

Nighthawk Prescribed Fire, Hall Ranch

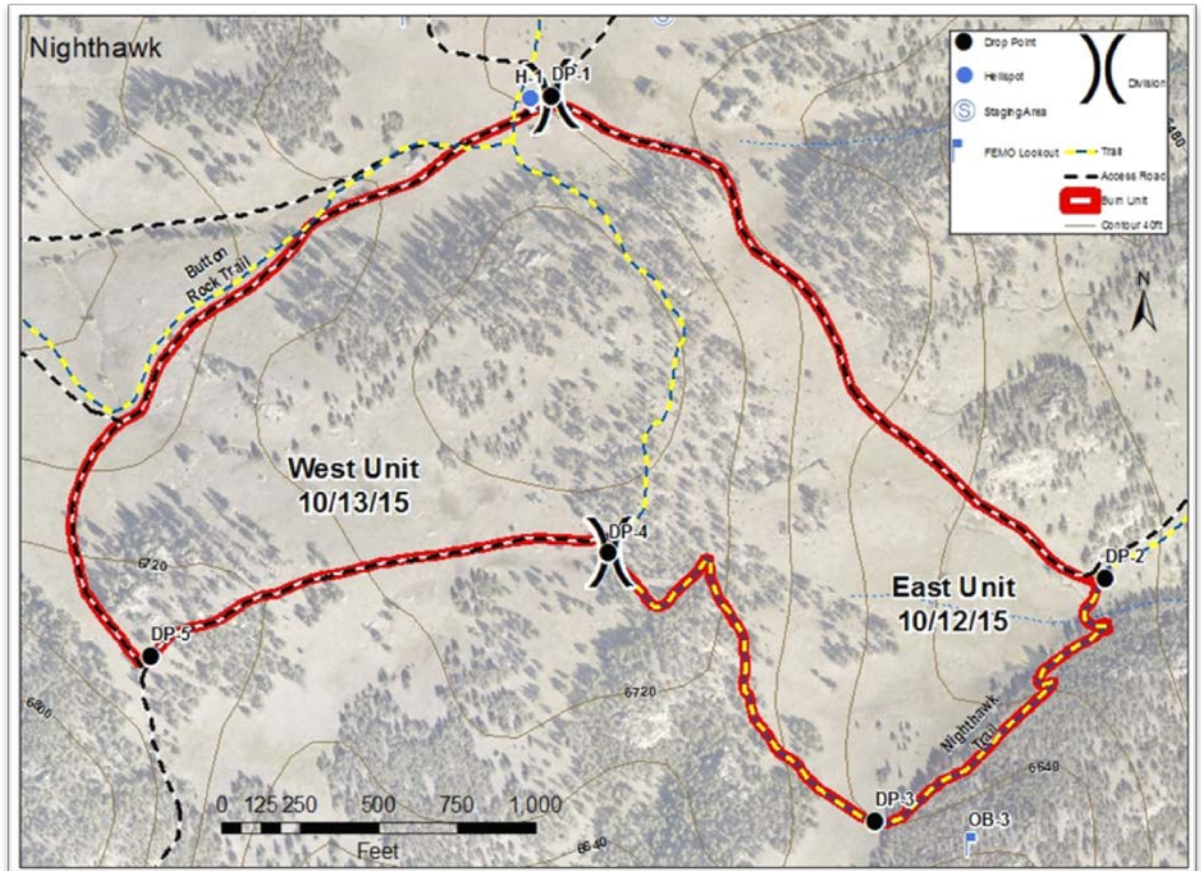
FEMO Report

Co-BLX-919

October 12-13, 2015

Summary

The Nighthawk prescribed fire was completed over two days of ignitions, from October 12-13, 2015. The prescribed fire was located at Hall Ranch, west of Lyons, CO. Boulder County Parks and Open Space manages Hall Ranch for many objectives including recreation, wildlife habitat, and ecosystem processes. The prescribed fire was proposed and implemented as part of integrated



ecosystem management combining hazardous fuels mitigation with ponderosa pine forest restoration following several years of mechanical treatment.

The unit is an 80-acre open ponderosa pine forest/meadow complex. Historically this ecosystem experienced spreading fire on a 30 year interval, but no fires have been recorded since 1859. The prescribed fire restores fire as a process to the landscape and begins to restore the fire regime. The objectives of the fire were to reintroduce fire to the landscape, reduce surface fuel loadings, and create conditions to support natural ponderosa pine regeneration.

The prescribed fire was successfully implemented, but all objectives were not fully met. All operations were completed

safely. Post-fire data shows that overall surface fuel loading decreased by 0.43 tons per acre, about 65% of the unit burned, and 4-6% of the burned area removed vegetation to mineral soil.

Background

Objectives

Objective #1: Reduce surface fuel loading by up to 75%. (estimates of 1-2 tons/acre reduced to less than 1 ton/acre)

Objective #2: Reintroduce fire to at least 75% of the unit, in a mosaic pattern. At least 56 acres should have fire move across the unit in as natural a pattern as safety allows.

Objective #3: Create conditions to support the establishment of natural ponderosa pine regeneration. Up to 25% of the unit should have intensities sufficient to remove all vegetation down to mineral soil.

Fuels

From 2011-2013, the entire unit was thinned mechanically. Pre-thinning, the stand average basal area was 95 ft²/ac and trees-per-acre was 246. Activity fuels were piled and burned, and all bole wood <5" was removed through public firewood sales. The resulting forest structure and fuel loading is shown in the *Pre-fire fuel characteristics* table.

<i>Pre-fire fuel characteristics</i>	
Basal area (ft²/ac)	45
Stocking (trees/ac)	48.3
Woody fuel load (tons/ac)	
0"-0.25" dia (1-hr)	0.2
0.25"-1" dia (10-hr)	0.2
1"-3" dia (100-hr)	0.2
3"+ dia (1000-hr)	0.4
Herbaceous & shrub load (tons/ac)	0.41
Litter load (tons/ac)	2.0
Surface fuel bed depth (in)	0.9
Duff depth (in)	0.9

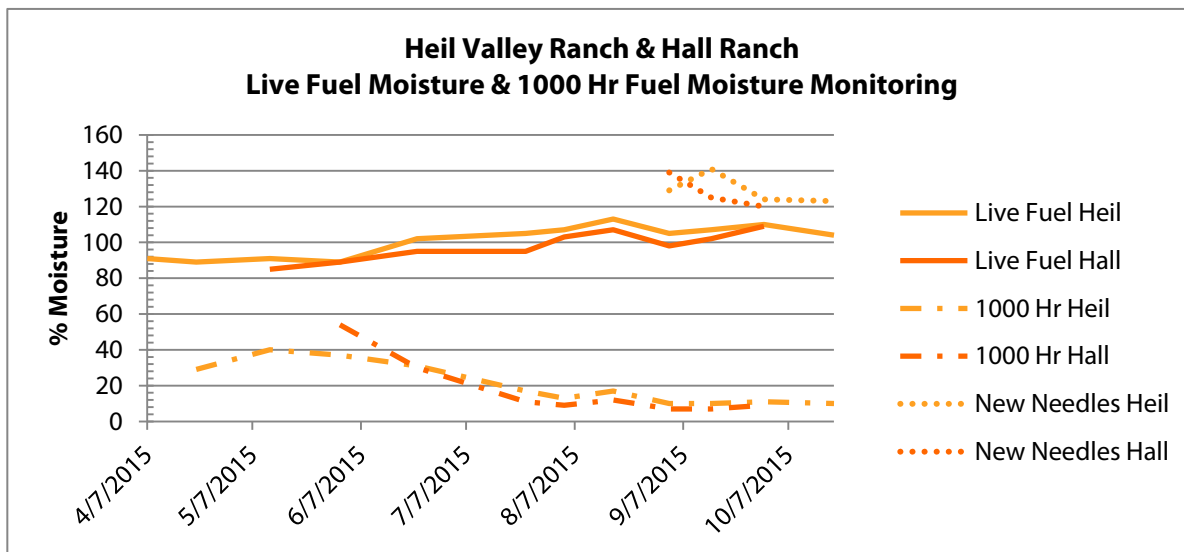
Pre-fire fuel characteristics by fuel type

	<i>Fuel model</i>	GR2 totals	TU1 totals	Unit avg
4 subplots per plot	Forb (T/a)	0.09	0.05	0.07
	Grass (T/a)	0.40	0.25	0.32
	Shrub (T/a)	0.01	0.02	0.01
	Grass Ht (ft)	0.85	0.77	0.81
	Forb Ht (ft)	0.38	0.42	0.40
	Shrub Ht(ft)	0.14	0.20	0.17
	Grass Cover (%)	38.75	18.22	28.49
	Forb Cover (%)	23.80	10.00	16.90
	Shrub Cover (%)	1.00	1.54	1.27
	1 HR TLF (T/a)	0.12	0.28	0.20
	10 Hr TLF(T/a)	0.10	0.31	0.20
	100 Hr TLF(T/a)	0.14	0.18	0.16
	1000 Hr TLF 3-6(T/a)	0.10	0.18	0.14
	1000 Hr TLF 6-12(T/a)	0.23	0.18	0.20
	1000 Hr TLF 12+(T/a)	0.00	0.03	0.02
	Litter Depth (in)	1.11	0.60	0.86
Duff Depth (in)	0.74	0.96	0.85	
Plot Center	Grass Cover %	46.25	27.57	36.91
	Forb Cover %	28.25	22.14	25.20
	Rock Cover %	7.00	6.29	6.64
	Duff Cover %	10.00	13.29	11.64
	Litter Cover %	8.25	23.57	15.91
	Bare Cover %	0.50	7.14	3.82

Pre-fire fuel loading was measured on 11 plots previously established for pre-thinning forest inventory. Plots were selected to represent the range of fuel characteristics throughout the unit including North, South, East, and West aspects and grass, shrub and timber-understory fuel beds. Fuel loading was measured using the Photoload Sampling Technique-estimating surface fuel loadings from downward looking photographs of synthetic fuelbeds (Keane, 2007).

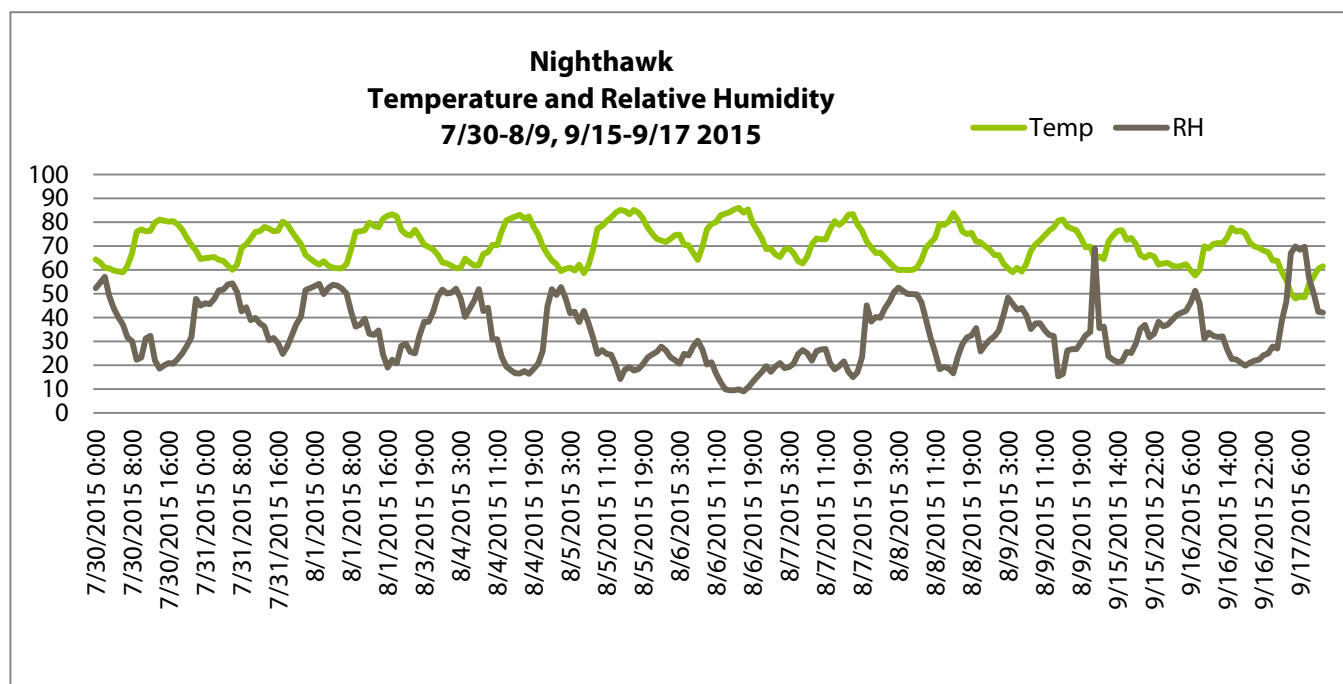
Fuel moisture was monitored bi-monthly throughout the season, from May through ignition. Fuels followed normal seasonal patterns.

The chart below shows the seasonal progression of Hall Ranch (Nighthawk) and Heil Valley Ranch (Overlook) fuel moistures.



Weather

Weather was measured on-site using a Nomad Orion portable weather station. However, rodent damage to the unit caused significant gaps in data. Weather conditions leading up to the burn were consistent with seasonal norms for the area.



Ignition Days

The Nighthawk prescribed fire was completed over two consecutive days of ignitions. Day one was the east side of the unit and blacklining the perimeter of the west side 33', totaling 41 acres. Ignitions were limited to 50 acres on 10/12 due to an adjective rating of 'Good' smoke dispersion for only one hour during the day. Day two completed the interior of the west unit, the remaining 34 acres. The smoke dispersion adjective rating on the 13th did not limit acreage, with five hours of 'Good' smoke dispersion.

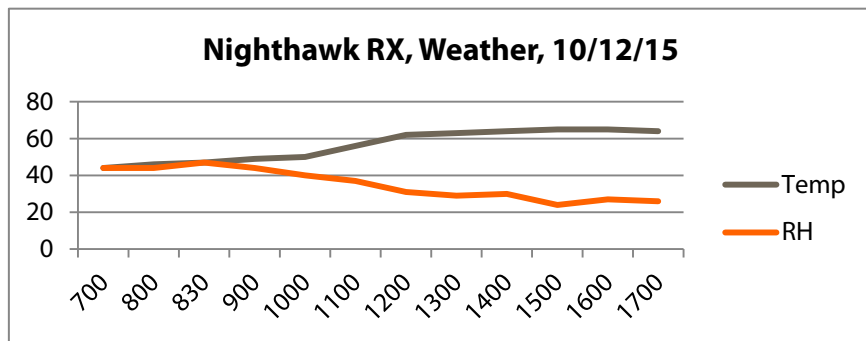
October 12, 2015

Test fire occurred at 10:05, starting at DP 1 and working south along the east side of the Nighthawk trail and along the access road. The test fire was successful and ignitions continued at 10:15. An ignitions team worked along the trail continuing south while a second team worked along the access road and across the eastern meadow. Both teams met at DP 2 and ceased ignitions on the east unit at 12:40. Blacklining from DP4 west to DP 1 began at 13:45 and was completed at 15:40.

Weather

Weather during the day was seasonal and mild. Winds were forecasted W at 3mph until 10:00, shifting to ESE and SE 3-6 until 17:00. Winds measured on the unit were upslope/up-valley, 2-4 mph with occasional gusts to 10 mph.

The temperature was forecast for a high of 65° F. Relative humidity was forecast at a low of 21. Measured temps on the unit tracked well with the forecast, topping out at 65°F at 15:00, but RH stayed higher than expected, with a low of 24 at 15:00, and hovering in the low 40s and high 30s for most of the day.



Fire behavior

During the test fire, flame lengths of 1-3 ft were observed in the grass, predominantly backing and flanking at <2 ch/hr. Fire spread was limited by shaded fuels. The dot-firing pattern across the eastern meadow produced backing and flanking fire 1-5 ft, with the highest flame lengths observed in shrubs, ~2 ch/hr with flame depths of 3-5 ft.

Fire behavior in the timber was similar to that in the meadow, with the addition of isolated torching in both ponderosa pine and rocky mountain juniper.

During black lining, strips 20 ft apart pulled together within 1.75 min. Rates of spread were up to 10 ch/hr with flame lengths of 2 ft.



Smoke

Smoke at the surface of the unit pulled inward, and lifted above tree line. Smoke observers at two vantage points reported a shearing column, rising 200' to the south west, then shearing to the east at 300-400'.

Smoke during blacklining was low lying and dispersed quickly just above treeline, 80-100'.



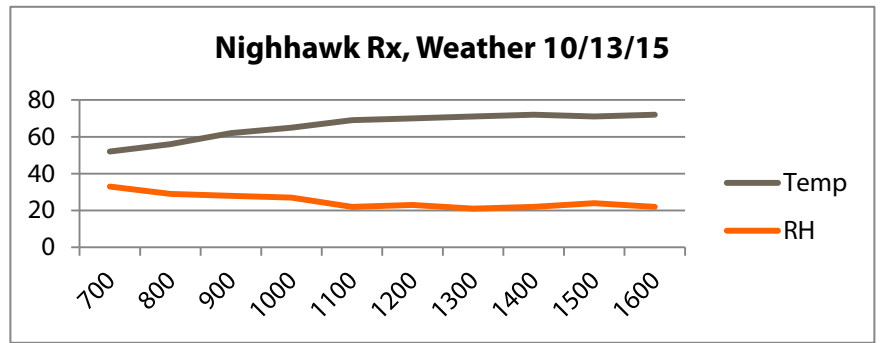
Multi Mission Aircraft Image 10/13/2015

October 13, 2015

The test fire began at 10:50 midway between DP1 and DP 4 along the Nighthawk trail. Ignitions continued with teams working along both sides of the ridgeline from east to west. Ignitions were completed at 15:15.

Weather

Tuesday, October 13th was hotter and drier than the previous day. Winds were forecast W and WNW 9-6 mph until 13:00, shifting to WSW and W 5-6 mph for the remainder of the day. Winds measured on the unit were E and ESE 2-4, gusting to 10mph.



Forecast high temperature was 72°F at 13:00 and the low RH was 14 at the same time. Temps at the unit tracked with the forecast, the high of 72°F was reached at 14:00, but RH was again higher than expected, with a low of 21 at 13:00.

Fire behavior

Like the day before, the test fire was characterized by slow/no rates of spread in shaded fuels. Where fuels were unshaded, 50-70% consumption was observed in surface fuels. As firing continued, head and flanking fire was observed as the slope, winds and fuel aligned along the ridgeline. Flame lengths of 4-8 ft and rates of spread up



to 6 ch/hr caused isolated and group torching in the ponderosa and rocky mountain juniper. As the flaming front moved from the ridgeline into a large meadow, fire behavior moderated to backing/flanking at 1-3', with rates of spread up to 25 ch/hr.




Smoke

Smoke lift was relatively lower than the previous day, rising 150-250' and dispersing to the west. By 1430 no rising smoke was observed.



Fire Effects

First order fire effects were measured in the month following the fire.

Objective	Met?	Measure
Reduce Surface Fuel by up to 75%		Total surface fuel load decreased by 0.43 tons/acre
Reintroduce fire to at least 75% of the unit		Total surface burned was 65% (avg. substrate % & vegetation % severity 1-4), approximately 52 acres
Up to 25% of the unit burns to mineral soil (1 or 2)		Total surface burned to severity 1 or 2 (bare mineral soil) was 2.5%, approximately 2 acres

Overstory-

Overstory mortality was predicted if <50% of the canopy was scorched.



Overstory					
Plot	Scorch (%)	Scorch Ht- Ft	Char Ht-Ft	Predicted Mortality (%)	Predicted Mortality 1 year (Aug 2016)
2	1.6	2.6	0.2	0%	0%
7	90	40.5	15	100%	0%
12	40	26	10	0%	0%
13	5	12	2	0%	0%
18	1	3	2	0%	0%
20	5	10	3	0%	0%
24	5	9	3	0%	0%
25	0	0	0	0%	0%
28	0	0	2	0%	0%
29	0	2	0	0%	0%
31	16	16	6	0%	0%
Average	14.9	11.0	4.0	9%	9%

Surface Fuel

Surface fuel consumption- Surface fuel consumption was calculated by comparing pre-fire fuel loading to post- fire fuel loading using the Photoload Sampling Technique.

Woody Fuels	1-hr (tons/ac)	10-hr (tons/ac)	100-hr (tons/ac)	1000-hr (tons/ac)	Duff (in)	Litter (in)
Pre-Fire	0.22	0.24	0.16	0.37	0.89	0.78
Post-Fire	0.13	0.29	0.12	0.33	0.522	0.83
Δ (Before-After)	0.10	-0.06	0.05	0.04	0.36	-0.05

Surface Fuel severity- Burn severity was assessed for both substrate and surface vegetation on a scale of 1-5, with 1 most severely burned and 5 unburned (0= not burnable, ie rock).

	Avg.	SD
Burnable substrate area (%)	97%	3%
Burnable vegetation area (%)	87%	12%
% Substrate severity 1	1%	2%
% Substrate severity 2	5%	6%
% Substrate severity 3	13%	10%
% Substrate severity 4	47%	19%
% Substrate severity 5	34%	26%
Avg. Substrate severity	4.08	0.42
% Substrate w/ black	66%	-
% Veg severity 1	1%	3%
% Veg severity 2	3%	4%
% Veg severity 3	12%	11%
% Veg severity 4	47%	27%
% Veg severity 5	36%	30%
Avg. Veg severity	4.15	0.4
% Veg w/ black	64%	-

Discussion:

The initial results from the fire show direct correlation to the diminished fire behavior in shaded fuels. If the objective is to burn a greater percent of the area and increase severity, conditions will need to be hotter and/or drier than the conditions were during Nighthawk operations. If a greater decrease in surface fuel is the objective, increased fire severity is also necessary.

If the conditions the fire burned under are desired for operational needs and abilities, writing more flexible objectives will create more opportunities for success on future prescribed fires.

Future monitoring

One year post-fire the overstory will be monitored for mortality. Monitoring of conifer regeneration, weeds, native grasses and forbs will continue in 2016 and as necessary.

Report prepared by Ashley Garrison. FEMO data from FEMO Nick Stremel, FEMO trainee Ashley Garrison, smoke observers Erik Hinkley and Shane Milne, Agency Administrator Stefan Reinold. Photo Credits: Nick Stremel, Ashley Garrison, Stefan Reinold, Erik Hinkley and Colorado Department of Fire Prevention and Control Multi-Mission Aircraft.

Appendix 1: Antelope Bitterbrush Exclosures at Nighthawk Prescribed Fire, Hall Ranch

Dave Hirt, Plant Ecologist BCPOS

Antelope bitterbrush (*Purshia tridentata*) is a fairly common shrub component of Hall Ranch, and the Boulder County foothills. The popular multi-use trail on the property is named for this species. While it inhabits ponderosa pine ecosystems that historically have experienced frequent fire intervals, it has been documented in the literature that bitterbrush typically does not survive fire very well. After noticing a high mortality of the species in the nearby prescribed burn on PA7U4 in 2010, staff wanted to monitor the fire effects to see if we would experience high mortality of individuals again.

While bitterbrush grows throughout the burn area, Plant Ecology staff identified three large stands, all on the east facing slopes within the Nighthawk Burn perimeter (Figure 1). While it was decided that no active exclusion would be implemented during operations, staff did weed whip and use a blower to create a 3' wide line to near mineral soil, around the north and central populations (Figure 2). The southern population was left unprotected as a control for fire effects.

During the fire operations, the line around the northern exclosure held, and the population of 22 individual bitterbrush experienced zero mortality. Fire did cross the line of the central exclosure, perhaps due to some recent needle fall and completely burned 38 out of 38 individual shrubs. Likewise the southern stand was also consumed by fire, burning 40 of 41 shrubs there. While the majority of shrubs were burned, it does not mean they are dead. Staff will revisit the site to check for any resprouting in 2016. The final determination as to mortality will not occur until the end of the growing season in late 2016.

While fire may kill bitterbrush, it may also be important in germinating new seedlings. Germination appears to happen more frequently on bare mineral soil and physical effects of fire and smoke on the seed coat may promote germination. To investigate this, plant ecology staff installed eight seeding plots, 2'x3' in size, four within the burned area, and four controls outside the burn. All plots were planted with 100 seeds (collected at Hall Ranch in 2010 and tested for viability in 2015) and are caged to prevent herbivory. Half of the seeds of each plot were manually scarified to help break dormancy. Staff will monitor all plots for visible germination in the spring of 2016 and beyond.

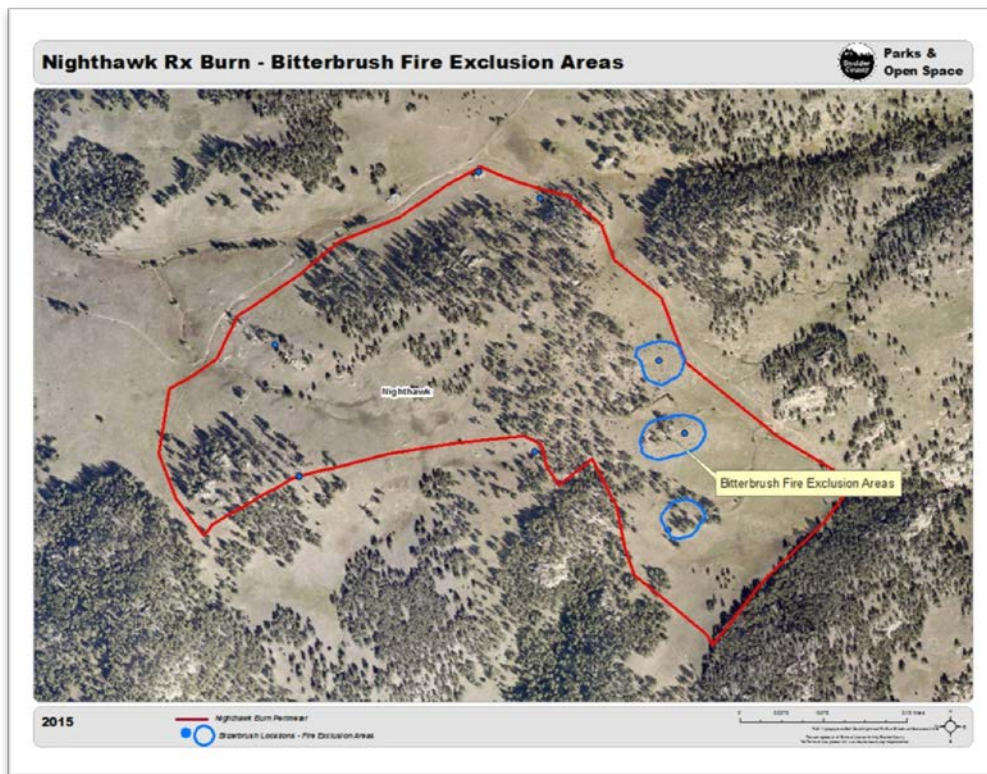


Figure 1. Nighthawk prescribed fire perimeter with locations of bitterbrush stands and three monitoring plots.



Figure 2. Northern bitterbrush plot #1, pre-burn.



Figure 3. Fire line around northern enclosure.