Wonderland Lake Wildfire Monitoring St
OSMP Studies
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WONDERLAND LAKE WILDFIRE

MONITORING STATUS REPORT

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Submitted to the City of Boulder Open Space and Mountain Parks Executive Management Team

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EXECUTVE SUMMARY

The Wonderland Lake wildfire occurred on Open Space and Mountain Parks (OSMP) land in July, 2002 during a severe drought year. Post-burn fire effects were difficult to predict due to the extreme climatic conditions and a lack of information available on the effects of mid-summer burning in Boulder's foothills grassland communities.

The burn occurred in a popular recreation area. In order to protect soils and vegetation left vulnerable to erosion and trampling effects after the burn, the area was temporarily closed to the public. A schedule was developed to monitor and evaluate the recovery of the burn area through fall 2002 and spring 2003. A central condition for reopening the area to the public was the recovery of the burn area in terms of native vegetation cover, non-native species status, and soil condition. No prediction could be made on how long the severe drought conditions would last and how drought would affect the recovery of the burn area. OSMP staff recommended that the decision to reopen the burn area be made no sooner than late June, 2003 so that the recovery of late spring growth in vegetation and weather conditions could be monitored.

OSMP staff worked with the hanggliding and paragliding community to select alternative flying sites on the Foothills and Hogback Trails to be used during the Wonderland area closure. Since the burn, volunteers from the surrounding neighborhoods and the hanggliding and paragliding community have contributed numerous volunteer hours to assist OSMP staff with priority weed management, and erosion control measures.

Vegetation monitoring was established in the wildfire area and in an unburned reference area in the vicinity of the Hogback Trail north of Lee Hill Road. Monitoring objectives included:

- Quantify post-fire changes in native and non-native plant species cover, frequency, richness, and in non-vegetated ground cover.
- Use results of plot monitoring and observations of burn area condition as a central condition in the decision of when to reopen the burn area to recreation.
- Develop and test methods for use in fire effects and recreation effects monitoring on OSMP.

The results of monitoring to date show good recovery of native vegetation as well as an increase in non-native, invasive species. Adequate precipitation during fall 2002 and spring 2003 brought an end to the drought and contributed to the recovery of vegetation in the burn. Monitoring data reveals that the burn area has greater native species diversity and cover than the reference area at this time. The increase in noxious weeds such as cheatgrass and goatgrass is of particular concern in the burn area.

Based on monitoring results and other field observations, staff provides the following management recommendations.

- The burn area has recovered adequately in terms of the cover of native vegetation and demonstrated soil surface stability to allow the reopening of the area to recreation. On-trail use only, and dogs on leash are recommended.

- Monitoring of vegetation and regular observations of site conditions related to fire recovery and recreational use should continue. A final report will be generated at the end of the 2003 monitoring season, and will include a recommended schedule for continued monitoring.
- High priority noxious weed populations should be monitored. Monitoring and management of priority weed species should be coordinated by IPM and plant ecology staff. High priority species are: Jointed goatgrass (*Cylindropyrum cylindricum*), diffuse knapweed (*Acosta diffusa*), common teasel (*Dipsacus fullonum*), and cheatgrass (*Anisantha tectorum*).
- Weed management should be implemented for several (minimum of two) years prior to the rerouting or new construction of trails.
- The condition of existing trails and launch sites should be monitored. Necessary maintenance should occur to prevent severe soil erosion. Work with hangglider/paraglider group to monitor and manage priority weeds on launch sites and access trails. Design and implement changes in the use of launch sites if threshold conditions are approached in terms of a decrease in native plant cover and/or an increase in priority weed species.
- Continue to encourage and facilitate involvement by neighbors, hanggliders, paragliders, and other interested public in the ongoing stewardship of the burn area.

INTRODUCTION

This document provides a status report on the effects of a 2002 wildfire in the vicinity of Wonderland Lake on Open Space and Mountain Parks (OSMP) land. The results of vegetation monitoring in the burn and an unburned reference area during late summer and fall 2002, and spring 2003 are reported. Management recommendations for the burn area are presented.

DESCRIPTION OF WONDERLAND LAKE WILDFIRE

The wildfire ignited on the evening of July 19, 2002. In the course of several hours, 297 acres burned on steep slopes in grassland and shrubland communities at the forest/grassland interface. The fire was actively suppressed where houses were threatened, and was contained using black-lining techniques and other efforts by ground crews. (See attached map of burn area.)

Fire behavior and weather

Fast-moving fire spread from north to south across steep slopes, fanned by winds ranging from ___ mph to ____mph. Relative humidity averaged ___. Conditions were very dry due to prolonged drought during 2002. Dry, above-ground biomass was entirely consumed by the fire in most areas. The soil surface did not appear to be severely scorched in most areas, because the fire moved quickly over the ground surface. However, some steep, upper elevation draws with shrubland patches, appeared to burn more intensely than surrounding grass-dominated slopes.

SITE CONDITIONS

Plant communities

Grassland communities in the burn area are generally dominated by native perennial grasses and forbs. Typical native species include western wheat grass (*Pascopyrum smithii*), big bluestem (*Andropogon gerardii*), sun sedge (*Carex pensylvanica*), and blue grama (*Chondrosum gracile*). A mosaic of grassland community types and shrubland patches occur in the burn.

Many species were in a dormant state due to drought conditions at the time of the mid-summer wildfire. Dormancy, combined with the fast-moving fire, may have protected plants from more severe fire effects.

Most native grassland plants and some non-native species are adapted to fire as a natural disturbance. Fire can increase the vigor of plants and improve conditions for germination of seedlings. Non-native species may increase in cover and/or density after fire. Intense fire behavior can lead to deeper heating and scorching in soils, decreased plant growth, and longer post-burn recovery times. Fire effects depend largely on the timing, frequency, and intensity of fire, and on climatic conditions before, during, and after a fire. The type of plant community, soils, topography and land use history also influence fire effects. The Wonderland Lake burn area had not burned for at least 20 years and probably not for many decades prior to the 2002 wildfire.

Weeds

Several non-native plant species of concern were documented in the burn area prior to the wildfire. High priority non-native species on the site are: Jointed goatgrass (*Cylindropyrum cylindricum*), diffuse knapweed (*Acosta diffusa*), common teasel (*Dipsacus fullonum*), and cheatgrass (*Anisantha tectorum*).

Trails and Recreation: The Wonderland Lake area is a popular area for hiking, dog-walking, hanggliding and paragliding. A network of trails, mostly formed by recreationists (i.e., undesignated trails), exist on the slopes that burned during the 2002 wildfire. After the post-wildfire assessment, OSMP staff recommended that the burned area be temporarily closed to recreation in order to protect fragile soils and plants as the plant communities recovered. Severe, ongoing drought conditions were factored into the recommendation to temporarily close the burn area. On August 1, 2002, the burn area was closed to recreation by City Manager Rule 8-3-3.H(02). A $1,000 fine was assigned to violations of the temporary rule.

Erosion: Concern over the possibility of severe erosion during a sudden heavy rainstorm, prompted the installation of several hay bales. The protection of the main trail and drainage culverts under the trail were a priority. Hay bales were placed along undesignated trails and some drainages uphill from and near the Foothills Trail, the main designated trail in the Wonderland Lake area. The Foothills Trail remained outside of the closed area. In 2002 and 2003, fall and spring rains and snowmelt were generally light to moderate in intensity, and no severe erosion resulted within the burn area.

Soils: The primary soil type of the burn is Baller stony sandy loam (9 to 35% slopes). The Baller soils typically have rapid runoff and a high erosion potential. In the burn site there are incursions of Nunn clay (3 to 5% slopes) along the eastern edge of the hogback between the 5640 to 5780 ft. contours north of Wonderland Lake and Nederland very cobbly sandy loam (1 to 2% slopes) south of Wonderland Lake.

Elevation and Landform: The elevation of the burn site ranges from 5640 to 6400 ft. The landform is a hogback rising from the east to a ridge of Dakota sandstone on the west.

MONITORING DESIGN AND METHODS

Monitoring Objectives:

- Monitor post-burn changes in forest/grassland interface plant communities. Quantify post-fire changes in native and non-native plant species cover, frequency, richness, and in non-vegetated ground cover. Use results of plot monitoring and observations of condition (soil erosion, traditional areas of concentrated recreational use, general status of weed species (distribution, densities)) as a central condition in the decision of when to reopen the burn area to recreation.
    - **Ground cover:** Compare ground cover data—soil, rock, litter, wood—between burn and reference areas.
    - **Vegetation cover:** Compare total/relative vegetation cover between burn and reference areas.
    - **Non-native cover by percent:** Compare % native and non-native cover between burn and reference areas.
    - **Native/non-native species richness:** Compare total native and non-native species per plot.
    - **Frequency:** Compare frequency of species between burn and reference plots
    - **Increase in cover by month:** Plot and compare total vegetation cover per plot by month for burn and reference areas.
    - **Slope/aspect correlations:** Check burn plot slope/aspect data for possible correlation for cover, species richness, and native/non-native species. It is not certain this will work due to micro-topography of plots. Analysis of data using slope and aspect stratification will be attempted for the final monitoring report.

- Develop and test methods for use in fire effects and recreation effects monitoring on OSMP. Select methods that are practical and possible to implement with limited staff time and resources, and that meet typical post-fire and other monitoring objectives.

- Obtain quantitative data on the recovery of the burn area, particularly adjacent to recreational trails and on launch sites, to use as an objective measure upon which to evaluate site conditions and base the decision to reopen the area to recreation.

Sampling Design Questions:

1. Are there enough reference sites for burned and unburned vegetation on the Wonderland Hogback itself? *No, the fire burned so extensively that there were not enough unburned patches of vegetation to compare with burned plots, so a physically similar reference site was chosen on the next hogback to the north of Lee Hill Road.*

2. Will the hill slope and aspect have an effect on how rapidly native vegetation reestablishes? *GIS queries showed the predominant aspects related to trails are NE and SE. The predominant slope adjacent to trails is 10-20%. Trails near the upper one-third of the hogback have slopes ranging from 20-40%. The range of slopes on the site is 0-50 %. Compass degrees were divided into 8 aspect classes starting at 0° using 45° increments.*

3. What are the soil types of the burn and reference sites? *The soil of the burn and reference hogbacks is primarily Baller stony sandy loam with 9 to 35% slopes. The Baller soils typically have rapid runoff and a high erosion potential. Near the bottom of the slope the soils are Nunn clay loam with 3 to 5% slopes along the eastern edge of the hogback north of Wonderland Lake and Nederland very cobbly sandy loam south of Wonderland Lake (1 to 12% slopes). In the reference site below the Baller soils there is a band of Renohill loam with slopes 3 to 9 % to the north and Nederland very cobbly sandy loam on the south edge.*

4. Are the burn and reference sites similar in elevation and landform? *Yes, both sites range in elevation from 5640 to 6400 ft. The landform of both sites is a hogback rising to the ridge of Dakota sandstone.*

Design Considerations:

1. Sampling impact--minimize trampling while sampling to avoid impacting the plot data or causing erosion. Location of quadrats in close proximity to trails but far enough from the trail so that plots would not be actually stepped on or disturbed by visitors.
2. Sampling schedule--collect data once per month during growing season starting in September 2002 through May 2003 and then reassess monitoring needs.
3. Intensity of recreation/trail use—distribute plots along trails to capture different kinds of recreation such as hiking or paragliding or hanggliding staging areas, however final placement should be random for the actual plot locations.
4. Quadrat size and shape should give a good indication of cover but be an efficient size for collecting data—a 0.25m x 0.25 m (1/4 m^2 was chosen).
5. Quadrat placement to reflect edge of trail impacts due to hiking.
6. Stratified random (stratified on slope and aspect), random within strata.
7. Two slope strata (10-20% and 20-30% slopes) and two aspects (NE, 45-90° and SE, 90-135 °) were chosen for sampling with four samples for each combination of slope and aspect. Two additional plots were placed on the main paragliding

launch area, one in a burned patch and one in an unburned patch to compare the fire effects in this impacted area. These plots do not fit the stratified random sampling methodology and will be addressed separately in analyses.

Plot Samples	Slope	Aspect
4	10-20%	NE
4	20-30%	NE
4	10-20%	SE
4	20-30%	SE

Methodology: (See attached maps of burn and reference plot locations)

1. Stratify combined slope and aspect into classes using a digital orthophoto and elevation model.
2. Choose 4 sample points from polygons for 10-20% slope for SE (12) and SW (13) aspects and 4 20-30% slope aspects at SE (22) and SW (23) aspects. Choose points from places in the polygons that are identifiable, such as near bend in trail or near large ponderosa pine tree.
3. Sample broadly for recreation types such as hiking or paragliding and hanggliding launch or staging areas within the slope/aspect classes.
4. Repeat general sampling scheme for the unburned reference site.
5. Count 10 paces from the stratified point and side of trail chosen on the orthophotos. At 10 paces measure 1 meter from the edge of the trail, and place the quadrat perpendicular to the slope. Mark NE/SE corners with large nails. Place metal tag stamped with plot ID on the NE corner. Mark the ID corner with a flag and both nails with flagging. If the NE corner cannot be marked with a nail, choose another corner and enter on datasheet. Collect GPS data for each plot location.
6. Estimate ground cover—soil, litter, rock, and wood—and vegetation cover using the following cover classes:

Cover Class Number	Percent Cover Class Range	Midpoint for Calculations
0	0-1	0.5
1	1-5	2.5
2	5-25	15.0
3	25-50	37.5
4	50-75	62.5
5	75-95	80.0
6	95-100	97.5

PA on wonderland Mapping?

7. Record other comments or observations.
8. Photograph plot using digital camera.
9. Make a list of species growing within the burn area outside sample plots.
10. Collect data at monthly intervals during the growing season, September and October 2002 and resume in March 2003 until the end of the growing season.

Assess the condition of vegetation on the burn and reference sites after taking the May 2003 data.

Data Analysis:
Monitoring data has been placed in a Microsoft ACCESS database, and queries have been developed to address key monitoring objectives.

- Average species cover in burned and unburned plots; native and non-native species cover (averaged across 5 monitoring dates).
- Frequency of species in burned and unburned plots; native and non-native species frequency.
- Total cover of all species in and out of burn (additive over 5 monitoring dates).
- Total ground cover by month/monitoring date and average plot ground cover value by month, in and out of burn.
- Species richness of native and non-native in and out of burn in September 2002 and May 2003.
- Total cover of native and non-native cover by month in and out of burn; total over all months.
- Total cover of all species by month in and out of burn.

RESULTS
Relative vegetation cover and other ground cover categories are plotted over time within the burn and compared to the reference area trends. Native and non-native plant cover, species frequency and species richness are compared among plots over time within and between the burn and reference areas.

- Total vegetation cover in the burn area plots in September 2002 was less than 20% of the vegetation cover in the unburned plots. By May 2003, total vegetation cover in the burn area plots was 50% greater than in the unburned plots. *Figures 1 and 2, Total Vegetation Cover – Burned and Unburned.*
- Total non-native cover in the burn plots in May 2003 was approximately 60% greater than in the unburned plots. Total native cover in the burn plots was approximately 40% greater than in the unburned plots in May 2003. *Figures 1 and 2, Total Vegetation Cover – Burned and Unburned.*
- Species richness (number of species) in September 2002 was 50% lower in the burned plots than the unburned. By May 2003, species richness of native and non-native species combined was 20 - 25% greater in the burned plots than in the unburned. There was approximately 25% greater native species richness in the burn compared to the unburned plots in May. Species richness of non-native species was slightly greater in the burned than in the unburned plots in May.
- Ground cover: Bare soil cover (surface area covered by bare soil) was consistently greater in the burned plots than the unburned over time. Litter cover was greater in September 2002 in the burn, probably due to higher vegetation cover in the overstory on unburned plots. Litter was lower on the burned area than the unburned by May 2003. Lower cover in the burn plots in May could have been due to the higher vegetation cover on those plots compared to the unburned plots. *Figure 3, Average Soil Cover.*

- Species frequency and individual species cover varied for several indicator or characteristic native and non-native species. The following table displays cover and frequency data for May 2003 in burned and unburned plots. Comparisons of the cover and frequency of the native species, western wheatgrass, blue grama, and white aster show notably higher values in the burn than in the reference area. The non-native species, cheatgrass, alyssum and filaree also occur with higher frequency and cover in the burn when compared to reference values.

Species Cover and Frequency, May 2003

Species	Native	% Cover Burn	% Cover Unburned	Frequency Burn	Frequency Unburned
Big bluestem	Yes	32.5	40.5	3	7
Native bluegrass	Yes	20.5	16.5	4	9
Western wheatgrass	Yes	300	100	10	15
Sun sedge	Yes	77	63	10	11
Blue grama	Yes	20.5	.5	4	1
Needle-and-Thread	Yes	20.5	20	4	3
White Aster	Yes	23	15	5	1
Yucca	Yes	55	0	3	0
Cheatgrass	No	231.5	185	14	15
Canada bluegrass	No	56.5	21	6	5
Filaree, Crane's bill	No	328	49	8	8
Alyssum	No	56	15	5	10

DISCUSSION (To be developed in the final report following the 2003 monitoring season)

MANAGEMENT RECOMMENDATIONS

- The burn area has recovered adequately in terms of the cover of native vegetation and demonstrated soil surface stability to allow the reopening of the area to recreation. On-trail use only, and dogs on leash is recommended.
- Monitoring of vegetation and regular observations of site conditions related to fire recovery and recreational use should continue. The suggested monitoring schedule after June 2003 consists of monthly monitoring in August, September, and October 2003. A final report will be generated at the end of the 2003 monitoring season, and will include a recommended schedule for continued monitoring.

- High priority noxious weed populations should be monitored by plot data collection and site evaluations. Monitoring and management of priority weed species should be coordinated by IPM and plant ecology staff. High priority species are: Jointed goatgrass (*Cylindropyrum cylindricum*), diffuse knapweed (*Acosta diffusa*), common teasel (*Dipsacus fullonum*), and cheatgrass (*Anisantha tectorum*).
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- Continue to encourage and facilitate involvement by neighbors, hanggliders, paragliders, and other interested public in the ongoing stewardship of the burn area.