, and noticed (one would think with absolute delight) that it contained gold. However, the quest for fortunes in gold had been closely tied to the creation of the Republic of Mexico and the opening of the Santa Fe Trail (Baxter). After the pueblo revolt in 1680, native people stipulated that the Spaniards were not to engage in mining, so we can imagine some mining activity before then. (USGS)

((Research: One source mentions Spaniards placer mining with native slave labor...this needs corroboration))

Placer mining

When gold-bearing volcanic rock erodes, the gravel down slope will have particles of gold in it. Placer mining takes advantage of the heaviness of gold fragments relative to other sediments. The earliest placer miners filled a wide wooden bowl, called a batea, with sand and water. They repeatedly shook and swirled the bowl to separate the heavier gold and rinse out the lighter silt. In deep placering, developed in the Ortiz Mountains between 1821 and 1840, miners dug into the gravelly earth almost to bedrock (30 or 40 feet) to get to the gravel richest in gold. Carrying bags of sandy gravel on their backs or heads, they climbed a ladder to the surface before rinsing it to find any gold fragments. The more sophisticated operations used a hand-cranked windlass to bring the bags to the surface. (Baxter)

Throughout the entire Mexican period (1821-1846) and into the Territorial Period (1850) small-scale placers were in constant operation in the Ortiz Mountains. (Baxter) Placer mining really picked up with the discovery of especially rich deposits in 1828. It continued off and on for the next one hundred years, with a great revival during the depression, when men needing a grubstake, or just grub, clambered over the mountains with their bowls and hopes. In the 1940's, metals essential for the war effort became a higher priority than gold mining; after the war, economic opportunities in the cities lured men away from the hard life of placer mining. (USGS, Johnson)

((Research: environmental impacts of placer mining at Ortiz and elsewhere))

BACKGROUND INFORMATION ORTIZ MOUNTAINS EP

Lode Mining

Lode miners would dig a vertical shaft and a series of horizontal tunnels into gold-bearing veins of rock. They used specialized digging tools, wedges, and hammers to wrest the gold-bearing stones from the rest of the rock, and rawhide buckets to lug it to the surface. There it was sorted, weighed and taken to the arrastra for crushing before fragments of gold could be washed out.

The Old Ortiz Mine is known as one of the earliest hardrock mines in the western United States, and the Preserve contains several historic mine shafts. In 2002, the New Mexico State Abandoned Mine Land Bureau sponsored a project to safeguard the 17 most hazardous mine shafts by fencing or filling. To protect a colony of Townsend's big-eared bats, the Tunia shaft of the old Santa Niño mine was stabilized and capped with a cupola gate—a special structure that allows for small mammal movement while restricting human access.

Town of Dolores

- Originally called el Real de Dolores (relates to Spanish law regulating tithes to king from mining revenue)
- Started as placer mining town
- Discovery of quartz veins in 1833 (quartz veins often carry veins of gold)
- Between 2000-4000 occupants at population height.
- Fairly compact, no larger than two city blocks, the village consisted entirely of one-story adobe houses, save for the store, and lay at the foot of the Ortiz mountains to the south.
- Dolores was six miles from the town of Cerrillos and three miles from Madrid, two towns now dependent on tourism rather than mining. Santa Fe, the territorial capital, lay twenty-five miles to the north.
- The Wind Leaves No Shadow is a novel about local early placer- era character, Doña Tules. It provides some good story-telling details about life in Dolores. ((Read and record))
- Processing ore Arrastras and Stamp mills. ((Research: Mercury amalgamation)
- 1840 discovery of gold in New Placer in San Pedro Mountains.
- Activity in Dolores declined from then on until only about 150 remained in 1870, 100 in 1893

- Earliest railroad from Ortiz mine to Dolores
- Miss Emma Belle Sweet's (young school teacher in 1890's) recollections provide engaging details of life in Dolores
- Thomas A Edison built a large plant in Dolores in 1900 with hopes of extracting gold with electricity. Did not work.
- · Dolores town site now a private ranch; no access.

((Research: connection between Ortiz Mountain Mining and the Santa Fe Trail, Santa Fe Trail history and description for context))

Comparison of Placer Mining and Lode Mining

Placer mines required little capital and a small labor force. The pay streaks are distributed sporadically so the smaller, nimbler cleaning and concentrating operations were more successful. Lode mines needed significant capital investment and some degree of workforce organization. They were much more easily disrupted by military invasion and economic downturns, and pretty much stopped operation after the Civil War started. For most of the history of mining in the Ortiz Mountains, it was placer mining that produced the significant wealth estimated at 2 million dollars. (USGS, Johnson) (Baxter)

This all changed in 1972 when Gold Fields South Africa Ltd, an international mining company, leased 36,000 acres of mineral rights and began test drilling operations in the Cunningham Hill formation, a volcanic feature where geological activity had concentrated gold. The veins and nuggets had disappeared from the Ortiz Mountains long before. What remained was tiny particles of gold embedded in hard volcanic rock.

Cunningham Hill Mine

Underground tunnels would not do the job. What was needed was an open pit, 50 ton capacity trucks and giant rock crushers. Leaching with sodium cyanide (called heap leaching) chemically separates the gold particles from the remaining fragments of rock. The gold-laden mixture, called a "pregnant solution," was caught in ditch and sump areas and flowed through carbon absorption towers. The gold was stripped from the carbon particles by a caustic solution, and finally electroplated onto stainless steel plates. The process was neither clean nor terribly efficient. Each ton blasted contained less than 1/20th of an ounce of recoverable gold, and involved the use of many toxic chemicals.

BACKGROUNDENFORMATION ORTIZ MOUNTAINS E

Between 1980 and 1987, Gold Fields extracted an estimated 250,000 ounces of gold, over half of all the gold brought out of the Ortiz Mountains by placer and lode mining during the previous 160 years.

Gold Fields moved 25 million tons of rock; a tailings pile is visible from the road up Placer Peak. In the 1990s, several serious environmental issues came to light. Acid rock drainage (formed when sulfite rocks are exposed to air and water and the water flowing over them becomes acidic) dissolves heavy metals and non-metal constituents from rocks. Acid mine drainage is dangerous and often lethal to both plants and animals. The New Mexico Environmental Department has identified heavy metals and other dissolved solids in the upper Dolores Gulch water supplies, at levels that exceed water quality standards. In addition, a plume of cyanide and nitrates had appeared in the groundwater beneath the leachate residue pile.

A citizens group, the Friends of Santa Fe County, formed in 1990 to discuss reclamation of the mine site along with possible controls on future mining elsewhere in the Ortiz Mountains. The Friends filed a lawsuit in 1994 against Gold Fields (and Pegasus and LAC Minerals, U.S.A, other gold mining corporations who had since acquired the mine) over pollution and damage to the environment. The suit was settled in 1996, with the stipulation that LAC (now the sole owner) would develop, in coordinations with the Friends of Santa Fe County, a reclamation plan for the area, and donate the western third of its holdings to an appropriate non-profit organization. Citizens remained very active in the process, and seven years later (2001) the New Mexico State Environmental Department and the Mining and Minerals Division accepted LAC's closeout and other reclamation plans. That same year, the Santa Fe Botanical Garden accepted the donation of the land now known as the Ortiz Mountains Educational Preserve. Today, the O.M.E.P is a property of Santa Fe County, administered by Santa Fe County Open Space and Trails, and managed by the Santa Fe Botanical Gardens. The Santa Fe Conservation Trust holds the property's development rights in perpetuity, ensuring that no building or other development can take place.

((Research; additional information on reclamation efforts (Baxter p.190))

Environment and Ecology

Sky Island

There are four vegetation communities on the preserve: 1) pinyon/juniper/blue gramma community on the lower slopes, below 7,500 feet, rising to 2) piñon/juniper/muttongrass, 3) piñon/gambel oak, and 4) mixed conifer/gambel oak community in the higher reaches, up to 8900 feet. The plant diversity is matched by a diversity of wildlife.

((Research and record addition information on unique qualities of the Sky Island environment))

Wildlife

((Research and record addition information on unique qualities of the Sky Island environment and importance to birds and mammals))

Baseline report and other

Bats in Mines

TOUR EVALUATION FORM: ORTIZ MOUNTAINS EP

Date of tour:	Tour leader's name	<u>.</u>			
We strive to make our programs enjouring the following 5-point scale, plea	yable and meaningfu ase circle your respo	ıl. Will you tak nses (1 means	e a moment to s "strongly disagre	hare your imp ee"; 5 means "	ressions with us? strongly agree").
My volunteer tour guide:	Strongly disagree				Strongly agree
Was well-informed	1	2	3	4	5
Made the topics interesting	1	2	3	4	5
Made me feel included	1	2	3	4	5
Treated people respectfully	1	2	3	4	5
Ensured we were safe	1	2	3	4	5
	Not at all likely				Extremely likely
How likely are you to recommend this program to others?	1	2	3	4	5
Additional comments? (If you'd like t Space property, you can mention the	o see programs on c em here, too.)	other topics re	lated to this site	or another SF	County Open
	and the second s				
If you'd like to be contacted regarding	ng your comments, p	lease let us kn	ow how to reacl	h you:	
On behalf of Santa Fe County Open	Space and Parks, tha	anks for sharin	g your day with	us.	

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Santa Fe County Open Space Ortiz Mountain-Least Cost Analysis Alternate Routes

May 27, 2016

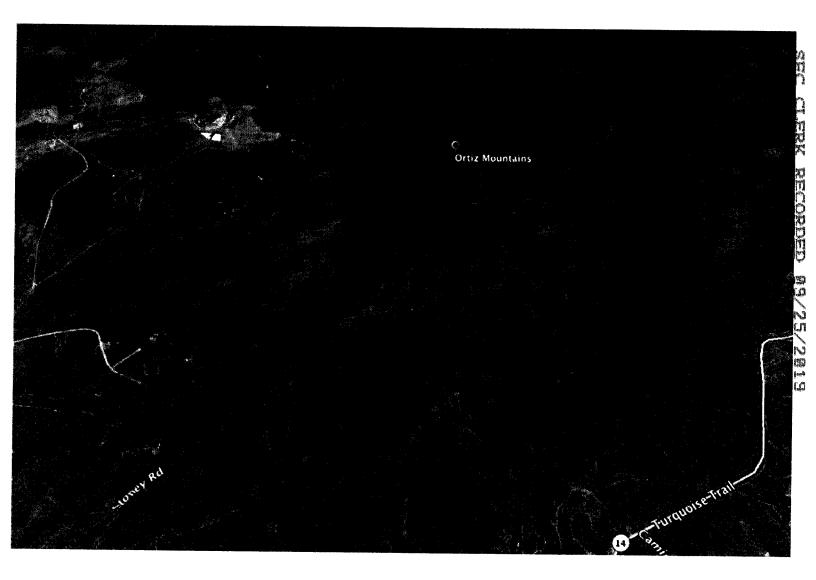


suroundings

Santa Fe County / Ortiz Mountains Educational Preserve Management Plan Appendices

Santa Fe County Open Space Ortiz Mountain-Least Cost Analysis Alternate Routes

May 27, 2016



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Santa Fe County Open Space

Ortiz Mountain Educational Preserve

Alternate Routes Assessment

This report summarizes the project goal, methodology and outcome observations for the Ortiz Mountain Alternate Routes Least Cost Analysis.

Assess possible alternate entry road routes to the Ortiz Mountain Education Preserve. Project Goal:

Least Cost Analysis of GIS data using weighted criteria and factors. Methodology:

The following steps were done in conducting the analysis.

1. Identify Evaluation Criteria

Evaluation criteria selected was based on general engineering considerations used in siting new roads.

- Slope. Slope influences a) the length of road needed to traverse a space, i.e. if the slope is steeper than 15% switchbacks are likely to be needed to create a safe roadway; b) slope variability increases cut and fill costs; c) side slope improvements are more costly when slopes are steeper.
- Soil Erodibility. More erodible soils requires more subgrade work to create a stable road bed.
- Depth to Bedrock. If bedrock is too close to surface it can add excavation and subgrade preparation costs.
- Aspect. North facing slopes tend to hold snow longer in the year which increases snow removal and surface repair costs.
- Wetland, Springs & Water Bodies. Water bodies need to be buffered from roads to protect them from non-point pollution created by roads.
- Hydrology. Where high water tables are likely, those areas need to be buffered for to protect from non-point pollution created by roads, and to avoid increased costs of building roads in satruated
- Archaeological Sites. Archaeological sites need to be buffered to prevent damage to resources from road construction.

Other criteria considered, but for which availabile public sources were not usable:

- Critical Habitat. Regional resource data related to critical habitat are too gross scaled to be usable for this process. The information cell sizes of available public data source included all of Ortiz Mountain Educational Preserve in two cells.
- Vegetative Cover. Available data sources were too gross scaled to be usualable for this process.
- Environmental Hazards. No data source found.

2. Find Relevant Data Sets

The following relevant public available information data sources were found and used for the least cost analysis.

- United States Geological Survey Digital Elevation Madel (USGS DEM)
- Soil Survey Geographic (SSURGO)
- National Wetlands Inventory (NWI) Wetlands
- National Hydrography Dataset (NHD) Water Bodies, Springs, Perennial and Ephemeral Streams
 - Archaeological Records Management Section/New Mexico Department of Cultural Affairs (ARMS/NMCRIS)

3. Assign Criteria Weights + Factor Ranges

Two levels of weighting for criteria and their factors was done.

- a) First, each criteria's data set was broken down based on physical or quantitative characteristics. As an example, depth-to-bedrock is a criteria because of the additional road building costs if bedrock encountered. Different depth-to-bedrock ranges were selected. Then, each range was assigned a value between 5 and 1, with 5 being best and 1 being worst.
- b) Second, each criteria was also given a percentage weighting against an total 100 percentage points. As an example, the "slope" criterial was given an overall importance of 30 percent of a total 100 percent of all factors due to its greater influence on road design complexity and costs. Where as "archaeology" was weighted lower as the ability to mitigate for road construction affects on archaeology are good for this particular site.

See the attached Criteria + Factors Matrix for details on each criteria, their factors and how they are weighted and valued.

4. Entry Points and Destination

Entry points and the end destination were identified. The destination is where the existing County-built shade shelter and parking area are on site. The entry gate to the adjacent LAC property was used as entry point for possible routes from east of the property. This was the only location tested from the east as no other viable publically accessible entry point could be identified on the east. To test possible routes from the west of the property, several locations along State Route 14 were selected. Although, these routes would require agreements with the private landowner to the west, it was considered a viable option from the County's perspective.

5. Run Least-Cost-Analysis Tests.

On page 4 and 5 of this report are the graphic results of the least-cost-analysis.

Outcome Observations:

Observations about the least-cost-analysis tests are:

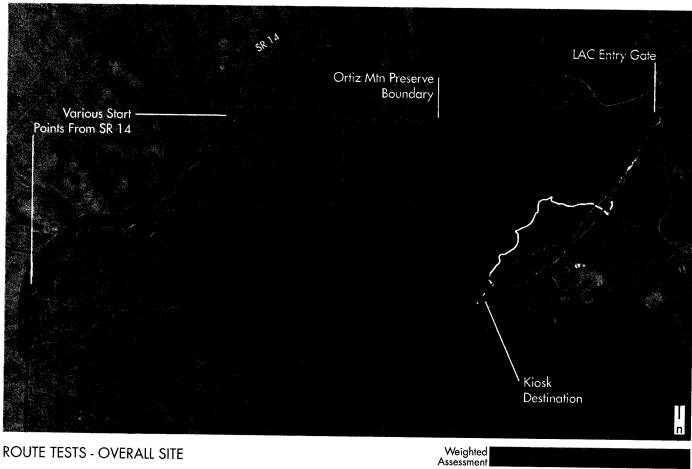
- A. Possible routes from the west are likely to be very high cost and perhaps impractical to construct, due to the majority of the road length having to traverse slopes over 18%.
- B. Routes from the east, are relatively close in routing to existing tracks.
- C. The apparent best route from the east traverses part of the large LAC mine excavation area.

Santa Fe County Open Space Ortiz Mountain Educational Preserve Alternate Routes Assessment

Criteria and Factor Matrix

Criteria Raster Models	Criteria Raster Weighting	Input Data Source	Criteria Factors Definition		Comments
			Range	Value	
			Slope between 0 to 5 percent	5	
			Slope between 5.1 to 8 percent	4	
Slope	30%	USGS DEM	Slope between 8.1 to 12 percent	3	
	30%		Slope between 12.1 to 18 percent	2	
			Slope greater than 18 percent	1	
Soil Erodibility		SSURGO data	All Other Lands	5	K-Value greater that .40 are considered highly
	20%		K-Value greater than .40	1	erodible
Bedrock Geology	20%	SSURGO data	Depth greater than 150 cm (59.05")	5	All available bedrock data is no more than 200 cm deep (78.72"). For areas with no data, it is assumed that the depth is mid-depth between 0 and 200 cm.
			Depth 100 cm to 150 cm (39.3 to 59 inches)	4	quepui is min-uepai section o ana ana
			NoData	3	_
			Depth 50 to 100 cm (19.69" to 59")	2	4
			Depth less than 50 cm (19.69")	1	A All the C Decree
	10%	USGS DEM	135 < 225 (S, SE, SW)	5	Orientation based on North as 0-Degree
Acnost			225 < 315 or 45 < 135 (E, W)	3_	
Aspect	1		0 <= 45 or 315 < 360 (N, NE, NW)	11	
		NWI Wetlands, NHD Water	Greater than 150 ft distance	5	
Wetlands, Spring &	10%	Bodies, NHD Springs	100 to 150 ft distance	3	1
Water Bodies	10%	(custom EAI versions)	0 to 100 ft distance	1	
		NHD Perennial &	Greater than 100 ft	5	
Hydrology	5%	Ephemeral Streams (custom EAI versions)	50 - 100 ft	3	
			0 - 50 ft	1	
	 	 	Greater than 100 f	5	For all sites with area less than that of LA 131092
Archaeological Sites	5%	ARMS/NMCRIS	0 ft to 100 ft	1	size.

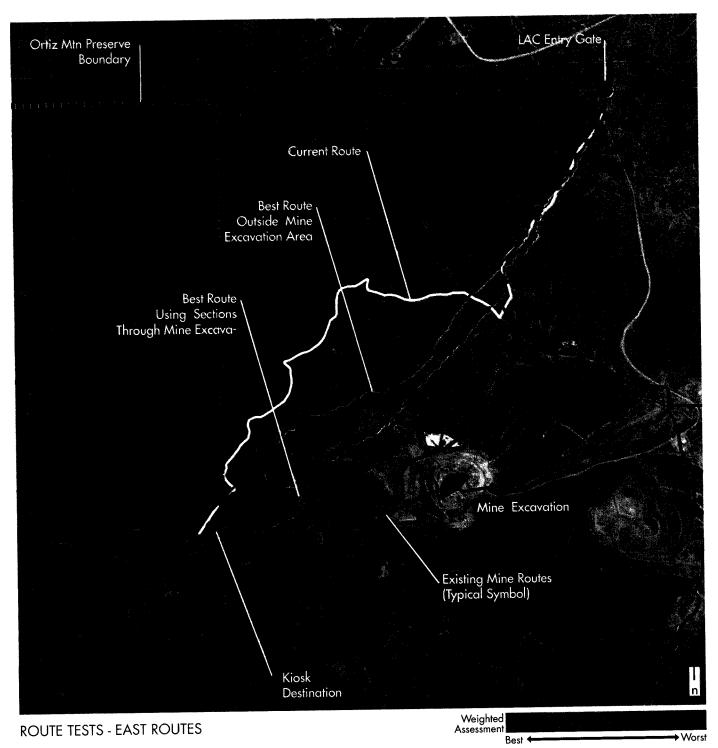
Vorst



Best **←**

ROUTE TESTS - OVERALL SITE

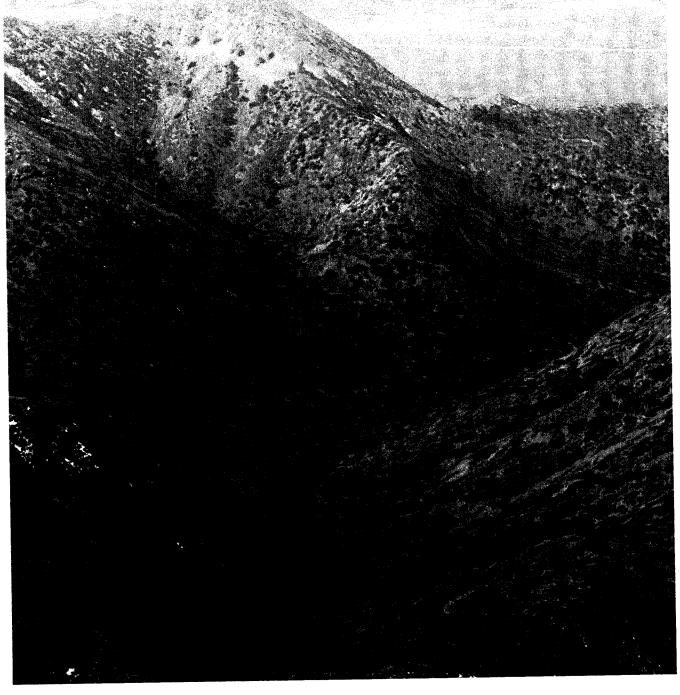
Possible routes from the west are likely to be very costly and perhaps impractical to construct, due to the majority of the road length having to traverse slopes over 18%.



The apparent best route from the east traverses part of the large LAC mine excavation area.

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Ortiz Mountains Educational Preserve Environmental Research Summary



INTRODUCTION

The initial habitat and environment research for the Ortiz MEP was done using publicly available habitat and natural resource data bases. The following is a summary of that data. Most of the available data is at a regional scale and is descriptive only. Mapped Information about the ecology of the Ortiz MEP is limited to soils and hydrology. As detailed ecological data is developed for the Ortiz MEP, site mapping will augment the basic soils and hydrology information. Future refined maps will create more specific terrain management units.

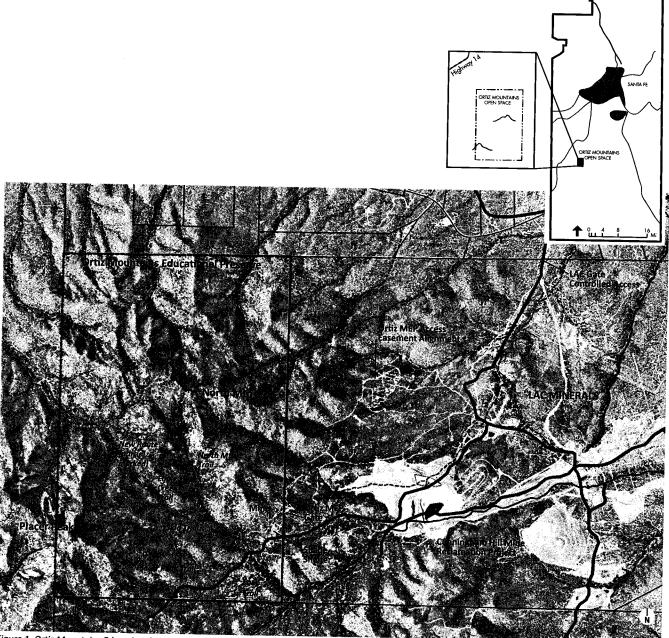


Figure 1. Ortiz Mountains Educational Preserve -Location + Existing Conditions

GEOLOGY

The Ortiz Mountains are on the east side of the Rio Grande Rift, with the Santa Domingo Basin and Hagan Basin of the rift to their west, with the Sandia uplift to the southwest, and the Espanola Basin and the Estancia Basin to the east. They form part of the watershed boundary between the Rio Grande and the Pecos River.

The Ortiz Mountains are part of the larger Ortiz porphyry belt of Santa Fe County, and consist of late Eocene to early Oligocene intrusive igneous rocks and their sedimentary host rock. Other members of the Ortiz porphyry belt are South Mountain, the San Pedro Mountains and the Cerrillos Hills. These porphyry intrusions were followed by movement on the Tijeras-Canoncito fault and later mid Oligocene (31.4–27.9 ma) intrusions of stocks and dikes with mineralization including both base and precious metals.

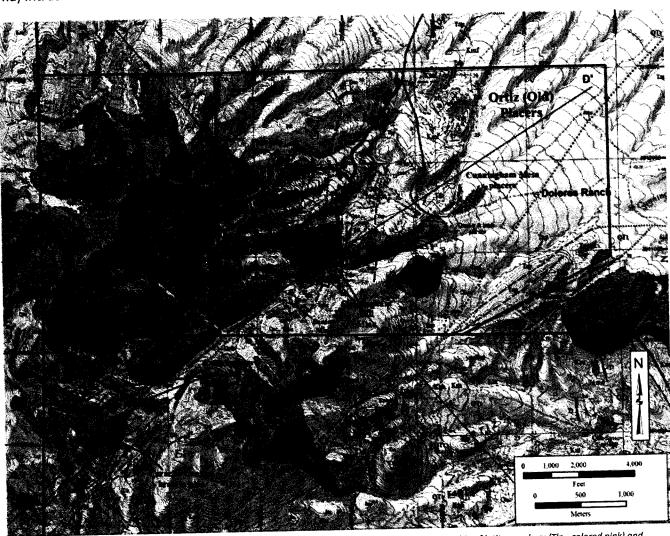


Figure 2. Geologic map of the Ortiz Mountain Educational Preserve and adjacent areas. Note spatial relationship of latite-porphyry (Tlp - colored pink) and volcanic vent (Tdv – colored olive green), the Carache Canyon breccias pipe, Cunningham Gulch porphyry, and Cunningham Hill Mine to east-northeast-trending strands of the Tijeras-Cañocito Fault System. Heavy red line is route of Dolores Gulch – Old Ortiz Mine geology tour. Southern-most dashed black line marks the route of the Old Ortiz Mine – Placer Peak tour. Datum: NAD27; UTM Zone: 13N; Topographic base from Golden and Captain Davis Mountain 7.5-minute quadrangles. Cross sections and map explanation are on following pages. Green diamonds indicate Ortiz Mountains Educational Preserve field hiking tour stops.

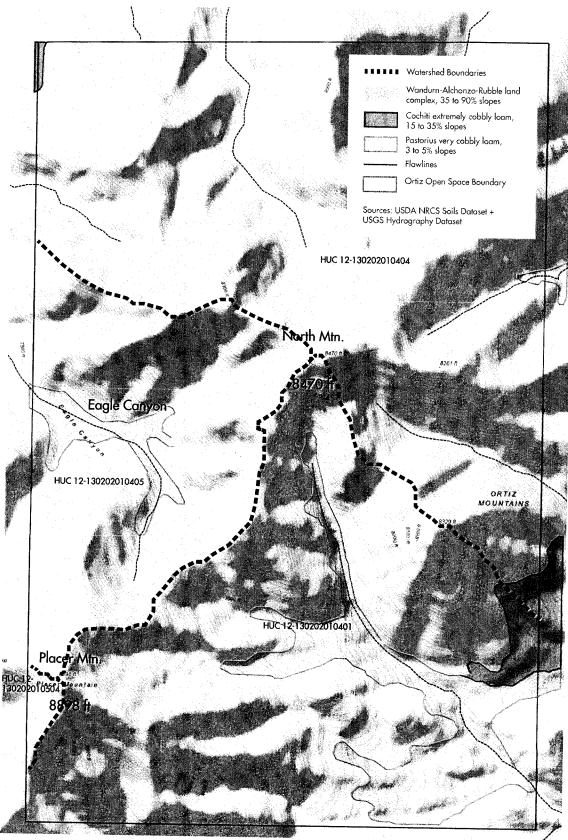


Figure 3. Ortiz Mountains Educational Preserve - Soils and Hydrology Mapping

SOILS PROFILE

Soils on the Ortiz Mountains Educational Preserve were researched using the United States Department of Agriculture, Natural Resources Conservation Service, Soils Maps website. The following soil types and descriptions were found. The soil zones are incorporated in the map on the facing page. The three soil types noted for the site are:

Wandurn-Alchonzo-Rubble Land Complex

Approximately 90.5 percent (approx. 1,222 acres) of the Ortiz Mountains Educational Preserve (Ortiz MEP) consists of Wandurn-Alchonzo-Rubble land complex. This soil type if highly associated with slopes that range from 35 to 90 percent grades (# of NRCS Santa Fe County Soil Survey). It gravelly woodland in nature with sparse cover on the north facing slopes and dense vegetation on south facing slopes and along drainages. Cemented lithic bedrock appears 47 to 57 inches below the ground surface beneath layers of very to extremely cobbly sandy clay loam and slightly decomposed plant material where more vegetative cover exists. Paralithic bedrock appears 0 to 10 inches from the ground surface in areas of Rubble Land where slopes range from 40 to 80 percent. In aerial imagery, these area can most commonly be seen on the north facing slopes. Areas of Ponderosa Pine and Gamble Oak are well-draining with high levels of runoff and no frequency of flooding.

Pastorius very cobbly loam

Approximately 7.8 percent (approx. 105 acres) of the site consist of Pastorius very cobbly loam. Slopes on this soil type range from 3 to 5 percent grades. These landforms are stream terraces on valley floors with linear and concave slopes. They are well-draining areas with medium levels of runoff are covered by Ponderosa Pine forests. Soils are composed of extremely cobbly loam beneath very cobbly loam and slighty decomposed plant material. On the Ortiz MEP, the Skid and Eagle Trail are routed through these areas due to the more subtle slopes.

Cochiti extremely cobbly loam

Approximately 1.7 percent (approx. 23 acres) consists of Cochiti extremely cobbly loam, which are 15 to 35 percent slopes of the mountainous landscape and receive 13 to 15 inches of rain annually on average. These steep, gravelly woodland areas are positioned at mountain bases with concave cross and down slopes. The soil profile is extremely cobbly sandy and clay loam down beneath extremely clay cobbly loam and extremely cobbly loam. On the Ortiz Mountains Educational Preserve, these soils are mostly in the southeast corner of the site and is where the shade shelter and the lower easier Loop Trail are located.

SURFACE HYDROLOGY

United States Geological Survey, Water Resources of the United State, Hydrographic Data was researched for watershed mapping for the Ortiz Mountains Educational Preserve. The site is headwaters to four water sheds--HUC 12:130202010401, HU 12-130202010404, HU 12-130202010405, and HU 12-130202010504. All are secondary contributing watersheds to the greater watershed basin of the Rio Grande Valley. The water sheds are not associated with any perennial streams. Run-off from each of the watersheds is be more strom event or seasonal snow melt related. As the heads of the watersheds, the quality of the habitat on the Ortiz Mountains Educational Preserve has downstream effects. Surface erosion at the head of the watershed creates non-point pollution that migrates downstream and can reduce water quality, increase turbity and disrupt stream flow patterns. The Ortiz Mountain Educational Preserve Conservation Easement emphasizes management of erosion causing activities at the site which supports watersheds quality.

WILDLIFE CORRIDOR

According to the corridor model for cougars that was developed by K. Menke (2008) for New Mexico Department of Game and Fish Wildlife, corridors link core habitats for sustaining populations across landcsapes. This model is used as a surrogate model for multiple species pending development of additional species-specific models. New Mexico Crucial Habitat Assessment Tool, New Mexico Dept. of Game & Fish is the current version of the model used to assess the regional wildlife criticality for the Ortiz Mountains Educational Preserve.

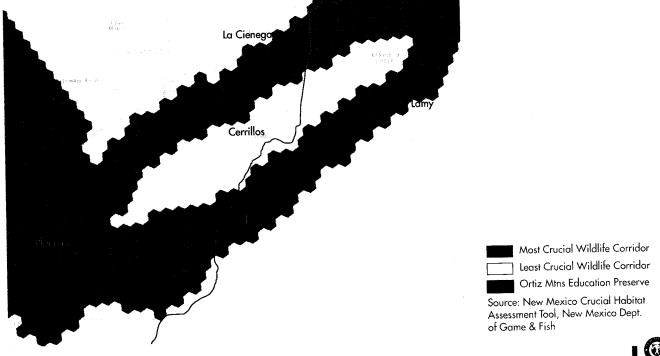
The Ortiz Mountains Educational Preserve is part of a regional wildlife corridor that spans between the Sangre de Cristo Mountains and the Sandia and Manzano Mountains, across the Galisteo Basin and Ortiz Mountains valley and west out to the Santa Ana Mesa and the Jemez River.

Wildlife habitat and corridor qualities on the Ortiz Mountains Educational Preserve are ample due to the mountainous landforms and more frequent rainfall events. This increases the area's function for forested overstory, winter and night shelter, foraging, and roaming grounds. The variation between open land, denser vegetation, and abandoned mining tunnels offer opportunities for shelter, nesting, and bedding for various animals.

Ambient conditions are favorable for the presence of wildlife. The area is generally remote; there is little pedestrian traffic and no off-road vehicle use.

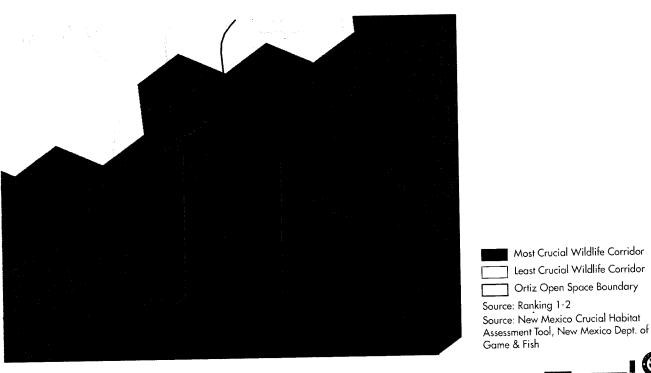
SPECIES POTENTIAL

The Ortiz Mountains Educational Preserve is known habitat to mountain lion, black bear, bobcat and mule deer. On the following page is a list of observed wildlife species at the site for all or part of their life or annual habitat range. Accompanying the list is mapping indicating the criticality of the habitat and the likelihood of multiple species of concern on the site.



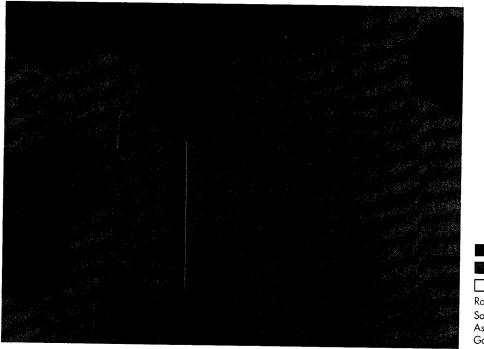
ORTIZ MOUNTAIN OPEN SPACE

Galisteo Basin Wildlife Corridor



ORTIZ MOUNTAIN OPEN SPACE

Wildlife Corridor



2nd-Most Crucial Habitat Rank
3rd-Most Crucial Habitat Rank

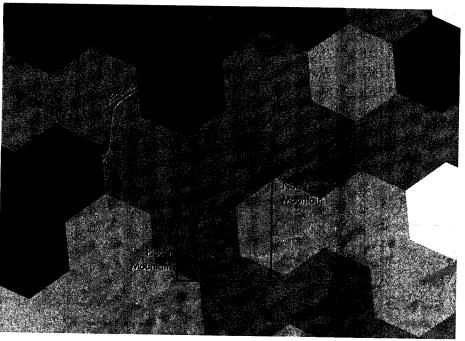
Ortiz Open Space Boundary

Ranking 1-6

Source: New Mexico Crucial Habitat Assessment Tool, New Mexico Dept. of Game & Fish

ORTIZ MOUNTAIN OPEN SPACE

Crucial Habitat by Area



2nd-Most Species of Concern
3rd-Most Species of Concern
4th-Most Species of Concern

5th-Most Species of Concern
Ortiz Open Space Boundary

Ranking 1-6

Source: New Mexico Crucial Habitat Assessment Tool, New Mexico Dept. of Game & Fish

ORTIZ MOUNTAIN OPEN SPACE

Species of Concern by Area



FOREST MANAGEMENT PLAN FOR THE ORTIZ MOUNTAINS OPEN SPACE AND PRESERVE

A SANTA FE COUNTY OPEN SPACE PROPERTY

FINAL DRAFT - May 23, 2019







FOREST MANAGEMENT PLAN FOR THE ORTIZ MOUNTAINS OPEN SPACE AND PRESERVE

A SANTA FE COUNTY OPEN SPACE PROPERTY

FINAL DRAFT - May 23, 2019

Pending input from:

- a Cultural Resources Survey
- a Wildlife Survey
- completion of appendices
- completion of illustrations
- feedback from Santa Fe Conservation Trust
- feedback from the Wildland Fire Team
- final edits from Open Space staff





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Table of Contents

EVE	CUTIVE SUMMARY	5
1.	PROPERTY SUMMARY	
	Location, Directions, Access	
a. -	Acreage	9
0.	Ownership and Contact Information	
c. 2	FOREST MANAGEMENT	
2.	Management Goals and Objectives	
a.	Purpose and Need for this Forest Management Plan	
b.	Forest Landscape Management	
c.	Forest Landscape Management Forest Management Units	. 11
d.	Forest Management Units	.11
e.	Local and Regional Forest Management Concerns	
f.	Landowner Management Capacity	
g.	Monitoring and Adaptive Management	15
h.	Neighbor and Stakeholder Connections	15
3.	PROPERTY DESCRIPTION	
a.	Current Conditions Summary	
b.	Property History, Cultural Resources, and Recent Land Use	10
c.	Geophysical Conditions	21
d.	Eco-regions and Biotic Communities	24
e.	Trends in Climate, Hydrology, Soils, Vegetation and Wildlife	25
4.		
a.	Data Collection Methods	
b.	Vegetation Communities and Forest Types	30
c.	Wildfire Assessment Findings and Evaluation	41
d.		43
e.	Ground Cover Vegetation Findings and Evaluation	43
5.		
a.		46
b.		47
6	. FOREST LANDSCAPE RESORATION TREATMENTS	51
a.		51

b.	Landscape	-wide Management Considerations	52
c.	Treatment	Plan	52
d.		Prescriptions	
e.		Fire Recommendations	
f.		eed Control	
g.		source Management and Protection	
h.		ual Monitoring and Adaptive Management Plan	
APF			
	ENDIX A.	CUSTOM SOIL SURVEY REPORT	
APP	ENDIX B.	LIST OF DOCUMENTED WILDLIFE SPECIES AND THEIR CONSERVATION STATUS	
APP	ENDIX C.	OVERVIEW OF THE SAMPLING POINTS AND THEIR SPECIFIC DATA	71
APP	ENDIX D.	DESCRIPTION OF FIELD ASSESSMENT PROTOCOL	72
APP	ENDIX E.	LOCALLY IDENTIFIED REFERENCE CONDITIONS	76
APP	ENDIX F.	A SUMMARY OF US FOREST SERVICE GUIDELINES FOR FIRE MANAGEMENT IN	
		EAS	
LITE	RATURE RE	FERENCES	79

EXECUTIVE SUMMARY

The Ortiz Mountains Open Space and Preserve (OMP) is a 1,350-acre parcel in southwestern Santa Fe County. The property has a rich mining history and is currently dominated by a second-growth forest that has regrown after mining operations ceased around 1900. The property serves as a cultural resource, forest and wildlife preserve and also has a limited educational purpose. However, access to the property is limited due to very rough terrain and poorly developed roads, which curtails the use and active management of the property. The OMP's function as a preserve has been secured by means of a conservation easement across the entire property held by the Santa Fe Conservation Trust.

The OMP is of considerable importance in the historic mining district that stretches between the Cerrillos Hills and Madrid to Golden, the San Pedro Mountains and beyond. Additionally, the isolated location and undisturbed ecology of the property plays an important role as habitat, stepping stone, and migration pathway for many bird species and terrestrial species of wildlife. The OMP also features prominently in many viewlines in Central New Mexico and from many locations in Santa Fe County. Its history and ecology comprise important educational opportunities and cultural heritage values and is of spiritual significance to tribal communities in New Mexico.

In 2018, in conjunction with the development of a Management Plan for the OMP, Santa Fe County initiated the development of this Forest Management Plan (FMP) to document baseline conditions, project future conditions if no actions are taken, and guide Santa Fe County Open Space staff in improving forest health to alleviate anticipated ecological degradation. Improving the OMP's forest health aims to contribute to increased biological diversity, improved wildlife habitat, protection of wildlife species of great conservation need, prevention of catastrophic wildfire, and enhancements to the area's soil health and herbaceous cover and diversity.

Management concerns for the property include the risk of wildfire and insect outbreaks that can have landscape-wide impacts on the mountain's scenic, ecological, and cultural resources. Climate projections forecast trends of increasing temperatures, greater irregularity in precipitation patterns, and the possibility of sudden die off of large areas of forest. Catastrophic fire and insect outbreaks could also have serious effects on neighboring land.

Scientific literature indicates the critical importance of maintaining the ecological heterogeneity of the forests, in terms of age classes, species composition, and spatial structure, in order to maintain ecological resilience to increasing stresses, along with other buffering mechanisms that heighten the threshold for catastrophic events to break out across the property (Raffa et al. 2008). Therefore, forest management interventions at OMP will need to optimize the ecologically diverse structure of the forests, increase the resilience and adaptive qualities of the ecosystems, and enhance the area's opportunities for serving as an ecological sanctuary or preserve.

Aerial imagery, forest stand modeling, and field research were used to identify several forest types, including piñon-juniper woodland types, ponderosa pine, and mixed conifer forest types. Small stands of each of these forest types form a fine-grained mosaic of vegetation communities, due to the great topographical variety on the property. Access limitations, forest types, and treatment considerations have contributed to the identification of nine different forest management units (FMUs). FMUs play a central role in future forest management treatment delineation, phasing, and monitoring.

Digital vegetation cover modeling through LANDFIRE and field sampling indicated that wildfire risk on the property is moderate to high. While the chance of ignition and fire frequencies are expected to be rather low, the risk of a spreading crown fire and the susceptibility of damage to local and adjoining resources is significant were a fire to erupt and spread. Insect outbreaks on top of ongoing parasitic infestations, such as (dwarf) mistletoe, could also have dramatic, landscape-wide effects and increase fire risks.

Many forest stands appear to have a moderately high potential for diverse and relatively dense herbaceous ground cover. Enhancing such cover would help improve wildlife habitat and wildlife species diversity, while it would also help reintroduce a natural, low- and mixed-intensity fire regime, and strengthen the rock mulch cover to slow soil loss and prevent erosion.

The FMP recommends that forest treatments start in the most-accessible, southwestern portion of the OMP. Treatments will include selective thinning (from below) of mostly ponderosa pine stands, piling and burning of slash, followed by selective thinning-from-below in mixed conifer and perhaps in some piñon-juniper woodland stands. Slash in piñon-juniper woodland stands will be lopped and scattered and excess fuels will be piled and burned. Monitoring of wildlife species richness and of the treatment results on the herbaceous cover and fuel loads will need to determine the extent of treatments in various forest types and locations over time.

The FMP includes a phased approach with phases of approximately 5 years which address areas of 150 acres to 300 acres in each phase. After completion of thinning in ways that result in more fire resilient ponderosa pine stands, prescribed fire and managed natural fire could be considered as treatment options as well. Initially, three phases have been identified, and in the third phase, the FMP will probably need to be updated and revised based on adaptive management conclusions.

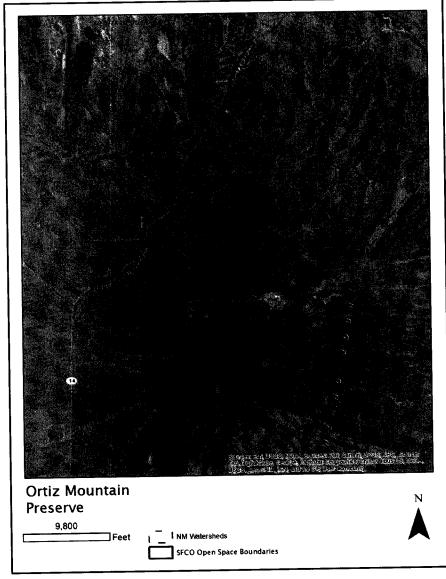
Monitoring and adaptive management are essential throughout the life of the FMP. They are especially important in the first phase and will drive priorities in future years, in order to adjust recommended treatments and priorities to monitoring findings, particularly concerning birds, wildlife, herbaceous cover regeneration, fuel loads, and ongoing ecological and climate impacts.

1. PROPERTY SUMMARY

a. Location, Directions, Access

The Ortiz Mountains Open Space and Preserve (OMP), a Santa Fe County Open Space property, is located in southwestern Santa Fe County, New Mexico, Township and Range coordinates T12-13N, R7E, in the Ortiz Mine unit (Figure 1). The property is described at the Santa Fe County Assessor's Office and the May 2001 conservation easement with the Santa Fe Conservation Trust as:

Tract 2, as shown on the Land Division Map dated October 30, 2000 and filed for record with the Santa Fe, New Mexico recorder on November 3, 2000, as Document 1127-797, Plat Book 461, at Page 27-28.



The property is reached exclusively via County Road 55 (Gold Mine Road). A gate at the end of this road gives access to a road easement across the LAC Minerals property that continues onto the OMP parcel (Figure 2). In 2018, road conditions on the LAC Minerals parcel were reasonable for the first mile and very rough for the remainder and onto the OMP parcel. No other official and improved points of access exist.

Figure 1. Vicinity map for the Ortiz Mountains Preserve.

Page **7** of **81**

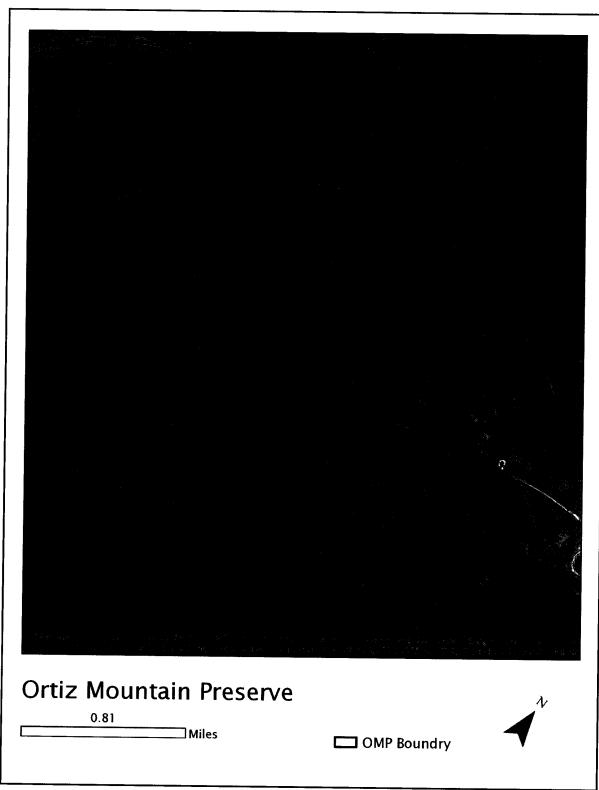


Figure 2. Oblique aerial view to the northwest of the Ortiz Mountains Preserve with the LAC Minerals mine reclamation site and entrance road to the east.

Directions from the City of Santa Fe are to travel south on State Road 14 for approximately 14 miles past I-25. In Cerrillos, just past the bridge across the Galisteo Creek, turn left onto CR 55 (Gold Mine Road). Travel south of CR 55 for approximately 5.6 miles to the gate of the LAC Minerals property. On the mine property, keep right and follow for approximately 1 mile, turn right on an unimproved road, and follow for nearly 2 miles to the OMP parcel.

b. Acreage

The OMP property encompasses 1,350 acres (nearly 2.11 square miles).

c. Ownership and Contact Information

Santa Fe County is the fee simple owner of the OMP property. Yet, the previous owner, the Santa Fe Botanical Garden ("Grantor"), deeded the development rights on the property in perpetuity to the Santa Fe Conservation Trust ("Grantee", SFCT) by means of a Conservation Easement (CE), dated May 1, 2001. The SFCT and Santa Fe County as the successor-in-interest to the Grantor of the CE agreed on an amendment, dated on May 9, 2007, which eases some access arrangements for motorized vehicles, deletes the arbitration clause, and eases certain communication procedures. Sub-surface rights to the OMP property are split from the surface rights and held by a third party owner.

Santa Fe County is the responsible party for property management within the limitations set by the CE agreement, as amended. SFCT is the responsible party for monitoring, oversight, and enforcement of the conservation values and use restrictions described in the CE, as amended.

2. FOREST MANAGEMENT

Management Goals and Objectives

The operational purpose of the Ortiz Mountains Open Space and Preserve (OMP) for Santa Fe County as the landowner and the Santa Fe Conservation Trust as the conservation easement holder is to preserve and maintain the landscape of the OMP with its natural, scenic, forested, open space, and educational values.

The Ortiz Mountains Open Space Management Plan of 2017 states the OMP's management goal as a vision in terms of actions that can be implemented and monitored.

Santa Fe County will maintain educational opportunities and support the existing wildlife and habitat at the Ortiz Mountains Open Space. The management goal is to allow the natural systems on the site to continue with a level of sustainable management and including operations and maintenance, encourage community stewardship, involve citizens in monitoring and maintenance, and protect the habitat and cultural resources on the site. Access to the site is for educational purposes and limited to allow the natural processes to thrive.

b. Purpose and Need for this Forest Management Plan

The purpose of this Forest Management Plan (FMP) is to document baseline conditions, project future conditions if no actions are taken, and guide Santa Fe County Open Space staff in improving forest health to alleviate anticipated ecological degradation. Improving the OMP's forest health will need to contribute to increased biological diversity, improved wildlife habitat, protection of wildlife species of great conservation need, prevention of catastrophic wildfire, and enhancements to the area's soil health and herbaceous cover and diversity.

The need for the FMP flows from Santa Fe County's realization that catastrophic wildfire could destroy many values on the property. A lack of active management during the last century, coupled with the increasing risk of wildfire and insect outbreaks, which will likely be exacerbated due to climate disruption, bring urgency to the need for this FMP. Santa Fe County also has a need to develop an appropriate treatment strategy along with a monitoring plan for adaptive management in future years.

The FMP responds to a need for documentation of baseline and reference conditions at the property, including projections on climate impacts, a fire hazard assessment, and the need for forest treatment recommendations. Detailed treatment prescriptions will need to improve herbaceous growth, plant diversity, wildlife habitat, and forest resilience to fire through selective thinning, burning of slash, and potential future prescribed or managed natural fire. The treatment plans need to be specific for identified forest and woodland types, and will need to address the need for a phased approach that identifies treatment size, locations, and priorities.

c. Forest Landscape Management

The forest landscape of the OMP in the past 25 years consisted of conservation-oriented activities, such as monitoring, development and maintenance of access infrastructure and basic visitor facilities, and deliberate deferment of terrain management. Santa Fe County Open Space (OS) staff visit the property several times per year for observations and maintenance purposes. Santa Fe Conservation Trust (SFCT) and OS staff visit the property once per year for monitoring related to the CE.

In recent years, OS staff undertook studies for a management plan and access improvement options. OS staff also observed a need for forest management planning with a view to wildfire prevention, improvement of herbaceous plant cover, erosion control, and wildlife habitat conservation, which led to this Forest Management Plan.

Physical and legal limitations to access, prohibited uses as part of the CE, and the goal of the property for wilderness conservation curtail forest management options. Yet, necessary forest and overall landscape management actions will need to respond to optimizing the land's ecological functions and infrastructure toward the vision and goal for the property, while minimizing liabilities to surrounding properties and their ecosystems. Potential liabilities of concern include the effects of catastrophic wildfire and drought or disease related forest die-off on the scenic values of the mountain range, on the risk of wildfire spreading to neighboring properties, and on the risk for mass wasting and flash flooding onto neighboring properties. Another liability from catastrophic events includes damage to cultural resources and the degradation of wildlife habitat and interruption of wildlife corridors across the property.

d. Forest Management Units

For purposes of future forest management, this Forest Management Plan identifies specific forest management units (FMUs) for treatments in the next 5-10 years and beyond (Table 1). The FMUs have been defined to create manageable units with similar terrain and forest characteristics. As a result, each FMU could over time have its own specific treatment plan. The selection of the different FMUs was based on (a) manageable unit size, (b) access conditions, (c) similarity in terrain and ecological characteristics, and (d) similarity in management concerns. Figure 3 includes a map of the FMUs.

e. Local and Regional Forest Management Concerns

Management concerns specific to forests that interact with the property focus on the local and regional risks of landscape-scale catastrophic impacts caused by a combination of stresses from drought, wildfire, and tree pathogens, such as dwarf mistletoe and bark beetle outbreaks. Weather patterns linked to a warming climate are largely causing the increased stresses on forest ecosystems in the region (NCA 2014, Robles and Enquist 2010, Williams et al. 2010), and by extension most likely also at the OMP.

Table 1. Overview and characterization of FMUs.

Unit	FMU	Approx.	Access	Terrain and Ecology	B.Companyant
Code	Description	Acreage	Access	Terrain and Ecology	Management
Α	Southeastern	139	Roads	Polling with door amount	Concerns
	corner	133	and	Rolling with deep arroyos;	1 '
	Corner		trails	Ponderosa with Piñon-	dense, stressed,
			trans	Juniper (PJ) forest and PJ	forest stands with
В	Southwestern	98	Chara	open woodland	ladder fuels
"		98	Steep,	Steep, W-, S-, and E-facing	· · · · · · · · · · · · · · · · · · ·
ŀ	corner		narrow	slopes and crests;	inaccessible land;
			trails	Ponderosa+PJ forest and	trail access to
	Countle		<u> </u>	PJ open woodland	Placer Peak
С	Southeastern hill	43	Trail at	Steep, S- and SE-facing	Steep terrain,
	side		bottom	slopes and crest; bare and	potential cultural
			 	dry PJ open woodland	resources
D	Central southern	135	Trails in	Rolling with drainages;	Cultural resources;
	valley bottoms		valleys	mostly Ponderosa forest;	dense, stressed,
				patches of mixed-conifer	even-aged forest
<u> </u>				(MC) and PJ	
E	Central southern	86	Endings	Steep, E- and SE-facing	Steep, nearly
	steep slopes and		of	slopes and crests; dense	inaccessible land;
	ridges		valley	PJ woodland + some MC	dense forest /
			trails		woodland
F	Central western	201	None	Steep, W-, SW-, S- and SE-	Steep, nearly
	steep slopes and			facing slopes and crests;	inaccessible land;
İ	ridges			dense MC forest and	dense, forest /
				Ponderosa+PJ forest	woodland
G	Central western	48	Old	Rolling with deep	Poorly accessible,
	valley bottoms		road	drainages; fine mosaic of	dense, stressed,
			running	Ponderosa, MC, and PJ	forest stands with
 +			to west	forest	ladder fuels
Н	Northern dry hill		None	Rolling and steep SE-, S-,	Steep, nearly
ĺ	sides			SW-, and W-facing slopes	inaccessible land;
				and crests; bare and dry	dry woodland, lack
		Approx.		PJ open woodland	of information
ı	Northern	600	None	Rolling and steep NE-, N-,	Mostly steep,
	forested slopes	together		and NW-facing slopes and	nearly inaccessible
	and valleys			valleys; fine mosaic of	land; dense, forest
			ļ	dense MC, Ponderosa, PJ,	and woodland,
				and oak brush forest	lack of information

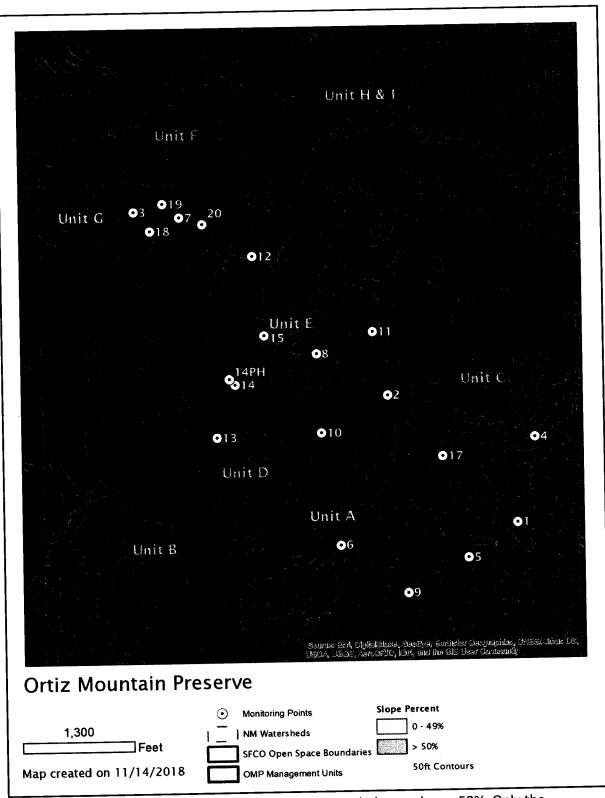


Figure 3. Forest Management Units and slope steepness below and over 50%. Only the southern half of FMUs H and I are shown.

Page **13** of **81**

The isolated location of the OMP probably limits the risks of catastrophic, landscape-wide impacts from fire and beetle kill spreading to the OMP from more remote locations. However, when they occur on the OMP, the spread of these threats from the OMP onto the immediately surrounding properties should be considered a real possibility. Similarly, fire from the immediately surrounding properties and beetle outbreaks in the region could spread onto the OMP and cause serious ecological damage to the unique OMP ecosystems.

Scientific literature indicates the critical importance of maintaining the ecological heterogeneity of the forests, in terms of age classes, species composition, and spatial structure, in order to maintain ecological resilience to increasing stresses, along with other buffering mechanisms that heighten the threshold for catastrophic events to break out across the property (Raffa et al. 2008). Therefore, forest management interventions at OMP will need to optimize the ecologically diverse structure of the forests, increase the resilience and adaptive qualities of the ecosystems, and enhance the area's opportunities for serving as an ecological sanctuary or preserve.

f. Landowner Management Capacity

Santa Fe County's capacity for forest management consists of:

- a. *Open Space planning staff* to provide day to day oversight and lead monitoring activities, adaptive management interventions, long-term planning initiatives, and public outreach and education activities.
- b. *Open Space maintenance staff* to provide hands-on technical assistance with infrastructure improvements and data gathering.
- c. **Santa Fe County Wildland Fire team members** to provide forest management staff, equipment, and expertise, and emergency firefighting capacity.
- d. Santa Fe County's experience with and capacity of hiring consulting services and mobilizing support from partner entities for specific management tasks.

SFC staff capacity for managing the OMP is available only on limited basis, as staff manages more than 5,300 acres of additional County properties spread over approximately 30 locations.

SFCT capacity is limited to a few days of staff time annually for monitoring and oversight of CE provisions and associated administrative duties.

g. Monitoring and Adaptive Management

Monitoring and adaptive management will be essential to realizing the management goals for the OMP. Santa Fe County management capacity relies on public and proprietary reference information and data collected during field assessments and updated through monitoring activities. For ongoing and adaptive management of the forest resources at the OMP, periodic monitoring is of critical importance.

Monitoring activities must be based on a plan that efficiently addresses the methods, means, timing, and labor requirements to collect data that are necessary to measure progress toward achieving forest management goals. As the specific goals of forest management activities change over time, monitoring goals and measures must change accordingly. A conceptual monitoring plan is included as part of the phased forest treatment schedule in Section 6.

h. Neighbor and Stakeholder Connections

Santa Fe County OS staff maintain relationships with a variety of entities and landowners in relation to the management of the Ortiz Mountains Preserve. The most important connections are with:

LAC Minerals (USA), Inc. – the landowner to the east of the OMP. The relationship concerns an access agreement through the LAC Minerals property, road condition coordination, and forest and woodland management in relation to fire hazard reduction. Given the location of the LAC Minerals restoration site downhill of a fire sensitive area on the OMP, the LAC Minerals property would be susceptible to possible embers, heavy runoff, and debris flows were catastrophic fire to erupt in the southeastern corner of the OMP.

Lone Mountain Ranch – the landowner to the south of the OMP. The relationship concerns an old forest road that continues from the OMP into the northern end of the ranch, potential access from the ranch along this road, and potential coordination regarding wildfire hazard reduction.

Ortiz Mountain (a.k.a. Chavez) Ranch — the landowner to the west of the OMP. The relationship concerns traces of an old forest road that continues from the OMP into the eastern end of the ranch, potential access from the ranch along this road bed, and potential coordination regarding wildfire hazard reduction.

Santa Fe Conservation Trust (SFCT) – SFCT is the owner of the conservation easement that has been placed on the OMP. County staff coordinates annually with the SFCT about access to and monitoring of the OMP.

Santa Fe Botanical Garden (SFBG) and site stewards – the previous owner of the OMP. The relationship concerns a group of former land stewards and interested stakeholders associated with the SFBG who have been trained as docents for educational tours at the OMP, and who maintain a keen interest in the botany and history of the OMP.

Neighborhood groups – based on previous public comments from residents from the Goldmine Road area and along State Highway 14 (Turquoise Trail) regarding gold mining in the Ortiz Mountains, it is likely that these community members continue to have a keen interest in the ecological health, fire risk, scenic quality, and cultural resource protection of the OMP.

3. PROPERTY DESCRIPTION

a. Current Conditions Summary

Currently, the Ortiz Mountains Open Space Preserve (OMP) is an entirely isolated parcel surrounded by private land with no active land use. The land is managed as a preserve and visited infrequently. Visible terrain disturbances are legacy impacts from mining activities that ended a century ago. The terrain is steep and rocky. Approximately half of the property is sloped at grades of 50% or steeper. Second- and third-generation forest and woodland covers large parts of the land. The forest and woodland consists of piñon-juniper (P-J) shrubland, P-J persistent woodland (Figure 4), P-J open woodland, ponderosa pine with a P-J understory (Figure 5), pure ponderosa pine forest (Figure 6), mixed conifer forest (Figure 7), and mixed conifer forest with a P-J shrubland understory (Figure 8). The trees on the property grew back after the impacts from traditional (axe and handsaw) wood cutting, subsistence grazing, and forest clearing in relation to the mining epoch that ended around 1920. Therefore, much of the woody vegetation is not more than 100 years old. Locally, on isolated or steep locations trees occur that are several hundreds of years old (Figure 6).





Figures 4 (left). Piñon-juniper persistent woodland. Figure 5 (right). Ponderosa pine with piñon-juniper understory.

Most ongoing disturbances on the property are of a natural, geophysical and ecological nature. They consist of the common weather impacts of a montane climate, including snow, periodic drought, and high winds. Other geophysical impacts include occasional landslides on scree slopes and low levels of soil erosion and sedimentation, especially along drainages.

Ecological disturbances consist of a combination of periodic severe droughts, mistletoe infestation, and insect outbreaks in clumps of trees in the conifer forests and woodlands, as well as occasional wildfire in the woody vegetation caused by lightning strikes (Figure 9).

Together, these disturbances cause tree die back, and combined with wind storms, lead to trees falling over.

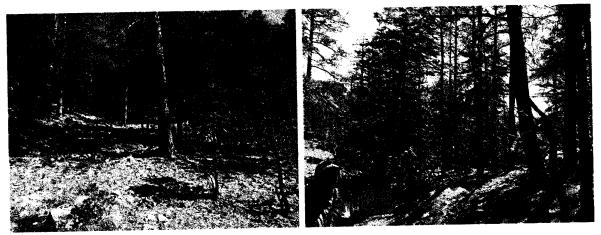


Figure 6 (left). Pure ponderosa pine forest; reference condition. Figure 7 (right). Mixed conifer forest.

The forest land, therefore, includes many openings with piles of dead wood as well as signs of plant regeneration in the form of herbaceous cover, oak brush, and tree seedlings and saplings. The OMP and surrounding Ortiz Mountain landscape is a known wildlife linkage zone between the Galisteo Basin and the Sandia-Manzano Mountain area. The insular mountain ecology is also of importance as habitat for many animal species — including birds and bats — that benefit from the area's location at the crossroads of 4 ecoregions in New Mexico.

The relics of the mining era constitute important cultural resources in the State of New Mexico. The property is also of cultural, historical, and spiritual importance for Native American tribes in the region. The mountain landscape is considered a valuable scenic treasure in Santa Fe County.



Figure 8 (left). Mixed conifer stands with a shrub understory, at high elevations. Figure 9 (right). Fire scarred trees due to lightning strikes.

b. Property History, Cultural Resources, and Recent Land Use

Many cultural resource investigations and field reconnaissance activities have taken place on and around the Ortiz Mountains, starting with the first by Adolph Bandelier in 1885 and more recent ones as late as 2011 (Baxter 2004, Lawrence 2012). The OMP includes several prehistoric and historic sites, including several eagle traps on Placer Peak (Stephen Post, personal communication 2018) and a variety of other sites in the southeastern corner of the OMP, associated with the former village of Dolores (Lawrence at al 2010).

Findings related to human habitation in the Ortiz Mountains area indicate that Late Paleo Indian people lived in the area of the Arroyo Tuerto to the south and southwest of the mountains between 6600 and 6000 BC. Other signs of prehistoric habitation in the area include findings of hunter-gatherers from the Archaic era in the period after 5500 BC until AD 600, the Late Developmental/Pueblo II-III period of AD 900-1200, and the Rio Grande Classic/Pueblo IV period of AD 1325-1600 (Mariah Associates 1991). Many archaeological findings were made in the southern and southeastern foothills and arroyos of the mountain complex, and were documented by Mariah Associates, Inc. in 1991 for the Ortiz Project Joint Venture, a gold mine development project, as well as by numerous others (Lawrence 2012, Stewart 2012).

Oral history about valuable mineral treasures must have reached Spanish explorers in the early 1500s in Mexico and encouraged them to send a series of exploratory expeditions to the area of the Oso Mountains (also named the Oro Mountains, and later the Ortiz Mountains) and the Galisteo Basin in the mid- and late-1500s (Lawrence 2012). It took until 1828, however, during the period of Mexican reign over the area, before gold was discovered in the Ortiz Mountains and people set up placer gold mining operations (Ortiz Project JV 1991, Baxter 2004, Lawrence 2012).

In 1833, the Mexican Government established the 60,659-acre Ortiz Mine Grant, named after Lieutenant Jose Francisco Ortiz, who was one of the first owners. This followed the discovery of lode (bedrock) gold and the possibility of lode gold mining in the "Old Ortiz Shaft" (a.k.a. Santo Niño mine), in the historic village of Dolores, located in the southeastern corner of the current Ortiz Mountains Preserve (OMP) (Ortiz Project JV 1991, Baxter 2004). Other sources mention the Ortiz Mine, a.k.a. the Santa Rosalia Mine, as the first lode mine in Dolores associated with Ortiz (Lawrence 2012).

Lode mining continued until around 1920, but was not very profitable due to the insufficient grade of the ore for the technology of that time. The village of Dolores grew during that period, and its western end currently overlaps with the southeastern corner of the OMP. The 1848 Treaty of Guadalupe Hidalgo established that holders of Spanish and Mexican land grants received official US recognition of legal ownership, effectively carrying forward the historical mining claims into the present era.

The mining history of 1828-1920 has left its mark on the southern and eastern sides of the OMP. An area of at most 500 acres in the current Preserve show signs of old exploratory

trenches, roads, trails, mine shafts, tailings, berms, ponds, a dam, and a few ruins, along with middens and scatterings of historic cans and glassware. Lawrence (2012) reports signs of sheetwash and alluvial erosion from the southern slopes of the OMP onto slopes and valley bottoms of the Lone Mountain Ranch to the south of OMP. The early mining community of Dolores in the early and mid-1800s used notched pine logs as ladders in the mine shafts and tended livestock in the mountains. Prominent mining explorers and merchants in Dolores acquired water and grazing rights in a 10-square mile area around the Ortiz mine. Many people in the Dolores area reportedly worked also as goat and sheep herders, and one account reported of as many as 5,000 sheep being herded in the mountains (Lawrence 2012).

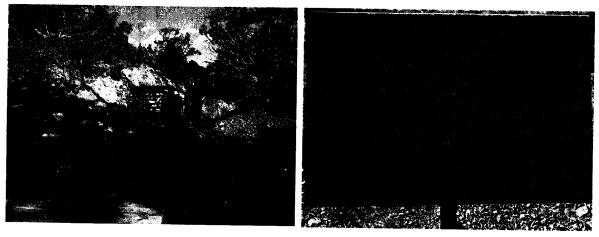
In 1865, the manager of the New Mexico Mining Company, which operated the mine patent between 1855 and 1871 with mixed economic success, established a sawmill to generate additional revenue by the sale of lumber (Lawrence, 2012). The arrival of the rail line across the Galisteo Basin in 1880 with a station in Cerrillos allowed the transport of base-metal ores and coal to smelters and other markets (Lawrence 2012). It is possible that for some time besides the low grade ore and placer materials also logs from the Ortiz Mountains were moved down the mountains to Cerrillos. However, by 1905 all placer and lode mining operations were closed down because they proved uneconomic (Lawrence 2012). Forest explorations in 2018 indicated that most ponderosa pine trees in the southern part of the OMP are approximately 100 years old and form nearly even-aged stands, which indicate that much of the current forest grew back after the end of the placer and lode mining period.

In 1973, Gold Fields Mining Inc. acquired the eastern portion of the Ortiz grant and developed a surface mine that operated between 1980 and 1986. The ore was processed with the cyanide heap leach methodology, and produced approximately 250,000 troy ounces of gold, according to the 1991 EA of Ortiz Project JV. Since about 1830, all Ortiz mining operations generated a total amount of approximately 300,000 troy ounces of gold mined from lode deposits. This amounts to about 0.48 cubic meter or 17 cubic feet of gold (Maynard 2014). While the 1991 Environmental Impact Statement report (EIS) shows maps that locate the western part of this mining area across the OMP, the report clarifies that the mining operations occurred in locations that are to the east of the current day's Preserve.

In 1983, LAC Minerals (USA), Inc., acquired a 100-percent interest in the Western portion of the land grant. In 1984, LAC and Pegasus Gold Corp entered into a joint venture mining agreement in which Pegasus became project operator. In 1990, the JV purchased the eastern portion from Gold Fields Mining. Between 1983 and 1996, the various companies operated gold exploratory mines in the Lukas Canyon and Carache Canyon on Lone Mountain Ranch, immediately south of OMP, and at the Ortiz Project processing mine east of the historic village of Dolores. After 1996 the mine areas were closed and rehabilitated for monitoring.

These mining activities probably had little impact on the OMP. Although the OMP area remained largely unscathed in the various recent mining activities, it is likely that the impacts on wildlife and groundwater from the neighboring mines may have had an effect on the current Preserve. Groundwater extraction may have led to greater drought conditions on the OMP, and noise and other impacts from the mines may have either driven wildlife away or concentrated animals in the relatively quiet canyons of the Preserve. Because the OMP was privately held and its main purpose was gold mining, no active land use and recreational uses were developed before the recent past and no active cattle ranching took place (Lawrence 2012).

In 1995, the Santa Fe Botanical Garden (SFBG) obtained the Ortiz Mountains Educational Preserve as part of a settlement between LAC Minerals USA, Inc. and the Friends of Santa Fe County to address cleanup of the Ortiz Project (a.k.a. Cunningham Hill) gold mine. The purpose of SFBG ownership was to provide an educational experience for visitors and to preserve the conservation values of the site (Santa Fe County 2017). SFBG worked with the New Mexico Abandoned Mine Lands Program to mitigate mine hazards throughout the southern portion of the property. SFBG also established a few simple trails, interpretive education opportunities, a shelter, and a small parking lot (Figures 11 and 12). In 2001, the SFBG placed the entire property under a conservation easement (CE) with the Santa Fe Conservation Trust.



Figures 11 (left) and 12 (right). A bat cupola, trails, and an interpretive sign contribute to the educational facilities of the OMP.

Santa Fe County purchased the property from SFBG in 2007, and included it in the County's Open Space system as Ortiz Mountains Open Space. SFBG continued to operate the property as an educational preserve with limited guided visits until 2015, when full management of the property was handed over to the County (Santa Fe County 2017). Santa Fe County staff continued to offer occasional educational tours with small numbers of people. Rough terrain conditions on the Preserve and very poor conditions of the access road across the LAC Minerals property greatly limit access of any kind.

In 2019, Santa Fe County conducted a cultural resources survey, which documents in detail the cultural resources on the southern part of the property. Known cultural resources on the property are mostly related to the mining era associated with the Ortiz Mine Project in the former village of Dolores between 1828 and 1920. The western part of this mining town overlapped with the southeastern corner of the present are of the OMP.

Current land use of the OMP is focused on ecological and cultural resource preservation and periodic, small-scale educational activities. The resource preservation purpose has been strengthened though the CE held by the Santa Fe Conservation Trust.

c. Geophysical Conditions

The Ortiz Mountains Preserve (OMP) is located in a rugged mountain area that includes the highest peaks in the Ortiz Mountains, Placer Peak and North Mountain (Santa Fe County 2017). The Ortiz Mountains were formed by a series of volcanic activities and uplifts in two episodes between 36 million and 31 million years ago. Both episodes included volcanism. Following these geologic events, the volcano eroded to its current shape. The mountain formation is geologically part of the Ortiz Porphyry Belt of Santa Fe County, a 25 mile-long, north-south trending group of small mountain ranges including, from north to south, the Cerrillos Hills, the Ortiz Mountains, the San Pedro Mountains, and South Mountain. The Ortiz Mountains reach a maximum elevation of 8,897 ft above sea level at Placer Peak, located in the southwestern corner of the OMP. The more gently sloping flanks of the mountain range from 6,600-7,000 ft (Maynard 2013 and 2014) (Figure 13).

The OMP straddles the highest and most mountainous part of the Ortiz Mountains. Rising at the southwestern edge of the Galisteo Basin to nearly 9,000 ft, the Ortiz Mountains are a visually and ecologically important landscape feature in central Santa Fe County. The Ortiz Mountains form the divide between the Galisteo Basin, the San Pedro Watershed, and several smaller drainages which all drain west into the Rio Grande, and a series of drainages that flow southeast into the Estancia Basin, a closed hydrological basin.

As an insular mountain range in the southwestern high-desert climate, the OMP in the Ortiz Mountains includes mainly montane and sub-alpine climate zones with variations in aspect because of the 360° slope aspects of the cone-shaped mountains. The elevations accumulate snow in winter and rainfall throughout the year, including summer thunderstorms. The OMP has a high incidence of lightning strikes.

The OMP forms the headwaters of four sub-watershed drainage systems (see terrain map, Figure 14). The largest sub-watershed drains the entire northern part of the OMP, north of the divide across North Mountain.

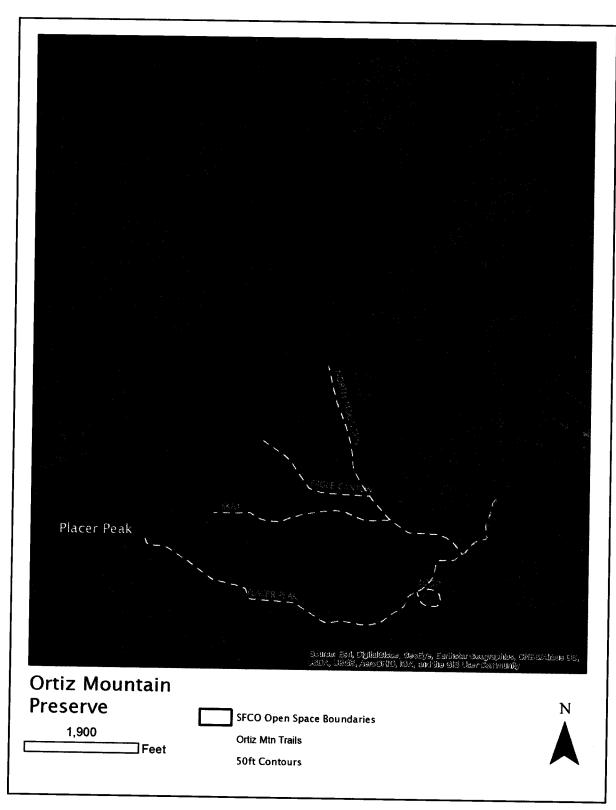


Figure 13. Aerial image of the Ortiz Mountains Open Space / Preserve.

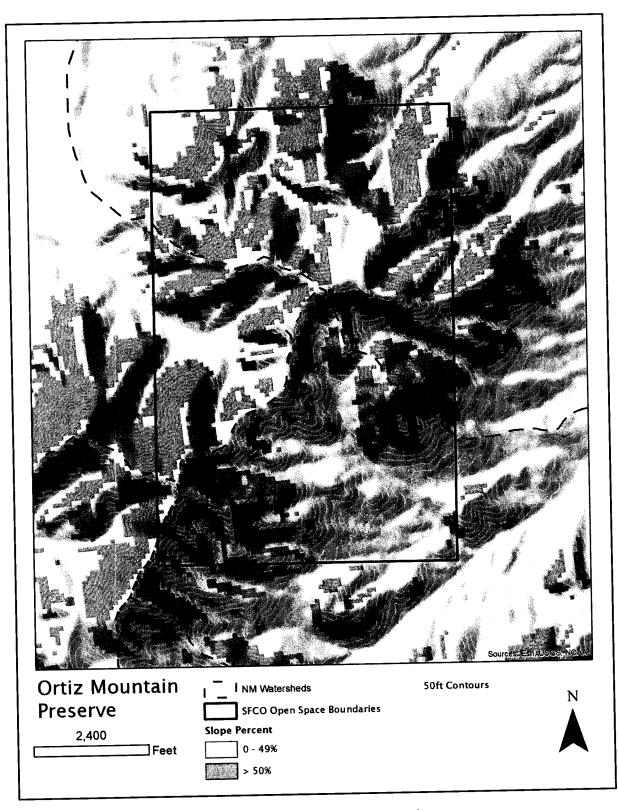


Figure 14: Topography map with slopes and drainages and divides.

Another large sub-watershed drains eastward toward the Cunningham Creek onto the LAC Mineral property. A smaller sub-watershed north of Placer Peak drains westward onto the Ortiz Mountain Ranch (a.k.a. Chavez Ranch), and another small sub-watershed drains to the south onto the Lone Mountain Ranch.

The soils of the volcanic mountain land of the OMP consist of extremely gravelly, sandy loam beneath a thin layer (up to 2") of slightly decomposing plant material, as part of the Wandum-Alchonzo-Rubble land complex with slopes between 30% and 90% (USDA 2018). Cemented bedrock is either visible at the ground surface or present within a depth of about 39". These soils make up approximately 91% of the soil cover (more than 1230 acres) in the OMP. The alluvial valley bottoms consist of very to extremely cobbly loam of the Pastorius very cobbly loam complex with slopes between 3% and 5%. These soils cover 107 acres or 8% of the OMP. A third soil type is located at the road entrance and parking area on the southeastern boundary of the OMP and consists of extremely cobbly loam (and clay loam, sandy clay loam, and sandy loam) of the Cochiti extremely cobbly loam complex, with slopes between 15% and 35%. This area covers approximately 14 acres or 1% of the OMP (USDA 2018). A soil survey report is included in Appendix A.

Field observations revealed that soil organic matter is generally very low, although on flatter areas and beneath trees, significant accumulation of organic matter occurs. All soils are well drained due to the sloped terrain, and soil erosion is relatively low. A few erosional areas occur where ruts on an old mining road, connecting the entrance area with the Lone Mountain Ranch, are turning into gullies. Other erosion occurs on and along the edges of trails and at several locations of incised drainages. An old sediment and storm water reservoir in the southeastern corner area of the property is filled up with sediment.

d. Eco-regions and Biotic Communities

Straddling several different watersheds and ecoregions, the Ortiz Mountains and OMP are located in the most northeastern corner of the Arizona-New Mexico Mountains ecoregion. This ecoregion consists largely of insular mountains and mountain ranges. The OMP borders the Arizona-New Mexico Plateau ecoregion to the west, and the Southwestern Tablelands ecoregion to the east (Griffith et al. 2006). Due to its proximity to the Southern Rockies ecoregion, which starts 25 miles to the northeast across the Galisteo Basin, the OMP is practically at the crossroads of 4 ecoregions and comprises potential habitat for plant and animal species from all these regions.

Various studies exist that indicate the important landscape connectivity function of the Ortiz Mountains in a wildlife linkage from the Sangre de Cristo Mountains (Southern Rockies ecoregion) and the Jemez Mountains to the Sandia and Manzano Mountains (Arizona-New Mexico Mountains ecoregion). The OMP is located within a well-studied linkage for cougar (Menke 2008), and at the junction of high value linkages between the Jemez Mountains, Sangre de Cristos, and Manzano Mountains for black bear, elk, and bighorn sheep (Wan et al. 2018).

This study's maps also suggests that the OMP is at the edge of high value core habitat for elk to the north and for black bear to the south.

The unusually diverse and uniquely isolated mountain ecology of the Ortiz Mountains is at the same time important habitat for a variety of herbivores, squirrels, bats, and bird species. The ecology constitutes an island of mountain habitats amidst the surrounding lower elevation habitats. Santa Fe County has started a long-term wildlife identification and monitoring program in the OMP. A preliminary list of animal species observed at OMP, including Species of Greatest Conservation Need (SGCN), is included in Appendix B.

The mine legacy of the OMP includes one open mine shaft, several exploratory trenches, several scattered pits, and collapsed shafts, which offer habitat to a diversity of animal species, including a variety of bat species, including the Townsend's big-eared bat (*Corynorhinus townsendii*). More research is necessary to describe the bat populations on the OMP and their relation to the forest ecology.

Digital vegetation cover modeling through LANDFIRE (https://www.landfire.gov/) indicates a fine mosaic-type forest landscape. Field assessments have confirmed that the forests and woodlands of the OMP form a very fine-scaled mosaic of mixed conifer, ponderosa pine, and piñon-juniper stands with different structural and ecological characteristics. The topography of the OMP landscape is equally variable, with great elevation differences, aspect changes, and subtle soil composition changes at short distances. Additionally, much of the southern part of the OMP was disturbed by mining until 1920, which has contributed to the variegated microtopography. The very fine-scaled vegetation mosaic is most likely an expression of these diverse topographical factors.

The regional vegetation modeling also indicates that current conditions are highly departed from a desired, historical age and density profile, with a high proportion of small diameter trees. These conditions have greatly increased the risk of wildfire in the OMP. Low-severity wildfire is a natural disturbance in ponderosa pine and to some extent mixed-conifer forests, and the natural vegetation succession in these forests depends on such fire patterns. However, the risk of high severity wildfire has increased due to the dense stand conditions. While fire risk from lightning ignition on the OMP is high, not all ignitions will cause wildfires with a high rate of spread. The overall fire risk should be considered moderate, due to the forest's relatively isolated location, variable stand density, structural heterogeneity, and absence of human-caused fire ignitions.

e. Trends in Climate, Hydrology, Soils, Vegetation and Wildlife

After 2000, an increasing number of studies indicate that temperatures have been rising steadily across the Southwest (NCA 2014, Robles and Enquist 2010, Williams et al. 2010). By 2006, temperature increases after 1950 ranged between 1.4° and 1.6° F (Robles and Enquist 2010), and are likely to increase 2.4° to 2.6° F by 2039 (https://svs.gsfc.nasa.gov/4110). According to a 2014 report (NCA 2014), increased heat, drought, and insect outbreaks, all linked to

climate change, have increased wildfires across the Southwest. Impacts to people include declining water supplies and increased risks of flooding, wildfire, and public health impacts. The impacts of a changing climate have led to ecological changes in 40% of Southwestern habitats, including changes in the timing of species events, increases in wildfire activity, widespread insect infestations and forest tree mortality (Robles and Enquist 2010).

Winter warming due to climate change has exacerbated bark beetle outbreaks and an increase of burnt forest lands caused by wildfire throughout the region (Robles and Enquist 2010, NCA 2014, Williams et al. 2010). However, field observations did not indicate any signs of significant or wide-spread beetle and wildfire impacts in the OMP.

While total precipitation changes are uncertain and may not change dramatically, the available water for plants is predicted to decline due to increased evapotranspiration losses and more concentrated stormwater runoff events. A TNC study reviewing climate change in the Southwest between 1951 and 2006 shows that these climate trends all apply to the subalpine forests and piñon-juniper woodlands of the Ortiz Mountains as well (Robles and Enquist 2010).

A USDA Forest Service study clarifies how ecological changes in ponderosa pine and mixed-conifer forest in the Southwest have caused shifts in forest composition (Reynolds et al. 2013). The forest has gradually changed toward a greater homogeneity in age and size classes. Forest structure has shifted toward greater densities with tree encroachment in meadows and beneath large trees. Field assessments in August 2018 confirmed that these general trends have also occurred in the OMP. Additionally, many forests have also changed in disturbance regimes toward less frequent but much more intense wildfires and more frequent and much larger scale insect outbreaks (Reynolds et al. 2013). While the OMP does not yet seem to have experienced these changes in disturbance regimes, the chance for these disturbances to reach the OMP have likely increased as a result of the first two trends in forest composition and structure.

As a result of drought stress, increased wildfire incidence, and more wide-spread bark beetle outbreaks caused by the gradual warming and drying climate, Williams et al. (2010) predict higher mortality of piñon pine, ponderosa pine, and Douglas-fir trees across the Southwest. The publication states that for all three tree species, "vulnerability to high mortality rates due to fire or drought-induced die-off is likely greatest in ecotones and dense stands where fuel build-up is high" (Williams et al. 2010). They caution, however, against taking these observations as a general impetus to start thinning out forest stands. Instead, they advise to follow an approach of site-specific assessments and a learning-oriented, gradual treatment implementation with careful monitoring and evaluation of results.

Field assessments for a forest type analysis in support of this Forest Management Plan in August 2018 confirmed that the ponderosa pine, Gambel oak, and piñon pine forest type as described by Reynolds et al. (2013) also occurs on the OMP (here identified as the ponderosa pine with piñon-juniper understory type), and that it represents a relatively cool and moist environment in comparison with any lower elevation piñon-juniper savannah type outside the

OPM. Reynolds et al. (2013) caution that climate change may lead to a change that would increase the area covered by ponderosa pine and shrub forest and separately piñon-juniper savannah, which represent warmer and drier forest types. As climate change progresses the ponderosa pine with P-J understory type would then increasingly be found only at the higher elevations and north facing slopes (Reynolds et al 2013).

Floyd, Hanna, and Romme (2004) observed that the ecological shifts in forest and woodland ecosystems that have been observed in the last few decades are generally not due to fire suppression or other direct human intervention. They concluded that the changes result from natural ecological responses to climatic variability. The island character and the absence of fire suppression on the OMP offer a unique opportunity for valuable research of these ecological shifts as they are not influenced by human interference.

Floyd and Romme (2012) point out that it is important to distinguish different piñon-juniper ecologies with different fire frequencies and levels of fire severity. Their research also clarifies that fire frequencies in piñon-juniper ecologies are different from those commonly identified in ponderosa pine forests. Fire frequencies in dense piñon-juniper woodlands without a grass component tend to be in periods of 400 years or more (Floyd and Romme 2012, Baker and Shinneman 2004). "Nearly all observed fires since EuroAmerican settlement in these woodlands were high-severity fires" (Baker and Shinneman 2004). Fire frequencies in piñon-juniper savannahs appear to have shorter fire frequencies. However, Baker and Shinneman (2004) and NMFWRI (2007) conclude that there are no reliable estimates of mean fire intervals for low-severity surface fires in these woodlands because of methodological problems and lack of reliable data. Their research also indicates that spreading, low-severity surface fires in piñon-juniper ecologies are likely not common (Baker and Shinneman 2004). They also point out that "fires can kill small trees in true savannas and grasslands, helping to maintain a low tree density, but in most piñon-juniper woodlands low-severity surface fires do not consistently lower tree density and may become high-severity fires" (Baker and Shinneman 2004).

Scientific research and anecdotal observations from forestry operators have cautioned that treatments in piñon-juniper woodland and savannah ecosystems leading to reduced stem densities could lead to increased die back and reduced vitality in remaining trees. A study by Morillas et al (2017) found that counter to the expected result, induced tree mortality led to a decrease in both soil volumetric water content and sap flow rates in the remaining trees in comparison with an untreated site. Drought stress seems to exacerbate this result for the remaining trees, suggesting that piñon mortality may trigger feedback mechanisms that leave treated PJ woodlands drier relative to undisturbed sites and potentially more vulnerable to drought (Morillas et al 2017). Recent research in forest soil microbiology concerning relationships between mycorrhizal and microbial life and tree clumps seems to suggest that impacts of individual tree removal lead to die off of parts of the mycorrhizal networks between trees, leaving the remaining trees with reduced underground capabilities of exchanging water and essential aminoacids for alleviating stresses on individual tree, which is of special importance in times of drought and insect attacks (Phillips 2017, Hart et al. 2018).

Analysis of the TNC study's findings on climate vulnerability for different landscape types results in the conclusion that the OMP area is ranked in this study as "somewhat vulnerable", because of a relatively lower temperature change than elsewhere in the Southwest, but with impacts for a relatively large number of species of conservation concern. However, the surrounding landscape of the OMP is ranked as "most vulnerable" (Robles and Enquist 2010). This logically would increase the ecological "island effect" of the Ortiz Mountains as a potential refuge for plants and wildlife. As the Ortiz Mountain area becomes ecologically more unique, the need to maintain landscape connectivity and ecotones for wildlife will be critical for the future habitat values of the Ortiz Mountains.

If the climate scenarios for the Southwest play out, it is possible that in the course of the 21st century, when biodiversity around the OMP degrades, a migration of animals to the OMP will occur for some time as they seek refuge from the stressors in the lower elevation landscape. This may cause temporary competition and predation conflicts. However, when landscape connectivity to the OMP further dwindles and species find it increasingly difficult to reach the OMP, it is likely that biodiversity of the OMP's ecosystems will begin to decline. Additionally, increased incidents of wildfire and bark beetle outbreaks may further degrade the OMP ecology while natural regeneration opportunities from the outside decline. Other trends will likely include changes in the timing of species events, such as nesting and pollination (Robles and Enquist 2010). Downward trends in surface water shortages and plant species dependent on animal pollinators would eventually have dramatic impacts for insects and bats in the area, cascading in the further collapse of the plant communities.

As a case in point, mortality in piñon-juniper stands in central New Mexico and the Southwest after 2000 have already led to a sharp, landscape-wide decline in the number of piñon pine trees and in the diversity and number of bird species that depend on this tree species (Faira et al. 2018, Coop and Magee 2016). The studies suggest that ongoing effects of climate, as well as proposed thinning operations in piñon-juniper stands, may further reduce bird species abundance and richness in these ecosystems

Die-off due to drought stress, fire and beetle impacts may lead to more homogeneous species, age, and genetic structure of forests and woodlands. This in turn will increase risks of sudden and large-scale beetle outbreaks (Raffa et al. 2008). Therefore, maintaining forest heterogeneity and reducing stressors in the forest is critical toward forest resilience in response to climate change impacts (Raffa et al. 2008). Dense, stressed stands in the lower elevation, transitional forests (ecotones) — in the case of the ponderosa pine with piñon-juniper understory stands and the pure ponderosa stands — are potentially effective targets for management as they may buffer fire impacts on the upslope forests (Conver at al. 2018, Williams et al. 2010). Treatments at these lower elevations will thus help maintain forest resilience to wildfire for the entire landscape (Conver at al. 2018) and reduce mortality during climate induced species composition conversions as suggested by Reynolds et al. (2013).

There seems to be growing consensus among forest scientists and biologists that thinning in piñon-juniper ecologies is only advisable in select situations and must be conducted with great

caution and with careful consideration of the impacts on the desired ecosystem (NMFWRI 2007). Most authors suggest that site-specific research and monitoring is needed to arrive at effective treatment prescriptions.

Floyd, Hanna, and Romme (2004) caution that their findings did not provide any ecological justification for aggressive management activities such as mechanical fuel reduction or prescribed burning, except in the immediate vicinity of vulnerable cultural resources. In 2012, Floyd and Romme, specified their advice for when thinning or mastication treatments would be advisable in piñon-juniper ecologies, depending on forest management goals and specific risk factors. Beyond maintenance thinning or mastication, such as for wildfire risk reduction and for cultural resource protection, they do not recommend any actions toward ecosystem restoration, except when piñon-juniper ecologies have been severely burnt or when noxious weeds, such as cheat grass, have encroached in these stands.

4. FOREST LANDSCAPE CHARACTERISTICS

a. Data Collection Methods

Forest characterization information for this forest stewardship plan was largely based on primary source data collection on the property within the limitations of the project budget. The forest assessment team consisted of Santa Fe County Open Space (OS) staff and two members of the Ecotone consulting team. The team visited 20 sampling sites throughout the southern half of the property. The sampling exercise included full assessments on eleven sites and rapid appraisals on eight sites. On one site, which was considered a reference site for old growth ponderosa pine, only field notes and photographs were taken. Figure 15 indicates the 20 sampling locations. Appendix C includes an overview of the sampling points and their specific data.

The team used a suite of forest assessment tools developed for the USDA Collaborative Forest Restoration Program (CFRP) (Moote et al. 2009) and adapted by the Forest Stewards Guild. For the rapid appraisals, the team used the Forest Bullseye monitoring method (Ecotone 2018). The Forest Bullseye monitoring method was developed in 2018 by Ecotone for Santa Fe County, based on the original Bullseye monitoring method for rangeland health (Gadzia and Graham 2013). The forms for the Bullseye monitoring method are included in Appendix D.

The forest assessment took place between August 27 and 29, 2018. The assessment focused on the southern half of the OMP, and in particular on accessible terrain where forest management treatments would be most feasible. A description of the field assessment protocol is included in Appendix D.

b. Vegetation Communities and Forest Types

The vegetation communities are so diverse in structure over short distances that it was useful to map assemblages of forest mosaics with similar conditions, based on a combination of aerial imagery interpretation, and digital vegetation cover mapping. Field assessments then verified and corrected the identification of vegetation communities and forest types in the OMP. The piñon-juniper classification follows the one developed by the New Mexico Forest and Watershed Research Institute (NMFWRI 2007 and 2019). The dominant vegetation communities of the OMP include:

- Mixed conifer forest
- Mixed conifer forest with piñon-juniper understory
- Piñon-juniper open woodland
- Piñon-juniper persistent woodland
- Ponderosa pine forest and piñon-juniper understory
- Ponderosa pine forest

And:

- Piñon-juniper shrubland
- Sub-alpine shrub and grassland
- Rocky outcrops and scree with scattered shrub, cacti, and herbaceous cover

The last three vegetation communities have been excluded from consideration in forest management planning, because no management action is needed and anticipated in these vegetation communities. The resulting forest type identification and mapping for the forest management planning area is summarized in Table 2 and displayed in Figure 15. Areas that were not visited during the field assessments were not interpreted for forest type identification.

Table 2. Forest Type Characteristics

Forest Type	Management Unit Prevalence	Dominant Plant Species	Sub- dominant plant species	Terrain and Ecological Characteristics
Mixed-Conifer Forest	Units D, E, F, and G	Douglas fir, white fir, ponderosa pine	Gambel oak, aspen	Higher and mid- elevations, N- and E- facing
Mixed-Conifer Forest with Piñon-Juniper Understory	Units D, E, F	Douglas fir, white fir, ponderosa pine, piñon pine, Rocky Mountain Juniper	Gambel oak	Higher elevations, steep slopes, N-facing
Piñon-Juniper Open Woodland	Units A, B, C, D, and E (and possibly H and I)	piñon pine, Rocky Mountain Juniper and one-seed juniper	Gambel oak, mountain mahogany, yucca, grass	Higher and mid- elevations S- and W-facing slopes
Piñon-Juniper Persistent Woodland	Units B, D, and E (and possibly I)	piñon pine, Rocky Mountain Juniper and one-seed juniper	Gambel oak, mountain mahogany, yucca	Higher and mid- elevations N- and E-facing slopes
Ponderosa pine with Piñon- Juniper Understory	Units A and B (and possibly H)	Ponderosa pine, piñon pine, Rocky Mountain Juniper and one-seed juniper	Gambel oak, mountain mahogany, yucca	Lower elevations, flatter, terrain, disturbed soils, or encroached on grassland, all aspects
Ponderosa pine forest	Units D, E, and F	Ponderosa pine		Higher and mid- elevation SW-, S-, and SE-facing

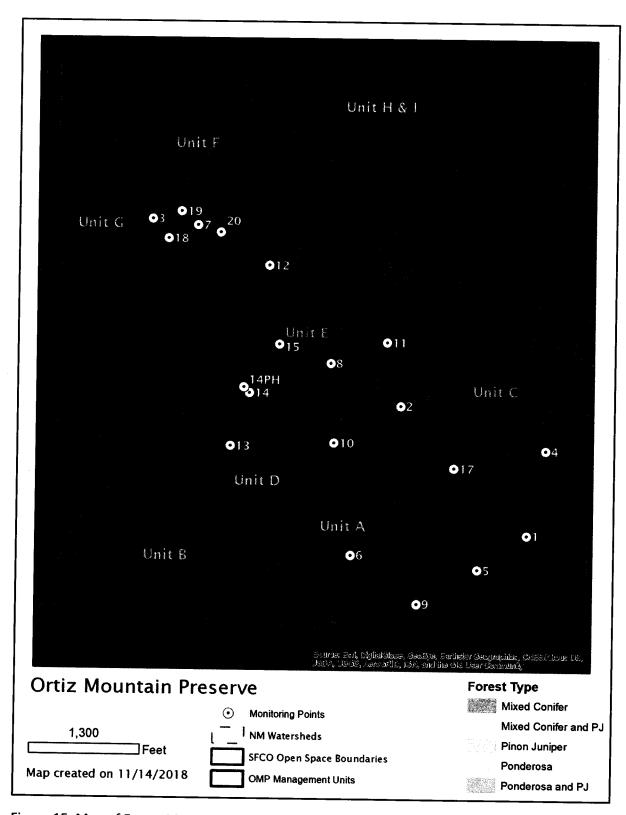


Figure 15. Map of Forest Management Units, sampling points, and forest types.

While the plan identifies piñon-juniper (P-J) persistent woodland and P-J open woodland separately, the mapping units for these P-J types have been combined, due to the fine-grained mosaic of stand type characteristics and a lack of detailed information on specific site characteristic. More on-site monitoring will be necessary to determine specific map units for each of these two P-J types.

Forest types occur with varying prevalence across the various Forest Management Units (FMU). For example, there is no mixed conifer forest in FMU A and ponderosa pine with piñon-juniper understory does only occur in FMUs A and B (and possibly in H). In each FMU, forest type characteristics and specific health features differ also.

Therefore, it is useful to review forest type conditions within each FMU when considering the forest health treatments designed for that FMU. The following pages provide an overview of forest conditions for each forest type in each FMU and lists suggestions for treatment.

Forest Management Unit A (Southeastern corner area)





Ponderosa Pine with Piñon-Juniper (P-J) Understory Type

<u>Terrain:</u> Gently sloped, alluvial soils, east facing, very fine-scaled mosaic of stands, dissected by various drainages

Present Concerns:

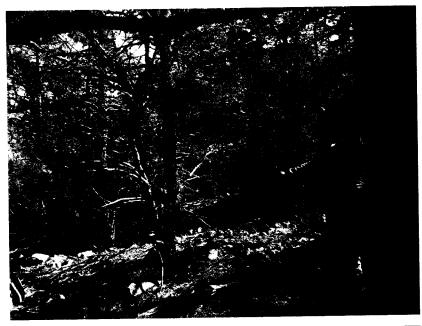
Drought stress, ladder fuels, high density, and dwarf mistletoe in ponderosa pine trees and mistletoe in piñons; high risk of wildfire

<u>Goal:</u> Mosaic of stands with lower stem densities in most stands, and openings with herbaceous cover

Treatment: Selective, site-specific thinning from below to remove ladder fuels from beneath ponderosa pine trees, leaving groups and clumps of P-J in areas between the ponderosa pine groups, and piling and burning of slash

Figures 16 and 17. Both images show ladder fuels (small trees below tall ones) and "doghair" (dense clumps of small trees) in which the small trees should be selectively thinned out.

Forest Management Unit A (Southeastern corner area)





Piñon-Juniper Open Woodland Type

Terrain: Gently sloped, disturbed and alluvial soils, south and east facing, very fine-scaled mosaic of stands, dissected by various drainages

Present Concerns: Drought stress, ladder fuels, high density, and mistletoe in piñons; moderately high risk of wildfire

Goal: Mosaic of stands with lower stem densities in most stands, and openings with herbaceous cover

Treatment: Contingent on results from wildlife monitoring in the first treatment phase, future phases may include highly selective, site-specific thinning from below to release large trees, leaving groups and clumps, increasing openings in grassy meadows, and lop & scatter and piling and burning of slash

Figures 18 and 19. Both images show ladder fuels and "doghair" in which some of the small trees should be selectively thinned out.

Forest Management Unit D - Central Southern Area





Ponderosa Pine Type

Terrain: Gently sloped, alluvial soils, northeast-, east-, southeast-, and southfacing, mosaic of stands, around several large drainages, many stands even-aged (around 100 years of age) with thick needle cast on forest floor

Present Concerns: Drought stress, high stem density, many stands even-aged (around 100 years of age) with thick needle cast on forest floor, and a considerable number of trees infected with dwarf mistletoe; high risk of wildfire

<u>Goal:</u> Mosaic of stands with lower stem densities and improved tree health

Treatment: Selective thinning from below, leaving groups and clumps, creating semi-open park with denser stringers, piling and burning of slash, underburning where feasible and appropriate

Figures 20 and 21. Both images show many spindly trees between and below mature ones and "doghair" in which the small trees should be removed through selective thinning.

Forest Management Unit D – Central Southern Area





Mixed Conifer (with P-J Understory) Type

Terrain: Moderately sloped, colluvial soils, northeast- to east-facing, small clumps and stringers, around several large drainages

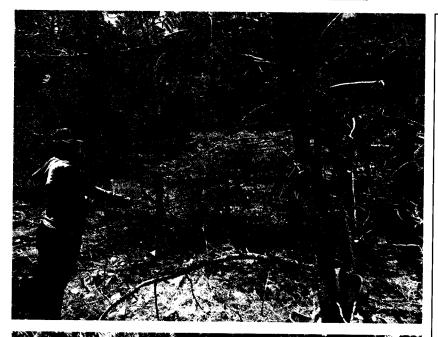
<u>Present Concerns:</u> Drought stress and high stem density

<u>Goal:</u> Mosaic of stands with lower densities and improved tree health

Treatment: Selective, sitespecific thinning from below to remove ladder fuels from beneath ponderosa pine, Douglas fir, and mature piñon trees, leaving groups and clumps of P-J in areas between the mixed conifer groups, and piling and burning of slash

Figures 22 and 23. Both images show dense groups of small trees that should be selectively thinned out and in which mature trees need to be maintained.

Forest Management Units D & E - Central Southern Area





Piñon-Juniper Persistent Woodland Type

<u>Terrain:</u> Gently sloped (unit D) to steeply sloped (unit E), alluvial soils with rock components, northeast-, east-, southeast-, and southfacing, mosaic of stands, around several large drainages

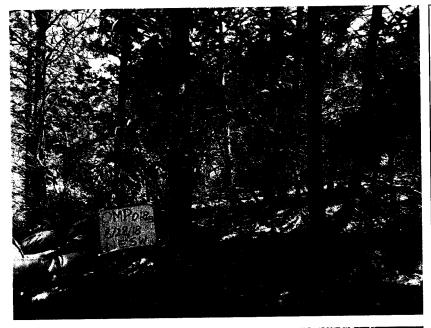
<u>Present Concerns:</u> Drought stress, high stem density, and species-specific mistletoe in piñons and junipers

<u>Goal:</u> Mosaic of stands with improved tree health

Treatment: Contingent on monitoring results in the first phase, there will likely be little to no treatment action in successive phases, except in relation to ponderosa pine stand improvement (see above)

Figures 24 and 25. Forest conditions for the piñon-juniper woodland stands are characteristic for this forest type.

Forest Management Unit G – Central Western Area





Fine Mosaic of Mixed Conifer, Ponderosa Pine and Piñon-Juniper Types

<u>Terrain:</u> Gently sloped, alluvial soils, northwest-, west-, and southwest-facing, mosaic of stands, around several large drainages

Present Concerns: Drought stress, high stem density, many stands even-aged (around 100 years of age) with thick needle cast on forest floor, and a considerable number of trees infected with dwarf mistletoe and piñon mistletoe; high risk of wildfire

<u>Goal:</u> Mosaic of stands with lower stem densities and improved tree health

Treatment: Selective, sitespecific thinning from below to remove ladder fuels from beneath ponderosa pine, Douglas fir, and mature piñon trees, creating semiopen park with denser stringers, leaving groups and clumps of P-J in areas between the mixed conifer groups, and piling and burning of slash

Figures 26 and 27. Both images show many spindly trees between and below mature ones and "doghair" in which the small trees should be removed through selective thinning, leaving the mature ones.

Risk and Liability Analysis

In this Forest Management Plan we define **risk** as the likelihood that an adverse or beneficial event occurs to Highly Valued Resources or Assets (HVRAs), such as cultural, ecological, or biophysical resources, and human-made improvements (Scott et al. 2013). In the risk assessment framework developed for the US Forest Service by Scott et al. (2013) and used by many wildfire professional today, the potential for wildfire effects can be quantified as "the expected value of the probability of an event occurring multiplied by the magnitude of the effect, given that an event has occurred". Risk determination is, therefore, a combination of the statistical chance for an event to occur and the susceptibility of human populations, valuable ecosystems, and valuable assets to such catastrophic events.

We define hazard as the vulnerability (level of exposure) of a certain resource caused by the spreading of accelerated or catastrophic events across the landscape and by the development of cumulative impacts to human life and wellbeing and to landscape values at a large scale. Scott et al. (2013) clarify that wildfire hazard "can be described qualitatively as a fire environment—fuel, weather, topography, and ignitions—with potential for causing harm or damage". They continue to express that quantitatively wildfire hazard consists of "two characteristics: (1) the probability of a fire occurring at a specific point during a specified time period, and (2) the expected distribution of intensity given that the event does occur" (Scott et al. 2013). Liability is the level of responsibility that could be attributed to landowners and which is expressed in costs associated with the occurrence of events that bear certain risks and hazards.

Dixon (2017) observed that neither scientists nor planners can predict the exact timing of certain disastrous events, but they can with reasonable certainty analyze their approximate location and size. In many cases, they also know the conditions under which the chance of catastrophic events to occur increases, and can indicate the approximate recurrence time for such events. Together, these factors help experts determine the risk levels of certain catastrophic events for specific locations.

The most important catastrophic events to be anticipated at the Ortiz Mountain Preserve are primarily wildfire and associated flash floods, mass wasting, debris flows, gully erosion, mud slides, and mass sedimentation. Additionally, the area could experience large scale forest die off due to insect infestations and drought, flash flooding, and mass wasting associated with reduced soil stability caused by the previous disastrous events.

The impacts of these events will affect the cultural, ecological, and geophysical values of the immediate surrounding landscape, as well as local infrastructure, downstream land and facilities, and particularly mine reclamation investments of the LAC Minerals operation. Impacts might also affect buildings, roads, and private property in the vicinity of the property, scenic

qualities, reduced air quality from smoke events for people in a wider area, wildlife habitat and corridor functions for wildlife. There is a reasonable expectation that catastrophic events on the property would to a large extent destroy the critical open space values and conservation purposes of the land and create instead a long-term management liability for Santa Fe County as the landowner, and to some extent also for the Santa Fe Conservation Trust as the conservation easement holder.

In the next section of this Forest Management Plan, we only offer a qualitative wildfire risk assessment, based on an interpretation of forest characteristics and HVRAs at stake. A quantitative assessment would have led beyond the scope and scale of this plan, and also would have been unnecessary for the scale and conditions of the OMP.

c. Wildfire Assessment Findings and Evaluation

The forest assessment did not identify any areas that showed signs of recent wildfire. In a few locations scattered across the OMP, burn marks occurred on individual trees or stumps, indicating that wildfire historically occurred across a wide area. However, the forest contained many indications of high risks of wildfire ignition and fire spreading, including:

• High stem density (standing live biomass)

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- High number of small-diameter stems, including seedlings and saplings
- Many signs of compromised vigor and diseases in individual trees
- Moderate to high number of dead standing trees
- High amounts of dead and down woody material
- Locally some dense cover of dried herbaceous plants
- General occurrence of ladder fuels (shrubs and small trees beneath tall ones)
- Low average crown-base height of forest stands (short distances between branches and the forest floor)

Findings show that stem densities are highly variable, with high numbers of stems at various places in the piñon-juniper stands with a ponderosa overstory in FMU A and in the piñon-juniper woodland, ponderosa pine stands, and mixed conifer stands in FMU D. Most stands have high numbers of small diameter trees (a mean of 478 tree and sapling stems per acre and 251 trees of 5" and larger across all measured plots). More than 80% of the sampled trees (not including saplings or seedlings) are smaller than 11 inches in diameter with two-thirds being smaller than 9 inches. Table 3 provides an overview of stem densities, reference ranges and target density ranges.

Table 3. Stem Densities of trees (>5" DBH or DRC).

Forest Type (and FMU)	Stem Density (Mean; [Min-Max])	Suggested Ideal Stem Density Range (stems/ac)*	Target Mean and Range for Stem Removal (stems/ac)**
PIPO with P-J understory – all trees (FMU A)	195 [50-320]	No information (variable targets)	Site specific
PIPO with P-J understory – PIPO only (FMU A)	53 [0-90]	2-72 (for stands up to 10 acres)	0 (except diseased trees)
PIPO with P-J understory – P-J only (FMU A)	142 [0-280]	No information (variable targets)	Site specific
PIPO (FMU D)	343 [270-420]	11.7-124	<220 [136-296]
MC (+PJ) (FMU D)	185 [130-240]	20.9-99.4	<86 [30-140]
All sampling plots (all forest types and all FMUs)	251 [50-420]	No information	N/A

^{*)} Source: Reynolds et al. 2013.

Locally, there are high densities of dead standing snags, such as in the piñon-juniper open woodland with an oak understory of FMU A, and in the oak brush and the ponderosa pine stands of FMU D. There are also dense piles and scatterings of dead and down woody material, especially in the steep, south and west facing piñon-juniper open woodland of FMUs A, C, E and F. Locally, the latter woodland areas also include high volumes of low shrubs and dry herbaceous cover.

Ladder fuels occur nearly everywhere, and particularly in FMUs F and G, but less so in the ponderosa pine stands in FMUs D and F. The mean crown base height is low in FMUs A, E, F, and G, and particularly in piñon-juniper open woodland and mixed conifer stands.

The remoteness and ruggedness of the property will complicate suppression efforts ignitions that occur in the OMP because of limited access and the difficult working conditions. Additionally, the steep topography could contribute to wildfire growth, the many steep and narrow canyons that provide the variety of forest types could cause high intensity fire to move quickly from low elevations up these features. However rocky ridges and scree slopes at the high elevations could serve and natural fire breaks between drainages. Based on observations

^{**)} The OMP forests are composed of mid-aged stands of ponderosa pine in fine-scale (<10 acres) to mid-scale (10-1000 acres) stand sizes, and of mixed-conifer in fine-scale stand sizes. Reference conditions (Reynolds et al. 2013) for such mid-aged stands contain a relatively high number of stems within the range of variability. Wildlife cover is also an important management goal and requires relatively dense stands for desired species. Therefore, the target removal rate adopts the highest reference density in the range.

in the field of forest type and topography, we could speculate that historically, before mining in the area, fires would have been predominantly from lightning ignitions and the fire regime would have been highly variable in both size and severity of fires. It is likely that there was a patchy distribution of many small and infrequent fires that self-extinguished at the boundary of changes in fuel type or natural fuel breaks, with very occasional larger scale fires.

Currently, wildfire risk is patchy throughout the forest with individual patches with high risk in the piñon-juniper and ponderosa stands in FMU A (southeastern corner, south of the forest road) and in FMU D in the northeast- and east-facing ponderosa pine and mixed conifer stands. Wildfire risk is also moderately-high to high in the central-western valley of FMU G. Table 4 provides an overview of forest health indicators and a qualitative wildfire risk and hazard assessment for the various sampling locations and FMUs.

d. Forest Insect and Disease Findings and Evaluation

Throughout the southern half of the OMP that was sampled in 2018, many trees were drought stressed and impacted by parasitic diseases, such as (dwarf) mistletoe, beetles, and fungi. Overall tree vigor was medium to low, except in a few, isolated, mostly higher elevation stands, which serve as reference sites of healthy conditions. Drought stress appeared to affect all woody species, including Gambel oak and mountain mahogany, but also many piñons, ponderosa pines, and Douglas fir trees.

Mistletoe infestation in piñons was particularly prevalent in FMU A, with severity ranges between 2 (moderate) and 6 (entirely infected), and also in patches of FMU E, with severity ranges between 2 and 4. Dwarf mistletoe in ponderosa pine occurred particularly in the western part of FMU A and in the central and western parts of FMU D and across FMU E, with severity ranges between 2 to 6, and in a patchy manner in FMUs F and G, with severity ranges between 2 and 4.

No specific observations were made of bark beetle. However there were some indications of localized, low level bark beetle infestations, particularly in piñon trees.

e. Ground Cover Vegetation Findings and Evaluation

Ground Cover Vegetation

The mean ground covering vegetation in the sampling plots on the OMP is 16.5%, with 6.6% herbaceous cover and nearly 10% shrub cover, while the mean bare ground percentage was nearly 23% with nearly 68% mean litter cover. However, plant cover is highly variable across the landscape.

In the lower, southeastern FMU (A), herbaceous cover was mostly around 2.5% with some exceptions around 13%, which indicates that the loamy, flat areas in this unit have a potential for grass cover development if trees were removed through forest thinning. However, FMU A

also exhibited a relatively high amount of bare ground (32%) and relatively modest amount of litter cover (59%).

Ground covering vegetation was more abundant in FMU D, and in particular in the mixed-conifer stands. The mean herbaceous cover was 8%, accompanied with a mean shrub cover of 6.6%. However, in pure ponderosa pine stands, herbaceous cover was entirely absent, most likely due to the thick needle cast on the forest floor. The mean bare ground was rather low, around 15%, while the mean litter cover was relatively high at 77%. No specific vegetative cover measurements were collected for the other FMUs.

Rare Plant Species or Plant Species of Concern

There are many species of cactus on the OMP, and it is likely that several cactus species are in fact rare or species of concern. Consultation with a botanist and/or cactus expert may be needed to identify whether there is a concern for the protection of rare plants and cacti in prospective forest treatment areas.

Invasive and Noxious Species

No invasive or noxious plant species were observed. This is a relatively rare condition, which is valuable to preserve. It will be advisable that any forest or fire management efforts take this into account, and any equipment and apparatus will need to be cleaned before entering the preserve to prevent inadvertent distribution of seeds of noxious weeds from outside the area.

Table 4. Overview of forest health observations and a qualitative fire risk and fire hazard assessment based on data collected during a field assessment in August 2018.

Plot For	For Type	Mgmt	Approx.	Health	Fire Risk	Fire	Priority	Limitations
		Unit	Stems/Acre incl. saplings			Hazard		
DAIA 100AMO	_	4		OK; QUGA stressed	lo Lo	Lo-Med	Low	Riparian ecology
	W nano Id	. 4		Drv. stressed	Lo-Med	Med	Low	Steepness; low impact
	id/Odid	4	\$	ok: dense Julvió	Lo-Med	Med-Hi	涆	Riparian ecology
	1d/Colo	Ą		OK: derise PI: stressed?	Med-Hi	Med-Hi	H	few
PILL SOUND	la/Odla	¥		Derise: NH(2-6), DIMIT(2-6)	Med	Med-Hi	田	few
		D		DMT(1-2): dry. stressed	Lo-Med	pəM-o1	Low	Riparian ecology
	Di nore wi	ء اد	430	dense clumps of small trees	Med	Med-Hi	Low	Piñon protection
	: :	م اد		Dense: Stressed: DIVITI2-4)	Lo-Med	Med-Hi	押	few
	c	ماد		Stressed by drought; even aged	Lo-Med	Lo-Med	Med-hi	Tew
ď	MC/PIPO	۵	dense	PIPO struggling; dry; even aged	Lo-Med	Med	Med	Access
	PIPO/PJ	D	dense	Stressed PIED; DMT(2-4); MT(2-4)	Med	Med-Hi	Med-Lo	Steepness, PJ, access
992.09	la la	٥	310	Stressed PIED; doghair	Med	Ŧ		Steepness; access
1	MC/PIPO	۵	450	OK, dense; 60 dead/acre	Med-Hi	Med	玉	few
	PIPO/PJ	E	oben	OK; DMT(2-4); beetle kill; lots of dead	Med	Med	Р	Access, steepness
ء	0	L	oben	large, old PIPO park: reference site!	lo	의	None	Access
1	ē	ŋ	medium	QUGA and PSME stressed	Lo-Med	Med-Hi	Low	Access
	PIPO/PJ	G	dense	PIPO Stressed, DMT(2-6)	Med	H	Med-Lo	Access
	PIPO/PJ	G	oben	OK; DMT(2-4); stressed PIPO	Lo-Med	Med	9	steepness, access
Γ		g	medium	stressed and diseased	Med-Hi	Med-Hi	Low	Access
Π	PIPO/PJ	ŋ	dense	stressed, DMT4-6, dense	Med-Hi	Ħ	Med-Low Access	Access

5. FUTURE DESIRED CONDITIONS

a. Landscape Vision and Need to Act

Santa Fe County's vision for the Ortiz Mountains Open Space is based on the existing conservation easement that aims to create and maintain a nature preserve to promote conservation, public education, and scenic enjoyment activities pertaining to the surface estate of the property. The Ortiz Mountains Open Space Management Plan (2017) describes the County's preliminary vision for the property as:

In 2025, the Ortiz Mountains Open Space is the "wild-ness" component of the Santa Fe County Open Space system. The site is a preserve for wildlife and the natural systems they rely on. The fauna and flora that share this land remain the fundamental element of the preserve in the future.

Guided groups visit the site to learn about and appreciate these rugged mountains, and, about the specific details of this place and how it affects the lands around it. Participants learn about the site's larger context as part of a wildlife corridor that stretches across the Galisteo Basin and beyond. The site educates about the history of mining on Ortiz Mountains and how land restoration continues.

The property is an example of land restoration practices, and the community and County are engaged together in maintenance and stewardship of the land including trails and educational improvements.

Management Goal

The Ortiz Mountains Open Space management goal states the vision in terms of actions that can be implemented and monitored (see Section 2).

Specific objectives related to forest landscape management include:

- i. Maintain educational opportunities
- ii. Encourage community stewardship and involve citizens in monitoring and maintenance
- iii. Protect the cultural resources on the site
- iv. Allow access only for educational purposes and natural resource management
- v. Support the existing wildlife and its habitat and pathways
- vi. Maintain the property's natural systems
 - Improve forest resilience
 - Reintroduce fire as a key ecosystem disturbance through natural ignitions and prescribed fire
 - Minimize the need for and implementation of management interventions and maintenance work

Forest Landscape Vision

This forest management plan proposes that the vision for the forest landscape of the OMP is that the forests and woodlands of the OMP are ecologically diverse (heterogeneous) in their spatial structure, tree age, and plant and animal species composition, in such a way that they adequately buffer the impacts of extreme biophysical and ecological events that could lead to catastrophic changes across the property, and that ecological functions of the forests and woodlands are resilient and adaptive to the stresses associated with climate trends, legacy impacts, occasional low-impact use, and increasing ecological isolation. The vision for the forest landscape also holds that the forests contribute to the role of the mountains as an ecological sanctuary (preserve) for plants and animals in connection with the wider landscape in the region.

Risks Assessment and Need to Act

Given increasing stresses on the forest from the impacts of climate trends and other factors, and the growing liabilities of potential catastrophic impacts on the conservation values of the OMP and on neighboring lands and ecosystems, this Forest Management Plan's recommendations intend to guide Santa Fe County with implementing interventions to pursue the vision and goal for this open space property.

Specifically, the purpose and need for timely action are:

A. There are critical values at risk:

- Forest ecosystems, view-sheds, wildlife habitat, and cultural resources could be impacted by potential wildfire and/or beetle kill of trees.
- The LAC Minerals Mine site infrastructure could be impacted by potential wildfire and associated debris flows and flash floods.
- Private homes on the northeast side of the OMP could be impacted by wildfire spreading from the south.
- B. The risks are high, due to nearly 100 years of no action, which have led to the current forest conditions that are moderately to highly departed from reference conditions cited in professional literature for the region (LANDFIRE model and Reynolds et al. 2013), in combination with poor access and anticipated climate change impacts.

b. Desired Forest Conditions

Desired forest conditions for the OMP are based on specific reference conditions found on the property, the management goal to maintain the property as a wilderness preserve and optimal wildlife habitat, and theoretical condition statements derived from an analysis of scientific publications that describe optimal forest conditions in relation to climate resilience (Reynolds et al. 2013), fire adaptability, and herbaceous cover. A few suitable reference conditions were found on the property at remote locations with apparent old-growth ponderosa pine stands. Other reference conditions included higher elevation piñon-juniper woodland and mixed

conifer with piñon-juniper understory. The locations of these conditions were documented and photographed. The occurrence of local reference conditions reduced the usefulness of using modeled sources from other locations. Locally identified reference conditions are described in Appendix E. Further forest monitoring will help identify more detailed reference conditions for ongoing forest management.

Many forest stands in the southeastern part of the property have been impacted by mining operations and do not represent reference conditions. These stands are typically even-aged and, in places, they are dense and diseased. Additionally, as cautioned by Reynolds et al. (2013), it remains to be seen to what extent the locally existing reference conditions remain relevant under the influence of the increasing stresses caused by the climate change impacts discussed above.

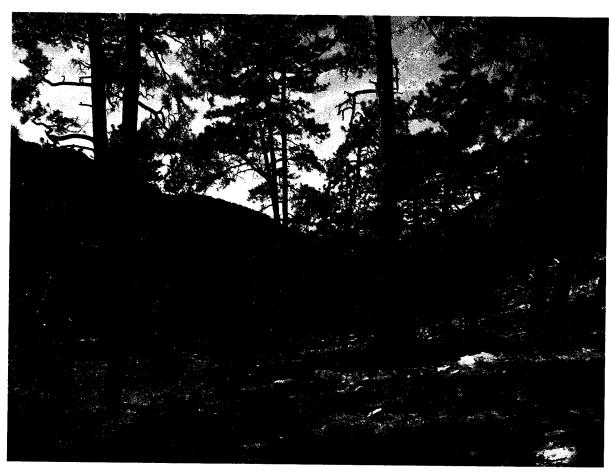


Figure 28. Image of an envisioned reference condition for ponderosa pine forest stands.

Desired forest conditions for the OMP largely follow the forest restoration framework for frequent-fire forests described by Reynolds et al. (2013) with modifications based on field assessments and wildlife conservation goals.



Figure 29. Image of an envisioned reference condition for mixed conifer forest stands.

These conditions are likely to increase the forest's resilience to disturbance events, described above, and to the exacerbating effect of climate change on these disturbance events. This means that these conditions would also prepare the forest for low-intensity fire as the appropriate disturbance regime, creating better soil conditions for nutrient cycling, biodiversity and food webs. In pursuing these forest conditions, it is important to preserve any and all existing old trees, old growth forest characteristics, and hydrologic functions.

In sum, forest conditions that are a natural reflection of the wilderness character of the OMP and that are most resilient to normal bio-physical disturbances, as enlarged by the impacts of climate change and other disturbances, include:

1. Forest heterogeneity -

- i. a diverse composition of species and age structure of trees
- ii. variability in spatial structure (with groups of trees, some scattered individual trees, open grass-forb-shrub interspaces, ecotone buffers, fine-scaled mosaics, and multiple canopies),
- iii. native plant and animal species richness,

- iv. diverse composition of herbaceous cover and understory vegetation
- v. presence of snags, logs, and woody debris
- 2. **Healthy riparian areas** that show resiliency in degradation and aggradation, high native plant species richness, dense cover, and periodically flowing and standing water
- 3. **Optimal wildlife and habitat conditions and connectivity of habitat** with effective pathways to surrounding habitat areas

Additional desired conditions include:

- 1. Functional access and infrastructure for management, occasional public education sessions, and good neighbor-to-neighbor relationships.
- Forest conditions that reduce the County's liability of wildfire or flooding damage to neighboring properties and that minimize maintenance needs to a bare minimum, commensurate with an infrequent maintenance regime for a wilderness preserve with very poor access (e.g. forest treatments once every 5-10 years after an initial restoration treatment phase).



Figure 30. Image of an envisioned reference condition for piñon-juniper persistent woodland.

6. FOREST LANDSCAPE RESORATION TREATMENTS

a. Summary of Objectives

This forest stewardship plan presents a prioritized time schedule for specific forest landscape restoration treatments. The time schedule aims to set in motion and direct a process that introduces change to the forest ecosystem and to transform the current conditions as described in Sections 3 and 4 toward the desired conditions described in Section 5. Ongoing monitoring will need to help specify desired conditions for each forest type.

The purpose of the proposed treatments is to maintain and improve the property's natural system functions while respecting and supporting the other land management objectives, as listed in Section 5a. The main operational goals of forest treatments are to:

- Improve forest resilience
- Reintroduce fire as a key ecosystem disturbance through natural ignitions and prescribed fire
- Minimize the need for and implementation of management interventions and maintenance work

Field assessments have revealed that forest health treatments will be necessary because there are critical values at risk, such as:

- Forest ecosystems, viewsheds, wildlife habitat, and cultural resources (at risk from impacts of potential wildfire)
- LAC Minerals Mine site infrastructure (at risk from potential impact of wildfire, debris flows and flash floods)
- Private homes to the northeast outside the OMP (at risk from wildfire spreading from the Preserve)

Field assessments confirmed that the *wildfire risk is moderate to high,* due to the current forest conditions caused by about 100 years of forest regrowth without any dramatic ecological dynamics or management actions, combined with poor access and anticipated disturbances that are likely to be magnified due to climate change.

Treatments will not include any tree harvesting, because of poor access which renders timber harvesting cost prohibitive. As a result, Santa Fe County will not need to obtain any permits with the State Forestry Division.

Proposed treatments will initially only include tree thinning in ponderosa pine and mixed conifer stands. Monitoring and adaptive management will direct future treatment plans. Treatments in piñon-juniper stands will be contingent upon additional information about potential impacts of treatments on bird species of high conservation concern and other ecological factors. Treatments will likely include lop & scatter of slash and piling and burning of

slash. In the future, prescribed jack-pot and/or broadcast burns could be considered as well to prepare the forest landscape for the reintroduction of low-intensity, natural wildfire.

b. Landscape-wide Management Considerations

Over time, the proposed treatments will benefit from improving collaborative relationships with neighboring landowners and communities to meet the management goals for the property. Forest health concerns extend beyond private property boundaries. Prevention of wildfire hazard and beetle infestations and maintaining landscape connectivity for wildlife migration will require a landscape-wide approach with neighbors and partner organizations. The protection of the OMP against wildfire might greatly benefit from the assurance that forests and woodlands to the west and south of the property are resilient to wildfire. Similarly, the protection of the OMP's forests against beetle kill at a landscape scale would benefit from forest health treatments on neighboring properties aimed at reducing the risk of beetle outbreaks. OS staff might consider working with the neighbors and pursuing forest health and fire risk reduction funds from the National Association of Counties and New Mexico Counties to realize forest health improvements on these surrounding properties.

At a practical level, collaboration with the neighbors to the south, west, and north regarding access to the OMP property would greatly improve opportunities for expanded forest management treatments in forest management units that are now practically inaccessible. Improved access from these directions would also increase any effective emergency wildfire suppression activities and evacuation options for visitors and maintenance workers.

Ongoing negotiations with LAC Minerals focusing on access improvement would enlarge opportunities for more effective and efficient maintenance and forest management work as well as for meeting the educational purpose of the Preserve. Access improvements could include making physical improvements to the roadways as well as pursuing an agreement on the use of alternative roadways into the Preserve.

c. Treatment Plan

The proposed treatment plan for the Ortiz Mountains Preserve is structured in different phases and prioritized treatment areas. Treatments will include forest thinning, combined with lop & scatter of slash, piling and burning of slash, potentially followed by jack-pot burns and managed natural fire. The focus of the treatments will be in the pure ponderosa pine stand type. Smaller scale treatments will take place in the ponderosa pine with piñon-juniper (P-J) understory type and the mixed-conifer forest type.

The desirable tree density in the ponderosa pine stands is initially the upper level of the historical reference conditions suggested by Reynolds et al. (2013). The upper level of reference conditions for fine-scale ponderosa pine elements (<10 acres) would then be stands of up to 72 trees per acre, and for mid-scale elements (10-1,000 acres) would be up to 124 trees per acre.

The mid-scale elements would apply to ponderosa pine stands in FMU D, and the fine-scale elements would apply to all other ponderosa pine stands in the southern part of the property.

Currently, the mean stem density in pure ponderosa pine stands is 257 trees (> 5 inch DBH) per acre, and 53 ponderosa pine trees in stands with a P-J understory. As a result, the thinning targets would lead to a removal of slightly more than 50% of the stems in the ponderosa stands in FMU D, and few to none in the ponderosa pine stands with a P-J understory.

The smaller-scale treatment in ponderosa pine or mixed-conifer stands with a P-J understory are meant to reduce ladder fuels and improve individual tree health. In these cases, thinning will be selective, from below, aimed at removing ladder fuels, dog-hair thickets, and a certain number of diseased trees with the goal to leave the number of mature ponderosa pine and mixed conifer stems largely intact.

Initially, in all forest types, all snags will be left as wildlife trees, except those posing a risk to treatment crews. After analysis of wildlife monitoring data, snag retention policies may be adjusted for future years.

Throughout the forest management plan implementation process, wildlife monitoring and fire modeling will be conducted to inform future treatment. Ongoing thinning activities in successive years and phases will derive adaptive management guidelines from monitoring and modeling results.

All treatment activities will take place outside bird and bat breeding seasons, which typically cover the period between early March and late August. Due to hibernating bat colonies on the OMP, all thinning and prescribed fire treatments need to take place between September 1st and October 31st.

PHASE 1 (years 1-5)

Phase-1 treatments are spread over 3 priority levels associated with different areas, starting in FMU A and in the lower elevation ponderosa pine forests of FMU D. The first treatments in FMU A should be close to the road in order to be accessible as pilot sites. Specific treatment locations will be determined in the field and be informed by the results of a cultural resource survey. Treatments in these FMUs span approximately 150 acres and would help protect the sensitive cultural resource sites on the property and offer experimentation opportunities for team work among the Santa Fe County Wildland Fire team and OS staff. Additionally, treatments in these areas would help open the forest to gain access for treatment in more remote stands. The three priority levels are summarized in Table 5 and Figure 31.

Table 5. Phase-1 Priority Areas for Treatment

Priority	Forest Type and	Management	Timeline	Treatment Type
Level	acreage	Unit		
Priority 1	Ponderosa with P-J	Unit A	Year 1-3	Selective thinning from below,
(red)	understory (Yr-1: 3-5			lop & scatter, pile burning
	ac; Yr-2: approx. 65			
	ac)			
	Lower Ponderosa	Unit D	Year 1-3	Selective patch cut thinning + pile
	forest (Y-1: 10-15 ac;			burning
	Yr-2: approx. 15 ac)			
Priority 2	Mixed-conifer (& P-J)	Unit D	Year 3	Selective thinning from below,
(yellow)	forest (approx. 15 ac)			lop & scatter, pile burning
	Higher Ponderosa	Unit D	Year 3	Selective patch cut thinning + pile
	forest (approx. 15 ac)			burning
Priority 3	Ponderosa with P-J	Unit D	Year 4-5	Selective thinning from below,
(green)	understory (approx.			lop & scatter, pile burning
	15 ac)			
	Mixed-con, Pondero-	Unit G	Year 4-5	Selective thinning from below,
	sa/P-J (approx. 10 ac)			lop & scatter, pile burning

Treatments will be specifically tailored to the diverse forest types in the OMP. Year-1 would have a pilot and demonstration character to calibrate thinning crews, monitor results, and adaptively manage and fine tune the prescriptions for future years. The initial thinning acreages will be determined in coordination with the Wildland Fire Team to optimize the efficiency of their work and effectiveness of results on the ground from the perspective of forest treatment and monitoring. This may mean that in Year-1 only approximately 10-15 acres of the pure ponderosa pine forest type and 5 acres of the ponderosa pine with P-J understory type would be thinned. The thinning in the ponderosa pine with P-J understory type will aim to remove ladder fuels from beneath large ponderosa pine and piñon trees while leaving untreated piñon-juniper clumps in interspaces. Slash will be piled and burned. Based on monitoring results, adaptive instructions may include additional treatments in Year-2.

Only treatment area perimeters will be flagged. Based upon the prescription, detailed site instruction and feedback after the first few days of work, crew members will develop an understanding of implementation details, such as individual tree selection, creation of openings, clump sizes, etc. After the first few days of review and feedback, crew members will be able to work more independently and cover more terrain.

Prescribed burn options of either pile burning or under-burning should be evaluated to follow up on manual treatment to effectively reduce slash and fine fuels. Monitoring and adaptive management would need to continue annually, in a collaborative partnership between OS staff and its forestry consultants, the Wildland Fire team, and Santa Fe Conservation Trust.

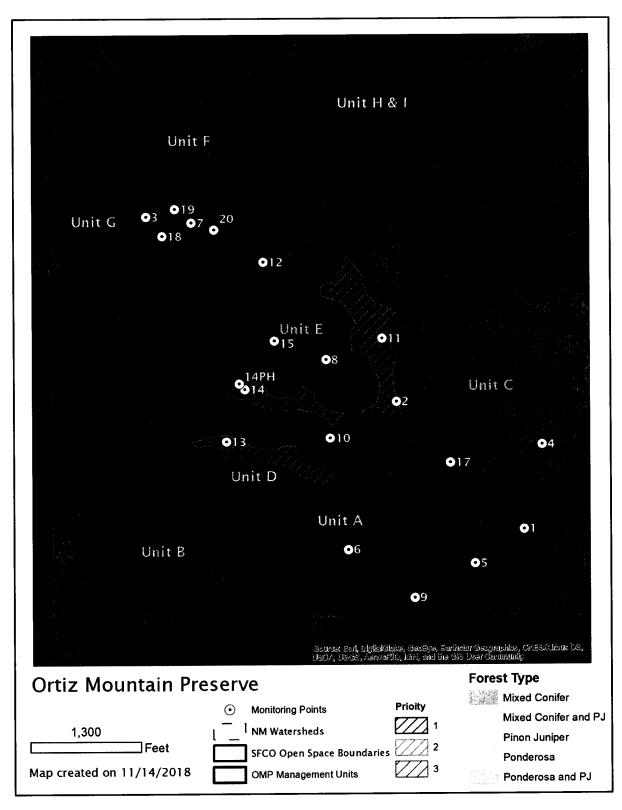


Figure 31. Map of Priority Treatment Areas of Phase 1.

PHASE 2 (years 6-10)

Phase-2 treatments would need to be spread over several priority levels, like in Phase 1. Phase-2 treatments would need to address any untreated areas of the Phase-1 priorities in FMUs A, D, and G, as well as any additional areas beyond these FMUs. Based on wildlife monitoring results, this may include select piñon-juniper stands that exhibit a high risk of wildfire and/or that are seriously diseased. Additional field assessment will need to identify at most 300 additional acres where forest health treatments are desirable and feasible in FMUs B, E, H and I. This would likely require negotiation of alternative access paths with neighbors to the south, west, and north.

PHASE 3 (years 11-20)

Phase-3 treatments would address any follow-up or repeat treatments for locations where treatment was recommended as a result of monitoring and adaptive management decisions based on Phase-1 and -2 results. Additionally, Phase-3 treatments could address areas identified but not treated in areas targeted during Phase-2, and would probably cover no more than 300 acres. The role of prescribed broadcast burns could be considered as one of the treatment tools if hand thinning of certain areas proves impractical. Phase-3 would also be used to revise and update this Forest Management Plan.

d. Treatment Prescriptions

The detailed treatment prescriptions included in this Forest Management Plan are split between:

- A. A Conceptual Prescription for Selective Thinning from Below in Highly Mixed-Species Stands
- B. A Modified Standard Prescription toward Un-Even Aged Ponderosa Pine Stands

Both prescriptions focus on enhancing a mosaic of a diverse-aged and diverse-species stands with increased wildfire resilience, improved tree health, and optimal wildlife habitat in the context of the other objectives. The prescriptions favor the creation of a clumpy-groupy pattern of remaining trees to enlarge spaces between clumps and, in lower elevations (FMU A), to (re)create grassy openings and restore meadow ecosystems. Implementation should take place between September 1st and October 31st with a view to limiting disturbance to roosting bat colonies on the property. The prescriptions will be adjusted, if necessary, based on the outcomes of a cultural resource survey report, due in mid-2019.

A Conceptual Prescription Implementation Guide & Treatment Check List for Selective Thinning from Below in Highly Mixed-Species Stands

empow the gro	rast to a quantitative prescription, this prescription defines desired conditions and ters thinning crews to act as foresters in defining how treatments are implemented on und. This approach will require increased coordination between the thinning crew and ers, but promotes creation of the desired heterogeneous forest conditions on the spe.
	Utilize existing terrain and vegetation features to guide implementation by expanding openings and defining clumps of trees. Use existing healthy clumps, existing openings (esp. when coinciding with existing depressions or drainage swales), and large/old trees (ponderosa and piñon pine in particular) as anchor points to define where thinning should occur (i.e., thinning around healthy clumps and large trees, and thinning out tree encroachment into grassy openings).
Openin	g Guidance
	Create small openings that are more or less parallel to contour lines. Avoid openings that create a long downhill run. "Leave-trees" (trees to be retained) can help serve as barriers to downhill runoff.
	Openings can include sparse individual trees or groups of 2-3 trees of varying size and age classes. Use existing ponderosa and piñon groups as anchor points for openings.
Clumps	s & Groups Guidance
Ġ	Tree group size is variable and will be determined in the field and over time through monitoring.
	Select between piñon pine and juniper based on creating the greatest health in a clump, removing severely diseased trees and disregarding (leaving) trees that are not diseased but only stressed.
	Where ponderosa and piñon groups exist, thin from below to remove small diameter trees below the drip line of leave-trees.
	Within groups of trees, strive for a diversity of age, height, and size classes.
Gener	al Guidance
	Primarily remove small (<5-8" diameter) vegetation.
	Avoid cutting any trees >12" in diameter at breast height and any piñon and juniper trees >10" at root collar.
	Favor ponderosa pine, piñon pine, and Douglas fir over other tree species.
	Improve forest health through removal of stress, damage, and mortality agents such as dwarf mistletoe, piñon mistletoe, bark beetle and ips beetle infected trees, and trees that are highly stressed. However, some diseased and dying trees should be retained for wildlife purposes.
	Do not limb leave-trees.

	Do not remove any oak and other browse species. Stump heights should not exceed 6" Boles of felled trees should be bucked to lengths to maximize contact with the ground.
Snags □	Retain all dead standing trees (snags), except hazard trees, until instructed otherwise. When instructed to fell snags, fell snags <5" DBH/DRC and <15' in height, and snags that pose a hazard to workers. Fell trees parallel to contours to help minimize erosion.
Slash I	Handling: Lop and Scatter
	Follow site-specific instructions for slash handling, as provided by OS staff and/or consultants. In principle lop & scatter all slash only in P-J areas for soil conservation purposes, unless indicated otherwise by Open Space staff. Slash height should not exceed 24" Limbs and tops should be separated from the bole
	To the greatest extent possible, spread slash evenly across exposed soil. For example, when moving between cut trees, drag slash with you. Slash will not be placed under the dripline of leave-trees.
	dandling: Piling
	Piles should include cut material 5" and smaller, larger material should be left Pile slash in openings where flames will not damage leave trees; piles should not exceed 5 feet in height
	Avoid piling slash on or within 3' of existing large diameter dead and down logs and standing snags greater than 12" in diameter.
Soil an	d Water Conservation
	Skid tracks and trails will be closed with rock water bars of approx. 3' wide and 18" high, adjusted to terrain conditions
	On slopes of 8% and greater, slash and logs will be placed on contour lines to reduce runoff concentrations and soil loss

A Modi	fied Standard Prescription Implementation Guide & Treatment Check List toward Un-
Even Ag	ged Ponderosa Pine Stands
	Utilize existing terrain and vegetation features to guide implementation by expanding openings and defining clumps of trees. Use existing healthy clumps, existing openings (esp. when coinciding with existing depressions or drainage swales), and large/old trees (ponderosa and Douglas fir in particular) as anchor points from where thinning could start (i.e., thinning around healthy clumps and large trees, and thinning out of encroachment into openings). In phase-1 (years 1-5), thinning intensity should aim at leaving an average of around 124 stems (>5 inches DBH) per acres.
Openin	g Guidance
	Create openings that are more or less parallel to contour lines. Avoid openings that create long downhill runs. Leave trees can help serve as barriers for downhill runoff.
	Openings should be 0.25-1.25 of an acre in size with a shape defined by topography and aspect (greater openings on south and west facing slopes, on gentle slopes, and in natural depressions; smaller openings on north and east facing slopes, steeper slopes
	and on ridges). Consider what openings would do to wind throw risks of any leave trees. Openings can include sparse individual trees or groups of 2-3 trees of varying size and age classes.
Clump	& Group Guidance
	Tree group size is variable and will be determined in the field and over time through monitoring.
<u> </u>	Within groups of trees, strive for a diversity of age, height, and size classes. Use existing ponderosa, Douglas fir, and piñon groups as anchor points for openings. Where ponderosa, Douglas fir, and piñon groups exist, thin from below to create more space around leave trees.
	al Guidance
	Identify large, older trees and remove ladder fuels from under the drip line. Primarily remove small (<5.0-8.9" diameter) vegetation, while leaving a certain portion (approx. 25%) of these small diameter trees and shrubs.
	Improve forest health through removal of stress, damage, and mortality agents such as dwarf mistletoe.
	Favor ponderosa pine and also keep Douglas fir and piñon pine, if present, and avoid cutting ponderosa pine trees >12" in diameter at breast height.
_ _	Do not limb leave trees. Do not remove any oak and other browse species. Maintain relatively dense ridgelines and transitions to piñon-juniper stands to prevent impacts from wind throw. Do not create pathways along ecotones (transition zones between forest types).
Snags	Retain all dead standing trees (snags), except hazard trees, until instructed otherwise.

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3" high to reduce
3

e. Prescribed Fire Recommendations

One of the goals of this Forest Management Plan is to prepare the forest for natural fire regimes. Forest treatment, therefore, aims to make the forest more resilient to wildfire, so that any wildfire or prescribed fire on the OMP would not lead to high severity burn impacts or spread onto neighboring properties.

It is recommended that in Phase-1 (years 1-5), the project team develop a burn plan and evaluate to what extent treatment results allow for implementing prescribed fire towards the end of this phase. Thinning treatments in Phase-1 will need to be designed in such a way that they meet all desired conditions and work towards building control features that allow prescribed burning. Prescribed burns will need to be implemented timely to follow up on intensive manual treatments before new fuels are recruited.

The timeline for introducing prescribed fire will need to be addressed with some flexibility in the planning process and reviewed throughout project implementation. The timeline and implementation aspects for prescribed fire depend on a variety of factors, such as treatment results in phase-1, the realization of control features, conclusions from field monitoring, weather conditions, and Santa Fe County capacity.

The US Forest Service has developed detailed guidance procedures for prescribed fire and managed wildfires in designated Wilderness areas. It could be argued that the OMP resembles in many ways the definition and purpose of federal Wilderness areas. As a result, the fire management guidelines in

Wilderness areas of the Forest Service may serve as useful guidance for a burn plan and managing wildfires and prescribed fire as management tools on the OMP. A summary of Forest Service fire management procedures in Wilderness areas is included in Appendix F.

Pile Burning

Pile burning will be critical throughout Phase-1 and future phases for reducing overall fuels and thus reducing the fire risk in thinned areas. Evaluation of pile burning experiences will help prepare for other forms of prescribed burns in the future.

Broadcast Burning

The opportunities for broadcast burning in the OMP will need to be evaluated throughout the implementation phase of the project. It is unlikely that opportunities will be favorable during Phase-1. In the course of phase-1, a burn plan will be made in order to be prepared for the implementation of prescribed fire when opportunities become favorable in future phases. Critical limitations to be addressed in the burn plan may include a lack of control features, continuous fuels that run up steep valleys, limited access for resources (most burns cannot be supported by any vehicles), remoteness which limits contingency plans and resources, and adjacent fuels (piñon-juniper) that will not be treated and are not ideal for broadcast burning but are still flammable. If a broadcast burn is decided to be feasible, timing will depend on completion of thinning treatments within and adjacent to proposed burn units, completion of control features, and a prescribed burn plan.

A first suitable area to consider for broadcast burning is the valley and north-facing slopes south and west of monitoring plot 10 and going west to plot 13. This area has a mix of ponderosa pine and mixed-conifer understory and is approximately 35 acres in size with a northern aspect. Broadcast burning here requires that thinning has been completed in Phase-1. Timing for this work could coincide with other crew work on the other forest restoration activities (Figure 32 and see sidebar for detailed recommendations).

Controlled Broadcast Burn Details

Control features for the burn include a road on the east, a trail along the valley bottom to the north, a trail and ridge on the west side and a long ridge along the south side. The control lines along the north and east will need little work beyond a hand line. A control line along the southern ridge with at least a 10' cut swath and a dug handline would be ideal to work off of. This line should ideally be placed away from the crest line, approx. 50 ft downslope in the lee of the ridge on the north-facing slope, and before the slope drops off too steeply, to prevent any future wind impacts on trees and soils along the ridgeline. This line placement is preferred because although the transition in forest type and corresponding decrease in fuel load from ponderosa to piñon juniper might be enough to stop fire spread, mid-slope lines are dangerous and hard to hold during burning. The road access on the east side of the unit will allow an engine to supply water through a hose lay along any or all of the control lines around the unit.

The area of highest concern for this broadcast burn would be in the north east corner where the line cuts across the slope for about 500 ft. below a steep drainage. There is a break in slope in this area, and by carefully locating the line and prepping and burning the area with a careful lighting technique these concerns can be mitigated. A second area of concern will be the two saddles along the ridge to the south. However, through proper lighting these areas can be managed as well.

f. Noxious Weed Control

The OMP is unusually blessed with a (near) absence of noxious weeds. In order to maintain this status, it is important to ensure that forest restoration treatments would not bring in any noxious weeds carried by vehicles and workers' boots and clothing. Therefore, it will be a critical Best Management Practice for all vehicles and forest workers to ensure that their equipment and clothing is seed and mud free from outside sources before entering the OMP.

If noxious weeds are found in the first year of work, it is essential that the plants and their roots be removed by hand, ideally before seeds or pollen have developed. Thinning and burning prescriptions may have to be adjusted to accommodate for the avoidance or eradication of the noxious weeds in the treatment areas depending on how the weeds propagate (e.g., in openings, or in burn areas, etc.).

g. Cultural Resource Management and Protection

All cultural resource areas will either be included in stands that will not be treated or excluded from treatment by applying standardized flagging tape around each cultural resource area, including a 50-feet buffer area.

h. A Conceptual Monitoring and Adaptive Management Plan

Monitoring will need to include different levels of data gathering targeted to different learning goals. The different monitoring levels include:

- 1. Implementation or Process Monitoring
- 2. Outcome or Impact Monitoring
- 3. Base-line Monitoring (Field Assessment) of Additional FMUs

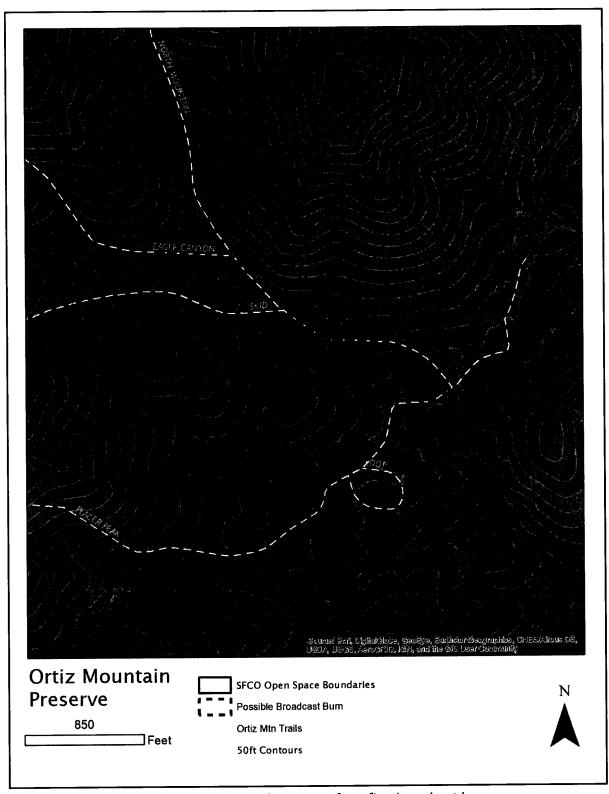


Figure 32. Suggested area of approximately 30 acres for a first broadcast burn.

Implementation (Process) Monitoring

The purpose of this kind of monitoring is to check whether planned activities, such as road improvements, erosion control, cultural resource protection measures, forest restoration treatments, work safety precautions, and Best Management Practices have been implemented correctly and completed. This kind of monitoring is done during and immediately after implementation work in the form of field inspections. The treatment prescription can be used as a check list to mark accomplishments. Additionally, photography (e.g., permanent photo points) should support the field observations to document findings. Locations of specific findings of concern should be marked with a GPS device or GPS app on a smartphone or tablet. Concerns will need to be discussed with the appropriate implementation team members in order to decide on the need, feasibility and timeline to make corrections and mitigate negative impacts.

Outcome (Impact) Monitoring

The purpose of this kind of monitoring is to verify whether the management goals and objectives for the property have been achieved. This kind of monitoring is done at intervals appropriate for observing change in the indicators associated with the management goals and objectives.

The management goals for the OMP as stated in Sections 2 and 5 lead to the need to monitor indicators of forest resilience, forest adaptation to wildfire, and reductions of management interventions and maintenance costs over time. Besides these main outcome monitoring indicators, additional indicators would be required to check other goals for the property at large, such as educational opportunities, community stewardship and public involvement, cultural resource protection, access characteristics, wildlife habitat and pathways, and open space conservation. Monitoring findings can then be compared with the desired conditions for different forest types described in section 5c, and with the desired stand conditions for wildlife conservation described in Appendix B. Evaluation of the comparison will reveal to what extent the outcomes of the treatment and natural forest regeneration have evolved toward the desired conditions.

Table 6 includes an overview of management goals, suggested indicators, measuring methods, and a time schedule. Monitoring should ideally be done with a team of people who are independent of the implementation team, and who are trained or experienced with this kind of data collection. The monitoring team could for example include OS staff, SFCT staff, County maintenance crew members, students, and consultants.

Table 6. Conceptual Outcome/Impact Monitoring Plan

Monitoring Goals	Indicators	Measuring Methods	Time Schedule
Improved forest	Forest heterogeneity:	Plot sampling with	Immediately after
resilience	spatial structure, age	(a) CFRP data	thinning work and
	classes, native plant and	sheets; and/or (b)	again after burns;
	animal species richness,	Forest Bullseye	after that every 5
	and herbaceous cover	forms; and (c) photo	years
		points at each plot	
	Healthy riparian areas:	Plot sampling with	Immediately after
	resiliency in channel	(a) CFRP forest data	thinning work and
	grade; high native plant	sheets; and/or (b)	again after burns;
	species richness; dense	Forest Bullseye	after that every 5
	cover; and periodically	forms; and (c) photo	years
	flowing and standing	points at each plot	
	water		
	Optimal wildlife and	Specific wildlife	One year prior to
	habitat conditions and	monitoring	thinning, and long-
	habitat connectivity:	protocols as	term yearly
	habitat characteristics	recommended and	monitoring after
	and effective pathways	used by OS staff	thinning (monitoring
	to surrounding habitat		will take place in late
	areas		spring/early summer)
Adaptation to	Forest structure, fuel	Plot sampling with	Immediately after
wildfire	loadings, and individual	CFRP data sheets	thinning work and
	tree vigor	and Brown's lines,	again after burns;
		and fire modeling	after that every 5
			years
		Fire Effects	During and after
		monitoring during	prescribed fire
		and after prescribed	treatments
		fire	
Reduced	Frequency and costs of	Tracking of time and	After each treatment
management	forest treatments and	costs associated	or maintenance
interventions and	maintenance work	with staff / crew	activity and reviewed
maintenance		work	over 5-10 years
Open space	Meeting goals of the CE	Field visits to select	Annually by SFCT
conservation		locations and aerial	
		surveys	
Cultural resource	Cultural resource areas	Visual observations	Immediately after
protection	integrity	during field visits	forest treatments;
			after that, every two
	i e	i	years

Monitoring Goals	Indicators	Measuring Methods	Time Schedule
Educational	Intact infrastructure	Visual observations	Annually
opportunities	and sites for education	during field visits	
Community	Public interest to visit	Tally of visitors and	Annually
stewardship and	the OMP and become	public participants	
public involvement	involved in some way	(via sign-up sheets)	
Adequate access	Access control and	Visual observations	Annually
	efficacy	during field visits	

Base-line Monitoring (Field Assessment) of Additional FMUs

The purpose of base-line monitoring is to conduct field assessments to prepare new areas for treatment in Phase 2 and thereafter. This kind of monitoring is done only once at the beginning of a new management phase or cycle. In the context of this Forest Management Plan, it would be appropriate to schedule this monitoring work in Year-5, just prior to Phase 2, or Year-6, the first year of Phase 2.

Adaptive Management Options

The response to lessons learned from monitoring is called "adaptive management." Evaluation of monitoring findings in comparison with goal statements and descriptions of desired conditions will lead to conclusions regarding the level of achievement of desired forest conditions and other management outcomes for the OMP. If certain conclusions point toward unsatisfactory achievement, it will be necessary to modify certain aspects of the plan. This might mean that goals need to be revisited, or indicators need to be reformulated, or treatments need to be adjusted. In some cases, impacts or damage will need to be mitigated.

During Phase-1 (years 1-5), adaptive management will involve that all thinning treatments will follow conservative targets. Treatments will be monitored, and monitoring results will inform any subsequent thinning treatments, where necessary.

Annual monitoring is critical to ascertain several practical steps, such as:

- What worked well and what would need improvement or change, and how does that affect any of the project team partners?
- Were planned activities completed; and if not, what is left to do?
- What would need to change in the prescriptions or implementation tactics (e.g., timing, duration, scope and scale) in order to be more efficient and effective?
- What are the side effects of the treatments and are there any needs for mitigation or restoration, or are there any recommendations for the crews to improve results?
- What desired conditions are being achieved; and if certain conditions are not achieved within a reasonable time frame, what kind of adjustments are needed?
- Is prescribed fire becoming feasible and what kind, type and scale of fire could be considered?

Responses to these questions will likely lead to adaptations in management of the OMP. Over time, perhaps after ten years, the adaptations and changes in management will need to be compiled in an updated Forest Management Plan.

APPENDIX A. CUSTOM SOIL SURVEY REPORT

APPENDIX B. LIST OF DOCUMENTED WILDLIFE SPECIES AND THEIR CONSERVATION STATUS

Ash-throated Flycatcher	Lesser Goldfinch
Bewick's Wren	Mountain Chickedge
Black-chinned Sparrow	(Crive-side): Sycarcher
Black-headed Grosbeak	Peregrine Falcon
Black-throated Gray Warbler	Pine Siskin
Blue-gray Gnatcatcher	Pinyon Jay
Broad tailed Hummingbird	Plumbeous Vireo
Brown Creeper	Fygmy Nuthamb
Big Bit it	Red-breasted Nuthatch
Canyon Wren	Red-tailed Hawk
Chipping Sparrow	Rock Wien
Common Poorwill	Ruby-crowned Kinglet
Common Raven	Rufous Hummingbird
Cordilleran Flycatcher	Say's Phoebe
Dark-eyed Junco	Spotted Towhee
Dusky Flycatcher	Statier's toy
Golden Eagle	Townsend's Warbler
Grace's Warbler	Turkey Vulture
Gray Flycatcher	Violet-green assolitosa
Hairy Woodpecker	Virginia's Warbler
Hepatic Tanager	Western Tanager
Hermit Thrush	Western Wood-Pewee
uniper Titmouse	White-breasted Nuthatch
adder-backed Woodpecker	White-winged Dove
	Woodhouse's Scrub-Jay
Proceeded No construction of the Assessment and Assessment and Assessment of the control of the first of the control of the co	Yellow-rumped Warbler
	Mary Tales and Market
Black Witch (moth)	Abert's Squirrel
Blue Species (butterfly)	Black Bear
Canyonland Satyr (butterfly)	Canid Species
Comma Species (butterfly)	Mountain Lion
wo-tailed Swallowtail (butterfly)	Mule Deer
Sulpher Species (butterfly)	Rabbit Species
Neidemeyer's Admiral (butterfly)	Townsend's Big-eared Bat
configuration and a second	
Plateau Striped Whiptail	The state of the s
Plateau Fence Lizard	tion with the second of the se
Greater Short-Horned Lizard	
Red=Species of High Conservation Con	entropy and the second

Page **70** of **81**

APPENDIX C. OVERVIEW OF THE SAMPLING POINTS AND THEIR SPECIFIC DATA

APPENDIX D. DESCRIPTION OF FIELD ASSESSMENT PROTOCOL

Is the forest diverse, productive or healthy? What could be the causes of the observed problems? What are the potential solutions? Are there any safety hazards? What work may be needed? What problems do we see? Other concerns? Amount of litter, duff, dead and decadent herbaceous material and fine fuels 5 Litter and fuels distribution Amount of medium to coarse fuel (dead & down) 6 Presence of soil life and soil moisture 8 Tree species richness and function Understory cover % Presence of top soil (lack of erosion) 7 % Desirable plants Current forest conditions: Current plants / trees: What do we see now? Current animals: **Forest Health Targets** Observers: Age diversity of desired tree species Date: Presence of living organisms Tree health and vigor 10 Accessibility 15 Ladder fuels and crown height 11 What do we want to see here? Understory vigor and function 14 Tree (stem) density 12 Tree canopy cover 13 Desired forest conditions: Site Name/Description: Desired plants / trees: Desired animals: Property:

Page **73** of **81**

Forest & Woodland Scoring Guide – Bullseye Method

		0.14	0.1	
		Gold Achieving Goal	Silver Moving To/Away from Goal	Bronze Not Achieving Goal
1	Understory cover %	Amount of understory cover nearly to totally matches that expected / desired for site.	Amount of understory cover is lower than expected / desired for site. Bare areas present.	Amount of understory cover is much lower than expected / desired for site. Many and large connected bare areas.
2	Presence of top soil (lack of erosion)	Little to no evidence of erosion, including desert pavement, pedestalling, rills and gullies.	Some signs of soil loss, including formation of desert pavement, pedestalling, rills and gullies	Soil is actively leaving the site. Advanced formation of desert pavement, pedestals, rills and/or gullies.
3	Amount of litter, duff, dead and decadent herbaceous material and fine fuels	The amount of litter, duff, dead and decadent herbaceous material and fine fuels nearly to totally matches that expected / desired for site.	The amount of litter, duff, dead and decadent herbaceous material and fine fuels exceeds (or is less than) that expected / desired for site.	The amount of litter, duff, dead and decadent herbaceous material and fine fuels greatly exceeds (or is less than) that expected / desired for site.
4	Amount of medium to coarse fuel (dead and down)	The amount of medium to coarse fuels (dead and down) nearly to totally matches that expected / desired for site.	The amount of medium to coarse fuels (dead and down) exceeds (or is less than) that expected / desired for site.	The amount of medium to coarse fuels (dead and down) greatly exceeds (or is less than) that expected / desired for site.
5	Litter and fuels distribution	Litter and fuels are uniformly distributed across the site.	Less uniformity of litter and fuels distribution. Litter and fuels are scattered or occasionally piled.	Litter and fuels distribution not uniform. Litter and fuels are patchy, piled, or beneath canopies.
6	Presence of soil life and soil moisture	Abundant signs of soil life and soil moisture.	Few to moderate signs of soil live and soil moisture.	Next to no signs of soil life and soil moisture. The ecosystem is desertified.
7	% Desirable plants	Greater than 66% of plants on site are desired. Remainder of plants are intermediate species.	33% to 66% of plant species on site are desired. Intermediary species have strong presence. Potential presence of undesired species.	Less than 33% of plant species on site are desired. Intermediary plan species dominate. Undesired species are also present.
8	Tree species richness and function	Number of tree species on site matches that expected for site. Forest structure and composition also matches that for site, plants serving diverse functions.	Number of tree species in the area below that expected for site. Forest structure and composition incomplete, plants serving limited functions.	Number of tree species minimal. Forest structure and composition monotone, with poor plant functionality.
9	Age diversity of desired tree species	The age diversity of desired trees nearly to totally matches that expected / desired for site.	The age diversity is limited and less than expected / desired for site. There are few old trees and/or limited regeneration.	The age class diversity is very limited; mostly single-aged trees.
10	Tree health and vigor	More than 75% of the trees on site are vigorous and in good health.	50% to 75% of trees on site are vigorous and in good health. The remainder shows signs of stress and / or disease.	Fewer than 50% of trees on site are vigorous and in good health. The majority of trees shows signs of stress and / or disease.

11	Ladder fuels and crown height	Fewer than 33% of trees and clumps have minimal ladder fuel conditions and crown height is generally above 6 feet.	33%-66% of trees and clumps have ladder fuel conditions and crown heights between 3 feet and 6 feet.	More than 66% of trees and clumps have ladder fuel conditions and crown heights lower than 3 feet.
12	Tree stem density	Stem density on site matches that expected / desired for site.	Stem density on site exceeds (or is below) that expected / desired for site.	Stem density on site greatly exceeds (or is greatly below) that expected / desired for site.
13	Tree canopy cover	Tree canopy cover on site matches that expected / desired for site.	Tree canopy cover exceeds (or is below) that expected / desired for site.	Tree canopy cover on site greatly exceeds (or is greatly below) that expected / desired for site.
14	Understory vigor and function	More than 75% of the understory on site is vigorous. Plants serving diverse functions.	50% to 75% of the understory on site is vigorous. Reduced plant functionality.	Less than 50% of the understory on site is vigorous. The majority of understory plants show signs of stress and poor functionality.
15	User and Emergency Access	The forest area is accessible by roads and includes some interior roads. Stands are accessible on foot.	The forest area is poorly accessible by road, includes few interior roads, and stands are poorly accessible on foot.	The forest area is very isolated, its interior is roadless, and access on foot is very strenuous.
16	Presence of living organisms	There are abundant signs of non-plant life and wildlife.	There are few to moderate signs of non-plant life and wildlife. Something is missing.	There are next to no signs of non-plant life and wildlife. The ecology is impoverished.

APPENDIX E. LOCALLY IDENTIFIED REFERENCE CONDITIONS

APPENDIX F. A SUMMARY OF US FOREST SERVICE GUIDELINES FOR FIRE MANAGEMENT IN WILDERNESS AREAS

The US Forest Service interprets the Wilderness Act as allowing lightning ignited fires to occur where they have historically been part of the natural fire regime in order to fulfil their natural ecological role within a wilderness (wilderness.net, FSM 2324.21). However, despite this understanding, fire suppression activities have continued to occur in wilderness areas because of the caveat that these fires may only be allowed to burn if the Forests have fire plans in place outlining specific objectives and criteria allowing fires to burn (Yung 2019)¹. As of 1998, such fire plans allowing natural ignitions to burn under the correct environmental conditions only existed in 15% of wilderness areas outside of Alaska, where natural fire use is more commonly used (Parsons, 2000)². Additionally, wilderness managers are required to consider non-wilderness values such as ignition source, threat to life or property, proximity to boundary, drought indexes, air quality and institutional capacity to deal with intense fires when deciding whether to suppress or let it burn (Yung 2019). The result has been decades of fire suppression, leading to overstocked fuel loads posing a greater risk for high intensity fires.

Fire is only mentioned within the Wilderness Act itself once, under Species Provisions (Sec. 4(d)(1)). Here it is stated that, "The use of aircraft or motorboats ...may be taken as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable." The fire policy has been further elucidated by House Report 95-540, which accompanied the bill which became P.L. 95-237, reading in part," This includes the use of mechanized equipment, the building of fire roads, fire towers, fire breaks or fire pre-suppression facilities **where necessary**, and other techniques for fire control. In short, anything necessary for the protection of the public health or safety is *clearly permissible*. Specific guidelines for fire management are issued by the administrating agency.

The Forest Service defines the objectives of fire management within wilderness areas as twofold: 1) Permit lightning caused fires to play, as nearly as possible, their natural ecological role within wilderness, and 2) Reduce to an acceptable level, the risk and consequence of wildfire within wilderness or escaping from wilderness (FSM 2324.21). This permits manager-ignited prescribed fires within wilderness areas to reduce fuel loads if they are expressly approved within a Fire Management Plan (FMP) and approved by the Forest Supervisor. The Forest Service allows prescribed burns in areas with "unnatural" fuel build up and gives the following criteria that must be met:

¹ Laurie Yung. Prescribed Fires in Wilderness - case study. Accessed March 15, 2019. DOI: https://www.wilderness.net/toolboxes/documents/fire/Prescribed%20Fires%20in%20Wilderness%20-%20case%20study.pdf

² Parsons, D. J. 2000. The Challenge of Restoring Fire to Wilderness. In: Cole, D. N., McCool, S. F., Borrie, W. T., & O'Laughlin, J., comps. Wilderness Science in a Time of Change Conference, Vol. 5: Wilderness Ecosystems, Threats, and Management; May 23-27, 1999; Missoula, MT. RMRS-P-15-Vol-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station Proceedings, pp. 276–82. Retrieved on October 29, 2009.

- 1. The use of prescribed fire or other fuel treatment measures outside of wilderness is not sufficient to achieve fire management objectives within wilderness.
- 2. An interdisciplinary team of resource specialists has evaluated and recommended the proposed use of prescribed fire.
- 3. The interested public has been involved appropriately in the decision.
- 4. Lightning-caused fires cannot be allowed to burn because they will pose serious threats to life and/or property within wilderness or to life, property, or natural resources outside of wilderness.

Additionally, FSM 2320 also insists that prescribed burns can only take place to meet management objectives, as defined in an FMP, rather than occurring for benefits to wildlife, vegetation types, forage production or other resource values- although these may be a by-product of the burn. Fire management activities are to be done in a matter compatible with preserving the wilderness character and give preference to methods and equipment that cause the least: alteration of the wilderness landscape, disturbance of the land surface and visitor solitude, reduction of visibility during visitor use, and adverse effect on air quality related values. FSM 2320 also outlines that the otherwise prohibited use of motorized equipment and mechanical transport may be approved by the Forest Supervisor in emergencies where the situation involves an inescapable urgency and temporary need for speed beyond that available by primitive means, including the category of fire suppression. This use may only be permitted when a problem threatening wilderness objectives cannot be resolved within reason through the use of non-motorized methods because of factors such as time or seasonal limitations, safety, or other material restrictions. Each wilderness should describe the circumstances under which use of motorized equipment, mechanical transport, or aircraft may be necessary in the protection of the wilderness in their respective Forest Plan. Additionally, the approving officer must describe what uses of the equipment are suitable and will have minimum lasting impacts of the wilderness resource.

In addition to the directives offered in FSM 2320, the Forest Service also has a *Wilderness Fire Management Planning Guide*, and *a Wilderness Fire Management Planning Checklist* to aid managers in creating an FMP for areas under their jurisdiction, available in the Fire Management Toolbox of wilderness.net. The planning checklist may be used by wilderness and fire managers when carrying out fire management planning and provides them with a detailed checklist of considerations covering land management, fire management, and suggested resources and training. The *Wilderness Fire Management Planning Guide* is a much more comprehensive document which goes into depth in both the fire management policy and the planning concepts and elements that must be addressed when creating an FMP. The planning guide specifies that FMPs involving federal lands must undergo the NEPA process and briefly describes this process for FMPs.

LITERATURE REFERENCES

Baker, William L., and Douglas J. Shinneman. 2004. Fire and restoration of piñon—juniper woodlands in the western United States: a review. Forest Ecology and Management, 189(1–3):1-21. https://doi.org/10.1016/j.foreco.2003.09.006

Baxter, William. 2004. The Gold of the Ortiz Mountains. A Story of New Mexico and the West's First Major Gold Rush. Lone Butte Press. Santa Fe, New Mexico.

Conver, Joshua L., D.A. Falk, S.R. Yool, and R.R. Parmenter. 2018. Modeling fire pathways in montane grassland–forest ecotones. Fire Ecology 14(1): 17–32. doi: 10.4996/fireecology. 140117031

Coop, Jonathan D., and Patrick A. Magee. 2016. Integrating Fuels Treatments and Ecological Values in Piñon-Juniper Woodlands: Fuels, Vegetation, and Avifauna: Final Report. Joint Fire Science Program. DOI: <a href="https://www.firescience.gov/projects/13-1-04-45/project/13-1-04-

Dixon, Timothy H. 2017. Curbing Catastrophe. Natural Hazards and Risk Reduction in the Modern World. Cambridge University Press.

Ecotone. 2018. Forest Health Thinning Prescriptions and Monitoring Plan for Santa Fe County Open Space Properties. Final Report, January 2018. Ecotone Landscape Planning, LLC.

Faira, Jeanne M., Charles D. Hathcock, and Andrew W. Bartlow. 2018. Avian communities are decreasing with piñon pine mortality in the Southwest. Biological Conservation 226 (2018) 186–195. Elsevier.

Floyd, M. Lisa, and William H. Romme. 2012. Ecological Restoration Priorities and Opportunities in Piñon-Juniper Woodlands. Ecological Restoration 30:1, March 2012, p37-49.

Griffith, G.E., J.M. Omernik, M.M. McGraw, G.Z. Jacobi, C.M. Canavan, T.S. Schrader, D. Mercer, R. Hill, and B.C. Moran. 2006. Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Lawrence, Hollis P., Darryl Del Frate, David H. Reynolds, and Elyse M. Sewell. 2010. Cultural Resource Protection at Lone Mountain Ranch, Santa Fe County, New Mexico. Discussion and Recommendations. Cienega Environmental.

Lawrence, Hollis P. 2012. Lone Mountain Ranch Historic Landscape District. National Register of Historic Places Registration Form. Ms. on files at Historic Preservation Division, Department of Cultural Affairs, Santa Fe, New Mexico.

Mariah Associates, Inc. 1991. Environmental Assessment. Ortiz Project Joint Venture.

Mariah Associates, Inc. 1991. Environmental Impact Statement. Ortiz Project Joint Venture.

Maynard. Stephen R. 2013. Educational Guide to the Ortiz Mountains Preserve. August 2013

Maynard. Stephen R. 2014 (revised version). Educational Guide to the Ortiz Mountains Preserve. May 2014.

McCarthy, Patrick D., 2012. Climate change adaptation for people and nature: A case study from the U.S. Southwest. Adv. Clim. Change Res., 3(1), doi: 10.3724/SP.J.1248.2012.00022.

Menke, Kurt. 2008. Locating Potential Cougar (*Puma concolor*) Corridors in New Mexico Using a Least-Cost Path Corridor GIS Analysis. Share With Wildlife Final Project Report, Bird's Eye View, Albuquerque, New Mexico, 40 pp.

Moote, Ann, Melissa Savage, Jesse Abrams, Tori Derr, Eytan Krasilovsky, and Martha Schumann. 2009. Multi-party Monitoring and Assessment of Collaborative Forest Restoration Projects, Short Guide for Grant Recipients. Northern Arizona University, US Forest Service, January 2009.

NMFWRI. 2007. DRAFT Piñon-Juniper Framework – New Mexico Forest Restoration Principles. New Mexico Forest and Watershed Research Institute. May 3, 2007.

 $\frac{https://nmfwri.org/restoration-information/for-land-managers/for-land-managers-resources/piñon-juniper-framework-new-mexico-forest-restoration-principles/view$

NMFWRI. 2019. Key for the Five Piñon-Juniper Types. New Mexico Forest and Watershed Research Institute. February 4, 2019. https://nmfwri.org/restoration-information/for-land-managers-resources/001009-hybridpif1on-722200834646.pdf/view

Raffa, Kenneth F., Brian H. Aukema, Barbara J. Bentz, Allan L. Carroll, Jeffrey A. Hicke, Monica G. Turner and William H. Romme. 2008. Cross-scale Drivers of Natural Disturbances prone to anthropogenic amplification: the dynamics of bark beetle eruptions. *BioScience* Vol. 58, No. 6 (June 2008), pp. 501-517. Oxford University Press on behalf of the American Institute of Biological Sciences. DOI: 10.1641/b580607. https://www.jstor.org/stable/10.1641/b580607

Reynolds, T. Richard, Andrew J. Sanchez Meadow, James A Youtz, Tessa Nicolet, Megan S. Matonis, Patrick L. Jackson, Donald G. DeLorenzo, and Andrew D. Graves. 2013. Restoring Composition and Structure in Southwestern Frequent-Fire Forests: A science-based framework for improving ecosystem resiliency. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-310, September 2013.

Robles, M.D. and C. Enquist. 2010. Managing changing landscapes in the Southwestern United States. The Nature Conservancy. Tucson, Arizona. 26 pp.

Santa Fe County. 2017. Ortiz Mountains Open Space Management Plan – Final Draft. July 2017. Santa Fe County Open Space and Trails Program and Surroundings Studio.

Scott, Joe H., Matthew P. Thompson, and David E. Calkin. 2013. A Wildfire Risk Assessment Framework for Land and Resource Management. USDA Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-315, October 2013.

Stewart, Tamara J. 2012. Cultural Landscape of the Greater Galisteo Basin, North-Central New Mexico, Multiple Property Documentation Form. Ms. on files at Historic Preservation Division, Department of Cultural Affairs, Santa Fe, New Mexico.

USDA. 2018. Custom Soil Resource Report, Santa Fe County Area, New Mexico, Ortiz Mountain Preserve. USDA Natural Resource Conservation Service. August 14, 2018.

Wan, Ho Yi, S.A. Cushman, and E. Landguth. 2018. Final Report New Mexico Wildlife Habitat Linkage Assessment. July 2018.

https://www.researchgate.net/publication/326468937 Final Report New Mexico Wildlife Habitat Linkage Assessment

Williams, A. Park, Craig D. Allen, Constance I. Millar, Thomas W. Swetnam, Joel Michaelsen, Christopher J. Still, and Steven W. Leavitt. 2010. Forest responses to increasing aridity and warmth in the southwestern United States. Proceedings of the National Academy of Sciences, PNAS December 14, 2010 107 (50) 21289-21294; https://doi.org/10.1073/pnas.0914211107

Web-based references:

CMIP5: 21st Century Temperature and Precipitation Scenarios. Scientific Visualization Studio. https://svs.gsfc.nasa.gov/4110

LANDFIRE model (https://www.landfire.gov/)

MACA's [Multivariate Adaptive Constructive Analogs] Climate Mapping tool – Summary Projections: http://www.climatologylab.org/maca.html

NCA 2014. https://nca2014.globalchange.gov/highlights/regions/southwest

Wildfire Risk Assessment Glossary: