

Grassland Resilience Workshop Series  
Brush Management and Soil Health  
Altar Valley

November 3, 2023

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**CART Brush Management and Soil Health Workshop Series**  
**Altar Valley Field Trip**

Friday, November 3, 2023 \* 9AM - 4PM

**Directions:**

**Location for arrival:**



**Map with all Field Trip Locations:**



**Field Trip Objectives**

- Observe the methods, goals, and results of a variety of brush management projects, including herbicide, mechanical, and fire
- Observe soil characteristics at each site and discuss their potential effects on treatment response
- Identify recommended monitoring techniques for brush treatment projects that incorporate soil health components
- Synthesize information about different types of treatments and consider the Altar Valley Brush Management Toolkit Matrix

**Agenda**

9:00AM	<p><b>Meet at the Elkhorn Ranch</b></p> <p><i>Directions:</i>  Travel west on 86/Ajo Way to Three Points. Turn left (south) onto Highway 286/Sasabe Road. Drive about 20 miles through the Border Patrol checkpoint. Immediately afterward, you will see the Elkhorn Ranch sign ahead to the right. Turn right at the sign and continue for about 10 minutes down Elkhorn Ranch road over two cattle guards. You will see cars parked on your left near an intersection.</p>
9:15	<p><b>Workshop overview</b></p> <p><b>Recap of Workshop #1</b> - Ariel Léger</p> <p>Goals:</p> <ul style="list-style-type: none"> <li>● Tie workshops together</li> <li>● What are people hoping to learn from the day?</li> <li>● Have an understanding of what came out of the previous workshop</li> <li>● Discussion on understanding of soil health</li> </ul> <p><b>Agenda overview and introduction to the Altar Valley</b> - AVCA</p> <p>Materials:</p> <ul style="list-style-type: none"> <li>● Agenda</li> </ul>
9:30	<p><b>Elkhorn Ranch herbicide treatments</b> - Mary and Charley Miller</p> <p>Goals:</p> <ul style="list-style-type: none"> <li>● Learn about objectives and methods of a decades-long mechanical and backpack herbicide project</li> <li>● Observe the vegetation and soil characteristics in an aerial herbicide treatment area + adjacent non-treated area</li> </ul> <p>Materials:</p> <ul style="list-style-type: none"> <li>● Map and descriptions for both treatments</li> <li>● Before photos and post-treatment photos of herbicide treatment</li> </ul>

10:35	<p><b>Elkhorn Ranch Media Lunas</b> - <i>Mary Miller and the AVCA</i></p> <p>Goals:</p> <ul style="list-style-type: none"> <li>• Learn about the effects small-rock media lunas are having on upland soils and vegetation</li> <li>• Compare soil type and other site characteristics to those at the herbicide treatment areas</li> <li>• Identify the most useful information about the study and recommended ways to continue monitoring</li> <li>• Discuss how soil treatments (e.g, rocks, downed wood, mulch, etc.) could complement brush treatments</li> </ul> <p>Materials:</p> <ul style="list-style-type: none"> <li>• Handout on initial results of media luna study</li> </ul>
11:00	<b>Drive to Santa Margarita Ranch</b>
11:15	<p>Santa Margarita Ranch grubbing treatments - <i>Walter Lane</i></p> <p>Goals:</p> <ul style="list-style-type: none"> <li>• Discuss the goals and activities of a large-scale, multi-phase grubbing treatment</li> <li>• Brainstorm ways the soil type and other aspects of the site may be affecting vegetation response</li> <li>• Discuss app and potential field use</li> <li>• Discuss removal techniques for mesquite piles</li> <li>• Identify potential long-term monitoring methods</li> <li>• Soil type demo: on-site testing and website/app</li> </ul> <p>Materials:</p> <ul style="list-style-type: none"> <li>• Map of Santa Margarita treatments/Altar Valley brush treatment corridor</li> </ul>
12:00	<b>Drive to the Buenos Aires National Wildlife Refuge Visitor Center</b>
12:15	<p><b>Lunch</b></p> <p>Presentation on BANWR Burned Area Recovery program - <i>Reese Crebbin</i></p>
1:45	<b>Walk to erosion control project</b>
1:55	<p><b>USFWS Restoration Projects</b> - <i>Reese Crebbin</i></p> <p>Goal:</p> <ul style="list-style-type: none"> <li>• Learn about multiple types erosion control structures and observe the vegetation/soil response in a semidesert grassland with minimal brush control treatments</li> </ul> <p>Materials: None</p>
2:15	<b>Drive to BANWR fire buildings</b>

2:20	<b>BANWR Fire Management and Grubbing - Shawn Sullivan and Reese Crebbin</b>  Goals: <ul style="list-style-type: none"> <li>• Introduce the management goals and approach for fire and mesquite removal on the BANWR</li> <li>• Discuss conditions that have influenced results of fires</li> <li>• Provide an orientation to land conditions we will see as we drive north</li> </ul> Materials: <ul style="list-style-type: none"> <li>• Maps of the burned areas we will be visiting</li> </ul>
2:35	<b>Drive to Milepost 7.5</b>
2:40	<b>Prescribed fire versus wildfire - Shawn Sullivan and Reese Crebbin</b>  Goals: <ul style="list-style-type: none"> <li>• Observe effects of a prescribed fire w/ minimal to moderate fire behavior, and a site with 2 prescribed fires</li> <li>• Discuss effects of different types and intensities of fire on vegetation and soils</li> </ul>
3:00	<b>Drive to Milepost 11</b>
3:05	<b>Extreme fire behavior at prescribed burn area - Shawn Sullivan and Reese Crebbin</b>  Goals: <ul style="list-style-type: none"> <li>• Learn about how a prescribed fire treatment helped contain an extreme wildfire</li> <li>• Observe the response of mesquite, understory, and soils to an extreme fire</li> <li>• Identify situations in which fire may be most beneficial for grasslands</li> </ul>
3:30	<b>Takeaways and conclusions on brush treatments - AVCA</b>  Goals: <ul style="list-style-type: none"> <li>• Discuss key takeaways from the day</li> <li>• Review brush treatment matrix and discuss suggested updates</li> <li>• Complete evaluation forms</li> </ul> Materials: <ul style="list-style-type: none"> <li>• Brush treatment matrix</li> <li>• Evaluation forms</li> </ul>
4:00	<b>Adjourn</b>

# Workshop Handout

## **CART Mesquite Management and Soil Health Workshops 2023**

### **Field Trip Stops 1-4**

#### **Stop 1. Elkhorn Ranch 30-Year Brush Treatment**

##### **Project Goals:**

- Reduce woody vegetation cover to increase productivity of herbaceous species
- Slow the flow of water in gullies to minimize erosion and keep water on the landscape

##### **Long-Term Treatments:**

- Brush management treatments were implemented on 1,000 acres starting with mechanical removal of woody vegetation between 1984 and 1990. Follow-up treatments with herbicide backpack sprayers have occurred since 2002. They have used Tordon since 2002 and started using Remedy in 2004 as a follow-up treatment. Maintenance includes annual spot treatment of resprouts and seedlings using herbicide backpack sprayers.

**Beneficial Use of Brush Piles:** Cleared trees were pushed into incised gullies to slow down water and help reduce erosion.

**Aerial Imagery Analysis:** To assess treatment effectiveness and monitor changes in woody species cover over time, the ranch owners collaborated with AVCA and a GIS contractor to analyze aerial imagery beginning with pre-treatment conditions of 1974.

##### **Monitoring to Inform Management:**

- The ranch owners have conducted annual rangeland monitoring with NRCS since 1983. Additionally, simply observing their land over time has afforded the ranch owners an intimate understanding of the landscape's response to variable climate patterns and management practices.
- Though the work took place on just 10% of the Ranch, it has had a noticeable impact on rangeland condition on the remaining acreage. The increase in productivity on treated areas has allowed for greater pasture rotation flexibility, and untreated areas have seen a recovery of native grass species.
- The treatment areas are more amenable to the guest ranch operations. The reduced woody vegetation cover has made these areas more scenic, more open, and easier to traverse on horseback.
- Using prescribed fire to maintain cleared areas has proven challenging in the past due to complex planning and permitting requirements, fuel and climate conditions, fire resource availability, and liability issues. Even with these challenges, ranch managers consider prescribed fire to be a critical tool and remain committed to working through the challenges in the near future.
- The ranch owners have observed a reverse in gully erosion trends in treated and untreated areas. This is likely due to a combination of factors including increased perennial grass cover following brush removal, and the practice of pushing brush into the gullies.
- Aerial imagery analysis shows that woody vegetation cover has declined each year since treatment began. However, imagery from 2017 suggests an increase in woody cover from 1% to 5%, possibly due to growing resprouts becoming more visible, as well as an increase in pixel resolution.
- Non-native Lehmann lovegrass was part of the seed mix after the initial treatments in the 1980s. Today, Lehmann lovegrass is considered an invasive species, but it was a commonly recommended species for seeding at the time. It has been effective at providing ground cover and watershed stability during and following periods of intense drought. Ranch managers have seeded with native species with varied success to establish a wider diversity of perennial grass cover.

# CART Mesquite Management and Soil Health Workshops 2023

## Field Trip Stops 1-4

### Stop 2. 2019 Aerial Herbicide Treatment

#### Overview

The 2019 herbicide treatment was the first in the Altar Valley, and so this project was meant to demonstrate how it would affect the local vegetation and watershed. Aerially applied herbicide has numerous potential benefits:

- Little ground-disturbing activity (therefore cultural resource surveys are not needed except where equipment is staged)
- Less expensive than most other methods (this project cost about \$89/acre)
- Can be done quickly (2,000 acres were treated in four days)

#### Project Objectives

- Kill mesquite
- Reduce the sediment that moves from the treated areas into water courses such as the Santa Cruz River
- Monitor sediment load changes, mesquite death, and changes in other vegetation species

#### Treatment Areas

Treatment areas had relatively high mesquite densities, a low enough slope for helicopters to fly safely overhead, and were located in pastures that could be rested for two growing seasons after treatment. Drainages were left untreated to avoid the herbicide washing downstream and affecting leafy riparian species.

#### Required Conditions for Herbicide Treatment

- Less than 20% humidity
- Greater than 75° F soil temperature at 12 inches depth
- Less than 90° F daytime air temperatures and less than 7mph wind speeds

#### Monitoring

A detailed monitoring plan was created before prior to pre-treatment monitoring. The ADEQ grant supported three rounds of monitoring: six months before treatment, six months after treatment, and 18 months after treatment. The monitoring methods include:

- Ground-based transects
- Aerial imagery
- Photo points
- Size measurements and estimates of live canopy of individual mesquites.

#### Results

- The GPS files from the helicopters show that **the flights followed the treatment areas very accurately.**
- **Treated mesquite began yellowing** within two weeks of treatment, and lost a large number of leaves shortly after.
- **Many mesquite started exhibiting canopy resprout** within a few months after treatment.
- The analysis of aerial imagery indicates that **non-treated areas were greener than treated areas** in years 1 and 2 after treatment, which indicates that mesquite foliage in treated areas did decrease.
- There were no statistically significant trends in any ground transect observations of vegetation or cover types.
- The Rangeland Hydrology and Erosion Model indicates that **slightly more sediment may have moved through untreated sites on all treated plots in 2019, but the sediment deposition increased again in 2020 for all but one plot.**

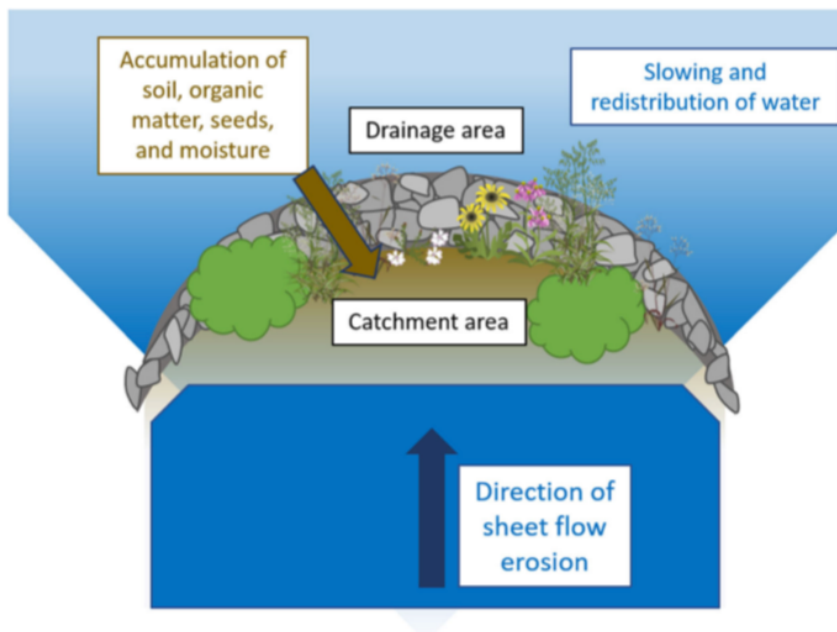
## CART Mesquite Management and Soil Health Workshops 2023

### Field Trip Stops 1-4

#### Stop 3. Elkhorn Media Lunas

##### Overview

- Installed low-cost rock structures (media lunas) to assess their ability to restore grasslands by slowing water flow, reducing erosion and improving plant establishment.
- Treatments included sites with small and large rock structures that were seeded with a native seed mix as well as sites with no seed or rock and sites with only seed addition.
- Collected summer percent cover for plants, litter, and rock and spring seedling count data. We also collected soil for nutrient, moisture, and microbial analysis.



##### Results

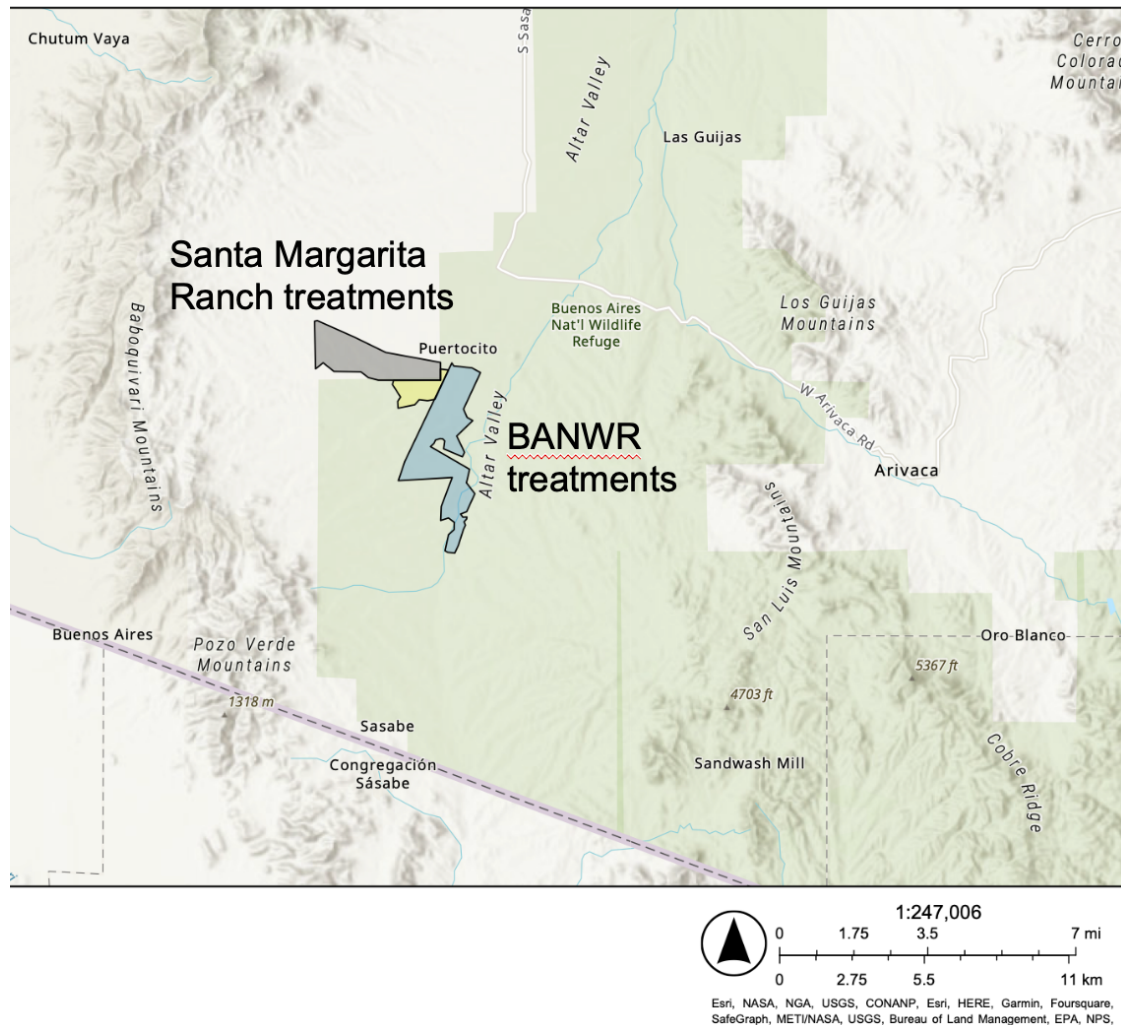
- Within the first year, we found no change in plant cover between rock structures of two rock sizes. We did find, however, an increase in soil moisture, litter, fungal richness, and spring seedling germination within the rock structures, despite a historic drought.
- Total plant cover was significantly lower in the middle of the large and small rock lunas.
- On average, the large rock lunas had 65–100% more total seedlings than the other treatments.
- Litter was significantly higher in the catchment of the large rock luna compared to the middle of the large and small rock lunas and the large rock drainage (4.7% cover).
- Total bacteria richness and cellulolytic bacteria did not significantly change with treatment or location on the luna.
- Fungal richness was highest in the middle of the lunas and more so under the large rocks compared to the small rocks.
- Differences in soil microbial communities were most likely driven by the increased soil moisture in the middle of the small and large rock lunas.
- This project demonstrates that rock structures can positively impact plants and soils of grasslands even within the first year.



## CART Mesquite Management and Soil Health Workshops 2023

### Field Trip Stops 1-4

#### Stop 4. Santa Margarita Ranch and Buenos Aires NWR Brush Treatment Corridor



#### Goals:

- Create continuous grassland habitat for wildlife from the east side of the Baboquivari Mountains to the Buenos Aires National Wildlife Refuge
- Facilitate wildlife movement across Highway 286

#### Treatments:

- Grubbing
- Herbicide pellets
- Prescribed fire

#### Monitoring methods:

- 3 years of ground-based vegetation transects in grubbed area (Santa Margarita only)
- Photopoints (Santa Margarita only)

# Brush Management Matrix



BRUSH MANAGEMENT TOOLKIT -- A PRACTICAL GUIDE  
Developed by University of Arizona School of Natural Resources and the Environment and Altar Valley Conservation Alliance  
Funded by the Western Sustainable Agriculture Research and Education Professional Development Program  
Last updated 2019 - Work in Progress

TREATMENT INFORMATION	BRUSH MANAGEMENT TREATMENTS									
TREATMENT DESCRIPTION AND RESOURCES	FIRE		MECHANICAL				HERBICIDE			
	Wildfire	Prescribed	Grubbing	Chaining	Pulling	Hand-cutting	Aerial Foliar spray	Soil applied pellets	Hand spray	Stump
Treatment description	Fire ignited naturally or unplanned human cause. Wildfire allowed to "let burn" becomes prescribed natural fire.	Planned fire conducted according to a prescribed fire plan	Machine pushes trees over to expose roots and kill tree	Two machines pull a large chain across ground that pulls trees out of ground to expose roots and kill tree.	Specialized machine pulls tree out of ground to expose roots and kill tree	Trees cut by hand, usually with chainsaw	Herbicide applied from air using plane or helicopter	Herbicide applied from air using plane or helicopter	Herbicide applied to individual trees using backpack sprayer	Cut stump treated with chemical herbicide or diesel
Treatment combinations or maintenance tools		Maintenance tool following other methods				Paired with chemical stump treatment			Maintenance following more intensive treatments	Paired with hand-cutting
Tools / materials	Fire Incident Command team & resources - trained people, vehicles, tools, air support, water & chemical resources	Fire Incident Command Team & resources - trained people, vehicles, tools	Bulldozer, trained operator, diesel fuel	Multiple bulldozers, chains, trained operators, diesel fuel	Excavator or other heavy machinery, plucking attachment, trained operator, diesel fuel	Trained sawyers, chainsaw, fuel	Trained pilot, specialized plane or helicopter, ground support, chemicals, water	Trained pilot, specialized plane or helicopter, ground support, chemicals, water	Trained applicator, backpack or OHV with spraying device, chemical, chemical marker, diesel or oil based mix agent	Trained applicator, spraying device, chemical, mix agent, marker agent
Specialized training or permits	Minimal "Red Card" fire certification, plus additional training for other fire team jobs	Prescribed fire plan. Minimal "Red Card" fire certification, plus additional training for other fire team jobs					If chemical is restricted, then Certified Grower Permit for landowner, Certified Applicator license for chemical applicator			
PLANNING CONSIDERATIONS										
Season	Indiscriminate - most frequent in spring / summer "fire season" when conditions are hot and dry; note that wildfire and prescribed fire resources are often one and the same. Wildfire emergency can trump prescribed fire plans, creating logistical complexity for prescribed fire implementation.	Prescribed fire plan describes required temperature and weather conditions - seeks balance between hot dry conditions necessary to achieve goals and safety / fire management factors. These conditions often coincide with wildfire season, resulting in scarce resources.	Anytime	Anytime	Anytime	If used in combination with stump treatment, must do at time that is within prescription of the chemical being used for stump treatment	Season can have impact on plant conditions necessary for successful treatment	Season can have impact on plant conditions necessary for successful treatment	Season can have impact on plant conditions necessary for successful treatment	If used in combination with hand cutting, must do within prescription associated with the chemical -- varies with chemical
Planning and permitting	Any project is likely to require a 6 - 24 month planning / permitting process prior to implementation. Permitting requirements for all treatments will vary depending on land ownership, funding source, and involved parties. Possibilities include: federal National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act, and Clean Water Act; State Land Treatment or Applications to Place Improvements, and others.	NEPA requirements would be triggered by land ownership and/or project partners and funding. Note that land management treatments supported by NRCS programs have been addressed by NEPA. *kristen input*  Consideration of endangered species and general wildlife habitat should be a planning factor. Permitting and possible survey complexity will be a factor of land								
Permitting factors	Consider Air Quality permitting factors									
National Environmental Policy Act (NEPA)										
Endangered Species Act (ESA)										
National Historical Preservation Act (i.e., cultural resources)		Cultural resources likely to be a concern in areas where there is ground disturbance, for example development of a fire line needed for implementation of prescribed fire plan. Surveys may be required.	Survey for and mitigation of cultural resource issues likely to be a planning / permitting factor due to occurrence of ground disturbance. Land ownership and degree to which project partners or funding trigger permitting needs may also be a factor.			Cultural resource concerns minimal to none due to absence of ground disturbance.				
Fire management jurisduction	Fire point of origin determines lead agency ~ generally managed with interagency groups.	Fire jurisdiction critical factor during planning. Interagency fire resources can be used to conduct fire. There are also private companies that provide these services.								
Land ownership (+ leased or deeded)	Indiscriminate. Fire's point of origin determines which organization has management authority for the fire.	Cross boundary projects possible, and contingency planning likely to require cross boundary planning	Single land owner or cross boundary possible	Single land owner or cross boundary possible	Single land owner or cross boundary possible	Single land owner or cross boundary possible	Single land owner or cross boundary possible - can be economic and logistical advantages to grouping several small projects into a larger project.	Single land owner or cross boundary possible - can be economic and logistical advantages to grouping several small projects into a larger project.	Single land owner or cross boundary possible	Single land owner or cross boundary possible
TREATMENT IMPACTS										
Target specificity	Indiscriminate	Indiscriminate; can protect key areas	Specific	Indiscriminate	Specific	Specific	Indiscriminate - will affect all dicot species in leaf at time of application	Indiscriminate - will affect all dicot species over several years	Specific, but there can be some drift to non-target species	Specific



Woody species size and canopy density	Indiscriminate	Effectiveness will vary with shrub / tree size and fire characteristics - higher temps and dryer conditions would increase burn effectiveness	Useful for varying sizes and densities	Useful for varying sizes and densities	Useful for varying sizes and densities.	Useful for varying sizes and densities	Useful for varying sizes and densities.	Useful for species like creosote and whitethorn on calcareous soils	Useful for varying sizes and densities	Useful for varying sizes and densities
Understory species, Grasses (monocots) ann/perennial, cover, production, native	Indiscriminate	Requires understory vegetation as fuel for fire - absence of fuel can prevent use of tool.	Consider whether treatment will affect valuable understory (monocot) species. Consider whether understory seed source available and/or whether additional seeding necessary							
Understory species, invasive grasses / forbs	Consider whether treatment will result in an increase in rates of spread of invasive grasses and forbs									
Understory species, Forbs, shrubs (dicots) cover, production, value for forage, habitat	Consider whether treatment will affect valuable understory (dicot) species						Indiscriminate - will affect non-target dicot species at time of application	Persistent in soil - will affect non-target dicot species over several years	Specific, but there can be some drift to non-taget species	Specific
Precipitation	Indiscriminate	Seek implementation window when winter rains sufficient to support perennial understory vegetation vigor - keep vegetation regrowth following fire in mind.					Soil moisture conditions must be met for successful treatment of some chemicals			
Soil	Indiscriminate	Consider stabilization of area with rock erosion control structures prior to burning if erosion of concern	Soil type and the degree to which it hinders or provides for site productivity should be a significant factor during planning. Expensive treatments may be most appropriate in highly productive soils. Less productive soils may benefit.				Note that some chemical prescriptions require particular soil types.			
Slope	Indiscriminate - wildfire may be the only practical treatment in steep or mountainous areas.	Address via fire plan	Increased slopes would impact machine operation safety.	Increased slopes would impact machine operation safety.	Increased slopes would impact machine operation safety.			Slopes above 12% are safety hazard for pilots		
Hydrology	Indiscriminate	See Soil comments	Note that woody vegetation debris can be utilized for gully erosion remediation.  Note that drainage areas are generally not cleared, to provide for wildlife habitat. Projects could consider a "thinning" rather than "clearing" in these areas.				Drainages generally excluded from aerial application plans.	Drainages generally excluded from aerial application plans.  For chemical treatments, research product effects on ground water and consider conservative approach appropriate to project area.		
Historic cultural resources	Indiscriminate	Mitigate via fire plan and general project plan - projects with ground disturbance likely to have higher risk or complexity.								
Present day improvements	Indiscriminate	Mitigate via fire plan and general project plan.								
<b>FINANCIAL CONSIDERATIONS</b>										
Cost considerations	High, unpredictable	Low, consider cost of fire plan prep, permitting, and implementation fire resources.	High, consider cost of planning / permitting, machines, operators, and diesel fuel. Diesel fuel cost a major factor.			Medium, consider cost of crew. Prisoner fire crews can be efficient and cost-effective labor source.	High, but predictable, fast and low labor.	High, but predictable, fast and low labor.	Low, consider cost of materials and how value labor. An approach that landowner can do at logistical and economic pace of their choosing.	Low, consider cost of materials and how value labor. An approach that landowner can do at logistical and economic pace of their choosing.
Natural Resource Conservation Service practices (NRCS)	Not applicable									
<b>MONITORING</b>	Consider project goals and related monitoring strategies. Consider cost of monitoring and whether long term logistical and economic commitment to monitoring is possible. Repeat photography = low cost method; comparison of pre-post treatment using available data = low cost but requires technical knowledge; on-the-ground field monitoring = medium cost, requires technical knowledge; drone flights = medium cost, requires technical knowledge.		<div> <b>MONITORING</b>  Consider project goals, cost, and related monitoring strategies. Also consider whether long-term logistical, personnel, and economic commitment to monitoring is possible. <div> <div>Method</div> <div>Relative Cost</div> <div>Level of Technical Knowledge Required</div> </div> <div> Repeat ProtographyLow </div> <div> Data-based comparison of pre-treatment and post-treatment conditionsLow </div> <div> On-the-ground field monitoringMedium </div> <div> Aerial imagery with drone flightsMedium </div> </div>							