

Colorado Tallgrass Prairie Managemen
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Colorado Tallgrass Prairie
Management Plan
City of Boulder Open Space &
Mountain Parks
Colorado Natural Areas Program
1986

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MANAGEMENT PLAN
CITY OF BOULDER OPEN SPACE
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cover art by Sue Galatowitsch

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I. INTRODUCTION

Tallgrass prairie once was common in eastern Colorado. Early botanists described tallgrass prairies along the length of the Front Range including the foothills near Boulder (Vestel, 1914, Dodds et al 1908, James, 1980, Branson et al., 1965). Overgrazing, cultivation, agricultural improvements, and urban development have destroyed most tallgrass habitats in Colorado. Moir, who studied the vegetation of tallgrass prairies in the late 1960's, realized their significance. He encouraged the City of Boulder to acquire and protect the relict prairies (Moir, 1969, 1972). The City of Boulder acquired most of these parcels. In the early 1980's, the Colorado Natural Areas Program supported a systematic inventory of potential tallgrass prairie habitat in Boulder County. The inventory determined that the Boulder tallgrass prairies are the largest and highest quality remnants in Colorado. Colorado Tallgrass Prairie, under City of Boulder ownership, was designated a state natural area in 1984. The Colorado Natural Areas Program and City of Boulder agreed to develop a management plan for the Boulder tallgrass prairie remnants.

The remnants included in the state natural area contain most of the vegetative components necessary to be restored to a true tallgrass prairie community. Although these areas have been affected by grazing, haying, and irrigation, all of the tracts are among the best examples of a natural community that once was prevalent throughout the surrounding area.

II. NATURAL AREA MANAGEMENT OBJECTIVES

The objectives of resource management for the Colorado Tallgrass Prairie are as follows:

- o Restore, conserve, and perpetuate the native flora and fauna to approximate pre-settlement conditions;
- o Maintain natural ecological processes in the tallgrass communities;
- o Encourage educational and interpretive use of tallgrass prairie relicts;
- o Encourage use of natural area for scientific research consistent with the basic purpose of the natural area.

III. AREA DESCRIPTION

LOCATION

The Colorado Tallgrass Prairie is located immediately south of Boulder, Colorado. The eight parcels, totalling 269 acres (108.9 hectares), are described in the Appendix 3. Figure 1 is a map of the natural area.

TOPOGRAPHY

The Colorado Tallgrass prairies are situated in the South Boulder Creek Valley. Land within the natural area gently slope toward South Boulder Creek. Elevations within the natural area range from 5480 to 5700 feet (1.67 to 1.74 kilometers).

GEOLOGY

South Boulder Creek begins in a high altitude basin on the Continental Divide in Gilpin County. The stream has carved its course through the granite of the Front Range and through sedimentary rocks at the junction of the mountains and plains. South Boulder Creek valley in the lower foothills (in the vicinity of the natural area) is covered by Quaternary alluvium deposited as fans and aprons along the ancient course of the river. Site 10, the north face of Davidson Mesa, is part of a mountain pediment, eroded through sedimentary rocks and later covered with gravel (Chronic, 1980).

SOILS

Figure 2 is a soil map of the natural area. The soil descriptions were provided by the Soil Conservation Service (USDA-SCS, 1975).

The proximity of a site to the location of the ancient stream course and mountains influences the soil found on that portion of the natural area. Soils of the Nederland series occur in the western portion of the natural area. These are deep, well drained soils which formed on old high terraces and alluvial fans. Many stones and cobbles are present on the surface. Soils of the Valmont series occur on the eastern edge of the outwash fans. These clay-loam soils contain varying amounts of cobbles and gravels. Soils of the Niwot series are present on bottomlands along South Boulder Creek. Pleistocene sand and gravel deposits are covered by recent loamy alluvium. Hargreave series soils occur in the eastern portion of the natural area. These sandy loams formed from weathered sandstone. Cobble and gravel may be present on the surface.

VEGETATION

Tallgrass prairie communities in the natural area are assumed to be relicts from early in the Holocene Atlantic episode, 8000 years before present (Gould et al., 1979, Axelrod, 1984). The coarse gravel stones that create the top layer of substrate on the Colorado Tallgrass Prairie

Figure 2a. Soil map of the eastern portion of the Colorado Tallgrass Natural Area (SCS). Soils: Te -terrace escarpments, Ha-Hargrove fine sandy loam, NdD -Nederalnd very cobbly sandy loam, VcC - Valmont cobbly clay loam.

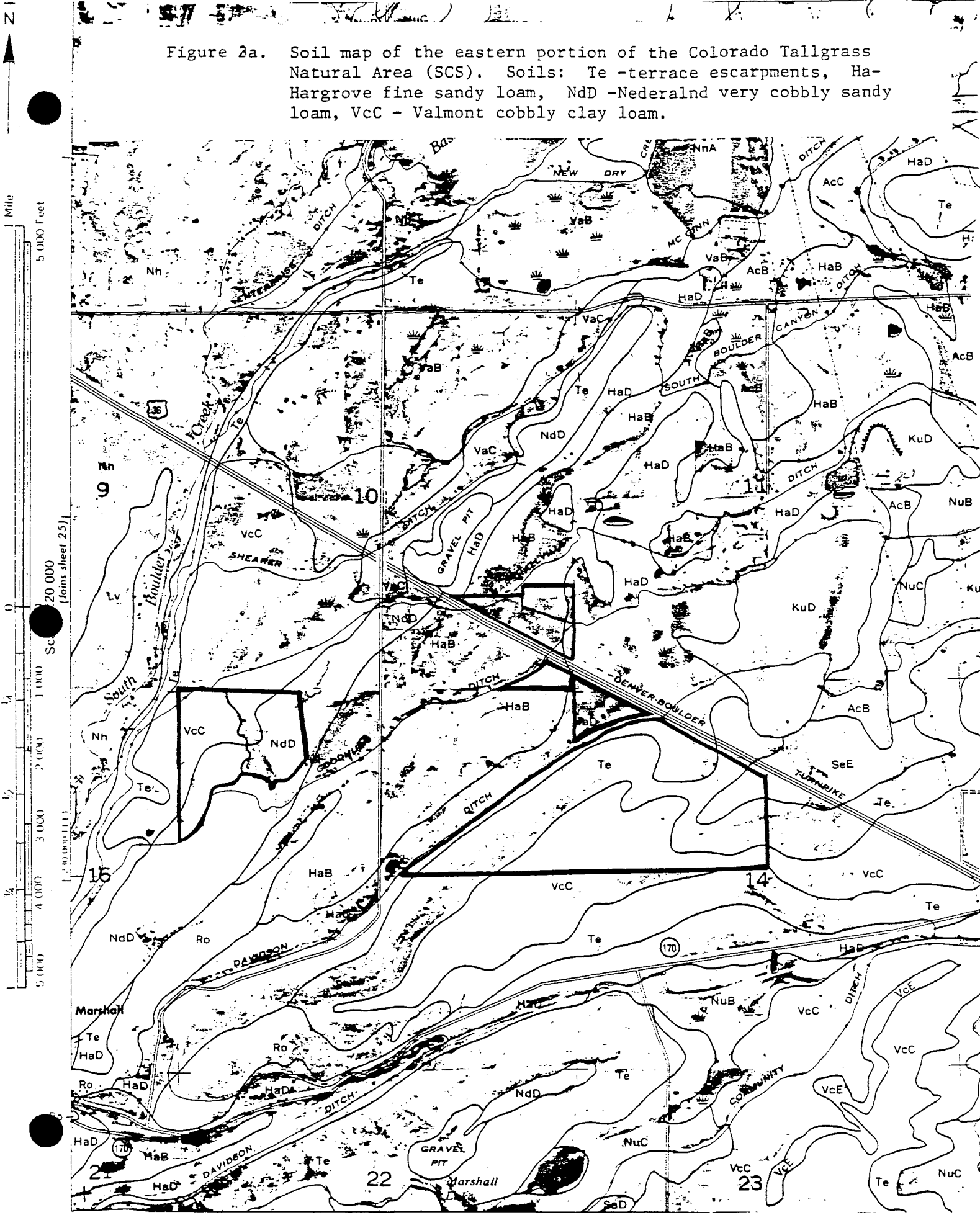


Figure 2b. Soil map of the western portion of the Colorado Tallgrass Natural Area (SCS) Soils: NdD- Nederalnd cobbly sandy loam, Nh-Niwot soils.



act as a mulch by allowing rapid infiltration of water and decreasing the amount of water lost from the soil and have greater available water for plant growth (Branson et al, 1965). Relict tallgrass prairie is restricted to these mesic conditions that form a narrow band along the mountain front.

A continuum of tallgrass prairie communities occur on the natural area. Moist, low-lying areas (representing mesic prairie) are dominated by big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), switchgrass (Panicum virgatum) and Indiangrass (Sorghastrum nutans). Drier, upland sites (xeric prairie) are dominated by big bluestem, little bluestem, and side-oats grama (Bouteloua curtipendula).

The flora of the Colorado Tallgrass Prairie is similar to that of western true prairies of the Great Plains, the Black Hills of South Dakota and other disjunct remnants (Moir, 1972, Dix, 1964). A partial plant list based on 1985 field work is in Appendix 1.

WILDLIFE

In the 1850's, the first settlers of Boulder County noted that this region was winter range for buffalo and antelope (Vickers, date unknown). No specific information on historic wildlife use of the tallgrass prairies has been found.

Few studies document recent wildlife utilization of tallgrass prairies in the Boulder area or in Colorado. The bobolink and grasshopper sparrow were documented to breed on Boulder City Open Space grasslands (Thompson and Strauch, 1985). Both species have a restricted distribution throughout their range, and are especially sensitive to habitat disturbances (Graul, 1980). Both species require tall grass for nesting. Grazing and haying before mid to late July are considered threats to these species (Thompson and Strauch, 1985)

Raptor species nesting on cliffs of nearby Flatirons and Eldorado Mountain hunt in the grasslands of South Boulder Creek Valley (Figs and Lederer, 1985). Prairie falcons and American kestrels utilize the grasslands most frequently.

Twenty-five bird species have been observed in grassland habitats of City of Boulder Open Space (Thompson and Strauch, 1985). These species are noted in a list of potential animal species generated by the Colorado Division of Wildlife (see Appendix 2).

No quantitative studies of mammals exist in Boulder County. Armstrong and Freeman (1982) provide a qualitative description. No studies have been conducted to document mammal, reptile, amphibian or invertebrate utilization of tallgrass prairie habitat in the Boulder area.

CLIMATE

Climate has changed markedly a number of times since tallgrass prairies were first established during the early Holocene period. Over the past 300 years, the climate has become warmer and drier. Recurring

drought has marked the recent climate (Gould et. al. 1979).

The climate in the vicinity of the natural area is strongly affected by the mountains. Most of the precipitation in the area is orographic: moist air is forced upward by the mountains, moisture condenses and precipitates. Orographic precipitation falls in the lower foothills in spring and fall, when air masses from the Gulf of Mexico back up against the mountains creating upslope conditions. Convective storms are frequent on late spring and summer afternoons. The average annual precipitation is 18 inches (457 mm) per year. The area in the vicinity of the natural area has a May precipitation maximum falling as rain or variably heavy, wet snow and a midwinter precipitation minimum (Mutel, 1976).

The average temperature in the vicinity of Boulder, Colorado is 51 degrees F (10.5C) with 152 frost free days (SCS).

Data collected from Marshall Mesa by the National Atmospheric and Oceanic Administration indicate that wind direction is predominantly from the west year-round (Al Bedard, research files NOAA). Wind direction is most variable in late spring, in May and June.

Wind speed is highest in the winter months, with a maximum for the year occurring in February at 3.73 m/sec (8.35mph). Minimum wind speeds occur in the spring and summer months with lowest average reading (1979-1982) in May at 2.68 m/sec (6.0 mph). A summary of climatological data is provided in Table 1.

Table 1. Climatological data for the vicinity of the Colorado Tallgrass Prairie Natural Area (NOAA records, 1985).

<u>MONTH</u>	<u>TEMP</u>	<u>HUMIDITY</u>	<u>PPT</u>	<u>WIND SP</u>	<u>WIND DIR</u>
January	32.5	47.3	0.47	7.3	W
February	36.1	42.5	0.56	8.4	W
March	40.8	46.5	2.13	8.0	W
April	48.9	37.8	1.78	7.3	W
May	56.6	44.8	3.16	6.0	W
June	66.6	35.8	1.68	6.1	W
July	72.7	33.0	2.24	6.6	W
August	72.0	37.8	1.37	6.2	W
September	62.9	35.0	1.89	6.3	W
October	50.8	35.5	1.49	6.3	W
November	40.4	42.0	1.20	6.7	W
December	33.9	46.5	0.78	6.0	W

TEMP Mean Temperature (F), 1980-1985, Boulder, Colorado.

HUMIDITY Mean Relative Humidity (%), 1100 hr, 1980-1983, Denver, CO

PPT Mean precipitation (inches), 1980-1985, Boulder, Colorado

WIND SP Mean wind speed (mph), 1979-1982, Table Mesa-Boulder, CO

WIND DIR Prevailing wind source, 1979-1982, Table Mesa-Boulder, CO

IV. LAND USE HISTORY

Boulder Valley was settled in the late 1850s. Permanent herds of domestic stock were introduced into the area at settlement and meadows were hayed as early as 1859 (Vickers, date unknown)

The U.S. Government Land Office surveyed South Boulder Creek Valley in January and February, 1864. Field notes for this area do not provide detailed landscape descriptions. Soils throughout the Colorado Tallgrass Natural Area tracts were characterized as first or second rate. The surveyor remarked that the grass was "good" along the section line of 11 and 14, parcel 9.

A road followed South Boulder Creek from Eldorado Springs along the north bank, passing through site 7. Field notes from 1864 do not indicate if the road was used heavily. A road from the Marshall foundry followed the section line to the east of Parcels 1 and 2, terminating approximately one-quarter of a mile beyond Parcel 2. Field notes do not describe a road in the present grade of U.S. 36 separating Parcel 6 from Parcels 4 and 5.

The Goodhue Ditch from South Boulder Creek to the Marshall Foundry was excavated before the 1864 land survey. This ditch flows south and east of Parcel 3. The foundry was constructed in 1864. Remaining lengths of the Goodhue Ditch and the Davidson Ditch were excavated after the original land survey.

The Colorado Tallgrass Natural Area tracts were claimed between 1871 and 1891 (Abstract Land Titles #39, 1883). Boulder County Treasurer records have not been searched to document when each parcel was claimed and changed ownership.

Parcels 1, 2, 4, 6, 9 and part of 10 were included in the Fox Ranch 100 years ago. The Ranchaw family purchased some or all of the Fox Ranch at an unknown time. The Yunker family purchased the portion of the Ranchaw Ranch including parcels 4, 6, 9 and part of 10 in 1943.

Dairy cattle grazed the upland portions of the ranch, including parcels 9 and 10, from mid-spring to early fall. The low-lying areas including 4 and 6 were hayed in the later part of July and grazed from fall to spring. Both parcels are irrigated.

Chemicals were not used on the Yunker property for weed control. Hay meadows were fertilized with manure. Prairie dogs and grasshoppers never significantly affected the range.

The Yunkers operated the dairy farm until 1960. The area was leased to various individuals until 1966. Albert and Leo Hogan leased the property from the Yunkers until City of Boulder acquisition in 1983.

A portion of the Fox Ranch including parcels 1, 2 and part of 10 was purchased by the Church family at an unknown date. The Hogans have

leased the Church property since 1943. Cattle have grazed the area from January to May 1 since the Hogans have retained the lease. No information was obtained on management prior to 1943.

Parcels 1 and 2 have been irrigated by a mine cave spring for 30-40 years.

Part of the Hogan lease burned approximately 65 years ago. The acreage burned was not extensive. The location of the burn, time of burn, and origin are unknown.

Parcels 3 and 7 are included in a tract that was owned by Rocky Mountain Fuel and Iron Company. The Thomas family leased before purchasing the property in 1945. Prior to the Thomas lease, sheep and goats grazed the property. Mr. Thomas grazed mules and horses until 1955 and grazed cattle from 1955-1967. Grazing was usually restricted to winter months.

The Hogans have leased the land for winter cattle grazing (Hank or Leo and Albert) since 1967, except for 1972. Heavy grazing occurred in 1972 during the summer under management of a unknown lessee.

Portions of Parcels 3 and 7 were hayed for two years in the early 1960s and may have been hayed in the early-mid 1900s. The areas were fertilized with manure and irrigated by nearby ditches.

No chemicals have been used to control weeds.

The City of Boulder began acquiring the Thomas property in 1979, the Yunker property in 1978, and the Church property in 1977. Table 2 summarizes the agricultural history of the three properties since City acquisition.

Table 1

History of Past Stocking Records*
Boulder Open Space Tallgrass Prairies
(Abstracted/computed from Sonja Hix Summary 4/4/86)

Dates of Record Named or Numbered Properties and Animal Units of Use

		Hogan-Parrish:		
		Unit #7	Unit #3	Units #7 and #3 Combined
1979		15 AUMs		
11/24 - 5/24 80/81		11 AUMs	14.4 AUMs	
12/8/81 - 6/8/82				90 AUMs maximum ¹
11/16/82 - 5/15/83				90 AUMs maximum
10/31/83 - 4/30/84				90 AUMs maximum
5/01/84 - 5/ 1/85				24 AUMs maximum
11/01/85 - 4/30/86				24 AUMs maximum ²

		Church and Yunker Combined:	
9/15/79 - 5/1/80		No record	
1980 - 1981		No record	
1/1/81 - 5/1/82		150 AUMs	
1/1/82 - 5/1/83		150 AUMs	
1/1/83 - 5/1/84		150 AUMs	
Some use to 1/1/85		Indefinite amount (cf David Kuntz letter to Jim Crain, 8-6-85 date)	

Notes on condition ratings 5/1/84 show Church property has 285 acres and 420 AUMs estimated as of that date. Yunker property had 190 acres and 280 AUMs.

Separate Records for Church Property Show:

Church East (160 acres) pre-1979 use	300 AUMs Feb. 1 - May 1
Estimated carrying capacity	200 AUMs of "range grazing"
	100 AUMs combined supplemental feeding and irrigated forage
1980 Prescribed Maximum Use: 100 cow-calf pairs for 3 months by continuing supplemental feedings, irrigation	

Church West (120 acres) Pre-1979 use varied:	50-120 AUMs plus few head in January
1980 Prescribed use (max.)	120 AUMs w/supplemental feeding

Maximum of 40 AUMs for 3 months plus feeding (1/1 to 5/1 5/1/83 Records fix 600 aum limitation for both properties (150 aum for 4 months

*Source: Sonja Hix records: computations of AUMs use table of animal unit equivalents attached to that report.

1 Figures are based on lease agreements of kind/age/number of animals and prescribed season. Actual total AUMs of use are often considerably less than total permitted due to early marketing, removal for illnesses, and weather emergencies particularly if pasture stocking is monitored. Actual stocking may vary from permitted use.

2 Lease agreement affected 5/1/84 prescribed use to 4/30/86 but did not state numbers or dates for 1985/86, only for 84/85 season.

V. MANAGEMENT

LITERATURE REVIEW

Numerous studies across the Great Plains have resulted in range recommendations for tallgrass sites. Kansas and South Dakota recommendations might be expected to be most similar to Colorado relict sites because of a relatively comparable climate and nearby geographic position (Heitlinger, Painter, personal communications, 1985). Management recommendations for relict tallgrass sites differ from most published range studies because (1) managing a natural area such as the Colorado Tallgrass Prairie has different objectives than managing for forage production, and (2) climatic differences exist between areas of the main distribution of tallgrass prairies and the Colorado foothill relicts.

Typical grazing practices seek to ... "make more efficient use of grazing resources that should increase livestock production and improve economic returns to producers, communities and the state" (Launchbaugh and Owensby 1978). Managing grasslands as natural areas is necessary because: "There is a high scientific value in preserving samples of typical environments both those relatively undisturbed by man and those which he has materially modified" (Subcommittee on the Conservation of Ecosystems, 1967).

If remnant grasslands are withdrawn from man's influence, the prairie vegetation may not improve and maintain itself, because of past uses, current climate and weather patterns, and the proximity to other agricultural uses (Cosby 1975). Vegetation management to replicate historic factors can include one or a combination of the following methods: mowing, burning or grazing.

Many observations and studies have reinforced the concept that tallgrass prairies are "fire derived and fire maintained" systems (Owensby, 1972, Daubenmire, 1968). Ponderosa pines have encroached upon prairie stands in ecotonal areas of Wind Cave National Park because of fire suppression (Schripsema, 1977). Natural and prescribed fires will slow or prohibit woody plant invasion (Bragg and Hulbert, 1976; Bock and Bock, 1984; Daubenmire, 1968). Wildfires, primarily caused by lightning, occurred year round (Jackson, 1965). The highest frequency of fires occurs during the summer season when fuel loads are higher (Daubenmire, 1968). Lewis and Clark reported that Native American tribes used fire to enhance new plant growth to attract large herbivores, primarily bison. Domestic cattle operations adopted this practice in the early 1900's to encourage early growth in tallgrass areas (Owensby 1972). Burning typically occurred in January or February. Subsequent range studies have established that prescribed burning should coincide with the start-up of growth of these grasses in the late spring to maximize production (Launchbaugh and Owensby 1978).

Several thousand years after the last glacial retreat, approximately 5000 years ago, bison emerged as the dominant grazers in the Great Plains

(McDonald, 1981) Pronghorn antelope, elk, deer, prairie-dogs, rabbits, rodents, and insects have occurred on the prairie since the Pleistocene period (Launchbaugh and Owensby 1978). Many grasses have adaptations which may have evolved as a response to fire and grazing pressures: placement of the growing point at the surface of the soil rather than elevated, the ability to have stem growth occur at several places along the length of the stem, and the ability to form mats (Branson, 1953, Owensby 1972). Bison and elk historically moved in herds, intensively grazing and trampling areas. The first cattle operation before 1900 herded livestock over large areas approximating the effects of native grazers. Cattle confinement with barb wire fencing and more intensive use drastically altered the tallgrass prairie (Owensby, 1972).

Domestic cattle differ substantially in diet and grazing behavior from bison (Schwartz and Ellis, 1981). but some natural areas managers use cattle to simulate native grazers. Deferred grazing and intensive early stocking have been used by natural areas managers (Heitlinger, personal communication 1985). In South Dakota, intensive early (until May 1) range use resulted in heavy utilization of cool season exotic grasses and forbs (Cosby 1975). Careful monitoring of the plant community is necessary, because the native vegetation can be heavily impacted by any use after apical growth buds are elevated into the animals grazing zone (Wasser, 1986, personal communication 1985). In the only published study of Colorado tallgrass prairies, Moir found that grazing caused a decrease in abundance of big bluestem, Indiangrass, and switchgrass while increasing blue grama (Boteloua gracilis), a shortgrass species, as well as silver sage (Artemisia frigida), a common indicator of disturbance (Moir 1972).

While light continuous grazing may at first seem to have potential for natural area management, results have generally been poor (Cosby, 1975). Cosby documented that cattle at low numbers prefer low areas and concentrate foraging in small areas while leaving other areas untouched. Bison prefer high, hilly land (Beth Painter, personal communication 1985) The selectiveness and unevenness of small herds grazing cause this method to be a poor imitation of the effects of grazing by large herds.

Mowing and haying on the Konza Prairie in Kansas has been used to simulate burning, resulting in a tallgrass prairie rich in species. The hayed native tallgrass prairie vegetation of Konza prairie benefits most from a single harvest in late July (Hulbert, personal communication, 1985). Harvesting hay in August or September rather than July reduces the warm-season perennial grasses and results in an increase of weedy species (Launchbaugh and Owensby, 1978). Mowing allows some species, such as sweetclovers, to invade that are kept out by burning (Hulbert, unpublished data, 1985).

While grazing and burning are used to simulate historic events, the effect on prairie vegetation from different management treatments may vary. Kentucky bluegrass, Poa pratensis increased in grazed areas in

Kansas tallgrass prairies, displacing native prairie species (Hulbert, 1978). However, time, frequency, and intensity will determine many of the changes that occur. For example, late spring burning reduces or eliminates cool season species such as Japanese brome (Bromus japonicus) and bluegrass (Poa esp.) (Anderson, 1972; Curtis and Partch, 1948; Ehrenreich, 1959; Hulbert, 1985a; McMurphy and Anderson 1965).

The timing of treatments can result in a variety of effects on prairie vegetation. Late spring burns on a Kansas tallgrass prairie favor big bluestem, winter and early spring burns favor junegrass (Koeleria cristata) and sedges, and early to mid spring burns favor little bluestem (Schizachyrium scoparium) (Towne and Owensby 1984). Wildfires, in late fall to late winter reduce warm-season perennial grasses because of loss of mulch and cover that reduces soil moisture, exposure of dormant plant regenerative tissue to winter weather extremes, and the puddling action of early spring rains. (Launchbaugh and Owensby, 1978).

MANAGEMENT RECOMMENDATIONS

a. Site Prescriptions

Management recommendations should be consistent with the objective to perpetuate native tallgrass prairies but are constrained on all parcels by lease commitments made by the City of Boulder. Therefore, the acreages dedicated to traditional management practices of grazing and haying greatly exceed the acreages for prescribed burning and no active management. Site prescriptions were developed by completing a site survey and evaluating the potential management treatments for each area. Prescriptions are limited to a three year plan after which results will be evaluated.

Grazing and haying are used to simulate natural historic influences on tallgrass prairie across the Great Plains.

The City of Boulder leases all designated tallgrass parcels to two lessees (Leo and Albert Hogan, Hank Hogan) to graze cattle and/or haying. Special management guidelines for the maintenance of tallgrass species have been included in the comprehensive management plan and contract for each lease. Tallgrass prairie areas to be grazed will only be available between October 15 and April 30 each year and only if forage is available. Stocking rates and grazing periods are based on rangeland, pasture, and hayland analyses conducted by the tallgrass committee in the fall of 1985 and late winter, 1986. The City of Boulder reserves the right to adjust stocking rates and/or season of use to reflect phenological changes or adverse growing conditions, when necessary. Stocking rates assume a 60-70% utilization of palatable forage. City of Boulder is responsible for monitoring trends in utilization. Winter forage tolerates more use; utilization in the non-growing season cycles standing dead vegetation and controls cool season exotics such as Kentucky bluegrass (Launchbaugh and Owensby, 1978).

Parcel 9-10 will be included in a short term-high, intensity grazing system with other Hogan lease tracts. Parcel 9-10 will be grazed at a rate which will not exceed 1.2 acres/Animal Unit Month. The duration will be shortened to a maximum of thirty days (no more than five consecutive days with minimum rests of 30 days). Season of use will vary annually and is described later in this section. This short term intensive utilization can be beneficial to native vegetation because it is thought to simulate the non-selective feeding behavior of large herds of bison (H. Sprock, personal communication, 1986). Close monitoring of the livestock is necessary in a short term-high intensity system. Severe damage to the range will occur if cattle are retained in an area past the appropriate removal time determined by plant phenology (M. Heitlinger, personal communication, 1986)

The hay on parcel 4 has traditionally been removed by early August. Hay will continue to be removed after July 30, generally the end of the nesting period for grasshopper sparrows and bobolinks (Thompson and Strauch, 1985). Tallgrass prairie is critical nesting habitat for both species.

Fire is an integral component of tallgrass prairie ecosystems (D. Ratzloff, personal communication, 1985). Numerous studies have documented the need to include prescribed burning in the management regime of tallgrass prairies (including Anderson, 1964; Anderson, 1972; Bragg and Hulbert, 1976; Cosby, 1975; Gartner and Thompson, 1972; Hulbert, 1985b). The technology has been developed to accomplish burn management effectively and safely (including Shilts et al, 1980, Wright and Bailey, 1982). Several small areas have been set aside in Parcels 3 and 7 to compare the effects of prescribed burning on the tallgrass natural area to grazing and haying. Prescribed burning methods used in Wind Cave National Park, South Dakota, Konza Prairie, Kansas, University of Wisconsin Arboretum, and Tamarack Ranch, Colorado will be employed on the tallgrass prairie remnants in Boulder.

The Tallgrass Management Committee met with Colorado State Forest Service staff responsible for the prescribed burning program in Colorado. The burns proposed by the committee were determined to be feasible by the State Forest Service. The Colorado State Forest Service routinely contracts with private and public land managers for prescribed burning in forested and non-forested habitats. They have conducted approximately five burns a year for fifteen years and have never lost control of a prescribed burn. In cases where a public agency has the trained staff to control fires, such as the City of Boulder, the State Forest Service acts as a consultant for preparing the fire plan, igniting the fire, and conducting the burn.

A fire plan including objectives, acceptable fire conditions, costs, and contingency plans is approved by the State Forest Service and contracting agency prior to the burn. The National Weather Service provides customized weather reports to the State Forest Service on the day of the burn to determine if conditions are acceptable. No more than ten people will be required to conduct each of the proposed two acre burns.

Control areas have been established in all parcels. Data from control areas will provide the necessary baseline information to evaluate manipulative treatments.

The following summarizes the management prescriptions for each parcel of the natural area:

- o Parcel 1-2 (12 acres) Mesic prairie occur within a larger grazing unit of 45 acres. Grazing will occur from October 15 to April 15 and will not exceed 5 AUMs on parcel one and 11 AUMs on parcel two. The site has been irrigated during the growing season. Permanent exclosures were recommended by the tallgrass management committee but City of Boulder staff has determined that no exclosures will be installed at this time. A 10 foot x 10 foot portable range exclosure was put on site 2.
- o Parcel 3. (23.2 acres) Xeric and mesic tallgrass communities occur on this site: 12.7 acres will be grazed, 4 acres will be burned, and 6.5 acres will be unmodified. Examples of mesic and xeric prairies will be included in each prescription. Grazing will occur from October 15 to April 15 and will not exceed 17 animal unit months (AUMs). Four acres will be burned in two units in mid-spring of 1987 when soil moisture is greatest.
- .. o Parcel 4 (6 acres) Site is irrigated and will continue to be hayed once a year after July 30. Grazing on the aftermath will occur from October 15 to April 15 and will not exceed 5 AUMs. The site will continue to be irrigated.
- o Parcel 6 (20.3 acres) Parcel six is entirely mesic tallgrass prairie: 13.5 acres will be grazed and 6.8 acres will be unmodified (3.0 acres of the unmodified portion have been severely overgrazed and are not included in the natural area designation). Grazing will occur from October 15 to April 15 and will not exceed 31 AUMs. Irrigation has been removed from the exclosure, but not from the remaining area. Fire was considered as a treatment but exclosure size was inadequate. Fire should be considered at a later date as a possible treatment.
- o Parcel 7 (100 acres) Xeric and mesic tallgrass communities occur on this site: 68 acres will be grazed, 8 acres will be burned, and 24 acres will be unmodified. Mesic and xeric prairie are included in the grazed area. Only examples of mesic prairie will be burned or left unmodified. Grazing will occur from October 15 through April 15 and will not exceed 108 AUMs. Four acres will be burned in two units in mid-spring of 1987 and another four acres will be similarly burned in 1988.

- o Parcel 9-10 (113 acres) Xeric and mesic tallgrass communities occur on this site: 113 acres will be grazed. Two portable monitoring exclosures will be used to evaluate range condition. Permanent exclosures were recommended by the tallgrass management committee, but City of Boulder staff has determined that no exclosures will be installed at this time. This parcel will be part of a short-term, high intensity grazing system and will receive use at a rate no greater than 1.2 acres/AUM. Cattle will graze the area for no more than a total of 30 days cumulative, five days consecutive, with a 30-60 day rest, based on plant phenology.

An unmodified area is particularly important for this site, because careful monitoring is critical for successful short-term, high intensity range management.

b. Weed Management

Exotic plant species, excepting noxious weeds, will not be managed. Weed control within the exclosures will be the responsibility of the tallgrass management committee. Designated tallgrass parcels outside the exclosures are covered by lease agreements and are the responsibility of the lessee. Noxious weeds will not be chemically controlled. The following is the official list of noxious weeds for the state of Colorado:

NOXIOUS WEED LIST: Noxious weeds known to occur in Boulder County are denoted with a *; those documented from natural area parcels in 1985 are denoted with a **.

A. Prohibited (primary) noxious weeds:

Bindweed, field (Convolvulus arvensis)**
Halogeton (Halogeton glomeratus)
Horsenettle, Carolina (Solanum carolinense)
Horsenettle, White (Solanum elaeagnifolium)
Johnson grass (Sorghum halpense)
Joint goat grass (Aegilops cylindrica)
Knapweed, Russian (Centaurea repens)**
Musk Thistle (Carduus nutans)**
Poverty-weed, silver-leaf (Franseria discolor)
Poverty-weed, woolly-leaf (Franseria tomentosa)
Sorghum alnum (Sorghum alnum)
Sowthistle, perennial (Sonchus arvensis)*
Spurge, leafy (Euphorbia esula)*
St. Johns-wort (Hypericum perforatum)*
Thistle, Canada (Cirsium arvense)*
Whitetop (Cardaria draba)*
Whitetop, hairy (Cardaria pubescens)*
Whitetop, tall (Lepidium latifolium)*

B. Restricted (secondary) noxious weeds:

Dock, curly (Rumex crispus)*
Dodders (Cuscuta spp.)*
Groundcherry, purple-flower (Physalis lobata)*
Lettuce, blue (Lactuca pulchella)*
Oat, wild (Avena fatua)*
Plantain, buckhorn (Plantago lanceolata)*
Poverty-weed, mouse-ear (Iva axillaris)*
Puncture vine (Tribulus terrestris)*
Quackgrass (Agropyron repens)*
Wild mustard (Brassica nigra)* (Brassica juncea)*
White mustard (Brassica kaber)*

c. Prairie Dog Management

The City of Boulder Open Space Department has established a prairie dog management advisory group to recommend management methods. A member of the tallgrass management committee has been assigned to the prairie dog advisory group to develop specific recommendations for the natural area.

Prairie dogs are present in the northwest corner of parcel 7. The tallgrass committee has determined that prairie dogs are incompatible with management goals on the parcel. No chemical control will be used on parcel 7, or other natural area sites pending advisory group recommendations. Non-chemical control is being used on the site this spring to limit emigration into the natural area.

Temporary visual barriers (hay bales) have been placed between the colony and the natural area. The road provides a buffer for the visual barrier. Barriers restrict visual and vocal communication.

Visual barriers are a temporary solution. Removal of grazing from the colony for several years is the effective long-term solution. Prairie dog impacts on tallgrass vegetation are an important relationship that should be investigated in the future.

MONITORING

Since the Colorado Tallgrass Prairie areas are relict communities, management of the area is experimental. Monitoring the effects of the treatments will be necessary to determine whether the management objectives are being met. Several measurements of the vegetation will be used to evaluate the condition of the sites: species diversity, species composition (frequency and cover), biomass production, and litter accumulation. Similar information has been collected for tallgrass prairies throughout the Great Plains. This information will be used to compare the data collected from the tallgrass relicts. In addition, data will be collected on animal species diversity, small mammal distribution, and breeding bird distribution.

A two acre permanent study plot will be established within each treatment unit. The following summarizes the proposed methods:

- o SOILS The Soil Conservation Service will characterize the chemical and physical properties of the soils on the tallgrass parcels and prepare a detailed soil map of the area.
- o SPECIES DIVERSITY (plants and animals)
Species diversity is the total number of species in a given area. A floristic list will be compiled by the Boulder Chapter of the Colorado Native Plant Society and the specimens deposited at the University of Colorado herbarium. The Boulder County Nature Association will coordinate developing a list of birds and mammals.
- o SPECIES COMPOSITION (plants)
Percent cover, the total amount of area covered by each species, and percent frequency (how often individuals occur in an area) will be measured by Daubenmire plot sampling. Twenty-five 0.5m X 1.0m plots are placed systematically in a criss-cross arrangement along a 50 meter permanent transect placed randomly in each 2 acre treatment plot. Percent frequency is the number of frames in which a species occurred relative to the total number of frames. Percent cover for a species is determined by averaging the basal cover measured for each frame. The Colorado Natural Areas Program will coordinate species composition sampling. Sampling will occur late during the growing season, in mid-August.
- o PRODUCTION AND LITTER ACCUMULATION (plants)
Biomass production is the total amount of air-dried plant biomass produced in a year. Litter accumulation is the total amount of dead plant material covering the soil surface. Twenty-five circular plots (1.00 m square) will be clipped within each treatment area for production and a 10 cm x 25 cm litter plot will be taken from within the area.. These plots will not be located with the species composition transect. The dead and live material will be separated. Live material will be separated by species. Air-dried weight will be calculated for the dead material (litter) and for each species (production). The City of Boulder Open Space staff will coordinate production and litter sampling twice during the growing season, in early June and late-August.
- o SAMPLE DISTRIBUTIONS (animals)
An estimate of small mammal abundance will be obtained from live trapping studies. Breeding bird estimates will be determined using methodology consistent with past City studies (Thompson and Struch, 1985). The Boulder County Nature Association will coordinate these distribution studies. Sites 3,6, and 7 are priorities for sampling animal distribution.

VI. CONCLUSIONS

The eight designated parcels of tallgrass prairie included in the Colorado Natural Area are remnants of a natural community that once extended throughout South Boulder Creek Valley and along much of the Rocky Mountain Front in Colorado. If properly restored and managed, this island archipelago of prairie can serve as an important baseline area for monitoring the range, pasture and hayland condition of surrounding, potentially similar habitat. In addition, managing these tallgrass remnants for their natural values will preserve an important part of the presettlement landscape of Colorado.

The prescriptions developed in this plan and strategies developed in the future should be consistent with the goals of managing a natural area. Although judicious land management has maintained vestiges of tallgrass prairie in the natural area, deliberate action is necessary to restore these areas to a pristine condition. Species diversity is low. The forb component of the community is depauperate (Kline, personal communication, 1986). Species present in presettlement time that have been extirpated will need to be reestablished in the natural area. The small acreage set aside from the traditional uses of grazing and haying in this plan may be inadequate to restore and maintain tallgrass prairie (Kline, Bock, personal communication, 1986).

For the next three years 220 acres of the natural area will continue to be grazed, 6 acres will continue to be hayed and grazed, 12 acres will have a prescribed burn, and 32 acres will be unmodified. Data will be collected in these areas to determine the effects of different land use on the tallgrass prairie communities. Additional information on land use history and on the historic flora of the prairies will be compiled. The City of Boulder and the Colorado Natural Areas Program with assistance from the Tallgrass Management Committee will review the information after three years to develop management strategies for the natural area.

VII. COLORADO TALLGRASS MANAGEMENT COMMITTEE MEMBERS:

<u>AGENCY OR ORGANIZATION</u>	<u>REPRESENTATIVE</u>
City of Boulder- Open Space	Chris Wilson Dick Antonio
Colorado Department of Natural Resources- Natural Areas Program	Dave Kuntz Steve O'Kane Sue Galatowitsch
Lessees	Hank, Leo and Albert Hogan
Colorado Department of Natural Resources- Division of Wildlife	Don Smith
Soil Conservation Service	Harvey Sprock Leonard Jurgens Dawn Genes
Boulder County Nature Association	Mike Figgs
Colorado Native Plant Society	Sue Martin
Colorado State University	Clint Wasser Beth Painter
University of Colorado	Jane Bock Bill Weber
Thorne Ecological Institute	David Cooper
Colorado Section of Society of Range Management	Tom Eamen Jane Bunin

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Appendix 1. Floristic List

Plant species occurring on the Boulder Tallgrass Prairies

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
FAB	<i>Astragalus tridactylicus</i>	three-toed milk vetch	9-10
EUP	<i>Euphorbia robusta</i>	robust spurge	9-10
AGA	<i>Yucca glauca</i>	soapweed	1,2,3,7,9-10
ALI	<i>Alisma brevipes</i>	NCN	7
ANA	<i>Rhus trilobata</i>	skunkbrush	7
API	<i>Cymopterus montanus</i>	chimaya	7,9-10
API	<i>Daucus carota</i>	wild carrot	3
ASC	<i>Asclepias speciosa</i>	showy milkweed	1,2,3,6
ASC	<i>Asclepias stenophylla</i>	narrowleaf milkweed	7
ASN	<i>Paronychia jamesii</i>	nailwort	1,2
ASN	<i>Spergularia media</i>	sand spurry	1,2
ASP	<i>Asparagus officinalis</i>	asparagus	6
AST	<i>Achillea lanulosa</i>	yarrow	3,6,7
AST	<i>Ambrosia psilostachya</i>	western ragweed	3,6,7,9-10
AST	<i>Ambrosia trifida</i>	giant ragweed	3,7
AST	<i>Antennaria</i> sp.	pussytoes	7
AST	<i>Aristida longiseta</i>	red threeawn	7,9-10
AST	<i>Artemisia frigida</i>	fringed sage	3,6,7,9-10
AST	<i>Artemisia ludoviciana</i>	Louisiana sagebrush	3,7,9-10
AST	<i>Virgulus (Aster) ericoides</i>	heath aster	1,2,6,7
AST	<i>Virgulus (Aster) falcatus</i>	aster	1,2,3,6,7,9-10
AST	<i>Aster hesperius</i>	Siskiyou aster	1,2,3,6,7
AST	<i>Aster porteri</i>	Porter's aster	1,2
AST	<i>Carduus nutans</i>	musk thistle	7,9-10
AST	<i>Centaurea diffusa</i>	Russian knapweed	3
AST	<i>Brickella eupatorioides</i>	NCN	1,2,6,7
AST	<i>Cirsium flodmanii</i>	Flodman's thistle	6
AST	<i>Bidens cernus</i>	beggar's tick	6,7
AST	<i>Arctium minus</i>	burdock	6
AST	<i>Cirsium undulatum</i>	wavy-leaf thistle	7
AST	<i>Helianthus annuus</i>	sunflower	6
AST	<i>Helianthus pumilus</i>	sunflower	1,2
AST	<i>Helianthus falcata</i>	sunflower	1,2
AST	<i>Erigeron flagellaris</i>	fleabane	3,7
AST	<i>Lactuca serriola</i>	wild lettuce	1,2,6,7
AST	<i>Heterotheca fulcrata</i>	golden aster	7
AST	<i>Cichorium intybus</i>	chickory	1,2,3,6,7,9-10
AST	<i>Cirsium arvense</i>	Canada thistle	1,2,3,6,7

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
AST	<i>Cirsium ochrocentrum</i>	thistle	1,2
AST	<i>Cirsium vulgare</i>	thistle	1,2,6,9-10
AST	<i>Oligosporus (Artemisia) dracunculus</i>	false tarragon	7,9-10
AST	<i>Ratibida columnifera</i>	upright prairiecone flower	3,9-10
AST	<i>Grindelia squarrosa</i>	curlycup gumweed	1,2,6,7,9-10
AST	<i>Gutierrezia sarothrae</i>	snakeweed	1,2,3,7,9-10
AST	<i>Heterotheca villosa</i>	hairy goldenaster	1,2,6,7,9-10
AST	<i>Liatris punctata</i>	prairie gayfeather	3,6,7
AST	<i>Gaillardia aristida</i>	blanket flower	7
AST	<i>Leucelene ericoides</i>	white aster	3
AST	<i>Conyza canadensis</i>	horseweed	7
AST	<i>Oligoneuron rigidum</i>	NCN	3,6,7
AST	<i>Podospermum laciniatum</i>		7
AST	<i>Sphaeralcea coccinea</i>	scarlet globemallow	6
AST	<i>Townsendia hookeri</i>	townsendia	6
AST	<i>Senecio spartoides</i>	broom groundsel	1,2,3,7,9-10
AST	<i>Solidago canadensis</i>	goldenrod	6,7
AST	<i>Solidago missouriensis</i>	Missouri goldenrod	6,9-10
AST	<i>Solidago cf. rigida</i>	stiff goldenrod	3,6
AST	<i>Solidago nana</i>	goldenrod	3
AST	<i>Taraxacum officinale</i>	dandelion	6,7
AST	<i>Tragopogon dubius</i>	goatsbeard	6,7,9-10
AST	<i>Xanthium strumarium</i>	cocklebur	6,7
BOR	<i>Cryptantha virgata</i>	cryptantha	7,9-10
BOR	<i>Lithospermum multiflorum</i>	puccoon	7
BOR	<i>Onosmodium molle</i>	wayside gromwell	6,9-10
BRA	<i>Alyssum minus</i>	NCN	6,7
BRA	<i>Lepidium densiflorum</i>	papergrass	1,2
BRA	<i>Lesquerella sp.</i>	bladderpod	9-10
BRA	<i>Lepidium campestre</i>	peppergrass	3,7
BRA	<i>Physaria vitulifera</i>	twinpod	7
BRA	<i>Sisymbrium altissimum</i>	tumble mustard	7
CAC	<i>Echinocereus viridiflora</i>	hen and chicks	7
CAC	<i>Opuntia compressa</i>	starvation cactus	1,2,3,6,7,9-10
CAC	<i>Opuntia fragilils</i>	brittle pricklepear	3,7
CAC	<i>Opuntia phaeacantha</i>	Mexican pricklepear	7
CRY	<i>Arenaria sp.</i>	sandwort	7
CRY	<i>Phlox</i>	phlox	9-10
CHN	<i>Amaranthus retroflexus</i>	pigweed	6
CHN	<i>Chenopodium album</i>	lambsquarters goosefoot	3,6
CHN	<i>Chenopodium berlandieri</i>	Lambsquarters	1,2
CHN	<i>Kochia sieversiana</i>	kochia	1,2,6
CHN	<i>Suaeda sp.</i>	seepweed	1,2
CHN	<i>Salsola collina</i>	Russian thistle	6
CHN	<i>Salsola kali</i>	Russian thistle	9-10

Appendix/Plant/Species

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
CNV	<i>Evolvulus nuttallianus</i>	Nuttall's evolvus	1,2,7
CNV	<i>Convolvulus arvensis</i>	field bindweed	1,2,3,6,7
CRY	<i>Dianthus armeria</i>	Deptford pink	3,7
CRY	<i>Silene antirrhina</i>	sleepy catchfly	7
CYP	<i>Carex heliophila</i>	sedge	3,6,7,9-10
CYP	<i>Carex douglasii</i>	sedge	1,2
CYP	<i>Carex praegracilis</i>	sedge	1,2
CYP	<i>Carex brevior</i>	sedge	6
CYP	<i>Carex simulata</i>	sedge	3
CYP	<i>Carex lanuginosa</i>	sedge	3
CYP	<i>Carex nebrascensis</i>	Nebraska sedge	7
CYP	<i>Carex scoparia</i>	sedge	7
CYP	<i>Carex eleocharoides</i>	sedge	7
CYP	<i>Schoenoplectus pungens</i>	NCN	6
ELE	<i>Eleagnus angustifolia</i>	Russian olive	1,2,3,6,7
EQU	<i>Hippochaete hyemalis</i>	horsetail	3
EQU	<i>Equisetum arvense</i>	horsetail	6,7
EUP	<i>Agaloma marginata</i>		6
EUP	<i>Comandra umbellata</i>	a sandalwood	3,7
EUP	<i>Tragia ramosa</i>	NCN	7
FAB	<i>Amorpha nana</i>	dwarf wild indigo	1,2,7
FAB	<i>Amorpha fruticosa</i>	false indigo	6
FAB	<i>Dalea (Petalostemum) candidum</i>	white prairie clover	7
FAB	<i>Dalea (Petalostemum) purpureum</i>	purple prairie clover	7
FAB	<i>Glycyrrhiza lepidota</i>	American licorice	1,2,6,7
FAB	<i>Lotus tenuis</i>	narrow-leaf trefoil	1,2
FAB	<i>Medicago lupulina</i>	black medic	1,2
FAB	<i>Lupinus argenteus</i>	silvery lupine	1,2,3,7
FAB	<i>Melilotus alba</i>	white sweet clover	6,7
FAB	<i>Melilotus officinalis</i>	yellow sweet clover	7
FAB	<i>Oxytropis</i> sp.	locoweed	9-10
FAB	<i>Psoralea lanceolata</i>	lemon scurfpea	7
FAB	<i>Trifolium pratense</i>	red clover	1,2,3,6,7
FAB	<i>Robinia pseudo-acacia</i>	locust	3
FAB	<i>Thermopsis divaricarpa</i>	yellow banner	3,7
FAB	<i>Trifolium repens</i>	white clover	3,6
FAB	<i>Psoralidium (Psoralea) tenuiflorum</i>	slender scurfpea	1,2,3,6,7,9-10
GRS	<i>Ribes aureum</i>	golden currant	9-10
HYD	<i>Phacelia heterophylla</i>	phacelia	7
HYP	<i>Hypericum perforatum</i>	St. John's wort	3,7
IRI	<i>Iris missouriensis</i>	Rocky Mountain iris	3,7

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
JUN	<i>Juncus longistylis</i>	rush	1,2,7
JUN	<i>Juncus arcticus</i>	rush	6,7
JUN	<i>Eleocharis palustris</i>	spikerush	3,6,7
JUN	<i>Juncus interior</i>	rush	3
JUN	<i>Juncus balticus</i>	Baltic rush	3,6,7,9-10
JUN	<i>Juncus torreyi</i>	bur rush	1,2,3,7
JUN	<i>Juncus alpinoarticulatus</i>	rush	1,2
JUN	<i>Juncus confusus</i>	rush	1,2,3,6,7
JUN	<i>Juncus dudleyi</i>	rush	1,2
JUN	<i>Juncus gerardii</i>	rush	1,2
JUN	<i>Juncus articulatus</i>	rush	6
JUN	<i>Eleocharis acicularis</i>	spike rush	6
JUN	<i>Juncus nodosus</i>	rush	3
LAM	<i>Lycopus americanus</i>	American bugleweed	7
LAM	<i>Prunella vulgaris</i>	self heal	3,7
LAM	<i>Mentha arvensis</i>	field mint	3,6,7
LIL	<i>Leucocrinum montanum</i>	sandlily	9-10
LIN	<i>Linum lewisii</i>	Lewis flax	9-10
LYT	<i>Lythrum alatum</i>	winged loosestrife	1,2,3
ONA	<i>Epilobium ciliatum</i>	fireweed	7
ONA	<i>Gaura parviflora</i>	velvety gaura	6,9-10
ONA	<i>Gaura coccinea</i>	scarlet gaura	6,7
ONA	<i>Oenothera villosa</i>	evening primrose	1,2,6,7
ONA	<i>Oenothera strigosa</i>	evening primrose	3,7
OXL	<i>Oxalis dillenii</i>	wood sorrel	3
PIN	<i>Pinus ponderosa</i>	ponderosa pine	7,9-10
PLG	<i>Acetosella vulgaris</i>	sheep sorrel	7
PLG	<i>Eriogonum</i> sp.	buckwheat	6,7
PLG	<i>Pterogonum (Eriogonum) alatum</i>	winged buckwheat	1,2,3,7,9-10
PLG	<i>Eriogonum effusum</i>	buckwheat	1,2,7
PLG	<i>Polygonum aviculare</i>	knotweed	3,6,7
PLG	<i>Polygala aviculare</i>	milk-wort	7
PLG	<i>Rumex crispus</i>	dock	3,6,7
POA	<i>Elytrigia (Agropyron) repens</i>	quackgrass	1,2,3,6
POA	<i>Agropyron smithii</i>	western wheatgrass	6,7
POA	<i>Agrostis gigantea</i>	giant wheatgrass	1,2,3,6,7
POA	<i>Agrostis alba</i>	redtop	3,6
POA	<i>Andropogon gerardii</i>	big bluesteam	1,2,3,6,7,9-10
POA	<i>Aristida purpurea</i>	purple three-awn	1,2,6,7
POA	<i>Botelua (Bouteloua) gracilis</i>	blue grama	3,6,7,9-10
POA	<i>Boteloua (Bouteloua) hirsuta</i>	hairy grama	
POA	<i>Bromus japonicus</i>	Japanese Brome	3,6,7,9-10
POA	<i>Anisantha (Bromus) tectorum</i>	cheatgrass	1,2,3,7,9-10

Appendix/Plant/Species

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
POA	Buchloe dactyloides	buffalo grass	1,2,6,7
POA	Agropyron desertorum	desert wheatgrass	6
POA	Dichanthelium lanuginosum	NCN	6,7
POA	Echinochloa crus-galli	barnyard grass	1,2
POA	Festuca pratensis	fescue	3
POA	Dactylis glomerata	orchardgrass	3,6,7
POA	Distichlis spicata	inland saltgrass	1,2,3,6
POA	Elymus canadensis	Canada wildrye	6
POA	Critesion (Hordeum) jubatum	foxtail barley	1,2,6,7
POA	Botelua (Bouteloua) curtipendula	side-oats grama	6,7,9-10
POA	Sporobolus heterolepis cryptantha	prairie dropseed	7,9-10
POA	Koeleria cristata	June grass	9-10
POA	Muhlenbergia asperifolia	alkali muhly	1,2,3,6,7
POA	Muhlenbergia montana	mountain muhly	7,9-10
POA	Muhlenbergia richardsonis	mat muhly	7
POA	Muhlenbergia wrightii	spike muhly	3
POA	Panicum wilcoxianum	panicle grass	3,6
POA	Panicum virgatum	switchgrass	1,2,6,7,9-10
POA	Phleum pratense	timothy	3,6,7
POA	Poa compressa	Canada bluegrass	1,2,3,6,7,9-10
POA	Poa pratensis	Kentucky bluegrass	1,2,3,6,7,9-10
POA	Poa sandbergii	Sandberg's bluegrass	9-10
POA	Poa fendleriana	Fendler's bluegrass	7
POA	Setaria sp.	bristlegrass	7
POA	Sitanion hystrix	bottlebrush squirreltail	3
POA	Sorghastrum nutans	yellow Indiangrass	1,2,3,7,9-10
POA	Spartina pectinatus	prairie cordgrass	3,6,7
POA	Sporobolus airoides	alkali sacaton	1,2,3,6,9-10
POA	Sporobolus asper	tall dropseed	1,2,3,6
POA	Stipa comata	needle and thread	3,9-10
POA	Schizachyrium (Andropogon) scoparium	little bluestem	1,2,3,6,7,9-10
POP	Populus angustifolia	narrowleaf cottonwood	3
POP	Populus deltoides	cottonwood	3,6
POR	Talinum parviflorum	fameflower	7
PTG	Plantago patagonica	Patagonian plantain	3,7
PTG	Plantago lanceolata	buckhorn plantain	1,2,3,6,7
RAN	Ranunculus macounii	buttercup	6
RHM	Ceanothus fendleri	buckbrush	7,9-10
RHM	Ceanothus herbaceous	New Jersey Tea	1,2
RHM	Ceanothus americanus	buckbrush	7

Appendix/Plant/Species

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
ROS	<i>Drymocaulis fissa</i>	bigflower cinquefoil	7,9-10
ROS	<i>Potentilla norvegica</i>	cinquefoil	3,7
ROS	<i>Prunus virginiana</i>	chokecherry	9-10
ROS	<i>Prunus besseyi</i>	sand cherry	9-10
ROS	<i>Rosa acicularis</i>	prickly rose	3,7,9-10
ROS	<i>Rosa arkansana</i>	Arkansas rose	1,2,3,6,7
RPR	<i>Symphoricarpos occidentale</i>	snowberry	3,6,7
SAL	<i>Salix exigua</i>	willow	6
SCR	<i>Penstemon secundiflorus</i>	sidebells penstemon	7
SCR	<i>Verbascum blattaria</i>	flannel mullein	1,2
SCR	<i>Verbascum thapsus</i>	flannel mullein	1,2,3,6,7,9-10
SCR	<i>Verbena hastata</i>	blue verbena	7
SCR	<i>Veronica americana</i>	American speedwell	6
SCR	<i>Veronica salina</i>	speedwell	6
SOL	<i>Solanum rostratum</i>	buffalobur nightshade	6
TYP	<i>Typha latifolia</i>	cattail	3,7
VIO	<i>Viola pedatifida</i>	prairie violet	7
VRB	<i>Phyla lanceolata</i>	northern fog-fruit	6
VRB	<i>Verbesina encelioides</i>	golden crownbeard	7,9-10
ZYG	<i>Tribulus terrestris</i>	puncture vine	6

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Appendix 2.

Animal species projected and observed for Boulder Tallgrass Prairies
(Colorado Division of Wildlife, 1985; Thompson and Strauch, Jr., 1985)

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>OBSERVED</u>
<u>AMPHIBIANS</u>		
<u>Ambystoma tigrinum</u>	Tiger Salamander	
<u>Bufo cognatus</u>	Great Plains toad	
<u>Bufo woodhousii</u>	Woodhouse's toad	
<u>Scaphiopus bombifrons</u>	Plains spadefoot	
<u>REPTILES</u>		
<u>Cnemidophorus sexlineatus</u>	Prairie-lined racerunner	
<u>Coluber constrictor</u>	Eastern yellowbelly racer	
<u>Crotalus viridis</u>	Prairie rattlesnake	
<u>Eumeces multivirgatus</u>	Northern many-lined skink	
<u>Heterodon nasicus</u>	Plains hognose snake	
<u>Holbrookia maculata</u>	Northern earless lizard	
<u>Lampropeltis triangulum</u>	Milk snake	
<u>Phrynosoma douglassi</u>	Short-horned lizard	
<u>Pituophis melanoleucus</u>	Bullsnake	
<u>Tantilla nigriceps</u>	Plains blackhead snake	
<u>Terrapene ornata</u>	Ornate box turtle	
<u>Thamnophis radix</u>	Western plains garter snake	
<u>BIRDS</u>		
<u>Agelaius phoeniceus</u>	Red-winged blackbird	X
<u>Ammodramus bairdii</u>	Baird's sparrow	
<u>Ammodramus savannarum</u>	Grasshopper sparrow	X
<u>Aquila chrysaetos</u>	Golden eagle	X
<u>Bubo flammeus</u>	Short-eared owl	
<u>Athene cucularia</u>	Burrowing owl	
<u>Bartramia longicauda</u>	Upland sandpiper	
<u>Branta canadensis</u>	Canada goose	X

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>OBSERVED</u>
<u>Buteo jamaicensis</u>	Red-tailed hawk	
<u>Buteo lagopus</u>	Rough-legged hawk	
<u>Buteo regalis</u>	Ferruginous hawk	X
<u>Buteo swainsoni</u>	Swainson's hawk	
<u>Calamospiza melanocorys</u>	Lark bunting	
<u>Calcarius lapponicus</u>	Lapland longspur	
<u>Carduelis flammea</u>	Common redpoll	
<u>Cathartes aura</u>	Turkey vulture	
<u>Charadrius vociferus</u>	Killdeer	
<u>Chondestes grammacus</u>	Lark sparrow	X
<u>Chordeiles minor</u>	Common nighthawk	X
<u>Circus cyaneus</u>	Northern harrier	X
<u>Colaptes auratus</u>	Northern Flicker	X
<u>Corvus corax</u>	Common raaven	
<u>Corvus cryptoleucus</u>	Chihuahuan raven	
<u>Dolichonyx oryzivorus</u>	Bobolink	
<u>Eremophila alpestris</u>	Horned lark	X
<u>Falco columbarius</u>	Merlin	
<u>Falco mexicanus</u>	Prairie falcon	X
<u>Falco peregrinus</u>	Peregrine falcon	
<u>Falco sparverius</u>	American Kestrel	X
<u>Gallinago gallinago</u>	Common snipe	
<u>Hirundo pyrrhonota</u>	Cliff swallow	X
<u>Hirundo rustica</u>	Barn swallow	X
<u>Lanius excubitor</u>	Northern shrike	
<u>Lanius ludovicianus</u>	Loggerhead shrike	
<u>Larus pipixcan</u>	Franklin's gull	
<u>Numenius americanus</u>	Long-billed curlew	
<u>Nyctea scandiaca</u>	Snowy owl	
<u>Passerculus sandwichensis</u>	Savannah sparrow	
<u>Pica pica</u>	Black-billed magpie	X
<u>Plectrophenax nivalis</u>	Snow bunting	
<u>Poocetes gramineus</u>	Vesper sparrow	X

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>OBSERVED</u>
<u>Sayornis saya</u>	Say's phoebe	X
<u>Selasphorus platycercus</u>	Broad-tailed hummingbird	X
<u>Sialia currucoides</u>	Mountain bluebird	
<u>Sialia mexicana</u>	Western bluebird	
<u>Spiza americana</u>	Dickeissel	
<u>Spizella arborea</u>	American tree sparrow	
<u>Spizella pallida</u>	Clay-colored sparrow	
<u>Spizella passerina</u>	Chipping sparrow	
<u>Spizella breweri</u>	Brewer's sparrow	X
<u>Stelgidopteryx serripennis</u>	Northern rough-winged swallow	X
<u>Sturnella neglecta</u>	Western meadowlark	X
<u>Tyrannus verticalis</u>	Western kingbird	X
<u>Zenaida asiatica</u>	White-winged dove	X
<u>Zenaida macroura</u>	Mourning dove	

MAMMALS

<u>Cynomys ludovicianus</u>	Black-tailed prairie dog	
<u>Dipodomys ordii</u>	Ord's kangaroo rat	
<u>Geomys bursarius</u>	Plains pocket gopher	
<u>Lepus californicus</u>	Black-tailed jack rabbit	
<u>Microtus ochrogaster</u>	Prairie vole	
<u>Myotis leibii</u>	Small-footed myotis	
<u>Onychomys leucogaster</u>	Northern grasshopper mouse	
<u>Perognathus flavescens</u>	Plains pocket mouse	
<u>Perognathus flavus</u>	Silky pocket mouse	
<u>Spermophilus tridecemlineatus</u>	Thirteen-lined ground squirrel	
<u>Taxidea taxus</u>	Badger	
<u>Urocyon cinereoargenteus</u>	Gray fox	

Appendix 3

COLORADO NATURAL AREAS PROGRAM
DEPARTMENT OF NATURAL RESOURCES
STATE OF COLORADO
COLORADO TALLGRASS PRAIRIE NATURAL AREA
ARTICLES OF DESIGNATION

These Articles of Designation, made this 20th of ~~November~~ 1984, by and between the Department of Natural Resources, State of Colorado, 1313 Sherman Street, Room 718, Denver, Colorado 80203, hereinafter the Department, and the City of Boulder, Municipal Building, 1777 Broadway, Boulder, Colorado 80302, hereinafter the City of Boulder.

WHEREAS, the City of Boulder owns and manages certain lands as open space in eight parcels and totaling 269 acres as described in Exhibits A and B, attached hereto and incorporated herein by reference, and known as the Colorado Tallgrass Prairie Natural Area situated in the County of Boulder, State of Colorado, hereinafter the Property; and

WHEREAS, the City of Boulder has declared that the best use of the Property is that it be preserved and protected, as evidenced by the proposed designation of the areas by the City as a "protected area;" and

WHEREAS, the Department is authorized to conduct and administer the provisions of the Colorado Natural Areas Act (C.R.S. 1973, 36-10-101, et seq.) which established within the Department the Colorado Natural Areas Program, hereinafter the Program, and the Colorado Natural Areas Council, hereinafter the Council; and

WHEREAS, the Department has determined, pursuant to its criteria, that the Property is a natural area and that it would be desirable to include the

Property within the Colorado Natural Areas System as a designated State Natural Area; and

WHEREAS, as a result of the attributes of the Property, the Property provides one or more of the benefits described in C.R.S. 1973, 36-10-104(2).

NOW THEREFORE, it is hereby agreed that:

1. Designation of the Property as a Natural Area. Upon filing of these Articles of Designation with, and acceptance of same by the Department, with the advice and approval of the Council, the Property described in Exhibits A and B, attached hereto and incorporated herein by reference, shall become a designated natural area and thereby shall become part of the Colorado Natural Areas System. Said designated natural area shall be known as the Colorado Tallgrass Prairie Natural Area.

2. Purpose of Designation. The Department has determined, upon recommendation by the Council, that the Property qualifies as a natural area to be included in the Colorado Natural Areas System due to the following:

A. Botanically, the Property represents good quality examples of, and the largest known area in Colorado, for:

1) Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium - Sorghastrum nutans Mesic Tallgrass Prairie (Big bluestem - switchgrass - little bluestem - yellow indiagrass Mesic Tallgrass Prairie).

2) Andropogon gerardii - Bouteloua curtipendula - Bouteloua gracilis - Schizachyrium scoparium Xeric Tallgrass Prairie (Big bluestem - sideoats grama - blue grama - little bluestem Xeric Tallgrass Prairie).

B. The Property contains grasslands which are known to be rare nationally and statewide. The tallgrass prairie remnants contain a unique Colorado flora similar to flora in the tallgrass prairie areas of the eastern Great Plains (eastern Kansas, Nebraska, Minnesota, Wisconsin, and Illinois).

C. The Property contains several unique animals, including the grasshopper sparrow (Ammodramus savannarum) (uncommon in Colorado).

D. The Property provides, among other benefits, the following benefits:

1) It serves as an example of the native condition in studies relating to air, water, and soil quality and habitat productivity and can serve as a baseline for re-establishing or restoring the native condition.

2) It provides outstanding opportunities for scientific research and study in the fields of botany, ecology, and zoology.

3) It serves as a resource from which new knowledge may be derived and as a reservoir of genetic material which has present and future value to scientific inquiry.

4) It serves as an area of high aesthetic value, scenic grandeur, and exemplary natural features.

3. Rights and Duties of the Department. The Department shall list the Property as a designated natural area of the Colorado Natural Areas Program and shall provide the City of Boulder with a Certificate of Designation and a signed copy of the Articles of Designation indicating said designation. This designation evidences the desire of the Department that the Property be protected from impacts adversely affecting the attributes for which the Property is designated.

A. Access.

The Department agrees that user-access to the Property will be the responsibility of the City of Boulder.

B. Visitation.

The Department may visit the site at any time to determine current uses and conditions for consistency with the Program. Following the visitation, the Department will consult with land provide any resulting reports to the City of Boulder.

4. Rights and Duties of the City of Boulder. The management of the Property shall be the responsibility of the City of Boulder, which agrees to preclude all development of the Property except as deemed necessary to protect the area for the purpose for which it is established and to protect the natural features of the Property.

- A. A management plan for the Property will be completed by December 31, 1985, to provide management guidelines for each of the eight parcels. The management plan will detail the control or restriction of grazing of domestic animals and the cutting of grass for hay, on a parcel-by-parcel basis. The objective of the management plan is to increase the viability of the native grassland species on the Property. The plan will include, but not be limited, to:

1. A parcel-by-parcel detail of how the grazing of domestic animals and the cutting of grass for hay will be controlled or restricted from the Property. Cutting frequencies and grazing levels will be reviewed upon expiration or renewal of grazing leases. Parcels number 3 and 6, as described in Exhibit A and on the attached map of the Property, will be used to establish ecological baselines for monitoring the Property. Grazing and haying will be excluded from parcels 3 and 6 by January 1, 1985.

2. Various grassland management techniques which will be used on the Property. Options will include, but not be limited to: periodic burning, cutting, and planting.
 3. In the development of the management plan, expertise will be sought from the Department and from researchers familiar with management of native prairie ecosystems.
- B. No hunting will be allowed within the Property.
 - C. No spraying of chemicals banned by the United States Environmental Protection Agency will be allowed within the Property, except when necessary as required by law. Hand spraying, where feasible, will be used.
 - D. No surface occupancy will be allowed for oil and gas leasing or extraction on those areas having City of Boulder-owned minerals. Any mineral leasing agreements for City of Boulder-owned minerals will include no surface occupancy stipulations.
 - E. No public use of motorized vehicles will be authorized within the boundaries of the Property.
 - F. The City of Boulder will provide the Department with basic information on the condition and uses of the Property based on a brief form provided annually to the City of Boulder by the Department.
 - G. The City of Boulder will continue to exercise all of its legally mandated rights and duties regarding the Property.
5. Default. If either party reasonably believes that the other party is in default in any of its obligations under this Agreement, it may give the other party written notice of the alleged default. Promptly thereafter, the parties shall confer and make a good faith effort to

correct the default and to resolve any difference of opinion which may exist as to the respective rights and duties under this Agreement. Default by the City of Boulder may result in the removal of the Property from the Colorado Natural Areas System.

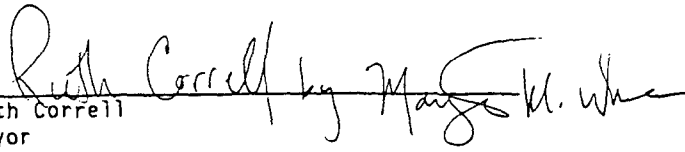
6. Termination. If either party desires to terminate this Agreement, it shall so notify the other party and give said other party an opportunity to confer regarding the reasons for termination. No less than 30 days after said initial notice, the notifying party may terminate this Agreement by notice to said other party. At the request of the City of Boulder, following termination of this Agreement, the Department shall execute and deliver to the City of Boulder a release of all its right, title, and interest in the Property which may arise out of this Agreement.

7. Notice. All notices to be given pursuant to this Agreement shall be in writing and shall be sent postage prepaid by registered or certified mail, return receipt requested, to the addresses first listed above or to such other person or address as the party to be notified may have designated prior thereto by written notice to the other party. Any notice so mailed shall be effective upon receipt.


8. Amendments. These Articles may be amended in writing by the parties hereto with approval of the Council.

IN WITNESS THEREOF, the parties hereto have executed this Agreement of the first day written above.

CITY OF BOULDER

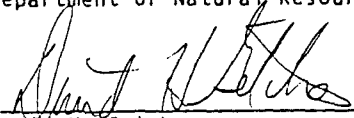


Ruth Correll
Mayor



Joseph M. de Raismes
City of Boulder Attorney

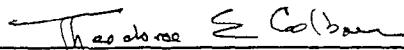
STATE OF COLORADO
Department of Natural Resources



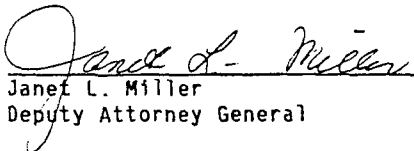
David H. Getches
Executive Director

APPROVED:

Colorado Natural Areas Council



Theodora Colborn
Chair



Janet L. Miller
Deputy Attorney General

EXHIBIT 3

MAP ATTACHMENT TO
COLORADO NATURAL AREAS PROGRAM
DEPARTMENT OF NATURAL RESOURCES
STATE OF COLORADO
COLORADO TALLGRASS PRAIRIE NATURAL AREA
ARTICLES OF DESIGNATION

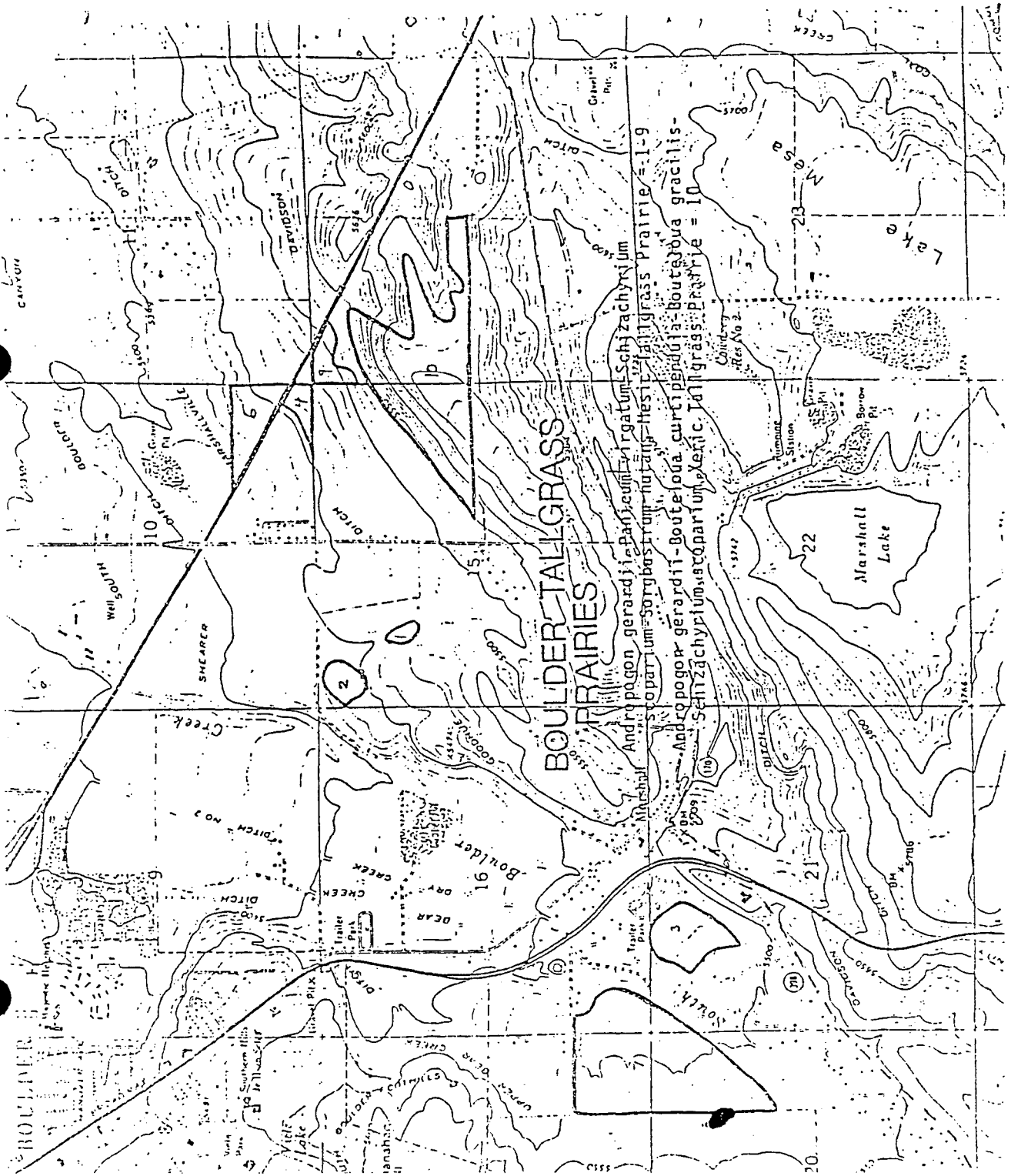


EXHIBIT A:

Boulder Tallgrass Prairie Natural Area
Legal Description

- Parcel 1: Approximately 4 acres located in the Northwest quarter of Section 15, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 2: Approximately 8 acres located in the Northwest quarter of the Northwest quarter of Section 15, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 3: Approximately 22 acres located in the Northwest quarter of Section 21, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 4: Approximately 6 acres located on the Southeast quarter of the Southeast quarter of Section 10, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 6: Approximately 17 acres located in the South half of the Southeast quarter of Section 10, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 7: Approximately 99 acres located in the Southwest quarter of the Southwest quarter of Section 16, Township 1 South, Range 70 West; and in the Southeast quarter of the Southeast quarter of Section 17, Township 1 South, Range 70 West; and in the East half of the Northeast quarter of Section 20, Township 1 South, Range 70 West; and in the Northwest quarter of the Northwest quarter of Section 21, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 9: Approximately 13 acres located in the Northwest quarter of the Northwest quarter of Section 14, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 10: Approximately 100 acres located in the Northwest quarter of Section 14, Township 1 South, Range 70 West and in the Northeast quarter of Section 15, Township 1 South, Range 70 West as outlined on the attached map.

Colorado Tallgrass Natural Area
Prescribed Fire Plan

I. TREATMENT AREA AND OBJECTIVES

PURPOSE OF FIRE MANAGEMENT

Objectives for vegetation management for the Colorado Tallgrass Natural Area are:

- o restore, conserve, and perpetuate the native flora and fauna to approximate pre-settlement conditions;
- o maintain natural ecological processes in the tallgrass community.

The Colorado Tallgrass Management Committee has developed a three-year experimental design to evaluate grazing, haying, fire and the active management on the natural prairie community (1986). Prescribed burning will replicate the effects of natural, pre-settlement fires. Portions of the natural area will be burned to determine if fire management:

- o decreases the abundance of non-native species such as cheatgrass (Bromus tectorum) and Kentucky bluegrass (Poa pratensis);
- o increases the abundance and diversity of native prairie forbs;
- o affects the productivity of native warm-season grasses (including Panicum virgatum, Sorghastrum nutans, Andropogon gerardii, Schizachyrium scoparium).

DESCRIPTION OF TREATMENT AREA

Size: Eight parcels, totalling 269 acres comprise the natural area. Twelve (12) acres, in two-acre units, will be burned over a two-year period.

Location: The treatment areas are located in the South Boulder Creek Valley in Parcel 3: NW 1/4 Section 21, and in Parcel 7: SW 1/4 Section 16, 17, 20, 21, T15, R70W.

Elevation: The treatment areas are at 5500 feet in elevation.

Landform: The treatment areas are nearly level, occurring in the floodplain of South Boulder Creek.

Soil Types: Nederland cobbly sandy loams forms the substrate of Parcel 3. Soils of the Niwot Series occur on Parcel 7. Niwot soils are sand and gravel deposits covered by recent loamy alluvium.

Vegetation: Mesic and Xeric tallgrass communities occur in the treatment areas. Three burn units are mesic tallgrass prairie, occurring in moist, low-lying areas dominated by big bluestem, little bluestem, switch grass and Indian grass. Three burn units are xeric tallgrass, occurring on drier, upland sites dominated by big bluestem, little bluestem, and side-oats grama. Composition data for the sites are included as Appendix A.

Dead Fuels: Levels of dead fuels present are adequate to carry the fire but will not be an important factor in containment as in forest habitats.

Climate and weathern patterns: The climate in the vicinity of the treatment areas is strongly affected by the mountains. Most of the precipitation in the area is orographic: moist air is forced upward by the mountains, moisture condenses and precipitates. Orographic precipitation falls in the lower foothills in spring and fall when air masses from the Gulf of Mexico back up against the mountains creating upslope conditions. Convective storms are frequent on late spring and summer afternoons. The average annual precipitation is 18 inches per year. The average temperature in the vicinity of Boulder is 51°F with 152 frost free days.

Wind speed is highest in the winter months, with a maximum for the year occurring in February at 8.4 mph, and a minimum in May at 6.0 mph. Wind is predominantly from the west year-round.

Weather data for the vicinity collected by the National Atmospheric and Oceanic Administration is summarized in Appendix B. The burn will be conducted in late April-early May when soil moisture will be highest and windspeed will be lowest. Burns will not be conducted in high wind or low soil-moisture conditions.

TREATMENT OBJECTIVES

The primary objective of the burns proposed in this plan is to decrease exotic species and increase the cover and production of warm-season grasses. Later season burns may be necessary in future years to enhance native forb diversity and abundance.

TREATMENT ALTERNATIVES

Alternative treatments being used on the natural area are:

a. GRAZING: The natural area has been grazed during the winter by livestock for several decades. During the three year experimental period, 226 acres will continue to be grazed. In the only published study of Colorado tallgrass prairies, Moir found that grazing caused a decrease in abundance of big bluestem, Indiangrass, and switchgrass while increasing shortgrass prairie species (Moir, 1972).

b. HAYING: The six acres of the natural area that have traditionally been hayed will continue to be hayed throughout the three year plan period. In Kansas, harvesting hay in August or September rather than July reduces warm-season perennial grasses and results in an increase of weedy species (Launchbaugh and Owensby, 1978).

c. NO ACTIVE MANAGEMENT: Thirty-two acres will be unmodified over the next three years. Studies of prairie management in the Great Plains suggest that the vegetation may not improve and maintain itself, because of past uses, current weather patterns and the proximity to other agricultural uses (Cosby, 1975).

TREATMENT CONSTRAINTS

a. Environmental constraints: No environmental constraints are foreseen. Lessees of City of Boulder Open Space are routinely issued open burn permits for ditch-burning. A permit for burning from the Boulder County Health Department will be requested. The City of Boulder Fire Department and Cherryvale Fire District will be informed of the prescribed burn. The burns will be conducted on days with favorable wind conditions to limit the effects of reduced visibility on Colorado Highway 93. Residences in the trailer court adjacent to parcel three may be affected briefly by smoke. Local law enforcement agencies (Boulder County sheriff, Boulder City Police) and the Colorado State Patrol will be informed of the prescribed burn.

b. Multiple Use Constraints: The treatment areas are separated from the rest of the parcel by permanent fencing. The cattle in the adjacent pastures should not be affected because they will not be directly downwind of the burn. Although a trailer court is adjacent to parcel three, no residences are located close enough to treatment units to be at risk. No residences are directly downwind of proposed burns.

Information on the need and safety of prescribed burning will be distributed to local residences prior to the burn to minimize negative response to the project.

c. Economic constraints: No economic constraints are foreseen.

d. Operational constraints: None. The City of Boulder Open Space Department has all equipment necessary to safely conduct the prescribed burns. Dr. Clinton Owensby, range scientist from Kansas State University, will head the burn crew. The City of Boulder and Boulder County Volunteer Fire Departments have trained staff for the burn crews.

e. Administrative constraints: None. The City of Boulder is adequately insured to conduct the two acre burns proposed in this plan.

II. FIRE PRESCRIPTION AND BURN PLAN

TREATMENT SPECIFICATIONS

Accomplishments: The burn will be conducted in late April to early May when cool season grasses are no more than three inches high and warm-season grasses show 1-1 1/2 inches of new growth. Herbaceous vegetation should be burned off at or near ground level. The resulting bare soil will improve growing conditions for the native prairie grasses.

Environmental conditions: The following fire conditions will be acceptable for desired results:

Windspeed - 5-10 mph
Relative humidity - approximately 40% (between 35% and 45%)
Air temperature - 60-75°

These environmental conditions are consistent with those used by Kansas State University, Texas Tech University, and Colorado Division of Wildlife for similar habitats.

Fire behavior: The fine fuel load of 2000-2500 lb/acre should permit a continuous, moderately hot fire. The fires will probably be ignited in early morning to ensure suitable environmental conditions.

PREPARATION FOR BURNING

Twelve crew members will burn each area. Clinton Owensby of Kansas State University will act as fire boss. The fire boss determines when environmental conditions are met and has the responsibility to see the burn is conducted safely and that equipment is operated properly.

Equipment: The following equipment is needed for the burn:

1. Three four-wheel drive fast attack vehicles with a 200 gallon water tank capacity;
2. One two-wheel drive water supply vehicle with 1000 gallon capacity;
3. Four drip torches and fuel;
4. Two four-wheel drive vehicles equipped with radios;
5. Two pack sets.

The City of Boulder has the equipment needed to conduct the prescribed burns.

Site preparation: Six-foot fire breaks will be mowed on all sides of the treatment units and a wetting agent will be applied prior to the prescribed burn. Mowed grass will be raked and removed from the mowed fire breaks.

Preburn contacts: Notification will be given to the following agencies on the day of the burn:

Colorado State Patrol
Boulder County Sheriff
City of Boulder Fire Department
City of Boulder Police Department
Adjacent landowners

IGNITION

A 40 foot strip will be backfired on the downwind side of each site to act as an additional fireline. A headfire will be ignited on the upwind side of each site. Figure 1 is the mapped fire scheme.

HOLDING

Permanent fire lines, proper backfiring, and firefighting vehicles placed in strategic locations will ensure containment of the prescribed burn. Escapes are not expected because of the time of the burn, habitat type, terrain and adequate holding techniques. Escaped fire will be suppressed immediately.

POSTBURN

One crew with a 200 gallon tank truck will remain on site for several hours after the burn to ensure the fire has been completely extinguished. The vegetation will burn in several minutes, but other materials such as wood and cow-dung often smolder for several hours.

MONITORING AND EVALUATION

Weather: Relative humidity, wind direction, wind speed and air temperature will be monitored at the City of Boulder Operation Center by City staff. This weather station is close to both treatment units.

Biological: Monitoring of species production and composition is being conducted on all treatment units. Appendix C summarizes these studies.

Burn Treatment: Dr. Phil Ome of the Forestry Department of Colorado State University will record fire behavior and initial treatment success during and after the burn.

COST SUMMARY

To be determined (between \$200. and \$1000).

Appendix A

Vegetation Data for Fire Treatment Areas

INTRODUCTION

Eighteen permanent transects were established and data collected on sites 3, 6, and 7. Sampling was conducted inside and outside the grazing enclosures. Data were collected between August 15 and September 15.

METHOD

Twenty-five 0.5 m by 1.0 m plots were placed systematically in a criss-cross arrangement along a 50 meter permanent transect placed randomly in each 2-acre treatment plot. Percent aerial cover for each species was recorded by Braun-Blanquet classes:

- r - single individual, insignificant cover
- t - many individuals, insignificant cover
- 0 - few individuals, cover less than 1%
- 1 - 1-5% cover
- 2 - 5-25% cover
- 3 - 25-50% cover
- 4 - 50-75% cover
- 5 - 75-100% cover

Total cover of vegetation, litter, bare ground, rock, and fecal matter was also recorded.

Percent frequency for each species was determined by the number of frames in which a species occurred relative to the total number of frames. The data for each plot are tabulated by frequency and cover class. Species are in alphabetical order, with introduced species (Eurasian) presented first, followed by native species, and unknown species.

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RESULTS

Species diversity information is tabulated by plot:

<u>Site</u>	<u>Plot</u>	<u>Exclosure (In/Out)</u>	<u>Intro.</u>	<u>Percent Native</u>	<u>Unkn.</u>	<u>Total # Species</u>
3	1	In	16.7	83.3	0	18
	2	In	27.5	70.0	2.5	40
	3	In	50.0	46.2	3.8	26
	4	In	35.0	60.0	5.0	20
	5	Out	32.2	54.8	12.9	31
	6	Out	27.3	69.7	3.0	33
		AVE.	31.5	63.7	4.8	
6	1	In	22.2	72.2	5.6	18
	2	Out	28.6	71.4	0.0	14
		AVE.	25.0	71.9	3.1	
7	1	In	35.7	64.3	0.0	28
	2	In	23.1	69.2	7.7	52
	3	In	20.5	76.9	2.6	39
	4	In	27.5	70.0	2.5	40
	5	In	26.2	69.0	4.8	42
	6	In	33.0	59.2	7.4	27
	7	In	19.6	73.9	6.5	46
	8	In	28.6	57.1	14.3	7
	9	Out	24.0	62.0	14.0	50
	10	Out	17.9	76.9	5.1	39
		AVE.	24.6	69.2	6.2	

Frequency and cover data will be analyzed in subsequent years.

EVALUATION

The data from 1986 indicate a high proportion of introduced species. Several of these species Poa compressa, Poa pratensis, and Bromus japonicus, have high frequency and cover at most sites. Many of the native species are grazing increasers, such as Gutierrezia sarothrae and Artemisia drancunculus, and may be present in greater abundance than expected in presettlement time. Diversity and frequency of tallgrass prairie forbs are low at all sites. For example, Petalostemum purpureum, Petalostemum candidum, and Ratibida columnifera rarely were encountered.

Changes in cover of introduced species, native graminoids, and native forbs will be analyzed using the Kolmogorov-Smirnov Goodness of Fit test. Changes in frequency of dominant species will be analyzed using chi-square tests.

Evaluation of plant species composition between treatments should include the following:

- changes in proportion of introduced and native species;
- changes in frequency and cover of native and introduced species;
- changes in frequency, cover, and diversity of tallgrass prairie indicator species (especially forbs).

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 3 - Exclosure - Plot 2</u>										
Acetosella vulgaris	I	12	4	3	3	2				
Achillea lanulosa	I	1	1							
Agrostis alba	I	1					1			
Bromus japonicus	I	13			1	2	9		1	
Centaurea diffusa	I	1				1				
Cichorium intybus	I	2	2							
Dianthus deltooides	I	17	3	7	4	3				
Plantago lanceolata	I	13	1	1	2	4	3	2		
Poa compressa	I	18			1	1	6	2	4	4
Poa pratensis	I	15				6	7		1	1
Tragopogon dubius	I	4	2	2						
Ambrosia psilostachya	N	13	4	4	3	2				
Andropogon gerardii	N	4				1		3		
Andropogon scoparius	N	2					2			
Aristida longiseta	N	2			1	1				
Aster ericoides	N	2	1		1					
Bouteloua gracilis	N	3					2	1		
Bouteloua hirsuta	N	5			1	4				
Carex heliophila	N	1			1					
Comandra umbellata	N	1	1							
Erigeron flagellaris	N	4	2	2						
Heterotheca villosa	N	3	1			1	1			
Juncus arcticus	N	7		4	1		2			
Juncus interior	N	3		1	1		1			
Leucelene ericoides	N	8	2	4	1	1				
Liatris punctata	N	3	1		1	1				
Opuntia compressa	N	3	2						1	
Opuntia phaeacantha	N	2			1	1				
Oxalis dillenii	N	2	2							
Panicum wilcoxianum	N	5		1	2	2				
Panicum virgatum	N	11			1	4	6			
Polygonum aviculare	N	1	1							
Psoralea tenuifolia	N	8	1	1	2	3	1			
Ratibida columnifera	N	1	1							
Rosa acicularis	N	3				3				
Solidago nana	N	6	1	1	3	1				
Sorghastrum nutans	N	8				3	3	1	1	
Stipa comata	N	1			1					
Symphoricarpus oreophilus	N	1						1		
Erigeron sp.	U	4	4							
Vegetation		92.6	±	4.9 (%)						
Litter		90.68	±	5.6 (%)						
Bare ground	TR									
Rock	TR									
Fecal Matter	TR									

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 3 - Exclosure - Plot 4</u>										
Agropyron repens	I	3		1		2				
Agrostis alba	I	11			1	1	6	2	1	
Asclepias speciosa	I	3	1			2				
Cichorium intybus	I	1	1							
Plantago lanceolata	I	5	3		1	1				
Poa compressa	I	3					2	1		
Poa pratensis	I	11			1	3	6	1		
Aster ericoides	N	1	1							
Carex lanuginosa	N	11			1	5		3	2	
Carex nebrascensis	N	10		1		1	2		1	5
Cirsium flodmannii	N	6		2	2		2			
Eleocharis macrostachya	N	13				1	1	4	1	6
Juncus arcticus	N	16					7	4	3	5
Juncus interior	N	2				1	1			
Juncus nodosus	N	4		1	1	1	1			
Mentha arvensis	N	4			1	3				
Muhlenbergia asperifolia	N	7		2	1	1	3			
Panicum virgatum	N	13		1		1	8	2	1	
Sorghastrum nutans	N	3					2			1
Carex sp.	U	1				1				
Vegetation	98.2	± 5.0 (%)								
Litter	97.8	± 5.0 (%)								
Rock	TR									
Bare ground	0									
Fecal matter	0									

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class						
					0	1	2	3	4	5	
<u>Site 7 - Exclosure - Plot 1</u>											
Alyssum alyssoides	I	1	1								
Bromus japonicus	I	11	1			4	5	1			
Cichorium intybus	I	7	3			3	1				
Convolvulus arvensis	I	5	1			4					
Dianthus deltoides	I	3	1		2						
Lactuca serriola	I	9	6			2	1				
Phleum pratense	I	1			1						
Plantago lanceolata	I	4				2	1	1			
Poa compressa	I	25					6	8	10	1	
Tragopogon dubius	I	1	1								
Ambrosia psilostachya	N	3	2		1						
Andropogon gerardii	N	2					2				
Andropogon scoparius	N	10				6	4				
Artemisia dracunculus	N	17	1		1	14	1				
Artemisia ludoviciana	N	5	2		2		1				
Aster ericoides	N	12	5		1	5	1				
Bouteloua gracilis	N	7			1	1	5				
Grindelia squarrosa	N	1			1						
Juncus arcticus	N	6	1		3	1	1				
Juncus balticus	N	8	2			3	2	1			
Muhlenbergia richardsonis	N	1	1								
Opuntia compressa	N	6	4		2						
Opuntia fragilis	N	3	3								
Panicum virgatum	N	14			1	4	7	2			
Plantago patagonica	N	1	1								
Psoralea tenuiflora	N	3				3					
Sitanion hystrix	N	1	1								
Sorghastrum nutans	N	5	2			1	1	1			
Vegetation		73.4		± 11.2 (%)							
Litter		59.5		± 25.8 (%)							
Bare ground		6.8		± 4.8 (%)							
Rock		6.2		± 3.9 (%)							
Fecal Matter				TR							

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 7 - Exclosure - Plot 2</u>										
Acetosella vulgaris	I	1	1							
Alyssum alyssoides	I	3	2	1						
Bromus japonicus	I	20			2	4	13	1		
Bromus tectorum	I	4			1	2		1		
Erodium cicutarium	I	1			1					
Hypericum perforatum	I	1				1				
Lactuca serriola	I	1	1							
Lepidium campestre	I	10	6	4						
Poa compressa	I	3				1	2			
Poa pratensis	I	14			2	5	7			
Sisymbrium altissimum	I	1	1							
Tragopogon dubius	I	4	2	2						
Agropyron smithii	N	2		1		1				
Ambrosia psilostachya	N	1	1							
Amorpha nana	N	1	1							
Andropogon gerardii	N	8				5	2	1		
Andropogon scoparius	N	1					1			
Aristida longiseta	N	2			1	1				
Artemisia dracunculus	N	6	2		3	1				
Artemisia frigida	N	9	1	1	3		4			
Artemisia ludoviciana	N	3		1			1		1	
Aster ericoides	N	1	1							
Bouteloua curtipendula	N	2		1	1					
Bouteloua gracilis	N	7			2	1	1	2	1	
Bouteloua hirsuta	N	3			2		1			
Carex heliophila	N	2		1	1					
Gutierrezia sarothrae	N	1		1						
Heterotheca villosa	N	1				1				
Juncus arcticus	N	4			2	1	1			
Juncus interior	N	2				1	1			
Koeleria cristata	N	3	1		1	1				
Liatris punctata	N	2	1	1						
Lithospermum multiflorum	N	2	1			1				
Muhlenbergia asperifolia	N	2			1	1				
Muhlenbergia richardsonis	N	1				1				
Opuntia compressa	N	1	1							
Opuntia fragilis	N	5		4		1				
Oxalis dillenii	N	3	2		1					
Panicum virgatum	N	12	1			3	1	2	1	4
Plantago patagonica	N	11	2	4		3	2			
Poa fendleriana	N	4			1	1	2			
Polygala aviculare	N	1	1							
Psoralea tenuiflora	N	6	3	1		2				
Scenecio spartioides	N	3				3				
Sitanion hystrix	N	1		1						
Sporobolus cryptandrus	N	2			2					
Stipa comata	N	9			2	5	1	1		
Thermopsis divaricarpa	N	1			1					

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 7 - Exclosure - Plot 2 - Cont'd</u>										
Chenopodium sp.	U	2		?						
Erigeron sp.	U	1	1							
Penstemon sp.	U	1	1							
Unknown forb	U	1	1							
Vegetation	79.5	± 16.2 (%)								
Litter	59.6	± 28.9 (%)								
Bare ground	12.8	± 15.8 (%)								
Rock	TR									
Fecal matter	0									

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 7 - Exclosure - Plot 4</u>										
Acetosella vulgaris	I	1				1				
Alyssum alyssoides	I	13	7	1	4	1				
Bromus japonicus	I	17	1		2	4	6	4		
Cichorium intybus	I	1	1							
Convolvulus arvensis	I	3	2			1				
Lactuca serriola	I	1	1							
Plantago lanceolata	I	2	1			1				
Poa compressa	I	14			1	2	4	6	1	
Poa pratensis	I	9	3			3	1	2		
Taraxacum officinale	I	2	1			1				
Tragopogon dubius	I	3	2	1						
Agropyron smithii	N	1					1			
Amorpha nana	N	1	1							
Andropogon gerardii	N	20	1			2	7	9	1	
Andropogon scoparius	N	4				2	2			
Artemisia dracuncululus	N	13	3	1	4	3	2			
Artemisia frigida	N	4	1		2	1				
Artemisia ludoviciana	N	3	1			2				
Aster ericoides	N	8	4		2	2				
Bouteloua curtipendula	N	1				1				
Bouteloua gracilis	N	2					1	1		
Carex heliophilum	N	1				1				
Comandra umbrellata	N	2	1		1					
Gaura coccinea	N	2	2							
Gutierrezia sarothrae	N	5	1	1		3				
Heterotheca villosa	N	1	1							
Juncus arcticus	N	6	1		2	2	1			
Juncus balticus	N	3	1			1	1			
Koeleria cristata	N	2					1	1		
Liatris punctata	N	3	2	1						
Opuntia compressa	N	4	2		1	1				
Opuntia fragilis	N	2	2							
Oxalis dillenii	N	2	1	1						
Panicum virgatum	N	8			2		3	2	1	
Petalostemum candidum	N	1	1							
Plantago patagonica	N	2	1			1				
Poa fendleriana	N	3	1	1		1				
Psoralea tenuiflora	N	13	4		5	1	3			
Sorghastrum nutans	N	3	3			2	1			
Trifolium sp.	U	2	2							

Vegetation 64.7 + 14.3 (%)
 Litter 54.9 + 27.3 (%)
 Bare ground 10.6 + 10.1 (%)
 Rock 6.4 + 9.7 (%)
 Fecal matter 0

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 7 - Exclosure - Plot 5</u>										
Agrostis alba	I	1						1		
Alyssum alyssoides	I	5	5							
Bromus japonicus	I	19		1		5	7	4	2	
Cichorium intybus	I	11	2		3	3	3			
Lactuca serriola	I	3	2	1						
Plantago lanceolata	I	4	1	2			1			
Poa compressa	I	12	1				3	4	1	3
Poa pratensis	I	8				1	5	1	1	
Taraxacum officinale	I	1	1							
Tragopogon dubius	I	1	1							
Xanthium strumarium	I	1	1							
Agropyron smithii	N	2		2						
Ambrosia psilostachya	N	2	1	1						
Amorpha nana	N	1	1							
Andropogon gerardii	N	7				1	3	2	1	
Andropogon scoparius	N	2				1	1			
Aristida longiseta	N	1		1						
Artemisia dracunculoides	N	3	1		1	1				
Artemisia frigida	N	3	1	1		1				
Artemisia ludoviciana	N	2		1		1				
Aster ericoides	N	1			1					
Bouteloua gracilis	N	3				2	1			
Carex eleocharoides	N	1				1				
Grindelia squarrosa	N	1	1							
Gutierrezia sarothrae	N	1	1							
Heterotheca fulcrata	N	5	3	1	1					
Juncus arcticus	N	10		1	2	4	3			
Juncus interior	N	6		1	1	1	3			
Opuntia compressa	N	3	2			1				
Opuntia fragilis	N	1	1							
Oxalis dillenii	N	1	1							
Panicum virgatum	N	19					6	9	3	1
Physaria vitulifera	N	1	1							
Polygonum aviculare	N	1				1				
Psoralea tenuiflora	N	1	1							
Ratibida columnifera	N	5		3		1	1			
Rosa acicularis	N	3	1			2				
Spartina pectinatus	N	4						1		3
Symphoricarpos oreophilus	N	1				1				
Thermopsis divaricarpa	N	4		1			2	1		
Lepidium sp.	U	4	1	1	1		1			
Rumex sp.	U	1			1					

Vegetation 83.2 +15.8 (%)
 Bare ground 12.3 +11.3 (%)
 Litter 73.0 +11.3 (%)
 Rock TR
 Fecal matter TR

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 7 - Exclosure - Plot 6</u>										
Achillea lanulosa	I	1	1							
Agrostis alba	I	2				2				
Cichorium intybus	I	16	6	2	5	3				
Dianthus deltoides	I	14	3	2	3	5	1			
Lactuca serriola	I	8	1	2	1	4				
Phleum pratense	I	4		1	1	1	1			
Plantago lanceolata	I	16	2	2	1	7	4			
Poa compressa	I	18				3	6	5	4	
Poa pratensis	I	20			1	9	7	2	1	
Agropyron smithii	N	10	1	1	4	1	3			
Ambrosia psilostachya	N	4	3	1						
Andropogon gerardii	N	4		1	1			2		
Andropogon scoparius	N	1				1				
Aster ericoides	N	8	3		3	2				
Bouteloua gracilis	N	1						1		
Carex eleocharoides	N	1					1			
Iris missouriensis	N	3			1	1	1			
Juncus arcticus	N	16	1	2	4	9				
Juncus interior	N	21				4	17			
Muhlenbergia richardsonis	N	6			2	2		2		
Panicum virgatum	N	15				3	7	3	1	1
Rosa acicularis	N	3				3				
Sorghastrum nutans	N	3		1		1	1			
Sporobolus heterolepis	N	3				1	1	1		
Carex sp.	U	8	1		1	3	2	1		
Lepidium sp.	U	1	1							

Vegetation 86.7 + 8.2 (%)
 Litter 84.1 + 6.3 (%)
 Bare ground TR
 Rock TR
 Fecal Matter TR

COLORADO TALLGRASS MONITORING 1986

Species	Origin	Total Frequency	R	±	Cover Class					
					0	1	2	3	4	5
<u>Site 7 - Exclosure - Plot 7</u>										
Acetosella vulgaris	I	10	1	2	4	2	1			
Achillea lanulosa	I	2	1		1					
Alyssum alyssoides	I	1	1							
Bromus japonicus	I	16				4	4	7	1	
Lactuca serriola	I	1		1						
Lepidium campestre	I	5	3	1		1				
Poa compressa	I	3	1		2					
Poa pratensis	I	19			2	6	4	4	3	
Tragopogon dubius	I	9	8	1						
Ambrosia psilostachya	N	10	1	6	1		1	1		
Andropogon gerardii	N	2					2			
Andropogon scoparius	N	1					1			
Artemisia dracunculus	N	3	1		2					
Artemisia frigida	N	8		1	2	4	1			
Aster ericoides	N	2	1			1				
Bouteloua gracilis	N	3		1		1	1			
Bouteloua hirsuta	N	2					1		1	
Carex heliophilum	N	2				1	1			
Comandra umbellata	N	3		1	1	1				
Echinocereus viridiflorus	N	2	1		1					
Elygonum alatum	N	1				1				
Gutierrezia sarothrae	N	1			1					
Heterotheca villosa	N	5	2	2	1					
Juncus arcticus	N	11		1		4	3		1	2
Muhlenbergia asperifolia	N	6	1	1	2	2				
Oenothera strigosa	N	1	1							
Opuntia compressa	N	5	1	1	2	1				
Opuntia fragilis	N	3	3							
Opuntia phaeacantha	N	1				1				
Oxalis dillenii	N	5	1	4						
Oxybaphus linearis	N	2	2							
Panicum virgatum	N	18				2	6	4	5	1
Petalostemum candidum	N	1		1						
Petalostemum purpureum	N	1		1						
Physaria vitulifera	N	1	1							
Plantago patagonica	N	1		1						
Psoralea tenuiflora	N	2			1	1				
Ratibida columnifera	N	2		1		1				
Rosa acicularis	N	1			1					
Senecio spartioides	N	2		1				1		
Solidago nana	N	1				1				
Stipa comata	N	9			1	1	2	2	3	
Yucca glauca	N	1							1	
Asteraceae	U	3	1		1		1			
Opodium sp.	U	3	3							
Erigeron Sp.	U	1	1							

Vegetation	3.8 + 15.7 (%)	Litter	59.2 + 22.4 (%)
Bare ground	18.6 + 20.5 (%)	Rock	4.3 + 5.5 (%)
Fecalmatter	TR		

Appendix B

Climatological data for the vicinity of the Colorado Tallgrass Prairie
Natural Area (NOAA records, 1985)

<u>MONTH</u>	<u>TEMP</u>	<u>HUMIDITY</u>	<u>PPT</u>	<u>WIND SP</u>	<u>WIND DIR</u>
January	32.5	47.3	0.47	7.3	W
February	36.1	42.5	0.56	8.4	W
March	40.8	46.5	2.73	8.0	W
April	48.9	37.8	1.78	7.3	W
May	56.6	44.8	3.16	6.0	W
June	66.6	35.8	1.68	6.1	W
July	72.7	33.0	2.24	6.6	W
August	72.0	37.8	1.37	6.2	W
September	62.9	35.0	1.89	6.3	W
October	50.8	35.5	1.49	6.3	W
November	40.4	42.0	1.20	6.7	W
December	33.9	46.5	0.78	6.0	W

TEMP Mean Temperature (F), 1980-1985, Boulder, Colorado.
HUMIDITY Mean Relative Humidity (%), 1100 hr, 1980-1983, Denver, CO
PPT Mean precipitation (inches), 1980-1985, Boulder, Colorado
WIND SP Mean wind speed (mph), 1979-1982, Table Mesa-Boulder, CO
WIND DIR Prevailing wind source, 1979-1982, Table Mesa-Boulder, CO

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Appendix B2
 Climatological Data for Spring Months
 for the Vicinity of
 the Colorado TallgrassPrairie Natural Area
 (NOAA records, 1985)

Temperature (° F)

	<u>April</u>		<u>May</u>		<u>June</u>	
	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>
1980	33.9	61.5	42.3	58.8	53.9	89.5
1981			missing data (NOAA)			
1982	34.6	56.6	42.4	69.3	48.3	76.2
1983	31.2	55.7	40.0	66.2	47.9	77.2
1984	30.6	56.1	44.5	76.2	50.8	80.3
1985	38.8	65.5	44.8	74.6	53.4	83.8

Precipitation (inches)

	<u>April</u>	<u>May</u>	<u>June</u>
1980	2.17	2.48	0.32
1981	1.16	4.47	1.75
1982	0.33	4.65	1.71
1983	2.88	5.54	2.55
1984	2.29	0.45	1.85
1985	1.82	1.37	1.91

Humidity (%)

	<u>April</u>		<u>May</u>		<u>June</u>	
	<u>5 am</u>	<u>11 am</u>	<u>5 am</u>	<u>11 am</u>	<u>5 am</u>	<u>11 am</u>
1980	62	36	72	42	50	22
1981	57	32	72	46	62	33
1982	53	27	69	43	72	42
1983	75	48	77	48	76	46
1984	70	46	65	34	72	36
1985	M	40	M	34	M	31

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Appendix C

Monitoring Established on Treatment Areas

- o SOILS The Soil Conservation Service will characterize the chemical and physical properties of the soils on the tallgrass parcels and prepare a detailed soil map of the area.
- o SPECIES DIVERSITY (plants and animals)
Species diversity is the total number of species in a given area. A floristic list will be compiled by the Boulder Chapter of the Colorado Native Plant Society and the specimens deposited at the University of Colorado herbarium. The Boulder County Nature Association will coordinate developing a list of birds and mammals.
- o SPECIES COMPOSITION (plants)
Percent cover, the total amount of area covered by each species, and percent frequency (how often individuals occur in an area) will be measured by Daubenmire plot sampling. Twenty-five 0.5m X 1.0m plots are placed systematically in a criss-cross arrangement along a 50 meter permanent transect placed randomly in each 2 acre treatment plot. Percent frequency is the number of frames in which a species occurred relative to the total number of frames. Percent cover for a species is determined by averaging the basal cover measured for each frame. The Colorado Natural Areas Program will coordinate species composition sampling. Sampling will occur late during the growing season, in mid-August.
- o PRODUCTION AND LITTER ACCUMULATION (plants)
Biomass production is the total amount of air-dried plant biomass produced in a year. Litter accumulation is the total amount of dead plant material covering the soil surface. Twenty-five circular plots (1.00 m square) will be clipped within each treatment area for production and a 10 cm x 25 cm litter plot will be taken from within the area. These plots will not be located with the species composition transect. The dead and live material will be separated. Live material will be separated by species. Air-dried weight will be calculated for the dead material (litter) and for each species (production). The City of Boulder Open Space staff will coordinate production and litter sampling twice during the growing season, in early June and late-August.
- o SAMPLE DISTRIBUTIONS (animals)
An estimate of small mammal abundance will be obtained from live trapping studies. Breeding bird estimates will be determined using methodology consistent with past City studies (Thompson and Struch, 1985). The Boulder County Nature Association will coordinate these distribution studies. Sites 3,6, and 7 are priorities for sampling animal distribution.

Appendix 1. Floristic List

Plant species occurring on the Boulder Tallgrass Prairies

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
FAB	✓ Astragalus tridactylus	three-toed milk vetch	9-10
EUP	✓ Euphorbia robusta	robust spurge	9-10
AGA	— Yucca glauca	soapweed	1,2,3,7,9-10
ALI	✓ Alisma brevipes	NCN <i>Water Plantain</i>	7
ANA	— Rhus trilobata	skunkbrush	7
API	✓ Cymopterus montanus	chimaya	7,9-10
API	✓ Daucus carota	wild carrot	3
ASC	✓ Asclepias speciosa	showy milkweed	1,2,3,6
ASC	✓ Asclepias stenophylla	narrowleaf milkweed	7
ASN	— Paronychia jamesii	nailwort	1,2
ASN	— Spargularia media	sand spurry	1,2
ASP	✓ Asparagus officinalis	asparagus	6
AST	✓ Achillea lanulosa	yarrow	3,6,7
AST	✓ Ambrosia psilostachya	western ragweed	3,6,7,9-10
AST	✓ Ambrosia trifida	giant ragweed	3,7
AST	✓ Antennaria sp.	pussytoes	7
AST	✓ Aristida longiseta	red threeawn	7,9-10
AST	✓ Artemisia frigida	fringed sage	3,6,7,9-10
AST	✓ Artemisia ludoviciana	Louisiana sagebrush	3,7,9-10
AST	— Virgulus (Aster) ericoides	heath aster	1,2,6,7
AST	— Virgulus (Aster) falcatus	aster	1,2,3,6,7,9-10
AST	✓ Aster hesperius	Siskiyou aster	1,2,3,6,7
AST	✓ Aster porteri	Porter's aster	1,2
AST	✓ Carduus nutans	musk thistle	7,9-10
AST	✓ Centaurea diffusa <i>repens</i>	Russian knapweed	3
AST	— Brickella eupatorioides	NCN	1,2,6,7
AST	✓ Cirsium flodmanii	Flodman's thistle	6
AST	✓ Bidens cernua	beggar's tick	6,7
AST	✓ Arctium minus	burdock	6
AST	— Cirsium undulatum	wavy-leaf thistle	7
AST	✓ Helianthus annuus	sunflower	6
AST	✓ Helianthus pumilus	sunflower	1,2
AST	✓ Helianthus falcata	sunflower	1,2
AST	✓ Erigeron flagellaris	fleabane	3,7
AST	— Lactuca serriola	wild lettuce	1,2,6,7
AST	✓ Heterotheca fulcrata	golden aster	7
AST	— Cichorium intybus	chickory	1,2,3,6,7,9-10
AST	✓ Cirsium arvense	Canada thistle	1,2,3,6,7

✓ *Acosta diffusa* —

DIFFUSE KNAPWEED

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
AST	✓ <i>Cirsium ochrocentrum</i>	thistle	1,2
AST	✓ <i>Cirsium vulgare</i>	thistle	1,2,6,9-10
AST	— <i>Oligosporus (Artemisia) dracunculus</i>	false tarragon	7,9-10
AST	— <i>Ratibida columnifera</i>	upright prairiecone flower	3,9-10
AST	✓ <i>Grindelia squarrosa</i>	curlycup gumweed	1,2,6,7,9-10
AST	✓ <i>Gutierrezia sarothrae</i>	snakeweed	1,2,3,7,9-10
AST	— <i>Heterotheca villosa</i>	hairy goldenaster	1,2,6,7,9-10
AST	— <i>Liatris punctata</i>	prairie gayfeather	3,6,7
AST	✓ <i>Gaillardia aristida</i>	blanket flower	7
AST	— <i>Leucelene ericoides</i>	white aster	3
AST	✓ <i>Conyza canadensis</i>	horseweed	7
AST	— <i>Oligoneuron rigidum</i>	NCN	3,6,7
AST	— <i>Podospermum laciniatum</i>		7
AST	— <i>Sphaeralcea coccinea</i>	scarlet globemallow	6
AST	<i>Townsendia hookeri</i>	townsendia	6
AST	— <i>Senecio spartoides</i>	broom groundsel	1,2,3,7,9-10
AST	— <i>Solidago canadensis</i>	goldenrod	6,7
AST	— <i>Solidago missouriensis</i>	Missouri goldenrod	6,9-10
AST	— <i>Solidago cf. rigida</i>	stiff goldenrod	3,6
AST	— <i>Solidago nana</i>	goldenrod	3
AST	— <i>Taraxacum officinale</i>	dandelion	6,7
AST	— <i>Tragopogon dubius</i>	goatsbeard	6,7,9-10
AST	<i>Xanthium strumarium</i>	cocklebur	6,7
BOR	✓ <i>Cryptantha virgata</i>	cryptantha	7,9-10
BOR	— <i>Lithospermum multiflorum</i>	puccoon	7
BOR	— <i>Oenothera mollis</i>	wayside gromwell	6,9-10
BRA	✓ <i>Alyssum minus</i>	NCN	6,7
BRA	— <i>Lepidium densiflorum</i>	papergrass	1,2
BRA	— <i>Lesquerella sp.</i>	bladderpod	9-10
BRA	— <i>Lepidium campestre</i>	peppergrass	3,7
BRA	— <i>Physaria vitulifera</i>	twinpod	7
BRA	— <i>Sisymbrium altissimum</i>	tumble mustard	7
CAC	✓ <i>Echinocereus viridiflora</i>	hen and chicks	7
CAC	— <i>Opuntia compressa</i>	starvation cactus	1,2,3,6,7,9-10
CAC	— <i>Opuntia fragillilis</i>	brittle pricklepear	3,7
CAC	— <i>Opuntia phaeacantha</i>	Mexican pricklepear	7
CRY	✓ <i>Arenaria sp.</i>	sandwort	7
CRY	— <i>Phlox</i>	phlox	9-10
CHN	✓ <i>Amaranthus retroflexus</i>	pigweed	6
CHN	✓ <i>Chenopodium album</i>	lambsquarters goosefoot	3,6
CHN	✓ <i>Chenopodium berlandieri</i>	Lambsquarters	1,2
CHN	— <i>Kochia sieversiana</i>	kochia	1,2,6
CHN	— <i>Suaeda sp.</i>	seepweed	1,2
CHN	— <i>Salsola collina</i>	Russian thistle	6
CHN	— <i>Salsola kali</i>	Russian thistle	9-10

Appendix/Plant/Species

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
CNV	✓ <i>Evolvulus nuttallianus</i>	Nuttall's evolvus	1,2,7
CNV	✓ <i>Convolvulus arvensis</i>	field bindweed	1,2,3,6,7
CRY	✓ <i>Dianthus armeria</i>	Deptford pink	3,7
CRY	— <i>Silene antirrhina</i>	sleepy catchfly	7
CYP	✓ <i>Carex heliophila</i>	sedge	3,6,7,9-10
CYP	✓ <i>Carex douglasii</i>	sedge	1,2
CYP	✓ <i>Carex praegracilis</i>	sedge	1,2
CYP	✓ <i>Carex brevior</i>	sedge	6
CYP	✓ <i>Carex simulata</i>	sedge	3
CYP	✓ <i>Carex lanuginosa</i>	sedge	3
CYP	✓ <i>Carex nebrascensis</i>	Nebraska sedge	7
CYP	✓ <i>Carex scoparia</i>	sedge	7
CYP	✓ <i>Carex eleocharoides</i> <small>eleocharis</small>	sedge	7
CYP	— <i>Schoenoplectus pungens</i>	NCN	6
ELE	✓ <i>Eleagnus angustifolia</i>	Russian olive	1,2,3,6,7
EQU	— <i>Hippochaete hyemalis</i>	horsetail	3
EQU	✓ <i>Equisetum arvense</i>	horsetail	6,7
EUP	✓ <i>Agaloma marginata</i>		6
EUP	✓ <i>Comandra umbellata</i>	a sandlewood	3,7
EUP	— <i>Tragia ramosa</i>	NCN	7
FAB	✓ <i>Amorpha nana</i>	dwarf wild indigo	1,2,7
FAB	✓ <i>Amorpha fruticosa</i>	false indigo	6
FAB	— <i>Dalea (Petalostemum) candidum</i>	white prairie clover	7
FAB	— <i>Dalea (Petalostemum) purpureum</i>	purple prairie clover	7
FAB	✓ <i>Glycyrrhiza lepidota</i>	American licorice	1,2,6,7
FAB	— <i>Lotus fenuis</i>	narrow-leaf trefoil	1,2
FAB	— <i>Medicago lupulina</i>	black medic	1,2
FAB	— <i>Lupinus argenteus</i>	silvery lupine	1,2,3,7
FAB	— <i>Melilotus alba</i>	white sweet clover	6,7
FAB	— <i>Melilotus officinalis</i>	yellow sweet clover	7
FAB	✓ <i>Oxytropis</i> sp.	locoweek	9-10
FAB	— <i>Psoralea lanceolata</i>	lemon scurfpea	7
FAB	— <i>Trifolium pratense</i>	red clover	1,2,3,6,7
FAB	— <i>Robinia pseudo-acacia</i>	locust	3
FAB	— <i>Thermopsis divaricarpa</i>	yellow banner	3,7
FAB	— <i>Trifolium repens</i>	white clover	3,6
FAB	— <i>Psoralidium (Psoralea) tenuiflorum</i>	slender scurfpea	1,2,3,6,7,9-10
GRS	— <i>Ribes aureum</i>	golden currant	9-10
HYD	— <i>Phacelia heterophylla</i>	phacelia	7
HYP	✓ <i>Hypericum perforatum</i>	St. John's wort	3,7
IRI	✓ <i>Iris missouriensis</i>	Rocky Mountain iris	3,7

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
JUN	✓ <i>Juncus longistylis</i>	rush	1,2,7
JUN	— <i>Juncus arcticus</i>	rush	6,7
JUN	✓ <i>Eleocharis palustris</i>	spikerush	3,6,7
JUN	✓ <i>Juncus interior</i>	rush	3
JUN	✓ <i>Juncus balticus</i>	Baltic rush	3,6,7,9-10
JUN	✓ <i>Juncus torreyi</i>	bur rush	1,2,3,7
JUN	✓ <i>Juncus alpinoarticulatus</i>	rush	1,2
JUN	— <i>Juncus confusus</i>	rush	1,2,3,6,7
JUN	— <i>Juncus dudleyi</i>	rush	1,2
JUN	— <i>Juncus gerardii</i>	rush	1,2
JUN	— <i>Juncus articulatus</i>	rush	6
JUN	✓ <i>Eleocharis acicularis</i>	spike rush	6
JUN	— <i>Juncus nodosus</i>	rush	3
LAM	— <i>Lycopus americanus</i>	American bugleweed	7
LAM	— <i>Prunella vulgaris</i>	self heal	3,7
LAM	— <i>Mentha arvensis</i>	field mint	3,6,7
LIL	— <i>Leucocrinum montanum</i>	sandlily	9-10
LIN	— <i>Linum lewisii</i>	Lewis flax	9-10
LYT	— <i>Lythrum alatum</i>	winged loosestrife	1,2,3
ONA	✓ <i>Epilobium ciliatum</i>	fireweed	7
ONA	✓ <i>Gaura parviflora</i>	velvety gaura	6,9-10
ONA	✓ <i>Gaura coccinea</i>	scarlet gaura	6,7
ONA	— <i>Oenothera villosa</i>	evening primrose	1,2,6,7
ONA	— <i>Oenothera strigosa</i>	evening primrose	3,7
OXL	— <i>Oxalis dillenii</i>	wood sorrel	3
PIN	✓ <i>Pinus ponderosa</i>	ponderosa pine	7,9-10
PLG	✓ <i>Acetosella vulgaris</i>	sheep sorrel	7
PLG	✓ <i>Eriogonum</i> sp.	buckwheat	6,7
PLG	— <i>Pterogonum (Eriogonum) alatum</i>	winged buckwheat	1,2,3,7,9-10
PLG	✓ <i>Eriogonum effusum</i>	buckwheat	1,2,7
PLG	— <i>Polygonum aviculare</i>	knotweed	3,6,7
PLG	✓ <i>Polygala aviculare</i>	milk-wort	7
PLG	— <i>Rumex crispus</i>	dock	3,6,7
POA	— <i>Elytrigia (Agropyron) repens</i>	quackgrass	1,2,3,6
POA	✓ <i>Agropyron smithii</i>	western wheatgrass	6,7
POA	✓ <i>Agrostis gigantea</i>	giant wheatgrass	1,2,3,6,7
POA	✓ <i>Agrostis alba</i>	redtop	3,6
POA	✓ <i>Andropogon gerardii</i>	big bluesteam	1,2,3,6,7,9-10
POA	✓ <i>Aristida purpurea</i>	purple three-awn	1,2,6,7
POA	— <i>Boteloua (Bouteloua) gracilis</i>	blue grama	3,6,7,9-10
POA	— <i>Boteloua (Bouteloua) hirsuta</i>	hairy grama	
POA	✓ <i>Bromus japonicus</i>	Japanese Brome	3,6,7,9-10
POA	✓ <i>Anisantha (Bromus) tectorum</i>	cheatgrass	1,2,3,7,9-

Appendix/Plant/Species

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
POA	✓ <i>Buchloe dactyloides</i>	buffalo grass	1,2,6,7
POA	✓ <i>Agropyron desertorum</i>	desert wheatgrass	6
POA	✓ <i>Dichantherium lanuginosum</i>	NCN	6,7
POA	✓ <i>Echinochloa crus-galli</i>	barnyard grass	1,2
POA	✓ <i>Festuca pratensis</i>	fescue	3
POA	✓ <i>Dactylis glomerata</i>	orchardgrass	3,6,7
POA	✓ <i>Distichlis spicata</i>	inland saltgrass	1,2,3,6
POA	<i>Elymus canadensis</i>	Canada wildrye	6
POA	✓ <i>Critesion (Hordeum) jubatum</i>	foxtail barley	1,2,6,7
POA	✓ <i>Botelua (Bouteloua) curtispindula</i>	side-oats grama	6,7,9-10
POA	— <i>Sporobolus heterolepis cryptantha</i>	prairie dropseed	7,9-10
POA	— <i>Koeleria cristata</i>	June grass	9-10
POA	— <i>Muhlenbergia asperifolia</i>	alkali muhly	1,2,3,6,7
POA	— <i>Muhlenbergia montana</i>	mountain muhly	7,9-10
POA	— <i>Muhlenbergia richardsonis</i>	mat muhly	7
POA	— <i>Muhlenbergia wrightii</i>	spike muhly	3
POA	— <i>Panicum wilcoxianum</i>	panicle grass	3,6
POA	— <i>Panicum virgatum</i>	switchgrass	1,2,6,7,9-10
POA	— <i>Phleum pratense</i>	timothy	3,6,7
POA	— <i>Poa compressa</i>	Canada bluegrass	1,2,3,6,7,9-10
POA	— <i>Poa pratensis</i>	Kentucky bluegrass	1,2,3,6,7,9-10
POA	— <i>Poa sandbergii</i>	Sandberg's bluegrass	9-10
POA	— <i>Poa fendleriana</i>	Fendler's bluegrass	7
POA	— <i>Setaria sp.</i>	bristlegrass	7
POA	— <i>Sitanion hystrix</i>	bottlebrush squirreltail	3
POA	— <i>Sorghastrum nutans</i>	yellow Indiangrass	1,2,3,7,9-10
POA	— <i>Spartina pectinatus</i>	prairie cordgrass	3,6,7
POA	— <i>Sporobolus airoides</i>	alkali sacaton	1,2,3,6,9-10
POA	— <i>Sporobolus asper</i>	tall dropseed	1,2,3,6
POA	— <i>Stipa comata</i>	needle and thread	3,9-10
POA	— <i>Schizachyrium (Andropogon) scoparium</i>	little bluestem	1,2,3,6,7,9-10
POP	— <i>Populus angustifolia</i>	narrowleaf cottonwood	3
POP	— <i>Populus deltoides</i>	cottonwood	3,6
POR	— <i>Talinum parviflorum</i>	fameflower	7
PTG	— <i>Plantago patagonica</i>	Patagonian plantain	3,7
PTG	— <i>Plantago lanceolata</i>	buckhorn plantain	1,2,3,6,7
RAN	— <i>Ranunculus macounii</i>	buttercup	6
RHM	✓ <i>Ceanothus fendleri</i>	buckbrush	7,9-10
RHM	✓ <i>Ceanothus herbaceus</i>	New Jersey Tea	1,2
RHM	✓ <i>Ceanothus americanus</i> <i>symphoricarpos oreophilus</i>	buckbrush	7

Appendix/Plant/Species

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>SITES</u>
ROS	— Drymocaulis fissa	bigflower cinquefoil	7,9-10
ROS	— Potentilla norvegica	cinquefoil	3,7
ROS	— Prunus virginiana	chokecherry	9-10
ROS	— Prunus besseyi	sand cherry	9-10
ROS	— Rosa acicularis	prickly rose	3,7,9-10
ROS	— Rosa arkansana	Arkansas rose	1,2,3,6,7
RPR	— Symphoricarpos occidentale	snowberry	3,6,7
SAL	— Salix exigua	willow	6
SCR	— Penstemon secundiflorus	sidebells penstemon	7
SCR	— Verbascum blattaria	flannel mullein	1,2
SCR	— Verbascum thapsus	flannel mullein	1,2,3,6,7,9-10
SCR	— Verbena hastata	blue verbena	7
SCR	— Veronica americana	American speedwell	6
SCR	— Veronica salina	speedwell	6
SOL	— Solanum rostratum	buffalobur nightshade	6
TYP	— Typha latifolia	cattail	3,7
VIO	Viola pedatifida	prairie violet	7
VRB	— Phyla lanceolata	northern fog-fruit	6
VRB	Verbesina encelioides	golden crownbeard	7,9-10
ZYG	— Tribulus terrestris	puncture vine	6

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