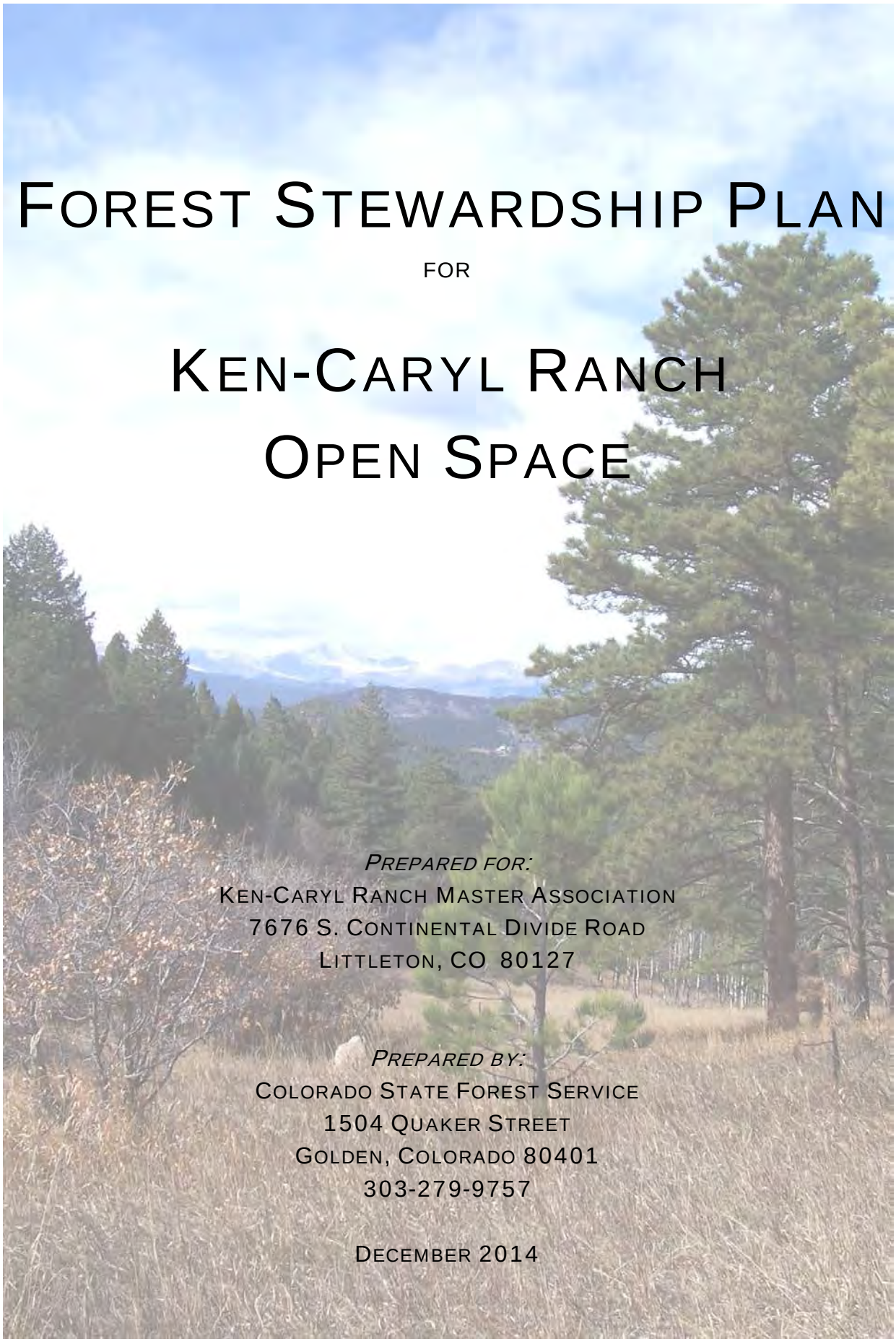


FOREST STEWARDSHIP PLAN

FOR

KEN-CARYL RANCH OPEN SPACE

PREPARED FOR:

KEN-CARYL RANCH MASTER ASSOCIATION
7676 S. CONTINENTAL DIVIDE ROAD
LITTLETON, CO 80127

PREPARED BY:

COLORADO STATE FOREST SERVICE
1504 QUAKER STREET
GOLDEN, COLORADO 80401
303-279-9757

DECEMBER 2014

FOREST STEWARDSHIP PLAN

FOR

KEN-CARYL RANCH OPEN SPACE

JEFFERSON COUNTY, COLORADO
WITHIN SECTIONS 25, 26, 27, 35, & 36,
TOWNSHIP 5 SOUTH, RANGE 70 WEST;
AND SECTIONS 1, 2 & 12 OF
TOWNSHIP 6 SOUTH, RANGE 70 WEST
2500 ACRES
(2505 FORESTED ACRES)

PREPARED FOR:
KEN-CARYL RANCH MASTER ASSOCIATION
7676 S. CONTINENTAL DIVIDE ROAD
LITTLETON, CO 80127

PREPARED BY:
COLORADO STATE FOREST SERVICE
1504 QUAKER STREET
GOLDEN, COLORADO 80401
303-279-9757

DECEMBER 2014

This management plan has been prepared at the request of the Ken-Caryl Ranch Master Association (KCRMA) to guide their forest management activities, which they will voluntarily apply on Ken-Caryl Ranch Open Space property. This plan has been developed using the Colorado State Forest Service standards for Forest Stewardship Plans.

This plan will guide the KCRMA in their forest management activities for the next ten years. However, if there is a major change in forest condition, management priorities, or ownership boundaries prior to 2025, this plan may be amended to accommodate those changes. The Colorado State Forest Service should be consulted prior to making major changes in the management plan or its implementation.

As the representative of KCMRA, I have reviewed this plan, which has been prepared at my request to guide KCRMA's stewardship management activities, and LCRMA will voluntarily apply them on its' property. I believe that the management recommendations in this plan are appropriate to meet KCRMA's goals and objectives, and will benefit the natural resources on this property. KCRMA intends to apply the recommended practices, thus helping the association to be a good steward pf the forest and associated resources entrusted to KCRMA on this property.

_____ _____

KCRMA Representative Date

_____ _____

CSFS District Forester Date

TABLE OF CONTENTS

1.0 INTRODUCTION

This Forest Management Plan has been prepared by the Colorado State Forest Service at the request of the Ken-Caryl Ranch Master Association (KCRMA) to guide them in implementing forest management activities on this property. This plan was completed in December 2014, and updates the previously prepared Forest Management Plan developed by CSFS-Golden District in April 2006.

This plan discusses the current condition and desired future condition of forest resources on the 2500 acres of Open Space on the west side of the KCRMA. The plan also outlines the goals of the landowner and recommends management activities that integrate these goals with accepted forest management practices. This plan represents a ten-year land management strategy that recommends completing specific activities on an annual basis. An annual work plan form is provided to assist the KCRMA in planning forest management activities.

This plan is intended to be a working document that can and should be modified to accommodate unforeseen events that may alter the property's landscape. Events such as insect and disease epidemics, wildfires, floods, and windstorms would undoubtedly affect the management of this property and subsequently change the scope of this plan.

2.0 GOALS & OBJECTIVES

Forest management goals are statements that express the KCRMA's desired future state of their property. The Association's management goals for this property were again verified to be:

- Reduce the threat and impacts of catastrophic wildfire;
- Maintain and improve wildlife habitat;
- Improve overall forest health;
- Maintain aesthetic and recreation resources;
- Enhance and protect water quality;
- Prevent soil erosion; and
- Integrate all management activities.

Forest management objectives represent activities that the KCRMA needs to implement in order achieve their goals. Objectives will establish the framework for creating measurable and planned results that correspond to pre-established forest management goals. The KCRMA's objectives for this property are**:**

- Thin stands for improvement of forest health and vigor, as well as to reduce risk and impacts of catastrophic wildfire;
- Treat and prevent insect and disease outbreaks;
- Create fuelbreaks to reduce the risk, spread, and impacts of catastrophic wildfire;
- Encourage Ken-Caryl Ranch resident awareness of the importance of active management to address wildfire hazard and to protect the values that the community receives from its forestlands;
- Work cooperatively with adjacent landowners to manage their land in a similar manner, in order to increase the effectiveness of treatments done on Ken-Caryl Ranch property; and
- Achieve objectives in a cost-effective and timely manner.

3.0 GENERAL DISCUSSION

3.1 LOCATION

Ken-Caryl Ranch is a primarily residential development located in Jefferson County, Colorado, in the southwestern part of the Denver Metro area. A portion of the community with a mixture of residential and commercial properties is located east of the Dakota hogback formation and C-470 highway. The portion of the community west of the Dakota hogback is a clustered residential development surrounded by open space areas, including the primary forestlands west of the community that are the focus of this forest management plan. Within the boundaries of Ken-Caryl Ranch are over 4,800 acres of Open Space, 2505 acres of which will be the subject of this plan.

The Open Space property discussed in this plan is located within Sections 25, 26, 27, 35, and 36 of Township 5 South, Range 70 West, and Sections 1, 2 and 12 of Township 6 S, Range 70 W (See **Map,** page 8). The approximate UTM coordinates of the site are Zone 13S, 484350N, 4379700E. The elevation of this property varies between 6200 feet and 7855 feet.

The primary access to the Open Space property can be reached by driving west on Highway 285 from Denver. From the intersection of C-470 and Highway 285, go south on C-470 for 4.5 miles. Exit at Ken-Caryl Avenue and turn right (west) at the bottom of the ramp. Proceed for 0.2 miles, and bear right onto Valley Parkway. Drive 1.0 miles, and bear left onto Valley Parkway. After 0.1 miles, turn right onto Mountain Laurel drive, and another right onto Manor House Road. Before reaching the parking lot for the Manor House Restaurant, turn right onto a dirt road. This road is the primary vehicular access to the Open Space areas, and is commonly known as the Manor House Trail. Vehicular access to other portions of the Open Space lands is open to Ken-Caryl staff via agreements with adjacent landowners, but is somewhat limited. Access into much of the forested areas in the Open Space is primarily via Ken-Caryl trails.

3.2 GENERAL DESCRIPTION

The Ken-Caryl Ranch Open Space that is the subject of this plan lies to the west of the residential development. The easternmost portion of the Open Space is at the edge of a valley and is composed of grassland on flat-to-moderate slopes. The western side of the property is considered part of the foothills of the Front Range, and the terrain is steeper and more rugged. Vegetation on the western three-fourths of the property is classified as a lower montane woodland, with drought-resistant, shrubby vegetation on the south sides of hills and heavy timber on the north sides of hills. A number of drainages run from the top of the Open Space property to the east and into the valley.

Looking west across the Open Space (as viewed from the primary access road – the Manor House Trail).

Forest Access Roads

3.3 HISTORICAL LAND USE

Ken-Caryl Ranch has a rich history, which has been well-documented by the Ken-Caryl Ranch Historical Society. Archaeological sites within the Ranch have yielded prehistoric and Woodland Indian artifacts. A site found in the area, thought to have been used as a shelter for indigenous peoples, has been dated to 565 B.C. Nearly 250 sites of archaeological significance have been found.

Little John's Chimney

Ken-Caryl Ranch was historically a part of a 10,000-acre ranch, first purchased and settled by Major Robert Boyles Bradford in 1859. The ranch changed hands several times until 1971, when it was purchased by the Johns-Manville Corporation, who bought it with the intent of locating its corporate headquarters there as well as setting aside home sites. The first residences were constructed soon thereafter.

Little John's Chimney (pictured, at left) has been preserved. It is one of many historically significant site in the area for which this plan is written. Forest management activities will enhance the aesthetic nature of the sites as well as protect them from future degradation, such as that caused by a wildfire.

The areas of Ken-Caryl Ranch outside the developed core of residential homes is primarily used for community open space. A small portion of these open space lands are located along the hogback geologic features to the east of the community (and next to the C-470 highway). The larger portion of these open space lands (and the focus of this Forest Stewardship Plan) are located to the west and uphill of the community, in the foothills of the Front Range of Colorado.

Many areas of the Front Range were historically subject to frequent wildfires (ranging from 10-50 year fire intervals). The Ken-Caryl Ranch Open Space was directly impacted by the 1978 Murphy Gulch wildfire, which originated immediately to the southwest. This wildfire burned across approximately 3,300 acres of land, including 2,102 acres on Ken-Caryl Ranch Open Space. The wildfire burned with considerable intensity in places, killing and removing some areas of mature forests and Gambel oak, while also burning less intensely in other mature forest areas. Recovery work after the fire occurred primarily through emergency grass seeding. The effects of this wildfire have directly shaped the kinds of forest and vegetation currently found on the Ken-Caryl Ranch Open Space lands.

3.4 CLIMATE

The elevation of this property varies between 6875 feet and 7942 feet. No specific climate data is available for this property. However, meteorological data is available for Evergreen, CO, located

approximately 7 miles to the northwest. The Evergreen weather station is the closest weather station most similar in topography and elevation (7040 feet) to this property, so one may assume that the meteorological data will also be similar. In fact, data from the Evergreen weather station was used in the 1972 analysis of the ecology of the western portion of Ken-Caryl Ranch.

The estimated climactic data for this property is:

- Average Annual Maximum Temperature (°F): 59.8
- Average Annual Minimum Temperature (°F): 29.1
- Average Annual Precipitation (in.): 19.25
- Average Total Snowfall (in.): 82.8

(Source: National Climatic Data Center, 2015)

3.5 IMPACTS ON NEIGHBORS

Stewardship of this property according to this management plan should not adversely affect any neighbors. In fact, management of this property will benefit the surrounding properties by implementing prescriptions to mitigate insect and disease outbreaks, as well as reduce the threat and spread of wildfire. Furthermore, the neighboring residential developments of Willow Springs and West Ranch have open space adjacent to Ken-Caryl. Both properties have forest management plans, and the opportunities for collaborative, cross-boundary efforts are abundant. Other adjacent private property landowners, as well as Jefferson County Open Space, may provide further opportunities for cross-boundary efforts. This opportunity will be discussed in more detail in **Section 7.0, Land Management Recommendations.**

3.6 SOCIAL, ECONOMIC AND MARKET CONDITIONS

Society is increasingly accepting of forest management activities, particularly regarding the need to address wildfire risk. A series of wildfires with large losses of homes along the Front Range (such as the Four Mile, Waldo Canyon, High Park, and Black Forest fires) have heightened awareness about the destructive capacity of this force of nature. This has led to an increased understanding among the general public regarding the role of fire in forested ecosystems and the effects of fire suppression during the last 100 years. Additionally, recent insect outbreaks (such as mountain pine beetle) have helped to increase awareness of the need for forest management.

Firewood generated from the construction of a fuelbreak on neighboring West Ranch, an example of potential removal of fuels and opportunity to reduce project costs.

The market for timber products continues to be somewhat limited along the Front Range of Colorado. Some improvements in demand for wood products have been noted recently, and there continue to be limited markets do exist for some sawtimber, post and pole, and furniture material. Air quality restrictions on wood burning previously affected the market for firewood in the Denver metropolitan area, but EPA approved wood stoves are now reaching a larger portion of the community. However, current high energy costs have led to a greater interest in and higher prices for fuelwood. Additionally, there still are markets for Christmas trees, sapling transplants, and Douglas-fir boughs.

Economic conditions have resulted in a shift in the way that management decisions are made. Because the market for timber products is limited, management prescriptions designed to use the value of forest products removed as a way to pay for management activities (or even to generate revenue) are in many cases inappropriate. This may especially apply to lands where aesthetics and recreational needs are of higher value, such as the Ken-Caryl Open Space areas. However, because of increased public understanding of the need for active management, recent years have seen increased public and private spending on projects where little or no product is produced (i.e. mastication projects). This option has been used on Ken-Caryl Open Space lands over the past 10 years in several locations. There are a body of contractors capable of doing such work, as well as removal of both merchantable and non-merchantable wood products. Accordingly, management practices which result in little or no forest products removed may be designed. Where access and appropriate harvesting methods match the community's goals and objectives, management practices which may result in removal of wood products may also be an option for the Ken-Caryl Master Association to consider.

By implementing this plan, the KCRMA will be promoting forest stewardship. This will enable Open Space land to continue to be managed into the future in an improved condition. This plan will serve as an example to the community and other landowners of how to reduce the risk of wildfire and increase the health of the forest, while at the same time preserving the integrity and beauty of the land.

4.0 PROPERTY RESOURCES

4.1 INSECTS AND DISEASES

There are few agents causing issues of major concern within the stands of Ken-Caryl Ranch Open Space. Several insects and diseases are causing occasional damage and mortality to trees within the stands, and these will be addressed in the following section. Populations of these insects should be monitored on an annual basis in order to assess whether or not they are becoming a major threat. How to monitor and manage these problems will be discussed in detail in **Section 7.0, Land Management Recommendations**.

Information concerning the identification and control of mountain pine beetle, Douglas-fir beetle, and western spruce budworm is included in **Appendix D**.

4.1.1 MOUNTAIN PINE BEETLE

During the 2006 and 2014 field survey, evidence was found of endemic populations of mountain pine beetle (*Dendroctonus ponderosae*). This means that the mountain pine beetle (MPB) has been killing a few trees per year for many years, but is not at epidemic levels. Adult beetles, which are black and about a quarter-inch long, lay a distinctive gallery of eggs in the wood tissue right underneath the bark. The beetles lay eggs in the fall, and the larvae develop over the winter and emerge as adults in mid-summer. Adult beetles also transmit bluestain fungi into the tree, and the combination of larval feeding under the bark and the growth of the fungus rapidly kills the tree.

The presence of MPB is identified by four factors: popcorn-shaped masses of pinkish-white sap on the boles of the tree (called pitch tubes; see **Photo,** above), boring dust (which looks like a fine sawdust) at the base of the tree and in cracks in the bark, a change in the color of foliage from green to red in the spring, and a blue stain in the wood (caused by fungus introduced by the beetles).

During drought years, populations of MPB may increase to epidemic levels and cause the mortality of groups of ponderosa. There have been two large epidemics or outbreaks of mountain pine beetle recently along the Colorado Front Range. The largest epidemic occurred during the late 1970s and into the early 1980's, and caused extensive loss of large ponderosa pine trees. There is evidence from the field inventory data (through tree cores) of how this epidemic greatly opened forest stands and result in significant growth rates for some time in the remaining ponderosa pine (and Douglas-fir) trees. A second, lesser extensive, outbreak occurred in the late 1990s and into the early 2000's in the area. This outbreak appears to have little overall impact on stocking levels and tree growth. The highly publicized MPB epidemic in the northern mountains of Colorado in the 2000's affected extensive areas of mature lodgepole pine,

and did not extend to the Jefferson County area. At this time, there are no significant areas of MPB populations in Jefferson County or near to Ken-Caryl Ranch. Continued monitoring both on Ken-Caryl Ranch Open Space and of nearby (within 2 miles) forested lands will be needed to provide early detection of MPB.

The treatment for mountain pine beetle is to cut down the tree and treat the wood, either chemically or by solar treatments. This must be done by June at the latest, in order to kill the larvae before they emerge as adults in late July and August. More specific information on the treatment of MPB is found in **Appendix D.**

4.1.2 DOUGLAS-FIR BEETLE

Ongoing mortality caused by Douglas-fir beetle.

The Douglas-fir beetle (*Dendroctonus psuedotsugae*), like the mountain pine beetle, has been causing sporadic mortality at endemic levels for years at Ken-Caryl Ranch. The beetle has been closely associated with Douglas-fir trees immediately adjacent to the boundary of the 1978 Murphy Gulch Fire. However, this insect will attack large, decadent Douglas-fir trees in any location, and some activity has occurred in other areas where damage from the Murphy Gulch fire did not happen to the remaining trees. Like most bark beetles, the Douglas-fir beetle is attracted to trees that have been under stress, and later will attack adjacent [healthy, but weakened] trees. In some cases, the fire likely killed part of the root systems of the trees at its edge, which did not kill the trees outright but caused them to be stressed. This encouraged attack by the Douglas-fir beetle. Once the trees stressed by fire had been killed by the beetle, the populations moved on to the nearby trees. Also, the stocking levels (number of trees) in some of the Douglas-fir stands are very high and the competition for resources has weakened some trees that are susceptible to beetle attack. That process has continued for decades, causing the mortality of several trees per year in several locations – most notably and visibly in the Massey Draw area.

The Douglas-fir beetle is an insect similar in size, color and behavior to the mountain pine beetle. The two are distinguished by the species of trees they attack, as well as the pattern of the egg galleries they create. While the Douglas-fir beetle does not usually create pitch tubes, it is easily identified by a proliferation of fine, red-orange boring dust in the cracks of the bark and around the base of the tree, and by the crown turning bright red in a matter of months.

Treatment and prevention of the Douglas-fir beetle is similar to that of the mountain pine beetle—cutting and treating the logs, and preventative spraying.

4.1.3 WESTERN SPRUCE BUDWORM

The western spruce budworm (*Choristoneura occidentalis*) continues to be active in places along the Colorado Front Range. The closest areas of damage to Ken-Caryl Ranch are in southern Jefferson County, around Kuester Road and south of Conifer. Damage is light to moderate in most of these areas, but has been persistent. Continued budworm activity therefore makes it possible for this insect to become active in other areas. Lightly affected trees were found in late 2005 on Ken-Caryl Open Space, and severely damaged trees were found on the adjacent West Ranch. No recent damage from western spruce budworm was noted during fieldwork for the 2014 plan update.

Defoliation caused by spruce budworm.

The spruce budworm is a moth larva. It is brownish in color and grows to around an inch long. The larvae feed on foliage, cones, and buds of Douglas-fire during the spring. The spruce budworm will infest a tree or forest stand for several years, repeatedly defoliating much of the crown, and eventually weakening the tree so much that it dies. During its weakened state, the Douglas-fir is also much more susceptible to bark beetle infestation and mortality. While the larvae are able to defoliate and kill a tree within just one season, the more common scenario is repeated partial defoliation and a slow decline in health until mortality occurs.

A light budworm infestation. Note slight discoloration at top of crown.

Spruce budworm epidemics in Colorado are cyclical in nature, and occur every few decades. The infestation can then last for years. During the large spruce budworm epidemic on the Front Range in the 1970s, a great amount of mortality across the Front Range (which is still easily visible throughout the Highway 285 and I-70 corridors) was caused by the combination of spruce budworm and Douglas-fir beetle, and a similar situation may occur again. Monitoring the level of spruce budworm infestation is crucial to continued forest health.

There are few cost-effective controls for the larvae; in fact, a hard, late spring frost can be the most effective control. Aerial spraying using parasitic bacteria (*Bacillingus thurlingensis*, or BT) has been moderately effective at control, but for it to be cost effective, a large area must be sprayed. High-value trees, such as those near trails, may be individually sprayed with chemical or microbial insecticides. Forest thinning will increase the health and vigor of the Douglas-fir, and make them less

susceptible to *mortality* by the spruce budworm (but will not reduce the incidence of infestation). Mixed species in any stand will also decrease damage levels and may provide for better forest cover in some situations. This can be achieved by underplanting or promoting natural regeneration of non-host species like ponderosa pine, which spruce budworm will not attack.

4.1.4 ASPEN DECLINE

The older trees within the aspen stands are beginning to decline in places. A natural ecological process called "succession" is occurring. Aspen, a somewhat short-lived species, are one of the first species to colonize a site after a disturbance such as a fire. Aspen stands begin to decline as the individual trees age and as conifers grow up underneath them. This process is identified by poor growth and the presence of decay in the older aspen trees.

***Phellinus* conk on the bole of an older aspen.**

"Heart rot" is a decay of the inner wood of aspen, caused by a fungus called *Phellinus tremulae.* It is characterized by hoof-shaped fruiting bodies, or "conks," which emerge from the bark of the tree trunk. While this fungus generally doesn't kill the tree outright, it weakens the structure of the tree (by making it hollow) and it is therefore likely to fall.

Various cankers caused by fungi, such as Cytospora and sooty-bark, are also causing the decline of trees in the mature aspen stands. These fungi attack the outer parts of the stems of trees, including the outer and inner bark. The fungus kills the bark and tissues that transport water and nutrients, grows bigger every year, and eventually kills the tree by girdling it. Canker fungi are often introduced to the tree when animal damage (such as antler rub) occurs.

There is no viable control treatment for the decline of individual trees. It should be viewed as a natural part of the forest cycle. However, some management can be done to ensure the entire stand does not decline. For example, small conifers can be removed, and declining aspen patches (clones) can be cut to encourage new shoots to come up. Management techniques will be discussed in more detail in **Section 7.0**.

Please note: Since the *Phellinus* stem decay is known to weaken trees, care should be taken when working or recreating near aspen with the visible conks. If possible, infected trees should be cut if there is a chance they may fall onto humans, vehicles, structures, or roads.

4.1.5 DOUGLAS-FIR TUSSOCK MOTH

A less common defoliating insect, the Douglas-fir Tussock Moth, poses a potential threat to the Douglas-fir stands on Ken-Caryl Ranch. This insect's caterpillar phase will eat the needles and growing buds, from the top down, on Douglas-fir and blue spruce trees. This results in top-kill, decline, and even death of the affected trees. It is especially damaging to high value blue spruce trees in ornamental, residential areas. In forested landscapes, a diversified mixture of tree species will help lower the potential for a buildup of this insect, and ensure some tree cover remains in the area. Ponderosa pine, lodgepole pine, aspen, Rocky Mountain juniper, and Gambel oak are tree species in the Colorado Front Range that are not affected by tussock moth. Tussock moths have irritating hairs in tufts on their bodies which can affect human skin, so handling these insect without gloves is not recommended.

Douglas-fir tussock moth (caterpillar) on DMP Birch Hill property, August 2014.

While Douglas-fir tussock moth has not been a major problem within Jefferson County, there was a small outbreak of approximately 50 acres along US 285 in the area around "Windy Point" from 2009-2011. Tussock moth has occurred in greater numbers and area on the Pike National Forest in Douglas and Teller Counties, especially in the mid 1990's, where it affected hundreds of acres and killed thousands of trees.

Douglas-fir tussock moth was detected in August 2014 by a ground survey on Denver Mountain Parks land (Birch Hill Park) immediately west of US 285 and north of North Turkey Creek road. While the extent and amount of this infestation is not known at this time, it is within 2 miles of the Tincup portion of the Ken-Caryl Ranch Open Space. Monitoring of the open space lands should include this insect as a potential damaging agent to watch for.

4.2 RIPARIAN FEATURES

There are limited riparian areas within the forested section of this property. One specific feature is a spring found in the lower portion of the aspen stand located in the Beacon Hill area, near Little John's Chimney. This spring and nearby vegetation has the presence of water and/or wet soils during much of the year. Riparian vegetation is also found in the area, such as alder (*Alnus incana*), blue spruce (*Picea pungens*), aspen, and sedges. This seep was at one time utilized by settlers (as evidenced by concrete structures). The drainage from this spring flows downhill

Spring in the Beacon Hill riparian area.

and west in the form of an intermittent stream that goes into the West Ranch community and eventually into North Turkey Creek.

Additional riparian areas are found in the form of intermittent streams located within the Shaffers, Lost Canyon, Massey Draw, and Docmann Gulch drainages. These streams have some areas of aspen forest and other riparian vegetation along most of their length. In some cases, there is adjacent conifer forest cover (especially Douglas-fir) to the streambanks. As these streams enter the grasslands and flatter areas of the Open Space property, the riparian vegetation transitions into narrowleaf and plains cottonwoods, along with some willows, sedges, and other plants.

Riparian vegetation along intermittent stream in Lost Canyon area.

Riparian areas are fragile, and often support the greatest diversity of species on the landscape. Therefore, it is important to perform work in these areas with care. Heavy management work is not recommended in the riparian area itself. When managing the aspen and Douglas-fir stands that lie on either side of the riparian area, care must be taken to not run through the riparian area with heavy machinery, or drag slash or wood products through it. The displacement of ground cover (such as litter and vegetation) should be limited in and around the riparian area. All forest management activities should follow the current Colorado Best Management Practices (BMPs), which are listed in **Appendix D**.

While there are other drainages in the Open Space areas, the amount of riparian vegetation is limited and they primarily occur in the grasslands. No management activities are planned for these drainage areas. For a map of the riparian areas, please refer to **Section 8.0, Figures.**

Riparian vegetation and streamside management zones need protection from recreation use and forest management activities.

4.3 SOILS

The Natural Resource Conservation Service (NRCS, Price and Amen 1980) describes eighteen soil types occurring on this property. A map (**Section 8.0, Figures**) and a brief description of each soil type are contained in **Appendix B.**

The large number of different soil types is a reflection of the varied topography of the Open Space. For the most part, water permeates quickly through the soils, keeping them fairly dry in nature. Other than the deep, fine soils associated with aspen stands and part of the grassland, the soils tend to be somewhat coarse and rocky. Erosion is a moderate hazard across much of the property.

Forest management activities can negatively impact the soils when heavy equipment is used, which tends to remove the vegetative cover and scarify the soil, thus making erosion from water a possibility. To avoid this, the number of skid trails created for thinning should be minimized, and as much ground cover (low-growing plants, small vegetative debris) should be left in place as possible. If the ground cover is disturbed, skid trails should be reseeded and erosion control devices or structures should be implemented to minimize erosion.

4.4 ACCESS ROADS AND TRAILS

Access roads to reach Open Space lands are limited, but are important to allow active forest management, to improve wildfire response, and may serve as recreational access as appropriate. The primary access road to Open Space lands is a maintained 4-wheel drive road from the Manor House vicinity, running west to Beacon Hill. This road is also known as the Manor House Trail, and has extensive recreational use by hikers and mountain bikers. This road connects to a 4-wheel drive road then connects to the adjacent West Ranch Open Space and community, through a gated entrance. A 4-wheel drive access road to the top of Massey Draw is available for Ken-Caryl Open Space personnel and service contractors to the top of Massey Draw through the West Ranch Open Space and community. This access route only extends for about 500 yards along Massey Draw before ending at various

Manor House trail/road, showing turnouts to remove water from road surfaces.

water supply structures. A third 4-wheel drive road Draw is available for Ken-Caryl Open Space personnel through private property off of Deer Mountain Road into Docmann Gulch. This road connects to the natural gas pipeline/access route that runs through Docmann Gulch and then southeast towards Deer Creek Canyon. Another potential access route could be established along the old wagon road along the north edge of Tincup Hill that connects to the old Murphy Gulch fireline/current trail system that enters Willow Springs HOA Open Space to the north of Tincup Hill. See the Map on page 9.

All access roads will continue to need to be maintained to reduce the potential for erosion and to allow management access. Maintenance is normally conducted by Ken-Caryl Ranch Open Space, but additional maintenance could be performed by contractors who may be using these access route for forest management activities (this can be a part of the service contract or timber sale agreements). Appropriate road design and erosion control features, like water turnouts and water bars, should be considered and installed in existing and any future access routes. Road design and maintenance for forest management work should meet or exceed the standards found within the following current CSFS publications: *Road Colorado Forest Road Field Handbook; Forestry Best Management Practices to Protect Water Quality in Colorado – 2010; Colorado Forest Stewardship Guidelines to Protect Water Quality – 1998.*

The majority of the Open Space lands can be reached by an extensive system of recreation trails established by Ken-Caryl Ranch. Many of these trails go through forested areas, which provide aesthetics and visual diversity. These trails are in good shape, and have design features to minimize erosion activities. Most of the current trails provide foot or bike access throughout the property for inventory, assessment, and monitoring, but are of less value for management activities. Trails may also provide access and support for fire suppression activities, but in most places the adjacent vegetation has not been sufficiently managed (reduced) to enhance wildfire control opportunities. These trails may provide educational opportunities concerning forest conditions and management activities through the use of signage and maps that include information about forestry and natural resource topics. See the map in **Section 8.0, Figures** for current trails.

Typical trail section within the Massey Draw area.

4.5 WILDLIFE

Ken-Caryl Ranch has a diverse landscape and diverse plant communities, and therefore hosts an excellent variety of wildlife. During the field survey, evidence of elk, deer, red-tailed hawk, black bear, Merriam's turkey, coyote, fox, pine squirrel, rabbit, deer mouse, black-capped chickadee, downy woodpecker, raven, and various songbirds were seen. Other species that have been seen on the property includes mountain lion, grouse, and various snakes. An inventory of birds was performed in the lower-elevation shrublands between 1997 and 1999. A summary of the study is attached to this document in **Appendix C.**

Deer tracks on Manor House Trail.

Forest management activities will maintain and improve most wildlife habitats. Thinning opens up the canopy of the forest, which allows more sunlight to pass through on to the ground and enables more understory vegetation to grow. That vegetation provides browse, forage, and habitat. Hiding cover for large animals will still be amply available in the neighboring [untreated] forest stands, and some slash piles may be left to provide habitat for small animals. While forest management activities (such as cutting trees or chipping slash) may cause a temporary disturbance to the fauna, the lasting effect will be a healthier forest.

4.6 THREATENED & ENDANGERED SPECIES

No threatened or endangered species have been directly observed in Ken-Caryl Open Space; however, there is potential habitat for one threatened and endangered species and a noteworthy rare species does exist in the park.

Bell's twinpod. Photo: www.stripe.colorado.edu

Although, none have been directly observed within KCROS boundaries, Ute ladies' tresses (*Spiranthes diluvialis*) is a federally threatened species and is known to inhabit stream terraces, irrigation canals, floodplains and oxbows at elevations between 4300-6850 feet in Jefferson County. Because best management practices limit forestry activities in riparian areas and wetlands, there is little danger of adversely affecting potential habitat.

Ute ladies' tresses.
Photo: Teresa Prendusi

Bell's twinpod (*Physaria bellii*), is rare but not threatened or endangered and is known to inhabit shale rock outcroppings in Ken-Caryl Open Space. It is prudent to exercise great care when working near it. Fortunately, forest management work will not

be performed near any shale rock outcroppings, and so the possibility of harming this species is minimal.

Colorado Natural Heritage Program has recently conducted further monitoring for threatened and endangered species and associated habitat, this information can be found in **Appendix F.**

4.7 UNIQUE RECREATIONAL QUALITIES

Excellent views of Mount Evans, the Front Range, and the Denver metropolitan area can be found in the management area. Numerous recreational trails cross the property, and are used for hiking, trail running, biking, and horseback riding. Several designated campsites and picnic areas are also within the management area.

View of Ken-Caryl Ranch, looking southeast.

Forest management activities will impact recreational activities in the short-term. Cutting and removing trees will create noise, dust, and a visual impact. Care must be taken to limit the access of Ken-Caryl Ranch residents during management activities, especially for their own safety. If cut trees and slash are properly removed in areas of high public visibility, the visual impact of management will abate quickly. Furthermore, thinning the trees will open up the forest canopy, allowing for better vistas and increased growth of attractive understory species, like grasses and flowers.

4.8 INVASIVE AND NOXIOUS WEEDS

Noxious weeds are found primarily along the trails, and only rarely in the general forest. Weed populations identified include Canada thistle (*Cirisum avense*), musk thistle (*Carduus nutans*), cheatgrass (*Bromus tectorum*), Russian knapweed (*Centaurea repens*), leafy spurge (*Euphorbia esula*), yellow toadflax (*Linaria vulgaris*) and mullein (*Verbascum thapsus*). In 2005, a contractor for Ken-Caryl Ranch created a detailed weed management plan, which will be supplemented annually with a work plan created by KCR staff. Because the weed management plan is in place, it is unnecessary to address the particulars of managing those weeds in this document.

Control and prevention of the establishment of noxious weeds is especially important when conducting forest management activities. Such activities, especially if machinery is involved, can remove the litter layer covering the mineral soil. This scarification allows noxious weeds to seed into the area and become established. Also, thinning operations open up the forest canopy, allowing more sunlight onto the forest floor. While this encourages native vegetation to flourish,

it can also encourage noxious weeds to flourish. Although there are few weeds in the interior of the forested stands, their seeds may lay dormant on the forest floor, and so the potential for populations to grow in the interior exists.

Four control measures are necessary to prevent the establishment and spread of noxious weeds in the stands. First, equipment and personnel working in the stands should be cleaned of seeds and plant material from noxious weeds before entering the stands. Second, the stands must be monitored for new populations of weeds. Third, if weeds are found in the stands, they should be removed by chemical treatment or hand-pulling. Fourth, any areas where the soil cover was removed should be reseeded with a native mix, in the hopes that those plants would be able to out-compete noxious weeds for establishment.

Smooth brome grass along the Manor House trail.

It is estimated that 10% of the 1300 native species in Colorado have already been replaced by noxious weeds. For the continued health of the forest and proper ecosystem function, these weeds must be controlled. Literature on identifying and treating these four noxious weeds is found in **Appendix D, Supplementary Information**. For more information on Canada thistle and other noxious and invasive weeds, access the Colorado Weed Management Association's website at: http://www.cwma.org.

Smooth brome, a non-native grass, is also a species of concern. After the 1978 Murphy Gulch Fire, much of the burned area on Ken-Caryl Ranch was reseeded with smooth brome to prevent erosion and provide forage. In many areas, the establishment of smooth brome was so successful that it prevented the re-establishment of native herbaceous species. Mowing and prescribed fire are the best options for reducing the smooth brome and restoring the appropriate level of native plants.

Russian olive tree in Open Space, in this case in aspen stand in Shaffer's Trail area.

Russian olive is a non-native tree species that was used for windbreak plantings and residential areas for much of the past 50 years. However, it is an invasive species that often takes over riparian areas, choking out non-native species. It has been classified as a Class B noxious species by the State of Colorado. Where Russian olive trees are identified on Open Space lands, they should be controlled by cutting, and spraying the stumps with appropriate listed chemicals. The Ken-Caryl Ranch community should also be provided with educational materials about the need to control Russian olive on private lots as opportunities occur to replace these trees in the landscaping around homes.

4.9 KNOWN ARCHEOLOGICAL SITES

Because of the numerous archeological sites, there may be sites, not identified in this plan, located within areas designated for treatment. KCRMA staff will evaluate any forest management activities for potential impacts to known sites, and adjust treatments in a manner as to not adversely affect the sites. If a new site is located during management, work will be adjusted as to not disturb the site and the site will be communicated to KCRMA staff. Little John's Chimney, a historical site (pictured on page 11) is within the management area, but will be protected from damage from management work. Management activities in the aspen stand near the chimney will be conducted manually (cutting down small conifers with chainsaws) and the risk of damage to the chimney is very low. Furthermore, the site is enclosed by a buck-and-rail fence, which will serve to protect it by providing a boundary for management activities.

5.0 WILDFIRE HAZARD

Wildfire is a natural part of the forest ecosystem. Before European settlers began suppressing them, wildfires would burn periodically through the forest. For example, a wildfire would occur in the low-density ponderosa every decade or so; once every few decades in the medium-density ponderosa; and every 50-200 years or more in the mixed conifer and lodgepole stands. Before settlement, litter, woody materials, and vegetation (grass, shrubs, and trees) were reduced by natural, low-intensity surface fires, so large fires occurred less frequently as there was less fuel for them to burn. One of the reasons to thin the forest, or conduct "wildfire mitigation," is to mimic the natural effects of fire without the risks. Wildfire mitigation reduces the fuel loading, and thus reduces the potential of severe, extreme wildfire behavior. The large wildfires of recent years, such as the 2002 Hayman Fire, were, in part, so severe because a century of fire suppression had created an unnatural amount of fuel loading. In fact, the 1978 Murphy Gulch Fire, which burned part of the Open Space, was considered one of the first significant fires in the Front Range wildland-urban interface.

Looking south across the Murphy Gulch Fire area (snow is visible in center left of photo)

Increased awareness of wildfire hazards and the need for active mitigation has led to advanced means of analyzing these hazards relative to the communities and homes within the wildland-urban interface. The Colorado Wildfire Risk Analysis Program (CO-WRAP) provides communities and land managers with opportunities to examine the wildfire hazards specific to their areas, as well as likely mitigation actions that may help protect their values at risk. The complete CO-WRAP report for the Ken-Caryl Ranch community can be found in the Community Wildfire Mitigation Plan. A summary of this report's findings indicates that: wildfire risk is greatest around the structures in the community; fire rates of spread are significant over most of the area due to fuel types and slopes; fire intensity is higher with shrub and forest vegetation types; and most fire activity will be ground or passive canopy fires.

Please also refer to the **Wildfire Hazard Map** on the following page. This map for Ken-Caryl Ranch Open Space property was developed in 2006 using fuel types and slope, which combine to give a prediction of how severe the wildfire hazard could be. Generally speaking, grassy areas contribute the least to the wildfire hazard of an area, and densely stocked areas of timber or brush would contribute the most. For example, grassy meadows have continuous horizontal fuel loading, and a fire can spread very quickly. But, since there is nothing above the grass (like trees), fire does not spread vertically. Because of this, it is often easier to control. In contrast, a stand of ponderosa with grass and Gambel oak underneath is much more hazardous. The grasses carry the fire horizontally, and the shrubs carry the fire vertically and into the crowns of trees, making the fire much more difficult to control and creating a much more severe wildfire hazard.

Wildfire Hazard

0 0.125 0.25 0.5 0.75 1
Miles

Colorado State Forest Service

N
W E
S

1:18,000

K. Berggren 12/20/05

Legend

- Open Space Boundary
- Trails
- 40' Contour
- Low Hazard
- Moderate Hazard
- High Hazard
- Extreme Hazard

The "flammability" of a site depends on four factors: 1) the amount of ground fuels, 2) the ease of ignition, 3) the dryness of the fuels, and 4) slope. Fuel models are useful in describing the first factor, but cannot take into account factors such as variable weather conditions, slope, and other geographic features. These fuel models should be used as a tool to help land managers identify which sites are a priority to treat, based on the potential intensity (given the rate of spread and flame length) of a fire. The Wildfire Hazard Map on page 25 takes into account the fourth factor, slope, and can be used to better predict priority treatment areas. Ease of ignition and fuel moisture are highly variable and cannot be predicted.

Fires will spread fastest in the fuel models with a grassy understory layer, but would burn most intensely (when one combines rate of spread *and* flame length) in the open ponderosa with a shrubby understory. A fire in the Gambel oak type would be a close second in terms of intensity and rate of spread. Fires in the mixed-conifer and aspen types present a moderate hazard, but if certain weather conditions develop a fire could be more severe and dangerous. Due to the density of trees and continuity of the litter layer beneath them, in the right conditions a fire in these fuel models could move quickly, burn hot, and kill the live trees.

The edge of the Murphy Gulch fire affected area.

Several factors in the area can act as ignition sources. Dry lightning storms are common in the summer, and could either ignite a fire on the property or in the area. As Ken-Caryl Ranch lies within the wildland-urban interface, there are many humans living, working, and recreating in the area. A spark caused by construction work, a carelessly tossed cigarette butt, or an escaped campfire are some of the many ways that humans could cause ignition of a wildfire.

The Murphy Gulch fire and the grasslands that cross the property help to serve as natural fuelbreaks. In parts of these areas, fuel loading is lower than that of the surrounding area—in areas of mixed conifer that burned (see above), the regrowth is sparse and mostly grassy. While some areas of Gambel oak are dense and well-established, others are comprised of 2feet tall oak interspersed with grass. If a wildfire were to occur, it would become less intense as it crossed the old fire scar and the grasslands. The fire spread may increase due to the lighter fine fuels, especially grass, in these areas, but the length of time that fire may burn in these areas would be shorter. This would provide an opportunity to control the fire in a safer and more efficient manner. The burned area and grasslands, due to their locations, would help to slow the spread of a fire from the south and north. The remaining threats to mitigate would be a fire that came from the west or north, as fuels are heavy and nearly continuous between Highway 285 and the Ken-Caryl boundary. Additionally, the prevailing wind in the area comes from the west. Because of those factors, fuelbreaks are planned on the western and northern boundaries.

Another method of classifying fuels and identifying potential fire severity is through using fuel models. Fuel models describe fuel loading, which, when combined with slope, wind, and humidity, can be used to develop fire hazard information. The fuel conditions on this property are best described using the U.S. Forest Service publication, *Standard Fire Behavior Fuel Models.* During 2006, field assessments were made during the preparation of this forest management plan, and the following information was generated concerning fuel models.

The grasslands are classified as Fuel Model GR4. If a wildfire were to occur here, it would move rapidly though the grasses. Grass fires can burn quite hot, but exhaust their fuel source quickly and are rapidly extinguished. Assuming a moderate wind speed (i.e. 10 mph) and moderate humidity (i.e. 30%), the fire could travel 1.8 miles in an hour, with flame lengths of 10 feet.

Fuel Model TU1.

The low-density ponderosa with a grassy (not shrubby) understory and the aspen stand type are classified as Fuel Model TU1. Fires in this type spread primarily through the fine herbaceous fuels (grass and litter) on the ground. Occasionally, they may encounter downed wood from the ponderosa, or small coniferous seedlings and saplings, which will create a higher-intensity fire that may produce firebrands. Assuming a moderate wind speed and moderate humidity, the fire could travel 330 feet in an hour, with flame lengths of 2 feet. Given a high wind speed and very low humidity, fire in these stands is predicted to reach a maximum spread of a quarter-mile per hour, with flame lengths up to 4.5feet.

Fuel Model SH5 represents the Gambel oak stand— the vegetation is composed of a continuous layer of shrubs, and the litter layer is also thick and continuous. Fires will easily carry through this flammable layer of vegetation with moderate wind speeds. Under moderate conditions, fire in this stand could travel 1.25 miles in an hour, with flame lengths of 20feet. Under severe fire weather conditions, fire could travel 2.5 miles per hour and have flame lengths of over 25feet. Obviously, fires in most conditions in this stand would be highly destructive, dangerous, and difficult to control.

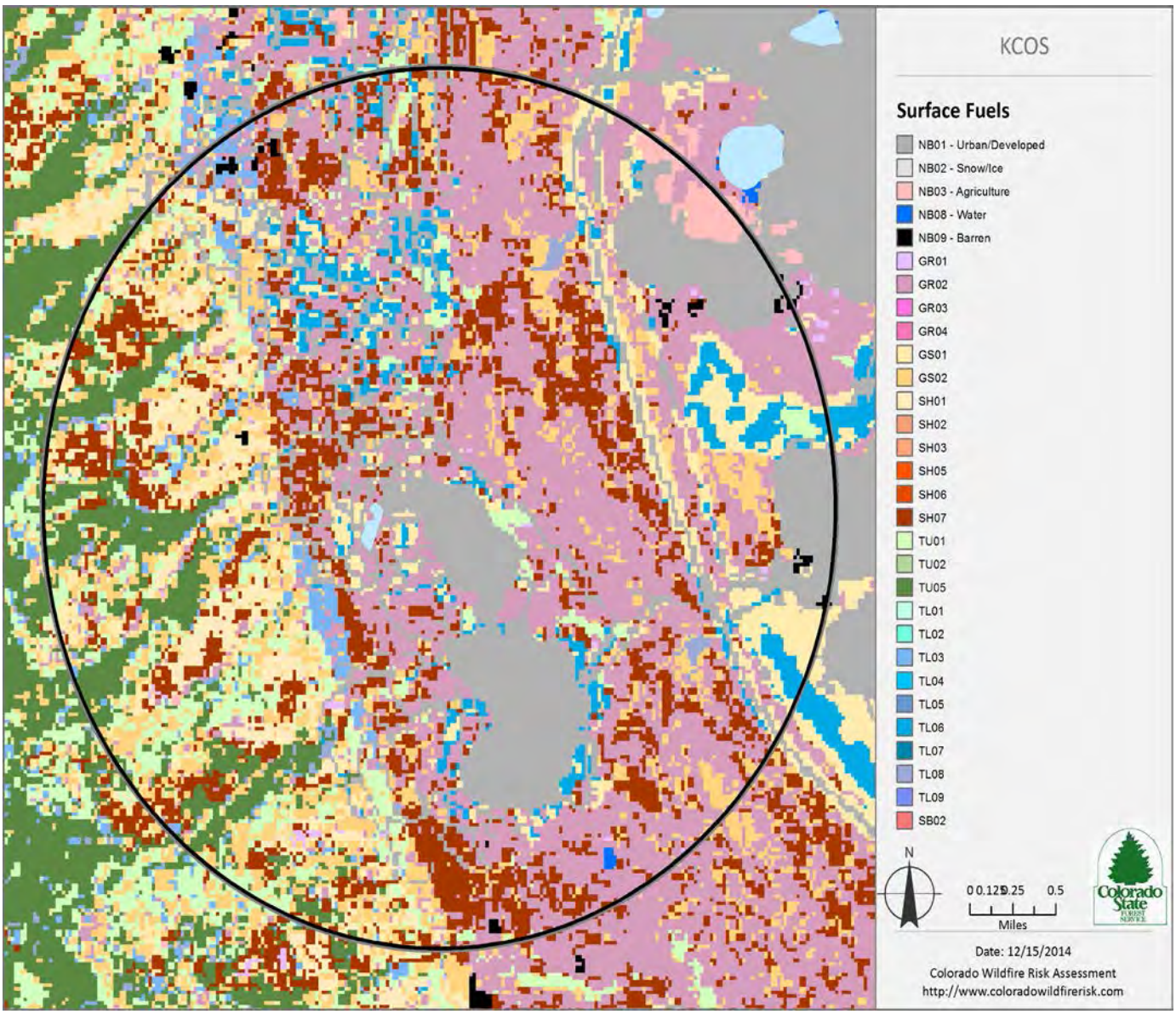
Fuel Model SH5 is representative of open ponderosa with a heavy Gambel oak or mountain mahogany layer in the understory. Fires here will carry through the shrub and grass layer, and cause individual trees to torch. Because most of this stand type is on steeper slopes (35-50%), fires would travel especially quickly. Under moderate conditions on these slopes, fires can travel up to 3 miles per hour and produce flame lengths of 25 feet.

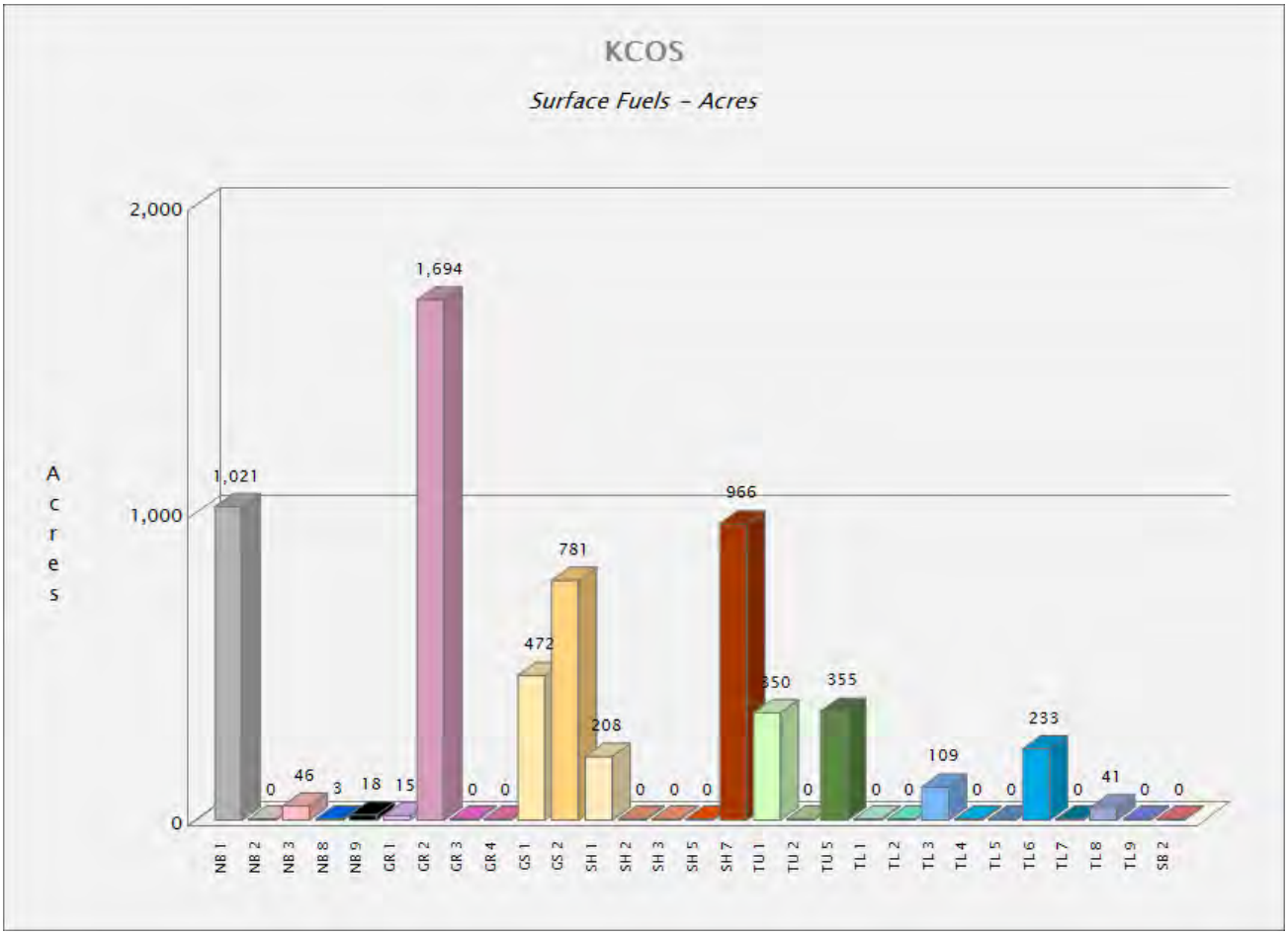
Fuel model SH-5.

The Douglas-fir stand can be described by Fuel Model TL1. In this model, fuel loading is low. There is little downed woody debris, few dead trees, and a compact litter layer. Under moderate conditions, fires would spread

120’ per hour and have flame lengths of less than a foot. Fires would carry in the litter layer and be unlikely to get into the crowns of trees. Evidence of such fire behavior can be found at the edge of the Murphy Gulch fire on a steep, north-facing slope in the Douglas-fir stand. The fire blackened the bases of the trees and consumed much of the debris on the ground, but the intensity of the fire was enough to cause mortality.

The CO-WRAP report for Ken-Caryl Ranch Open Space also generated maps and information concerning fuel models and wildfire hazard. These maps are created large-scale data sets concerning current vegetation, based upon aerial imagery (satellite). The interpretation of this information by the software leads to some other fuel models being indicated. The main difference in this information appears to be the exact nature of the grass, shrub, and forest fuels that may be found on the ground and how it affects fire behavior. In most cases, there is very little difference between the fuel models identified by CSFS field work, and the CO-WRAP generated maps. This information from the CO-WRAP report is shown below.





Thinning, fuelbreaks, fire road access, and other forms of wildfire mitigation are critical to human life, forest health, aesthetics, and the continued valuation and "livability" of the property. Wildfire mitigation is discussed in more detail in **Section 7.0, Land Management Recommendations**, and especially for around the Ken-Caryl community in **Section 7.2, Fuel Treatments – Ken-Caryl Ranch Community**.

6.0 RESOURCE INVENTORY

6.1 FOREST RESOURCES

The open space property consists of twelve distinct types of forest cover and a grassland vegetation type (see **map** on page 36). The forest types fall within the general classifications of: Douglas-fir; ponderosa pine; aspen; and Gambel oak. These four general classifications were originally identified in the 2006 plan, and since this plan focuses on the management of the forested portions of the property, the grassland was not inventoried.

The four original forest classifications (also called stands) were inventoried by Ken-Caryl Ranch Park Rangers and Colorado State Forest Service personnel between 2001 and 2005. A variable plot sample was used in to inventory the Douglas-fir and ponderosa pine stands, using a basal area factor (BAF) of 20. Regeneration within the stands was measured using a $1/100^{th}$ acre fixed plot, as was the Gambel oak stand. Because of the small size of the aspen stand, individual aspen trees were randomly sampled to obtain data. A total of 34 sample points were established in 2005. Two computer software programs were used to process the data from the timber inventory - Forest Vegetation Simulator and RMCRUZ5. The full timber inventory output tables from 2005 are located in **Appendix A.**

A majority of the inventory conducted for the 2006 plan was focused on the Beacon Hill / Tin Cup areas. The inventory used as base data and stand delineation for the creation of this plan was conducted on a significant portion of the forested area throughout the forested portion of the Ken-Caryl Ranch Open Space.

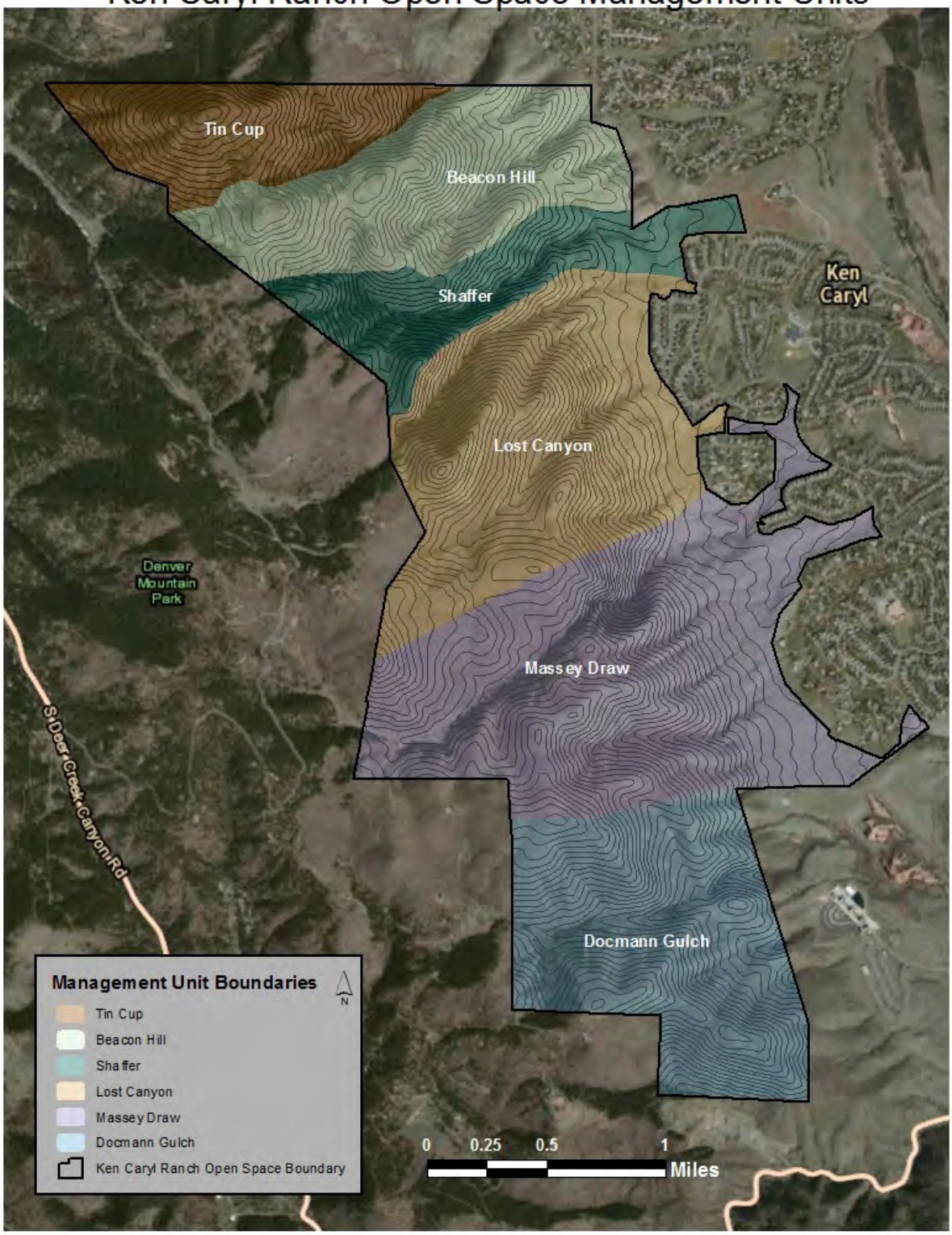
For the 2014 revision of this plan, the four forest classifications were re-examined and further refined to better define and delineate the range of conditions found within the Ken-Caryl Ranch Open Space. A total of 43 sample points were established across all forest types to confirm the previous inventory conditions and to establish base conditions for the additional forest types. This re-examination identified a greater diversity within the 1,649 acres of forest at Ken-Caryl Ranch, and this provides additional management needs and opportunities for the community. Notes and plot maps from this fieldwork are located in **Appendix A**. There is a short narrative of the attributes of each forest type included in this section. Some of the terms used in this section may be unfamiliar to the reader; please consult the **Glossary** in **Section 9.0** for definitions.

To further assist with identifying specific areas of the Ken-Caryl Ranch Open Space for forestry activities, the 2014 revision of this plan has designated six named Management Areas. These Management Areas will allow more specific observations of forest conditions, management recommendations, and assist with planning specific forestry projects throughout the open space lands (see map, on page 36). The description of the Management Areas is:

KCOS FMP – Management Areas (From north to south)

Management Area Name	Access/ Slopes	Geographic and man-made features/ description
Tincup	Access is currently via the Manor House Trail (road) to Beacon Hill. Access then by trails or crossing open ground. Slopes are moderate along ridgetops and the slopes of "Tincup Hill", but steeper along north facing slopes of drainages to the east of Tincup Hill.	Tincup trail area; hill located along the north border with Willow Springs Open Space; area north of the Manor House trail corridor up to aspen/meadow area.
Beacon Hill	Access is via the Manor House Trail (road). Road access is also via the 4WD service road from West Ranch. Several trails leave the Manor House trail to reach other parts of this area. Slopes are moderate around Beacon Hill and ridgetops, but become steeper on south and north facing slopes of drainages east of Beacon Hill	From Manor House along Manor House trail (main access road) to Beacon Hill and aspen/meadow area.
Shaffer	Access is via trails from Beacon Hill to the north, and Lost Canyon to the south. Access downhill from the West Ranch HOA property line for ATVs or other 4WD vehicles may be possible. Slopes are moderate, except along the intermittent drainage on the north side, as well as the sides of the ridge running downhill to the main community.	Starts along drainage south to Manor House trail/road, south to divide with drainage containing Lost Canyon Trail.
Lost Canyon	Access is via trails from Shaffers/Beacon Hill to the north, Massey Draw to the south, and Manor House to the east. Access downhill from the West Ranch HOA property line for ATVs or other 4WD vehicles may be possible. Slopes are moderate along the west side near West Ranch and the ridge towards Massey Draw, but very steep along the ridge and intermittent drainage running east towards the main community.	Drainage containing Lost Canyon trail, and drainage immediately south with isolated forest cover (east of West Range Road).
Massey Draw	Road access is via the 4WD service road from West Ranch. Other access is from several trails from the Lost Canyon area, and up Massey Draw from the main community. Slopes over much of the area are moderate, except for some steep slopes along the lower portions of Massey Draw.	Massy Draw drainage containing Massey Draw trail and south to divide with Docmann Gulch.
Docmann Gulch	Road access is via a 4WD service road from Deer Mountain road across private property, down to the gas pipeline right of way. The gas pipeline right of way provides access along Docmann Gulch and then southeast towards Deer Creek Canyon. Slopes over much of the area are moderate, except for some steep side slopes in various drainages.	Docmann Gulch drainage from Deer Mountain Rd, east to Jefferson County Open Space, and south to Deer Creek Canyon drainage.

Ken Caryl Ranch Open Space Management Units



Looking south from Beacon Hill toward the Shaffers management area in mid-ground of photo, and Lost Canyon area in rear of photo. Gambel oak/ponderosa pine on Beacon Hill in foreground, with Douglas-fir (mature) in Shaffers area along drainages in mid-ground. Aspen and Gambel oak in Shaffers area in mid-ground ridge. Douglas-fir (mature) on steep north facing slopes in Lost Canyon in rear, along with Gambel oak on right in rear of photo.

Looking north from Shaffers management area towards Beacon Hill (in center rear of photo) and Tincup (right rear of photo) management areas. Douglas-fir (mature) in Shaffers management area in middle ground of photo, with areas of Gambel oak, Douglas-fir regeneration, and ponderosa pine/Gambel oak. On Beacon Hill and Tincup, Gambel oak and Gambel oak/ponderosa pine are seen on south facing slopes, leading to ponderosa pine and Douglas-fir on ridgetops and north facing slopes.

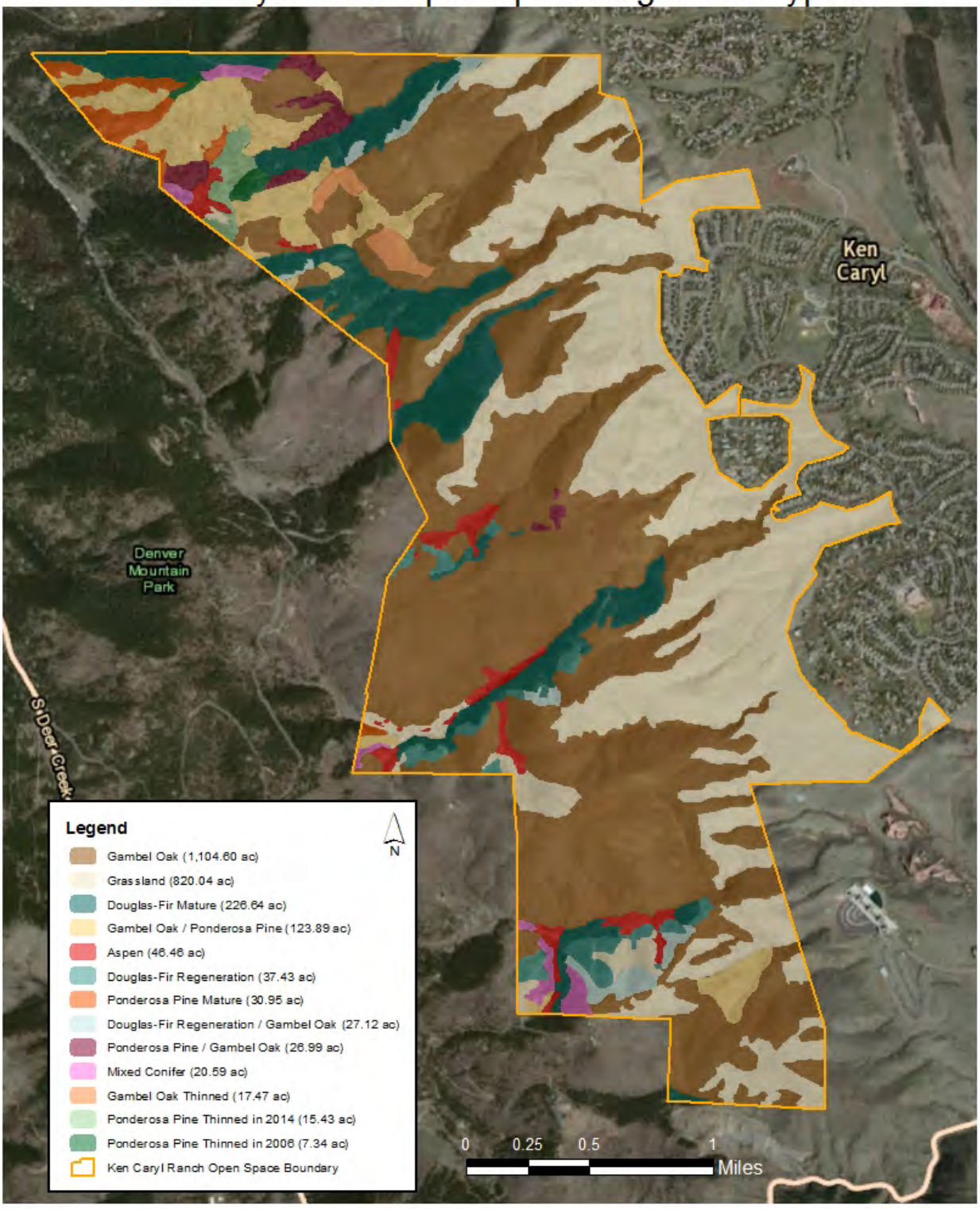
Looking west in the Shaffers management area showing Gambel oak in the foreground, with aspen in the middle ground along wetter areas and along intermittent streams. Gambel oak and Douglas-fir regeneration areas in the rear on south facing slopes, and Douglas-fir (mature) on north facing slopes. This arrangement of vegetation is also typical of the Massey Draw and Docmann Gulch management areas.

Looking southeast across the south end of the Lost Canyon management area showing Gambel oak in the foreground, with aspen in the middle ground along drainages. Douglas-fir regeneration areas are also shown in the middle ground north facing slopes, and Douglas-fir (mature) is also found along some north facing slopes. This arrangement of vegetation is also typical of parts of the Massey Draw and Docmann Gulch management areas.

The 2014 field assessment work identified 13 forest and vegetation cover types:

Forest Type Name	KCOS Management Areas	Acres
Douglas-fir (mature)	Tincup, Beacon Hill, Shaffers, Lost Canyon, Massey Draw, Docmann Gulch	226.64
Douglas-fir (regeneration)	Shaffers, Lost Canyon, Massey Draw, Docmann Gulch	37.43
Douglas-fir regeneration/ Gambel oak	Beacon Hill, Shaffers, Lost Canyon, Massey Draw, Docmann Gulch	27.12
Ponderosa pine (mature)	Tincup, Beacon Hill, Massey Draw	28.4
Ponderosa pine, thinned 2006	Tincup, Beacon Hill	14.9
Ponderosa pine, thinned 2014	Beacon Hill	7.34
Mixed Conifer (Ponderosa pine/Douglas-fir)	Tincup, Beacon Hill, Massey Draw, Docmann Gulch	21.06
Ponderosa pine / Gambel oak	Tincup, Beacon Hill, Lost Canyon	26.99
Aspen	Beacon Hill, Shaffers, Lost Canyon, Massey Draw, Docmann Gulch	46.46
Gambel oak	Tincup, Beacon Hill, Shaffers, Lost Canyon, Massey Draw, Docmann Gulch	1114.61
Gambel oak – thinned/treated	Beacon Hill	7.46
Gambel oak / ponderosa pine	Tincup, Beacon Hill, Shaffers, Massey Draw, Docmann Gulch	126.46
Grassland	Beacon Hill, Shaffers, Lost Canyon, Massey Draw, Docmann Gulch	820.04

Ken Caryl Ranch Open Space Vegetation Types



6.1.1 DOUGLAS-FIR, MATURE

This forest type is a total of 227 acres in size and is located primarily on north-facing slopes. Within the open space, there are approximately 10 separate (non-contiguous) stands (areas) of "mature" Douglas-fir. While there is some variation within the stands of this forest type, there are some common attributes and measured statistics. The slope averages 25%, but varies from 10 to 50%. The dominant species in the stand is Douglas-fir (*Pseudotsuga menziesii*), but ponderosa pine (*Pinus ponderosa*) also occurs as a minor component in places. Gambel oak may also be found in the understory in various places, especially adjacent to the boundary between the mature Douglas-fir and Gambel Oak forest types. There are also scattered clones of aspen in this forest type, too small to be mapped as part of the main aspen forest type. Density of the trees and their crowns is somewhat variable, ranging from 25 to 65% crown closure and averaging 230 trees per acre. The basal area in this forest type averages 113 square feet/acre, but can range from 90 to 290 square feet/ acre.

Typical conditions within the Douglas-fir, mature forest type.

Trees in this forest type average 9.5 inches diameter at breast height (DBH) and 45feet tall. The average age of these stand is 67, but dominant, large trees are mostly 105-130 years old (with a few individuals approaching 200 years). Trees in this forest type have an average growth rate below 0.5 inches in diameter every ten years, and increase in height 0.75 feet annually.

Based upon 2014 fieldwork, there is some range in these overstory measurements by individual stands (areas), specifically: Tincup area had an average basal area of 253 square feet per acre, 11.2 inches average DBH, and heights of 43-75 feet; Beacon Hill area had an average basal area of 170 square feet per acre, 11.3 inches average DBH, and heights of 35-78 feet; Shaffers area had an average basal area of 150 square feet per acre, 14.3 inches average DBH, and heights of 41-84 feet; Lost Canyon area had an average basal area of 230 square feet per acre, 13.5 inches average DBH, and heights of 53-68 feet; Massey Gulch area had an average basal area of 170 square feet per

acre, 14.7 inches average DBH, and heights of 71-83 feet; and Docmann Gulch had an average basal area of 160 square feet per acre, 15.0 average DBH, and heights of 51-85 feet. Some of this variation is related to the effects of the 1978 Murphy Gulch fire, which did not reach some of these stands (Tincup), burned through the understory of other stands (parts of Beacon Hill, Shaffers, Massey Gulch, Lost Canyon, Docmann Gulch), and did not burn through this forest type in other places (parts of Beacon Hill, Shaffers, Massey Gulch, Lost Canyon, and Docmann Gulch).

The trees in the stand are mostly healthy, but as they continue to grow, competition will increase and the stands will continue to remain dense and grow less vigorously. This will continue to make this forest type susceptible to insect attack, as has been noted with some areas of Douglas-fir beetle killed trees in various stands.

Due to the variable crown closure in the stand, the abundance of understory vegetation is also variable. For the most part, tree regeneration (seedlings and saplings) is somewhat limited within this forest type. Douglas-fir seedlings are found along the edges of the stand and in small openings where there are no overstory trees (typically from patches of insect attack). Likewise, the greatest amount and variability of other understory vegetation is found where sunlight reaches the ground, i.e. along the edges of the stand and in small openings. Major shrub species in the Douglas-fir stand include Oregon grape (*Mahonia repens*), common juniper (*Juniperus communis*), ninebark (*Physocarpus monogynus*), cliff jamesia (*Jamesia americana*), buffaloberry (*Sheperdia canadensis*), and woods rose (*Rosa woodsii*). Herbaceous species in the understory include sun sedge (*Carex heliophila*), smooth brome (*Bromopsis inemis*), mountain muhly (*Muhlenbergia montana*), and heartleaf arnica (*Arnica cordifolia*). The remainder of the forest floor is composed of litter, moss, and small rock outcroppings.

Douglas-fir stands tend to be more cool, moist, and densely treed than other areas within the lower elevations of the Colorado Front Range. Douglas-fir trees reach maturity at around 200 years old, and regularly attain diameters greater than 15 to 20 inches in unmanaged stands, although in this area some individuals may grow as large as 30 inches. Seed crops are produced every one to three years and are dispersed by wind. Douglas-fir is a shade-tolerant species, which means that growth (and regeneration) can occur successfully even under a thick, closed canopy. Douglas-fir stands can be successfully managed (with techniques such as thinning, and absent any major disturbances like wildfire or insect attack) up to 400 years of age.

6.1.2 DOUGLAS-FIR, REGENERATION

Typical conditions within the Douglas-fir, regeneration - forest type.

This forest type is a total of 37.43 acres in size and is located primarily on north-facing slopes, areas adjacent to current (mature) Douglas-fir stands, and in areas that were previously within Douglas-fir forest cover before the Murphy Gulch fire. The amount of Douglas-fir regeneration ranges from light, scattered trees in grass or scattered aspens, to patches of thick, "dog-hair" seedlings and saplings that are impassable. There are approximately 14 separate (non-contiguous) stands (areas) of Douglas-fir regeneration, scattered over the property. This forest type has become significant over the past 10 years as it increases the total forest cover in the open space areas, and shows continued recovery from the impacts of the 1978 Murphy Gulch fire. The slope averages 25%, but varies from 10 to 50%. The dominant species in the stand is Douglas-fir (*Pseudotsuga menziesii*), but ponderosa pine (*Pinus ponderosa*) also occurs as a minor component in places. Gambel oak may also be found in various places, but is not significant in the forest type. There are also scattered aspens in this forest type, especially near to the established aspen forest type. No inventory plots were taken in these stands due to the variable stocking levels and their continued development into larger trees. It is recommended that these stands be inventoried during the next revision of this forest management plan, as some development of large trees can be expected by that time. Trees in this forest type range from <1 to 2 inches average diameter at breast height (DBH), and range from 1 to 15feet tall.

The trees in the stand are mostly healthy, but as they continue to grow, competition will increase and the stands will become denser and grow less vigorously. Also, wildfire hazard is higher due to the dense vegetation and grass understory, and poses a threat to adjacent mature Douglas-fir stands in places.

Due to the variable crown closure in the stand and the impacts from fire, the abundance of understory vegetation is also variable. Because this forest type is being reestablished in areas that had been previously burned in the 1978 Murphy Gulch Fire, the understory vegetation is limited. Herbaceous species include sun sedge (*Carex heliophila*), smooth brome (*Bromopsis inemis*), and mountain muhly (*Muhlenbergia montana*).

6.1.3 DOUGLAS-FIR, REGENERATION WITH GAMBEL OAK

This forest type is a total of 27.12 acres in size and is located primarily on north-facing slopes, areas adjacent to current (mature) Douglas-fir stands, and in areas that were previously within Douglas-fir forest cover before the Murphy Gulch fire. The amount of Douglas-fir regeneration ranges from light, scattered trees in grass and Gambel oak (and scattered aspens), to patches of seedlings and saplings found in gaps in the Gambel oak that are impassable. There are approximately 6 separate (non-contiguous) stands (areas) of Douglas-fir regeneration mixed with Gambel oak. This forest type has become significant over the past 10 years as it shows an increase in the total forest cover in the open space areas, and shows continued recovery from the impacts of the 1978 Murphy Gulch fire. The slope averages 25%, but varies from 10 to 50%. The dominant species in the stand is Douglas-fir (*Pseudotsuga menziesii*), but ponderosa pine (*Pinus ponderosa*) also occurs as a minor component in places. Gambel oak is found throughout these stands. No inventory plots were taken in these stands due to the variable stocking levels and their continued development into larger trees. It is recommended that these stands be re-evaluated at the time of the next forest management plan revision, to determine if inventory work is warranted with continued Douglas-fir tree growth.

Typical conditions within the Douglas-fir regeneration with Gambel oak - forest type.

Douglas-fir trees in this forest type range from <1 to 2 inches average diameter at breast height (DBH), and range from 1 to 15feet tall. The trees in the stand are mostly healthy, but they continue to compete with the Gambel oak for space, light, nutrients, and water. Also, wildfire hazard is higher due to the dense Gambel oak vegetation and some grass understory, and poses a threat to the growth of the Douglas-fir trees.

Due to the variable crown closure in the stand and the impacts from fire, the abundance of understory vegetation is also variable. Because this forest type is being reestablished in areas that had been previously burned in the 1978 Murphy Gulch Fire, the understory vegetation is

limited. Herbaceous species include sun sedge (*Carex heliophila*), smooth brome (*Bromopsis inemis*), and mountain muhly (*Muhlenbergia montana*).

6.1.4 PONDEROSA PINE, MATURE

This forest type is 28.4 acres in size over several stands (areas), and is located primarily in the northwestern portion of open space property. Slopes vary between 10 and 50%, and average 30%. This forest type is located along ridgetops and sideslopes, and has east, south, and west aspects. The dominant species is ponderosa pine, with scattered Douglas-fir and Rocky Mountain juniper (*Juniperus scopulorum*) throughout the stand. Some portions of the forest type also have some Gambel oak (*Quercus gambellii*) in the understory. Douglas-fir regeneration is occurring in isolated areas in the form of seedlings and occasional saplings. The forest type consists of moderately-dense, larger ponderosa pine with some medium size ponderosa pine as part of the stand. The condition of this forest type is good; there were few recent dead or mountain pine beetle attacked trees were observed and growth is adequate. This stand has an average of 184 trees per acre, which have an average DBH of 11.3 inches and dominant tree heights of 37-43 feet. The average basal area is 173 square feet per acre, and the dominant trees are 70-155 years old with 10-year growth increments of .2-.3 inches diameter. On average, about 60-70 of the basal area in these stands is small to medium sized (5-8 inches DBH) trees.

Typical conditions in Ponderosa Pine – mature, forest type.

The understory vegetation is mostly grass, and the major species are smooth brome, mountain muhly, Kentucky bluegrass (*Poa pratensis*), little bluestem (*Schizachyrium scoparium*), and mountain timothy (*Phleum pratense*). Mountain mahogany (*Cercocarpus montanus*) and kinnickinnik (*Arctostaphylos uva-ursi*) are common shrubs. Forbs found in the ponderosa pine stand include yarrow (*Achillea millefolia*), fringed sagewort (*Artemisia frigida*), prairie sagewort (*Artemisia ludoviciana*), yellow salsify (*Tragopagon dubius*), and hairy goldenaster (*Heterotheca villosa*). Exposed rock, bare mineral soil, and litterfall make up the remainder of the ground cover.

Ponderosa reach maturity around 160 - 200 years of age. They can live 500 years or more on the Colorado Front Range, attaining diameters of over 40 inches. Ponderosa pine stands can be successfully managed (with techniques such as thinning) at any age, but respond best (in terms of growth) before 200 years of age. Removing small-diameter trees (such as Gambel oak and Douglas-fir) from the understory will increase the health of the old-growth ponderosa, as well as encourage their longevity. For example, thinning around a medium-sized 100-year old ponderosa can yield a dramatic increase in growth and vigor, and the tree may eventually attain a large diameter and height. Thinning around a medium-sized 250-year old ponderosa will increase health, but it will not become a much larger tree over time as the younger ponderosa tree would.

6.1.5 PONDEROSA PINE – THINNED IN 2014

A portion of the Ponderosa Pine-Mature forest type was thinned (from below) in fall 2014, using mastication of understory conifers and Gambel oak. The area treated was approximately 15 acres,

immediately west of Beacon Hill, and adjacent to the large aspen stand at this location. Slopes vary between 10 and 20%. The dominant species is ponderosa pine, with scattered Douglas-fir, aspen, and Rocky Mountain juniper (*Juniperus scopulorum*) in the stand. This stand also have Gambel oak (*Quercus gambellii*) in the understory. The forest type consists of moderately-dense, larger ponderosa pine with some medium size ponderosa pine as part of the stand. The condition of this forest type is good, especially after this treatment. This stand now has an average diameter of 13.6 inches an average height of 39.7 feet, and an average basal area of 85 square feet per acre. The dominant overstory trees are 85-95 years old, with a ten-year growth increment of .25 - .4 inch diameter. Distribution of residual trees is somewhat uneven, with some clumps of larger trees or uncut Gambel oak interspersed with grass and masticated understory.

6.1.6 PONDEROSA PINE – THINNED IN 2006

This forest type (on Tincup hill and Beacon Hill) was thinned (from below, to remove understory trees and Gambel oak) around 2006. Cores taken from the trees showed a short-term increase in growth rates after the thinning occurred; however, growth increases did not continue and the stand is in need of further management - including thinning to a lower residual density. This will be discussed in greater detail in **Section 7.0, Land Management Recommendations**.

This forest type is 7.34 acres in size over two areas on Tincup hill and Beacon Hill. Slopes vary between 10 and 20%, and average 15%. This forest type is located along ridgetops and sideslopes, and has south and west aspects. The dominant species is ponderosa pine, with scattered Douglas-fir and Rocky Mountain juniper (*Juniperus scopulorum*) throughout the stand. There is also Gambel oak (*Quercus gambellii*) in the understory in mature condition, as well as regrowth from previous treatments. The forest type consists of moderately open grown, larger ponderosa pine with some medium size ponderosa pine as part of the stand. The condition of this forest type is good, but regrowth of understory vegetation (Douglas-fir seedlings and Gambel oak sprouts) has started. This forest type has an average diameter of 13.2 inches, an average height of 46.2 feet, and an average basal area of 105 square feet per acre. The dominant overstory trees are 110-155 years old, with a ten-year growth increment of .3 - .4 inches diameter.

6.1.7 MIXED CONIFER (PONDEROSA PINE/DOUGLAS-FIR)

This forest type consists of 21.1 acres within 6 small stands scattered across the Open Space property. These areas are comprised of mature ponderosa pine and Douglas-fir trees found in transition zones between the more predominant ponderosa and Douglas-fir forest types. In general, these mixed stands can be managed for either or both species, depending upon the immediate issues found or the long-term objectives of the landowner. These small stands are found in the Tincup, Beacon Hill, Massey Draw, and Docmann Gulch management areas.

Slopes vary between 5 and 40%, and average 15%. This forest type has north, east, south, and west aspects. The dominant species are ponderosa pine and Douglas-fir, with scattered Rocky Mountain juniper (*Juniperus scopulorum*). Some portions of the forest type also have Gambel oak (*Quercus gambellii*) in the understory. The forest type consists of moderately-dense, larger ponderosa pine and Douglas-fir, with some medium size ponderosa pine as part of the stand. The amount of both species varies by stand and aspect, but ponderosa pine tends to be the majority species. In general, condition of this forest type is good; there were only a few dead trees found that indicate any kind of insect activity. This forest type has an average diameter of 15.4inches, an average height of 50.2 feet, and an average basal area of 161 square feet per acre. The dominant overstory trees are 87-125 years old, with a ten-year growth increment of .25- .5 inches diameter.

Some thinning work has occurred in several of these small stands. The stand on top of Tincup hill was partially treated as part of understory thinning (mastication) in 2006. This stand has an average diameter of 11.8 inches, basal area of 120 square feet per acre, and height of 34.3 feet.

The stands adjacent to the aspen stand and meadow at Beacon Hill were treated (understory mastication) as part of the larger

project in mature ponderosa pine stands in that area during fall 2014. The residual stand has an average diameter of 18.1 inches, basal area of 97.5 square feet per acre, and height of 57 feet.

6.1.8 PONDEROSA PINE/GAMBEL OAK

Ponderosa pine/Gambel oak forest type on south side of Beacon Hill.

This forest type is 27 acres in size, found in several stands (areas), and is located primarily in the northwestern portion of open space property. Slopes vary between 10 and 40%, and average 25%. This forest type is located along ridgetops and sideslopes, and has east, south, and west aspects. The dominant species is ponderosa pine, with Gambel oak (*Quercus gambellii*) in the understory. There are scattered Douglas-fir and Rocky Mountain juniper in places. The forest type consists of open grown, larger ponderosa pine with some medium size ponderosa pine in some stands. Gambel oak exists as mature clones with diam DBH in the understory of the ponderosa pine, and in openings between the ponderosa pine. Much of the forest type exists on the edge or outside the perimeter of the 1978 Murphy Gulch fire, which probably led to the current density of ponderosa pine and mature Gambel oak that was not damaged during that fire. The condition of this forest type is good but very dense and has a high wildfire hazard due to the continuous understory fuels. This forest type has an average diameter of 17.3 inches, an average height of 42.8 feet, and an average basal area of 112.5 square feet per acre. The dominant overstory trees are 47-155 years old, with a ten-year growth increment of .3- .7 inches diameter.

6.1.9 ASPEN

The aspen forest cover type covers a total of approximately 46.5 acres, and is found as distinct stands within the various management areas. These stands range from 1 to 10 acres in size. The sizes of each stand, as well as the amount of this forest type at Ken-Caryl Ranch, is small yet significant. Aspen stands are rare at this elevation and in this portion of the Front Range, and so this forest type bears some discussion despite its small area. These forest type is in found in several parts of the property, except the Tincup management area. However, it should be noted that aspen can be found in several other forest types, especially the Douglas-fir (mature) in the Tincup area, and management to increase aspen presence and health should be part of the work planned in these other forest types. Most of the aspen is found in associated with intermittent streams, meadows, or drainages in between ridges and side slopes. Slopes are mostly is gentle (0-15%) and aspects can be north, east, south, and west depending upon the stand locations.

The aspen, on average, in most stands of this forest type are between 3 and 5 inches DBH, around 35feet tall, and about 40 years old. There are approximately eight hundred trees per acre, an average basal area of 150 square feet per acre. However, the aspen stand located in south edge of the Docmann Gulch management area has an average DBH of 6.6 inches DBH, height of 40.75 feet, and age of 60-80 years old. For the most part, the aspen in the various stands are healthy, although some of the more mature individuals (>40 years old) have begun to decline, as evidenced by heart rot and standing dead stems. The younger aspen remain vigorous and show good annual growth, when not suppressed by competing conifers or Gambel oak.

Aspen found in other forest types on the property is generally in poorer condition, being shaded out by the dominant overstory (especially in the mature Douglas-fir type). Many of these scattered clones are declining and would need immediate removal of both small and large conifers in order to generate sufficient disturbance to rejuvenate the root systems.

Understory vegetation in the aspen forest type is generally grassy, with smooth brome dominating. Other common herbaceous species include elk sedge, timothy, yarrow, geranium (*Geranium caestitosum*), and goldenbanner (*Thermopsis divaricarpa*). Shrub species include common juniper, kinnickinnik, wild rose, and serviceberry (*Amelanchier alnifolia*). Gambel oak is occasionally found as a shrub component in the aspen forest type. The ground remains fairly moist throughout the year and the soil is deep and fertile, and so it is almost entirely vegetated. Areas not covered by living plants are covered in litter and dead vegetation.

Aspen stands are usually short-lived, although it depends on the availability of moisture and site conditions. While this forest type is primarily associated with areas of higher moisture (relative to the rest of the property), it is probably not moist enough to produce a long-lived stand of large trees. As the overstory aspen trees reach maturity, they should begin to decline. As they die, they may be replaced by new aspen shoots from the root system, if there is sufficient sunlight and a lack of competition from other trees. Conifers (such as Douglas-fir and blue spruce) have begun to encroach into portions of different aspen stands. As they do, they will begin to compete with and shade out the aspen. It is important to remove these conifers in order to allow the stand to continue to reproduce and exist.

6.1.10 GAMBEL OAK

The Gambel oak stand is by far the largest vegetative type in the Open Space, covering 1,115 acres. It is found on a variety of slopes and aspects throughout the Open Space, and forms a nearly continuous canopy from north to south along the base of the foothills on the property.

Interestingly, Ken-Caryl Ranch is close to northern edge of where Gambel oak is found along the Front Range. Grassland and Douglas-fir stands create the breaks in the Gambel oak stand, and occur when the slopes are either too dry to support this species, or receives enough moisture to support denser conifer growth at shades out Gambel oak (respectively). Occasional ponderosa pine and Rocky Mountain juniper are found in the stand.

Gambel oak is a multi-stemmed, shrublike species of tree. In this forest type, the stems average 1.8 inches DRC (diameter at root collar)

and 6feet tall. The average age is 27. There is great variability within the stand; individuals grow larger in drainages where more water and deeper soil is available, and much smaller on hot, rocky hillsides. The largest specimen identified was 12.3 inches DRC, 20 feet tall, and at least 60 years old. The smaller specimens (which are much more common) were a fraction of an inch at DRC and a foot tall.

The oak forms a continuous canopy throughout most of this forest type. The ground is covered by grass, forbs, and fallen leaves, with occasional rock outcroppings. Common species include yarrow, rosy pussytoes (*Antennaria rosea*), golden aster, bluegrass, smooth brome, sun sedge, mountain muhly, bluestem, chokecherry (*Prunus virginiana*), and woods rose.

Gambel oak.

Gambel oak typically grow on sites which are too dry and hot to support timber species. They grow in unbroken thickets and can cover many, many acres. Gambel oak usually reproduce by suckering—roots spread out laterally from the existing tree, and will create new individuals when they break the surface of the soil. The oak are considered "early successional" species, which means that they are one of the first species to re-colonize a site after a catastrophic event such as fire. This is visible on Ken-Caryl Ranch where the oak has regrown in areas burned by the 1978 Murphy Gulch Fire.

Oak are susceptible to dieback, which occurs when the leaves and buds at the tips of branches die from a hard frost or a root problem. A late-season frost in spring of 2003 caused dieback in many of the Gambel oak stands in this part of the Front Range, although it appears this forest type has since recovered. Gambel oak stands can live for over 100 years, but rarely do individuals grow larger than a diameter of 4 inches.

6.1.11 GAMBEL OAK –THINNED/TREATED

Gambel oak stands along the Manor House road/trail have been treated to create a fuelbreak along this man-made feature. Some of this thinning has occurred primarily along the road, within 50 feet of the roadside. However, a larger area along the road was treated on the south-facing slope located at the ridge saddle where the Manor House and Bradford trail junction occurs. This treatment location (and forest type) is a total of 7.46 acres in

size. Slopes are 10-25%. It has been created by cutting the Gambel oak stand into clumps of approximately 20-50feet (based upon the clonal nature of this tree species. The stumps of the cut trees were treated by spraying with herbicides too prevent regrowth. This treatment has been effective in breaking up the fuels within this area. As additional treatment work in Gambel oak is planned and accomplished, this forest type should be remapped and continued to be inventoried.

6.1.12 GAMBEL OAK/PONDEROSA PINE

This forest type is 126.5 acres in size, found in a number of stands. This forest type is primarily found in the northwestern portion of open space property (Tincup, Beacon Hill, and Shaffers management areas), with three other stands located in the Massey Draw and Docmann Gulch areas. Slopes vary between 10 and 50%, and average 30%. The dominant species is Gambel oak (*Quercus gambellii*), with sufficient ponderosa pine throughout the stand to be noted and potentially significant for future management opportunities. There are also very scattered Douglas-fir trees, and some Rocky Mountain juniper (*Juniperus scopulorum*) throughout the stand.

Gambel oak with ponderosa pine forest type.

This forest type differs very little from the Gambel Oak type with regards to the predominant species. Gambel oak stems average 1.8 inches DRC (diameter at root collar) and 6 feet tall. The average age is 27. There is great variability within the stand; individuals grow larger in drainages where more water and deeper soil is available, and much smaller on hot, rocky hillsides. The largest specimen is 12.3 inches DRC, 20 feet tall, and at least 60 years old. The smaller specimens (which are much more common) were a fraction of an inch at DRC and a foot tall.

The presence of ponderosa pine is found throughout the forest type, but not in sufficient numbers to justify an inventory. The majority of the trees are larger open grown ponderosa pines, often in concert with some rock outcrops or openings in the predominant Gambel oak vegetation. The ponderosa pine in this forest type does not exceed an average basal area of 20 square feet per acre in any particular area.

The oak forms a continuous canopy throughout most of this forest type. The ground is covered by grass, forbs, and fallen leaves, with occasional rock outcroppings. Common species include yarrow, rosy pussytoes (*Antennaria rosea*), golden aster, bluegrass, smooth brome, sun sedge, mountain muhly, bluestem, chokecherry (*Prunus virginiana*), and woods rose.

6.1.13 GRASSLAND

The remaining 820 acres of Open Space is classified as grassland. It occurs in areas which generally are unable to support tree species due to poor soils and little available water. However, in some places there are patches of Gambel oak, scattered Rocky Mountain junipers, and occasional ponderosa pines. There are also some shrubs and cottonwood (narrowleaf and plains) found in places along intermittent streams and drainages running through the grassland areas, but of such small extent as to not warrant mapping or inventory. These trees provide some forest cover and benefits, but are too scattered or isolated to be significant enough for mapping. Management of these trees would be difficult, so a resource inventory and narrative were not developed for the grassland. Any management needs involving these trees could be developed on a case-by-case basis if other natural resource management activities are planned in the vicinity.

7.0 LAND MANAGEMENT RECOMMENDATIONS

Management activities recommended for Ken-Caryl Ranch will take place in all parts of the Open Space. The most significant activities will continue in the northwestern portion of the Open Space, in order to complete the previously (2006) proposed fuel treatments that help protect this area. Additionally, continued activities around the community center of Ken-Caryl Ranch for direct protection of the public and structures are to continue. Major management activities are proposed in the following manner: identifying and removing hazardous trees along recreation trails; creating or maintaining fuelbreaks and fuels treatments around Ken-Caryl Ranch; restoring aspen stands; thinning in the ponderosa forest types; and thinning in the Douglas-fir forest types. Minor management activities include: slash management; monitoring and treating for insects and diseases; controlling invasive and noxious weeds; public outreach and education; and collaborating with neighboring landowners to conduct cross-boundary management work. This plan should be implemented within the next ten years, and revised as necessary in 2025. Additionally, the Prioritized Forest Health and Wildfire Mitigation Recommendations proposed at the time of this plan's development should be reviewed, updated, and tracked annually.

The main goal in conducting forest management activities is to reduce the threat of catastrophic wildfire. In doing so, many other benefits will be reaped. Forest health will be improved, wildlife habitat will be maintained and expanded, and aesthetics will be maintained and improved. By reducing the risk of stand-destroying events such as wildfire or insect epidemics, Ken-Caryl Ranch will also reduce the risk of soil erosion and water quality degradation. Furthermore, recreation resources and property values should be protected and enhanced both in the short-term and long-term.

The management activities are primarily focused on areas with good accessibility, so that people and/or equipment may get into the project areas without undue difficulty. Proposing management activities off of the existing roads and trails system improves the opportunity to implement work without delays to create additional access. Furthermore, establishing fuelbreaks off of roads and trails makes them much more efficient and usable by firefighters. Conducting management activities in the other forested portions of the Open Space property besides the Tincup and Beacon Hill management areas was not recommended in the original 2006 forest management plan because the difficulty of accessibility made management work less feasible. Since then, some access has been identified through neighboring properties for Ken-Caryl Ranch Open Space staff, which makes management activities in other portions of the property more feasible and worth evaluation. Opportunities to increase access for forest management and wildfire suppression in other portions of the Open Space property should continue to be explored and developed as opportunities become identified. A Map of the current access roads is located on Page 8.

Some of the terms in this section may be unfamiliar to the reader. Please consult the glossary in **Section 9.0** for definitions. A **Map** of the management areas is located on Page 33 and in **Section 8.0 Figures**.

7.1 FUELBREAKS – FORESTED OPEN SPACE

Fuelbreaks are an important line of defense against a wildfire. Their primary function is to break up the continuity of fuels in a forest and provide an area where the fire will slow down and be more easily controlled. Fuelbreaks are strategically located, generally along topographic features like ridges or man-made features like roads. When protecting a property or community from wildfire, the likely direction of fire spread is important. Most large fires along the Front Range spread with the prevailing south, southwest, west winds that overcome local topographic influences (such as the daily "upslope, upvalley" winds caused by solar heating of higher elevations). Fuelbreaks are also located in areas that are rapidly accessible by firefighting personnel and equipment. Fuelbreaks will reduce the intensity of a fire to the point that it can be safely fought, but are not able to stop the fire by themselves.

A very important key to fuelbreaks is that one *must make a commitment to maintaining them*. Thinning trees in the fuelbreak area often allows the ground to receive more sunlight and precipitation, which causes an increase in the quantity of vegetation. This new vegetation increases the fuel loading in general, and also creates ladder fuels. So, if the fuelbreak is not maintained, the fire hazard will be greater than before it was created. Following the fuelbreak maintenance schedule is crucial to its success. Access, similar to that needed by firefighters, is important to being able to maintain fuelbreaks.

Two fuelbreaks were originally planned in the northwestern portion of the Open Space property. These fuelbreaks need to be completed and maintained. Previously planned and partially completed "thinning" areas will now be included in these fuelbreaks' design.

7.1.1 MANOR HOUSE TRAIL FUELBREAK

The previously established fuelbreak along the Manor House Trail (as its anchor) needs to continue to be maintained and expanded. The predominant vegetation in most places of this fuelbreak is the Gambel oak that grows thickly along the road. This fuelbreak will not only break up the continuity of fuels, but it will also protect the road, allowing firefighters to travel safely along it in the event of a wildfire. According to the Colorado State Forest Service's current fuelbreak guidelines (**Appendix D**), fuels should be modified 210 feet below the road and

A section of the Manor House Trail fuelbreak, prior to treatment.

110 feet above it. All Gambel oak within 30 feet of the downhill side of the road should be removed, and all oak within 15 feet of the uphill side should be removed. Beyond those boundaries, the oak should be partially removed, and cut into a mosaic pattern. Ponderosa pine and Douglas-fir occur sporadically along the road in the Gambel oak forest type, and occur more readily in other locations in the Gambel oak-ponderosa pine forest type. Oak should be cut within 10 feet of the edge of the crowns of conifers—this will reduce wildfire hazard, and help the conifers to grow better.

Previous work in the Manor House Trail fuelbreak has focused in areas within 50-100 feet of the road. There is one area of significantly larger treatment that occurred on the downhill side of the road, where the Braddock Trail connects to the road. This larger treatment area created a distinct forest type (Gambel oak-thinned) of 7.5 acres. This portion of the fuelbreak has been well maintained, and very little additional work is needed. Other portions of the previous treatment have been maintained, but new conifer regeneration is becoming established in places, and some work is needed. This fuelbreak should be extended to the northeast from the large treatment area (Gambel oak-thinned forest type) in the operable areas of Douglas-fir-Gambel oak and Gambel oak forest type, increasing the effectiveness of this fuel treatment. Finally, this fuelbreak needs to fully connect to the other fuel treatments from 2006 and 2014 where the Manor House Trail (road) reaches the saddle below Beacon Hill. In many places along this fuelbreak, work could be accomplished by mechanical equipment doing mastication, similar to what has been done in other fuel treatments. Whether work is completed by hand or mechanically, follow-up with spraying of Gambel oak regrowth will be needed.

Gambel oak grow in "clones," where an individual tree has many stems that branch underground. This clonal tendency is visible in aerial photos, where Gambel oak thickets take on a circular shape. When creating the fuelbreak (beyond the 15- and 30-foot total exclusion zones), personnel should work with the clones. The outer stems of the oak should be cut, so that clones have corridors between them at least 10 feet in width. Cutting the outer stems, but not the entire clone, will help to prevent resprouting and will still break up the continuity of fuels. Resprouting will be the greatest obstacle to maintenance of this fuelbreak, and will be addressed in more detail below.

Ken-Caryl has several options for removing the oak. First, it could be manually felled with chainsaws, and the debris hauled to the road and disposed of. However, that would be very

labor-intensive and time-consuming. If extensive re-sprouting occurs, it may have to be re-cut within three years. This hand work could be again completed by Ken-Caryl Ranch personnel, if time and funds were available. A masticating machine, such as a Hydro-ax or other (smaller) equipment, is the least labor-intensive and perhaps less costly, but generally requires the use of outside contractors. Because of the steep slopes in some places along Manor House Trail, the machine may only be able to work in portions of the fuelbreak, and a crew would have to manually fell the oak beyond that boundary. The specifics for each portion of the fuelbreak should be part of the project scoping process.

Using goats to consume Gambel oak sprouts and prune trees is an environmentally-friendly option that has been proven to be very effective in certain situations, but the use of manual felling may still be necessary to meet objectives for removing the overstory Gambel oak stems. This option has not been extensively used in Jefferson County, but has been tried in other Front Range locations.

A third option is the use of chemicals to kill live Gambel oak trees and to abate re-sprouting. A number of chemicals and methods of use are available. For example:

- The oak could be cut and the stumps immediately sprayed with Round-Up to prevent re-sprouting. The use of Roundup may impact other plants in the area if runoff occurs.
- Pronone Power Pellets (a selective herbicide) can be distributed on the surface of the fuelbreak over two seasons, causing mortality of oak and juniper by the end of the second year.
- Arsenal can be sprayed on the live foliage of a few individuals per clone. The herbicide will get into the oak's root system and kill the entire clone, permanently.
- If possible a selective herbicide specifically labeled for Gambel oak treatment should be used to reduce the impacts to other desired species.

Use of herbicides still involves the manual felling to remove the overstory Gambel oak stems. Although the oak will die, they will still need to be cut for aesthetic purposes. A combination of any of these methods may be effective, as demonstrated by the previous work completed in this fuelbreak to date. Information on all these methods is included in **Appendix D**.

7.1.2 TINCUP-BEACON HILL FUELBREAK

The second fuelbreak is located from the top of Tincup hill and runs down to Beacon Hill. The top of this fuelbreak would be anchored to the old bulldozer lines from the Murphy Gulch Fire. This would also connect to proposed fuelbreaks that could be created on adjacent Willow

Springs HOA open space property. The bottom of the fuelbreak would connect to and include the previous fuels treatments on and around Beacon Hill. This fuelbreak would include activities in the ponderosa pine, Douglas-fir, and Gambel oak-ponderosa pine forest types. This fuelbreak should meet the current Colorado State Forest Service guidelines (**Appendix D**) for width and residual tree spacing.

In general, the guidelines for creating this fuelbreak are as follows:

- The fuelbreak should extend at least 300 feet in width, and be based or centered upon existing roads or trails wherever possible.
- Separate crowns of conifer trees by at least 10 feet, needle-tip to needle-tip.
- The largest, healthiest trees are preferred for "leave trees."
- Branches on remaining trees should be pruned to between 6 and 10 feet, but not more than 1/3 the height of the tree.
- Ladder fuels should be removed from around and under conifer trees, including brush and regeneration.
- Dead trees and downed woody debris should be removed.
- When treating Gambel oak, remove stems from under ponderosa pine trees where present; thin other oak into clonal patches, with at least a 10 foot width between the patches.

Untreated portion of the Tincup-Beacon Hill fuelbreak in mixed-conifer forest type.

After proper construction of the fuelbreak as outlined above, there needs to be a commitment to its maintenance over time. At least every five years, an assessment should be made as to whether or not the fuelbreak needs maintenance. Some signs that it needs maintenance are:

- Regeneration of conifer seedlings is reaching such a height that it begins to act as a ladder fuel (generally, over 6 feet tall).
- Shrubs and Gambel oak have grown back and are several feet tall.
- An insect or disease outbreak, or an abiotic event such as a windstorm, has killed numerous trees in the fuelbreak.

Because an important aspect of a functioning fuelbreak is being able to access it with firefighting personnel and equipment, Ken-Caryl managers should explore the possibility of keeping the old dozer line open across Tincup hill. While the steepness of the slope may prevent 4-wheel drive vehicles from being able to drive on portions of this line, it should be kept clear of debris and stumps so that handline or a new dozer line could be easily constructed in the event of a wildfire. Also, mechanized equipment to maintain the fuelbreak may be able to use this access route as well.

7.2 FUEL TREATMENTS – KEN-CARYL RANCH

Fuel treatments around the Ken-Caryl Ranch community interface with Open Space property and were originally planned as part of a separate Fuels Treatment Plan developed in 2007 by Walsh Associates. These fuel treatments reflected the types of wildland-urban interface fuels and exposure by community resources. In general, these fuel treatment recommendations are still valid, and will be included in a Community Wildfire Hazard Mitigation plan that will replace the previously developed Fuels Treatment Plan. Some recommendations have been addressed or do not directly affect Open Space lands, so they will not be included this Forest Management Plan.

The fuel treatments recommendations that will affect Open Space properties around the Ken-Caryl Ranch community interface are:

- Fuelbreaks along trails and roads
- Fuels management in parks and specific community locations
- Fuels reduction around houses

Fuelbreaks along trails and roads were originally proposed in 2007. These fuelbreaks have been implemented and have been maintained by Open Space personnel since that time. These fuelbreaks consist primarily of mown strips of native grass on both sides of the primary or Open Space access roads, and trails, between and adjacent the various neighborhoods and houses. The mown strips and road/trail footprint result in a total width of 10 feet, which is adequate for the expected fire behavior seen in the native grasslands where the community is located. These mown fuelbreaks should continue to be maintained annually, by mowing up to 3 times per year on paved surfaces and 2 times per year on natural surface trails. Another rule of thumb is the mow whenever the native grasses become dormant, such as after spring greenup and after the first killing frost in the fall. Fuelbreaks are an important line of defense against a wildfire, especially in grass fuel models. Their primary function is to break up the continuity of fuels and provide an area where the fire can be more easily controlled.

Fuels management in parks and specific community locations were also proposed in the 2007 Fuels Management Plan. Fuel reduction

activities were identified for locations in Bannon Gearhart open space park, based upon nearby neighborhoods or streets. Other locations in Open Space property were identified based upon nearby neighborhoods or streets. All of these initial treatment locations were addressed by Ken-Caryl Ranch Open Space over the past 8 years, and any further work would be mostly maintenance. In many cases, most of the work identified was concerning low hazard fuels such as hardwood trees and shrubs, or down and dead wood in light grass fuels. These types of issues can be addressed by normal maintenance activities by Open Space personnel, and do not require a prioritized list of potential treatment sites. Most fire activity in these open space areas can be addressed by the annual mowing along trails and around houses.

Fuels reduction around houses on open space property was the last proposal in the 2007 plan that is included in this Forest Management Plan. This activity consists of blanket approval by Ken-Caryl Ranch for private landowners to mow a 4 foot strip in native grass along the edge of their property line on the adjacent Open Space property. This amount of mowing should be adequate to prevent rapid spread of wildfire from Open Space property onto private property, when adequate defensible space has been created on the private land. Defensible space around houses that meets or exceeds the current recommendations of the Colorado State Forest Service (see **Appendix D**), is also an important part of this recommendation. However, that activity must be completed by private landowners, which is beyond the scope of this Forest Management Plan. For more details on defensible space, see the Community Wildfire Hazard Mitigation plan.

7.3 ASPEN RESTORATION

The aspen forest type is a unique and aesthetic resource on the Open Space property, and efforts should be made to ensure that the current stands and isolated clones are healthy and maintained. Conifers and Gambel oak are encroaching on these stand and clones at various levels, natural regeneration of the aspen clones have slowed, and some of the older trees are beginning to decline. The priority areas for these treatments are the aspen stands located in the Massy Draw, Shaffers, and Docmann

Gulch management units. Some additional work should be considered for the scattered aspen clones found in the Douglas-fir forest type, especially in the Tincup, Shaffers, Massey Draw, and Docmann Gulch management areas. This work could be conducted as part of general thinning in the Douglas-fir forests types, but in some cases the aspen clones are declining now and may not survive a lengthy delay while waiting for a treatment to occur in those areas.

In order to maintain these aspen stands' function, the encroaching species should be removed. Any Gambel oak, blue spruce, or other conifers greater than 2feet tall should be cut and removed within the clones or immediately adjacent to them. Where aspen clones show signs of decline (presence of conks on bole, many dead branches in crown, or standing dead stems) the aspen clones should also be cut down.

Doing so will serve two purposes—first, it will reduce the hazard of rotten trees accidentally falling on recreationists. Second, cutting the trees will cause a hormonal signal to be sent to the roots of the aspen clone, signaling the need for regeneration. The roots will then send up new sprouts, and the aspen stand will continue living. Removing the competing oak and conifers will also increase sunlight to the forest floor, which can also trigger new shoots to begin to grow from the aspen clone root system. In many cases, the removal of competing trees around the perimeter of the aspen clones will trigger new shoots to grow – expanding the aspen clone's physical area.

Much of this work will consist of hand felling the competing oak and conifers, with lopping and scattering of the slash being the preferred slash treatment. However, where aesthetics may be a concern, the slash could be chipped or masticated. Standing dead aspen can be handfelled as well. However, if the aspen clones have declined significantly (and/or competing conifers and oak have become widespread), then cutting or mastication of entire areas of trees will be the most effective method (cost and ecologically) of rejuvenating the aspen stands. This type of treatment has been used in other Front Range locations (such as Mount Evans State Wildlife Area, Staunton State Park, and Golden Gate Canyon State Park) with outstanding results.

7.4 THINNING

Thinning the forested stands on Open Space lands will achieve multiple objectives. By reducing the density of the forest, competition for water, light, and nutrients between the remaining trees

will be reduced. Because of that, they are under less stress, will grow faster, and will be less susceptible to damage and mortality by insects and diseases. Therefore, forest health and vigor will be increased. Healthy, vigorous trees also tend to live longer, so thinning will not only protect existing old growth, but also encourage the creation of more areas of old growth trees. A reduction in tree density will also decrease the fuel loading in the forest. Should a wildfire occur, it may burn slower and cooler, and may not have as severe an effect as it would in an unthinned forest. Reducing tree density will also create better wildlife habitat, as it creates a more open environment for large ungulates and birds to travel, allows more light onto the forest floor which increases the amount of palatable vegetation, and creates a more diverse stand structure which is useful for feeding, hiding, and breeding for a wide variety of species.

Forest thinning has several components. First, the most healthy and vigorous trees should remain, and the small, unhealthy trees should be cut. Often, the most health and vigorous trees are the "dominants"—that is, the largest trees in the stand. Dominant trees have that characteristic because of the microsite on which they grow (i.e. better water and nutrient availability), genetic superiority, or the fact that they are the older trees in the stand and were able to establish themselves before the other trees. Many smaller trees are often "suppressed," meaning that competition with other trees has not only slowed their growth over time, but their future potential for becoming a vigorous tree is permanently reduced.[1] Such suppressed trees are more likely to be stressed, and therefore susceptible to damage and mortality by insects, diseases, and environmental factors like drought.

For both the ponderosa pine and Douglas-fir forest types, "thinning from below" will be the predominant method to use. In this thinning approach, it is important to again stress that the most "vigorous" trees should remain—the largest, healthiest trees, with full crowns and little or no visible insect or disease damage. Vigorous trees are likely to survive for many more years, and will provide a good (genetically sound) seed source for the future forest. "Understory" trees, or those trees which grow underneath the crowns of larger trees, should be removed. Understory trees present a wildfire hazard because they can act as ladders which can carry the fire from the ground into the tops of trees. They are also slow-growing, and even with thinning they will probably never grow into a large tree. Trees that have obvious insect, disease, or significant animal damage should be removed. Finally, trees with poor crowns are also good candidates for removal. If the length of the crown is small in relation to the total length of the tree (such as a crown 10feet in length on a tree that is 45feet tall), they are unproductive and the tree should be removed.

Some (but not all) standing and fallen dead trees should be removed. Dead wood can contribute significantly to fuel loading, and therefore greatly increases the hazard of a severe wildfire. However, retaining several dead trees per acre is good for wildlife purposes—birds utilize the tops of standing dead trees (called snags), and rodents, amphibians, and small mammals utilize downed woody debris as habitat. If possible, three standing and five down dead trees over 8 inches in diameter should remain in place, as wildlife favor larger material as habitat. The remainder of the woody debris should be removed from the stand for wildfire hazard reduction purposes, as time and resources allow.

[1] The length of time it takes for a suppressed tree to become "permanently suppressed" varies by species, but it generally occurs between 70 and 100 years of age.

Other types of thinning may be employed as needed to address the specific needs of different forest stands. These thinning types may include: "timber stand improvement" (TSI), where dense areas of smaller trees are treated to allow selected individuals develop into well-spaced and healthy trees; "improvement" cuts, to remove insect and disease infested trees; and "forest restoration" treatments that are intended to change the forest structure to reflect conditions that are more resilient to disturbances like wildfire or insect and disease outbreaks. Forest restoration treatments are particularly important as they represent a significant effort to establish conditions that will require less intervention into the future to address wildfire hazard and impacts. For more information on Forest Restoration guidelines, see **Appendix D**.

7.4.1 THINNING IN PONDEROSA PINE

The areas recommended for thinning in ponderosa pine can be found in the Prioritized Forest Health and Wildfire Mitigation Recommendations and corresponding maps on page70. One unit is on the southwest flank of Tincup, and the other is on Beacon Hill. A portion of both of these areas was thinned previously, but the density of trees should be further reduced and regrowth of ladder fuels needs to be addressed. The particular goal of this thinning is to increase spacing between the ponderosa and remove ladder fuels (Gambel oak, Douglas-fir, and smaller ponderosa pine), thus reducing wildfire hazard and increasing forest health.

The Beacon Hill unit currently has an average diameter of 13.2 inches, an average height of 46.2 feet, and an average basal area of 105 square feet per acre. The Tincup stand has an average diameter of 11.8 inches, basal area of 120 square feet per acre, and height of 34.3 feet. In general, the target basal area for this forest type should be 60-80 square feet per acre. The thinning work should be conducted on a basis of tree spacing and the health and vigor of individual trees. Ponderosa grow best when spaced 15-25 feet apart between trunks, and when at least two sides of the crown receive sunlight. As there are few insect and disease problems in the stand, the "leave" trees may be prioritized by relative location and relative crown health. The following are guidelines for thinning the ponderosa stand:

- Remove trees that are growing directly underneath the crowns of larger trees, including small ponderosa pine, Douglas-fir, and Gambel oak.
- Remove trees that have a crown ratio less than 20%.
- Remove trees that appear to be in declining health. Indicators of declining health are:
    - Severe mistletoe infection
    - Dead top
    - Discolored foliage
- Remove trees that are leaning severely, or have a severe crook.
- Space trees in the medium-density ponderosa pine type to 15 to 25 feet apart between boles.

The spacing recommendation is in place because it will allow the trees to optimize

their access to light, nutrients, and water. By reducing competition between trees, they will grow faster, larger, live longer, and be less susceptible to insect and disease infestations. However, the spacing recommendation is not ironclad. Leaving small groups of thicker trees will retain wildlife habitat (such as hiding cover for deer and elk) and prevent the stand from looking like a plantation. Similarly, in some areas the trees may be thinned to an even wider density, which will create more diversity in the stand structure.

It is also possible to create vertical diversity in the stand. While for the most part it will be the smaller trees that are removed, some should be maintained as part of the "future forest." In general, these smaller trees should occur in small openings within the dominant stand, and not underneath the overstory. For example, mountain pine beetle favor infesting larger trees, and if an epidemic occurred, the smaller ones would be very valuable because they would not be attacked by the beetle. So, while the guidelines listed above are considered ideal for meeting our *main* goals of wildfire hazard reduction and forest health improvement, it is still important to retain diversity within the stand to achieve the other goals of wildlife habitat and aesthetics. To quantify this, 90% of the management area should be thinned to the standards on the bulleted list, and 10% should be thinned to retain diversity.

To thin this area, remove the leaning tree, smaller overstory trees, and most of the small Douglas-fir trees in the background.

7.5 THINNING IN DOUGLAS-FIR (Mature)

The Douglas-fir mature forest type is overly dense for ideal forest health. This density reduces the vigor of individual trees, making them more susceptible to outbreaks of insects and diseases, like Douglas-fir beetle. For the most part, the Douglas-fir stand is even-aged; most of the trees are of similar age, height, and diameter. Ladder fuels are not as great of a concern here as they are in the ponderosa stands—the high crown closure and attendant lack of sunlight prevents regeneration of new trees. A few areas (such as that pictured below) have some fallen dead trees, but not enough to appreciably increase fuel loading. Some areas within this forest type have Douglas-fir seedlings and saplings in the understory, resulting in some ladder fuels. The management goal for thinning in this forest type is to reduce the density of trees, enabling them to grow faster and be more resistant to insect and disease outbreaks. Thinning will separate the crowns and allow more sunlight onto the forest floor, which will encourage the growth of herbaceous vegetation and thus improve wildlife habitat.

Thinning in the Douglas-fir (mature) forest type will result in large amounts of biomass in the form of stems (logs), limbs and tops from the cut trees. This will require significant planning and access to effectively accomplish thinning in this forest type. Removal of usable wood produced by this thinning may help reduce the costs of the thinning. Therefore, any planned treatment units will need to be located near to current (or future) access roads. Priority treatment areas are the operable portions of Douglas-fir stands in the Beacon Hill and Tincup management areas. Additional treatment work could occur in the upper portion of the Massey Draw and Docmann Gulch management areas, if access through adjacent properties is negotiated.

Generally speaking, trees in this stand should be removed so that the remaining trees are spaced 10-15 feet apart between trunks. The following are guidelines for thinning the Douglas-fir (mature) forest type:

- Remove trees that appear to be in declining health. Indicators of declining health are:
  - Dead top
  - Antler rub over more than 50% of the trunk circumference
  - Discolored foliage
- Remove trees that are leaning severely, or have a severe crook.
- Remove seedlings, saplings, and shrubs over 2 feet tall that are growing directly underneath larger, healthy trees.
- Remove trees with a crown ratio of less than 15%.
- Space trees 10 to 15 feet between trunks.

The Douglas-fir (mature) forest type has a variable density of trees, ranging from 25 to 65% crown closure and averaging 230 trees per acre. The basal area in this forest type averages 113 square feet per acre, but can range from 90 to 290 square feet per acre. Trees in this forest type average 9.5 inches in diameter at breast height (DBH) and 45 feet tall. Thinning should remove roughly one-third of the trees, so the stand will have a target residual density of 154 trees per acre and a basal area of 76 square feet per acre. This basal area is low enough that the stand will become more vigorous and healthy, but crown closure will remain high enough that it will be difficult for new tree seedlings and shrubs to become established or compete with the remaining overstory trees.

It is a good idea to create structural diversity within the stand. Trees should be thinned so that a few clumps of trees remain intact for hiding cover and visual variability. The smallest trees must not always be removed, as they will be the future forest and some of them should be left to grow. This should occur in openings where the overstory trees have fallen or been removed, and the smaller trees will not serve as ladder fuels to the overstory. However, this type of management should be limited to 5% of the stand or less. If such vertical diversity of structure is limited to a small portion of the stand, it will still reap benefits for wildlife and aesthetics, but not change the character of the entire stand in a manner that would predispose it to a spruce budworm infestation.

Where aspen clones occur within the Douglas-fir (mature) forest type, all conifers should be removed in and around the aspen stems. This will enhance the health and survival of this tree species, providing diversity and wildlife habitat within these stands.

7.4.2 THINNING IN DOUGLAS-FIR REGENERATION

The Douglas-fir regeneration forest type is variable in density. In many areas, the density is too high for ideal forest health and leads to increased wildfire hazard. This density reduces the vigor of individual trees, as they fight for sunlight, water, and nutrients. Wildfire hazard is more severe as there are continuous vertical and horizontal fuel connections. Where these regeneration areas occur immediately adjacent to other forest types (especially mature Douglas-fir), this wildfire risk increase the chances of a ground fire spreading into the crowns of the mature forest stand.

Thinning in this forest type will be "timber stand improvement", where the best developed and shaped trees should be kept, with an average spacing of 10-15 feet between the residual trees. No trees should be left adjacent (within 20 feet) to mature overstory trees. This work can be conducted by hand crews, or may be conducted by the use of mechanical equipment (such as mastication machinery). The amount of fuels produced from this thinning may be substantial, as almost all cut trees will essentially be fine fuels. Treatment or removal of the cut trees will be important to protect the residual, keep trees. Options for treating these fuels may include: piling and burning of slash; chipping of trees along access roads; and mastication of hand felled trees throughout the stands.

Utilization of the cut trees is another method that should be explored. In the case of the Douglas-fir regeneration stands in the Docmann Gulch management area, Ken-Caryl Ranch Open Space has been removing Christmas trees for use by community residents. This practice should be continued and expanded wherever possible. Additional thinning and sale of Christmas trees by commercial vendors should be explored. Removal of other smaller Douglas fir trees for use as holiday greenery by commercial vendors can also be an outlet for utilization of these cut trees.

Finally, in areas with access, suitable soils, and gentle slopes, possible commercial transplants of Douglas-fir seedlings and saplings may be another method to thin these stands. This process would need to be closely managed to avoid resource damage, and may not be effective in denser areas of Douglas-fir regeneration.

7.5 SLASH TREATMENT & WOOD UTILIZATION

Slash treatment on the Ken-Caryl Open Space property presents a problem. Unless a masticating machine is used (which will chip all slash and live trees in place), most thinning projects will be conducted manually. While most of the thinning units are near trails, they are still far enough from roads that hauling the slash away is a difficult undertaking. Piling and burning is a good option, but is limited by factors such as local fire department restrictions and Jefferson County air quality permits. The effects of such limitations could mean things like piles would have to be extinguished by 4pm, and they might have to be accessible by a fire engine. So, where possible, slash should be brought to an area where it could either be chipped, hauled away, or burned near a road. Where pulling slash out of the units would be too far to be feasible, and where it would

not present a problem with aesthetics (like along trails) it should be lopped and scattered. Some piles (three to four per acre) may be left in place to create wildlife habitat.

If Ken-Caryl Ranch Open Space can acquire a ATVs or a small tracked machine with a chipper that runs via a Power Take-Off (PTO), this would be an ideal means for its own personnel to conduct hand work and treat slash in place. ATVs can be modified to have a large basket on the back that can hold slash, or they could pull a small trailer that slash could be loaded on to. A tracked machine with a chipper would also be useful, as it could operate on steeper slopes, and slash would only have to be handled once. Proper slash treatment is important for wildfire mitigation, especially in the fuelbreaks. The depth and compactness of slash (i.e. lopped-and-scattered slash vs. chips) can influence fuel loading, and thus wildfire hazard. Furthermore, the type and amount of slash left in the units can have a negative impact on aesthetics, which would be in contradiction with management goals.

ATVs and/or a tractor would also be helpful for removing logs from the units. The trees cut could have many uses, such as buck-and-rail fences, benches, and firewood. Removing logs by hand is time-consuming and difficult, so it would be best if there were a mechanized process of getting the wood out.

Tree killed by Douglas-fir beetle.

7.6 MONITOR AND TREAT FOR INSECTS AND DISEASES

Ken-Caryl Ranch staff should monitor and treat for insects and diseases on a yearly basis. At the current time only minimal insect and disease damage exists within the Open Space. However, given the dense forest conditions and cyclical nature of many insects/diseases, the potential for insect and disease outbreaks always exists.

During the 2006 forest inventory, minor western spruce budworm damage was noted in the very northwestern corner of the Open Space. No current evidence of budworm was noted during 2014 fieldwork. Given the dense, multi-storied nature of Douglas-fir stands in the Open Space property, the potential exists for a significant outbreak. This insect should continue to be monitored for in coming years to determine if treatment is warranted. Treatment would likely consist of an aerial application of a naturally occurring insecticide (like *Bacillus thuringiensis*). Additionally, because insect outbreaks occur across ownership boundaries, communication should be maintained with adjacent landowners as to the extent and level of damage. Doing so will result in more effective and cost efficient treatment, if warranted.

As Ken-Caryl has had problems with mountain pine beetle and Douglas-fir beetle in the past, these populations should be monitored. Most of them have historically occurred on or near

Beacon Hill, and along the edges of the Murphy Gulch Fire. Considerable Douglas-fir beetle activity has occurred in the past 5 years within the Massey Draw and Shaffers management areas of the Open Space property. Detection surveys have identified actively infested or killed trees, but a lack of access or costs for manually felling and treating these trees has prevent extensive control work.

The long-term (and most effective) strategy towards insect and disease management is the creation of healthy, vigorous stands of trees which are resilient to insect and disease outbreaks. To this end, actions such as the general thinning of both ponderosa pine and Douglas-fir forest types described in the previous sections will work to create such healthy and vigorous stands. Beyond this general strategy, continual monitoring should be done for new and previously undetected insect and disease issues. Once identified, a determination can be made as to the appropriateness of any treatment activities.

7.7 CONTROL NOXIOUS AND NON-NATIVE WEEDS

Noxious and invasive weeds present a great threat to biodiversity and the ecological function of Ken-Caryl Open Space. Noxious weeds should be controlled according to the 2005 Noxious Weed Management plan, and the property should be surveyed annually to monitor the extent of current populations and location of new ones.

Smooth brome is an incredibly prevalent non-native species on the Open Space. Its prevalence creates problems for diversity, and an effort should be made to restore the native grassland. Many of the grassy areas occupied by smooth brome are on steep, rocky slopes, and management activity is not feasible. However, it is possible to manage brome in the upper meadow (near the aspen stand).

The meadow should be mowed in mid- to late-May, after the brome has put up its seedhead spike but before it has produced mature seed. Immediately after mowing, the meadow should be reseeded with a native grass and forb mix—preferably one which includes mountain muhly, little bluestem, sun sedge, timothy, sageworts, and various wildflowers, the major native species that should be found in the meadow. This process may need to be repeated for several years, or until the smooth

Smooth brome was used to revegetate the area after the Murphy Gulch Fire.

brome has mostly been replaced by native species. The meadow should be monitored in the future, in order to ensure that the brome has not returned in a large population. Similar results can be done through prescribed fire, although such an activity is more involved and would require more planning than can be done in this document.

If Ken-Caryl Ranch managers would like to further explore prescribed fire opportunities, they may create a burn plan at a later date.

Russian olive trees within open space lands need to be identified, and removal planned during other management activities planned in these locations. Trees should be cut down while actively growing or immediately before leaf-out, and stumps sprayed with chemicals such as Roundup. Additional treatments of cut stumps may need to occur if sprouting occurs – the new leaves and vegetation would need to be treated to finish killing the root system.

7.8 ACCESS AND CROSS-BOUNDARY MANAGEMENT

The management recommendations described in this plan are the best, most efficient options for meeting Ken-Caryl Ranch's goals for the Open Space property. The proposed treatment areas could also dovetail with those proposed projects in the 2006 forest management plans on adjacent West Ranch and Willow Springs. Such cross-boundary management is very effective, and provides the opportunity for collaboration between these communities. If possible, these management activities can be coordinated so that resources can be shared (such as thinning contractors, mastication machines, chippers, etc.). Sharing resources will reduce the amount of disturbance, such as noise pollution and dust, enhance removal of wood products and wildfire fuels, and could also reduce the cost of treatments. Forest conditions occur on both sides of property lines, so management work should not stop at these boundaries.

Part of the process of cross-boundary management may also entail shared access. For example, it would be very beneficial if Willow Springs could use Manor House Trail to access and construct the fuelbreak on their southern boundary. Ken-Caryl would receive the benefit of the Willow Springs fuelbreak, because it would reduce the wildfire hazard on their own property. Willow Springs benefits from Ken-Caryl Open Space fuelbreaks that help protect their lands. Creating such agreements to cooperate is, of course, up to the property managers.

A **Map** of forest management projects prescribed for adjacent properties (which provide opportunities for cross-boundary management) is included in **Section 8.0, Figures**.

7.9 HAZARD TREE MANAGEMENT

Hazard trees along all recreation trails and at developed campgrounds or picnic areas should be identified, and prioritized for treatment. This has been especially needed in areas with Douglas-fir beetle killed trees in the Douglas-fir (mature) stands. This activity is needed to reduce the hazard of rotten trees accidentally falling on recreationists.

7.10 PRESCRIBED FIRE

Prescribed fire is a tool used by natural resource managers to maintain or affect the condition of forests, grasslands, and wildlife habitat. It is also used to reduce the fuels that occur in forests and grasslands, as well as those produced by other management activities. In general the use of fire in this manner is according to a “prescription”, or plan, that determines when, where, why, and how fire will be applied. Prescribed fire should be considered when the land management needs match with the landowner’s goals and objectives.

Prescribed fire is usually implemented in Colorado through the use of “broadcast fire”, or “pile burning”. Common elements that must be addressed by both types of prescribed fire, generally as part of the planning process: objectives and target results; resources (personnel and equipment) to be used; smoke management needs and smoke permits; minimum and maximum weather conditions; predicted fire behavior; ignition and control plans; and monitoring plans.

Broadcast burns involve applying fire across the entire area being treated, to the targeted fuels. Fuels can be grass, shrubs, trees, and even plant materials that have been left from management activities (example: tops, branches, and unusable wood from forestry work). Broadcast burns are typically conducted when the target fuels are dry enough to burn, without being too hazardous to keep the fire activity to be contained to the treatment unit. This means that these burns usually occur in the spring or fall seasons of the year. The amount of planning, and resources (personnel

and equipment), are related to the complexity and amount of area being treated – but generally greater than pile burning.

Pile burning involves applying fire to accumulations of activity fuels, typically in piles constructed by hand or machines. Pile burning is used to remove the fuel resulting from forest management thinning or harvesting, typically tops, branches, and unusable wood stems. Pile burning is usually conducted when only the target fuels (piles) will be burned without spreading into the adjacent areas (and fuels). This normally means that the piles are ignited when there is sufficient snow cover (or moisture in the surrounding fuels) to prevent fire from "creeping" out of the burning fuels. This means that these burns will generally occur from late fall to early spring of the year.

Pile burning could be used in support of various other management activities recommended in this plan, including: thinning, aspen restoration, fuelbreaks, and slash management. Pile burning can be more economical than other types of slash treatment like chipping, removal, or mastication, especially in areas with limited to no access. Guidelines for the creation and burning or pile are included in Appendix 4. Pile burning could be conducted by KCROS staff, with the support of West Metro Fire Rescue, Inter-Canyon FPD or Jefferson County Sheriff's Office resources for both planning and execution of the burns.

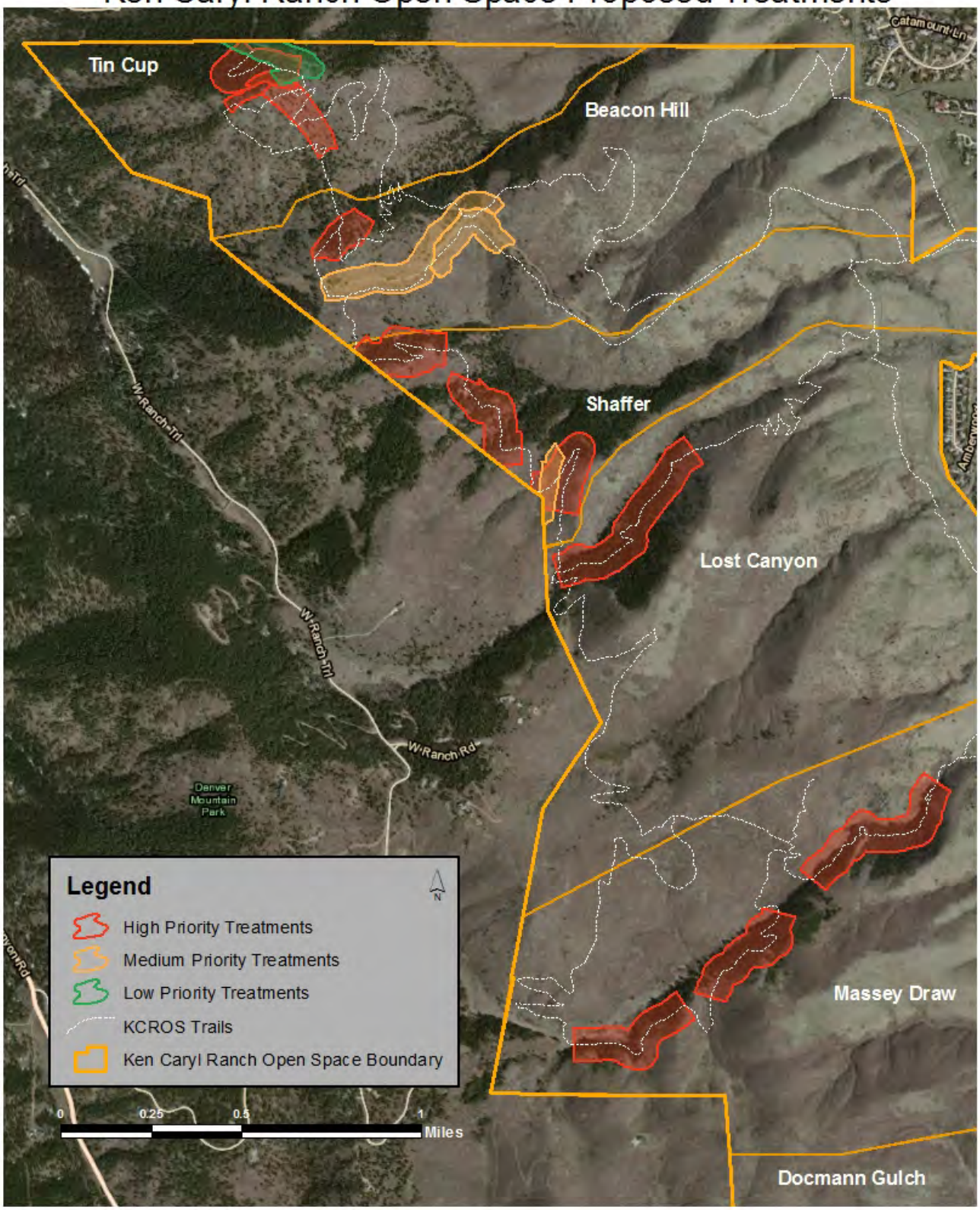
Broadcast burning is a tool that could be used in the grassland and Gambel oak resource types to rejuvenate the natural vegetation. This tool has been used previously at Ken-Caryl Ranch on Open Space areas near and along the Dakota Hogback by KCROS staff and West Metro Fire Rescue. Its use in the areas covered by this Forest Management Plan would be appropriate as properly planned in association with other forest management work.

7.11 Prioritized Forest Health and Wildfire Mitigation Recommendations

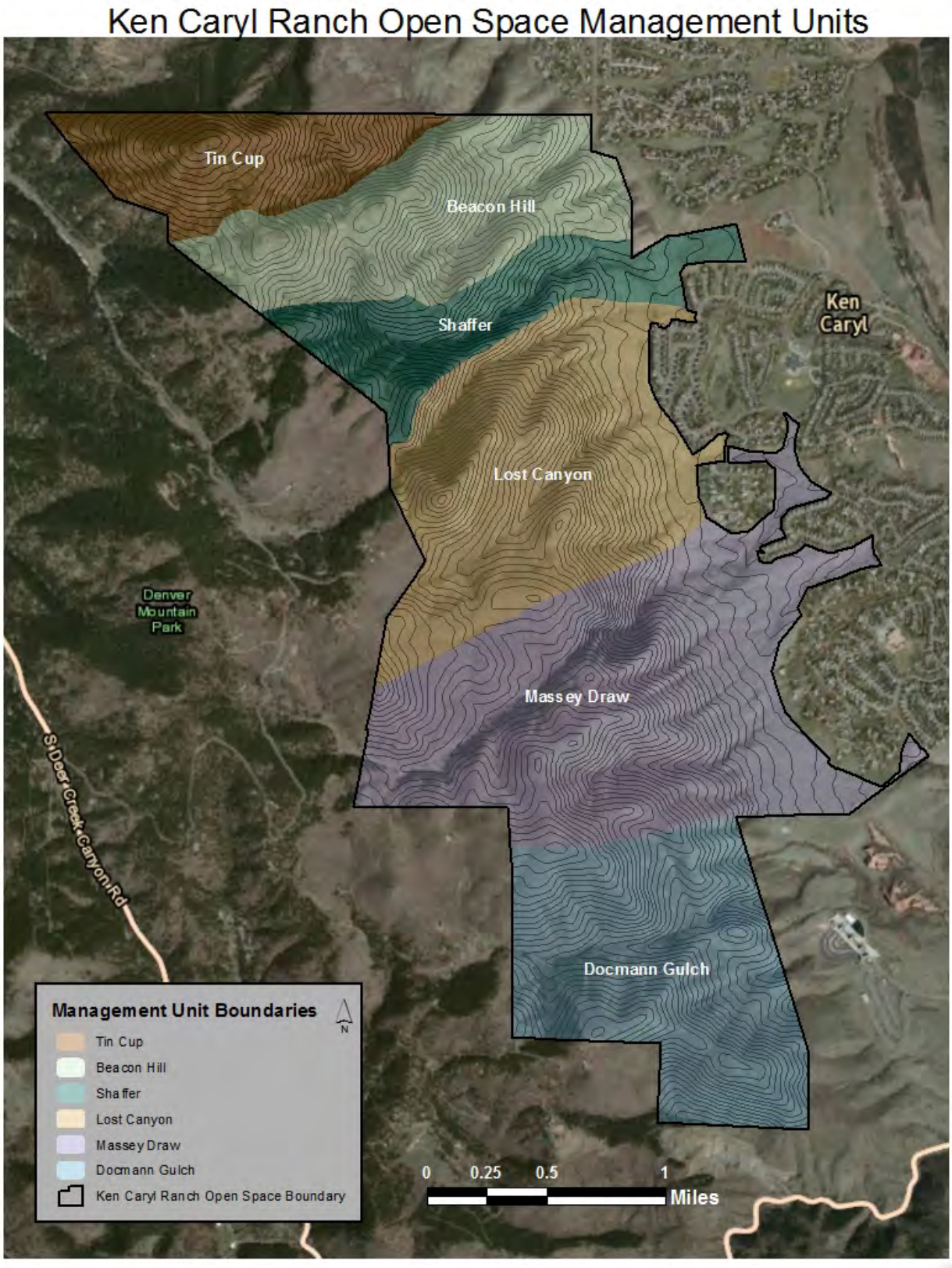
See also the Project Maps, ***Section 8.0 Figures.***

Priority	Management Unit	Treatment	Goals	Completed
High	All - especially Shaffers, Massey Draw	Identify hazardous trees along the trails; Prioritize and treat (possible contract for cutting/removal)	Improve overall forest health; maintain aesthetic and recreation resources; reduce the threat and impacts of catastrophic wildfire.	
High	Tincup	10 acre fuelbreak in Gambel oak/ ponderosa pine	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health	
High	Beacon Hill	Fuelbreak - Retreat 7.34 acres of 2006 thinned ponderosa pine	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health; enhance and protect water quality	
High	All	Monitor for insect and disease	Improve overall forest health; maintain aesthetic and recreation resources	
High	Tincup	Fuelbreak - Retreat 7.15 acres of 2006 thinned ponderosa pine and mixed conifer	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health; enhance and protect water quality	
Medium	Beacon Hill	Fuelbreak - Retreat and expand Manor House fuelbreak to full width on 10 acres	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health; enhance and protect water quality	
Medium	Beacon Hill	Fuelbreak - Maintain Gambel oak thinned area and extend Manor House fuelbreak to the NE on 10 acres	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health; enhance and protect water quality	
Medium	All	20 acres of Aspen restoration	Maintain and improve wildlife habitat; improve overall forest health; maintain aesthetic and recreation resources	
Low	Tincup	Create 5 acre fuelbreak in Douglas-fir forest	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health; enhance and protect water quality	
Low	Beacon Hill	Thin 10 acres of Douglas-fir forest	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health	
Low	Docmann Gulch	Thin 10 acres of Douglas-fir forest and mixed conifer	Reduce the threat and impacts of catastrophic wildfire; improve overall forest health	
Low	All	Revise Forest Management Plan	Integrate all management activities	

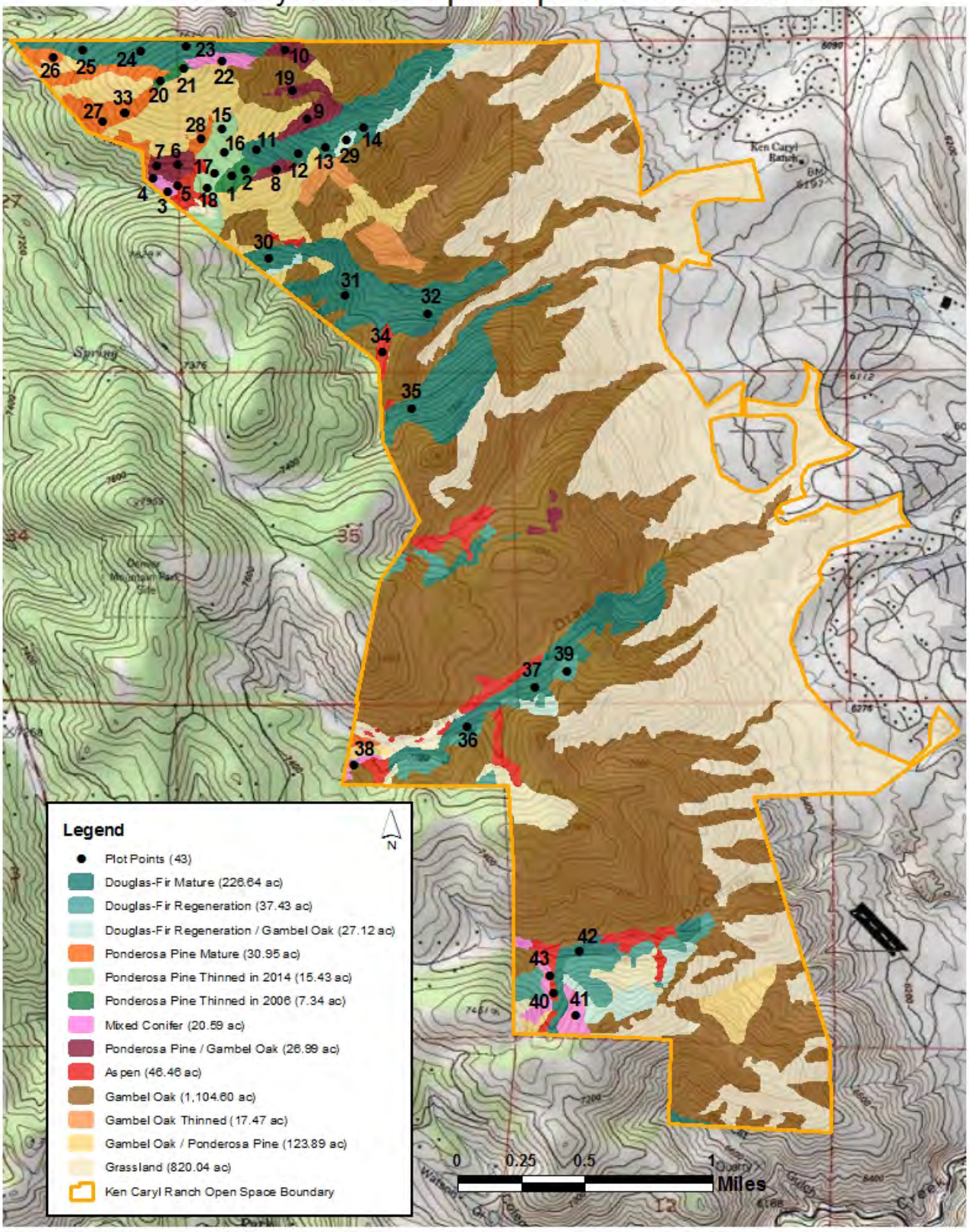
Ken Caryl Ranch Open Space Proposed Treatments



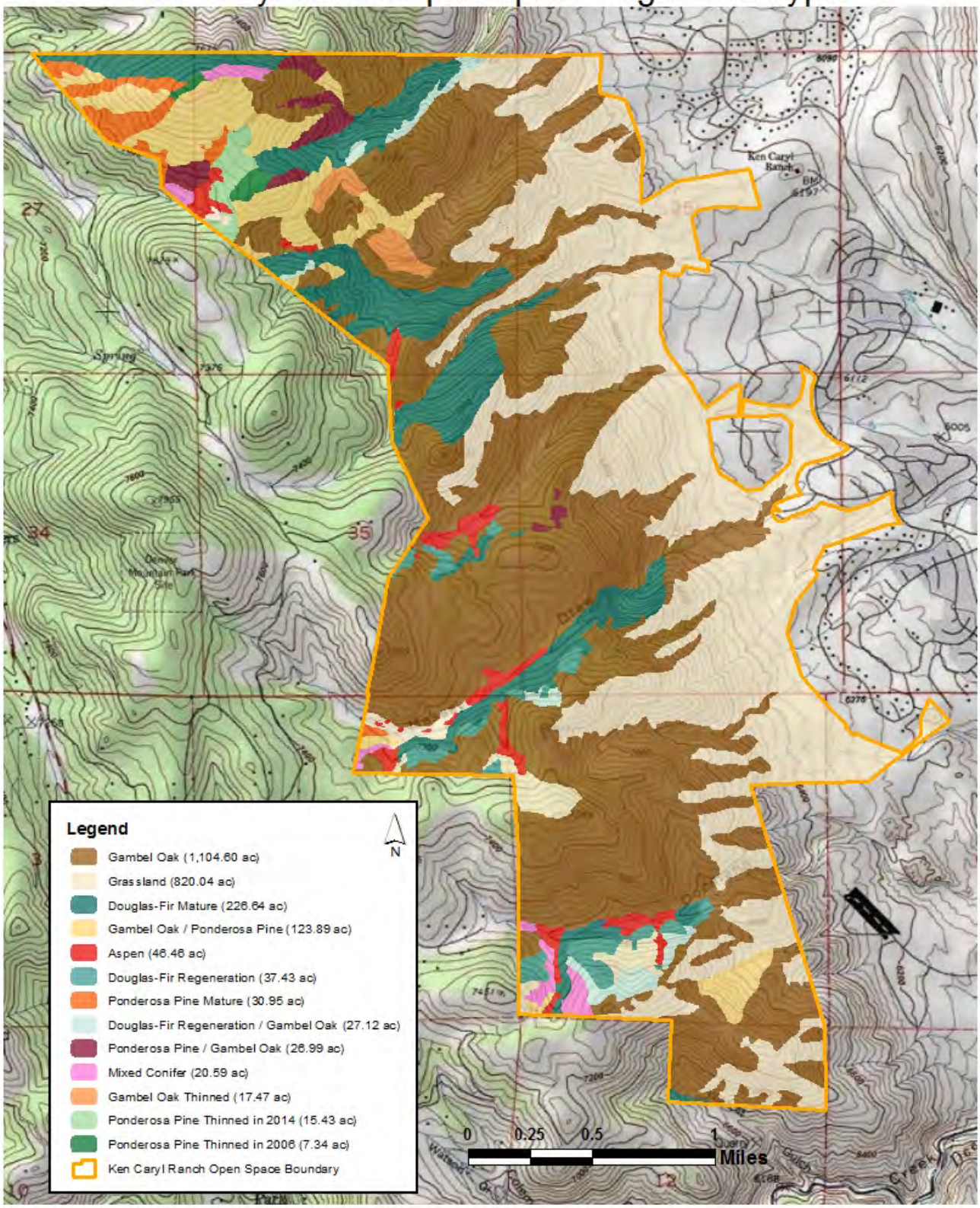
8.0 FIGURES


Ken Caryl Ranch Open Space Management Units
Tin Cup
Beacon Hill
Shaffer
Ken Caryl
Lost Canyon
Denver Mountain Park
Massey Draw
S Deer Creek Canyon Rd
Docmann Gulch
Management Unit Boundaries
N
Tin Cup
Beacon Hill
Shaffer
Lost Canyon
Massey Draw
Docmann Gulch
Ken Caryl Ranch Open Space Boundary
0
0.25
0.5
1
Miles

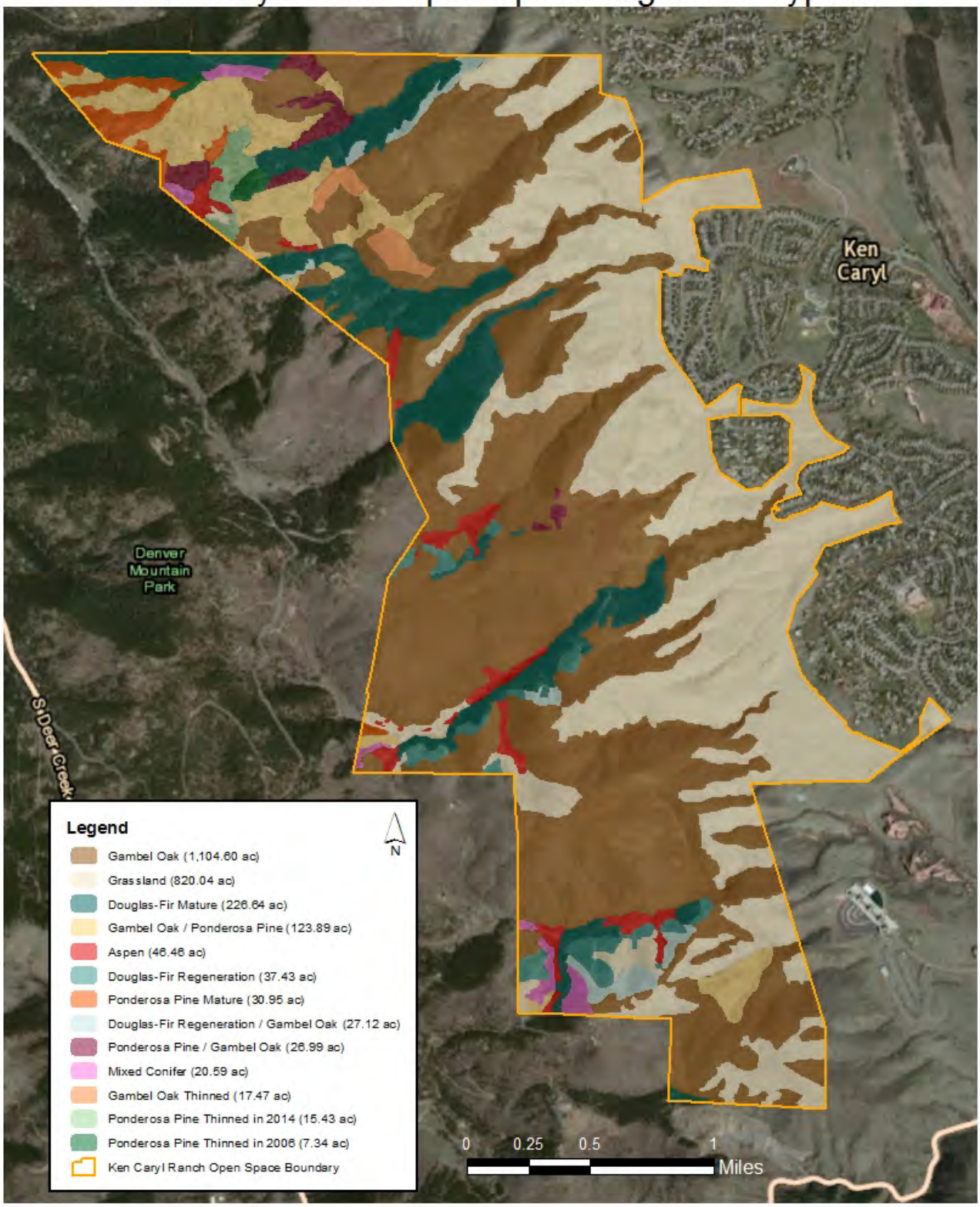
Ken Caryl Ranch Open Space Plot Locations



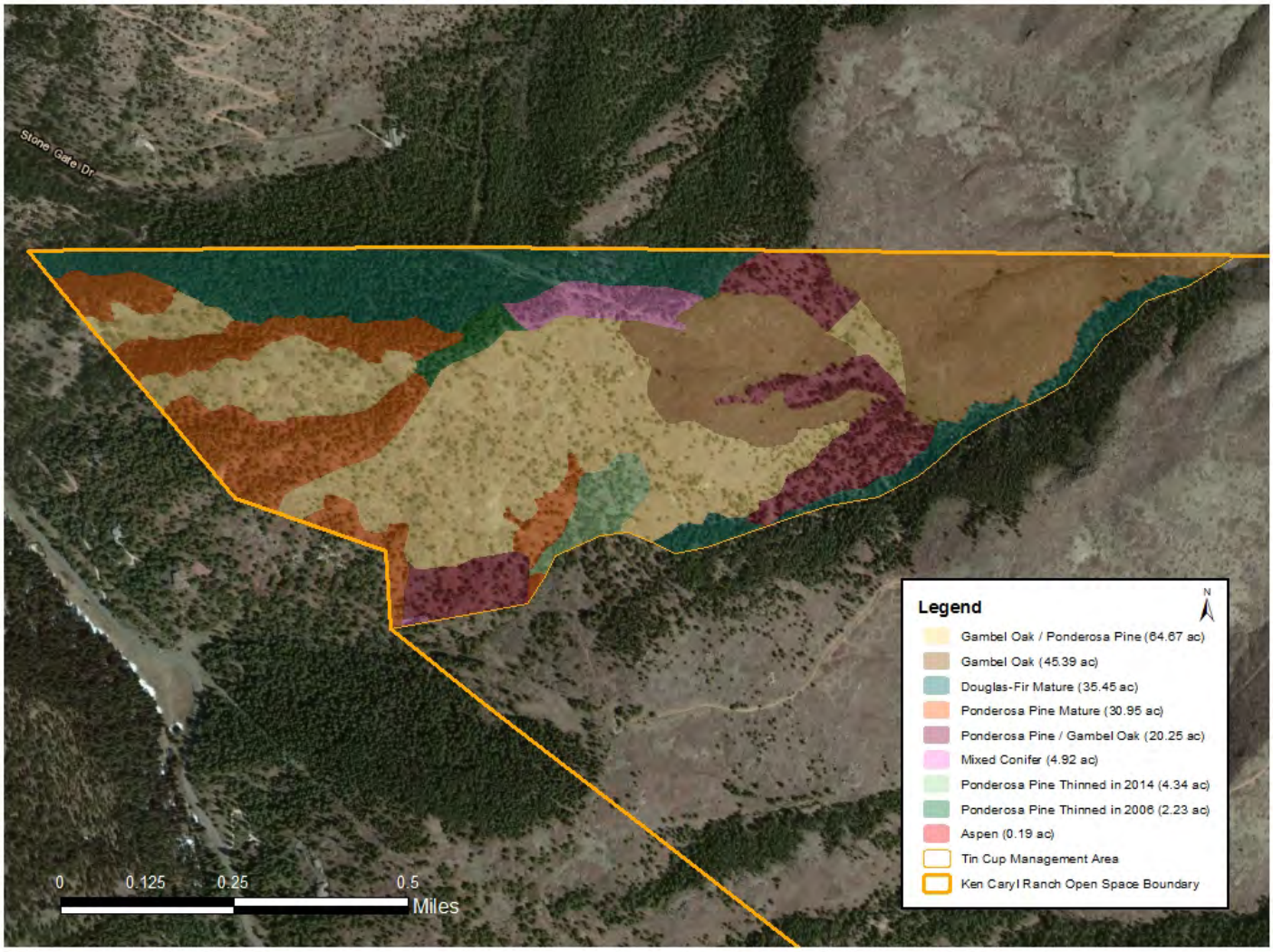
Ken Caryl Ranch Open Space Vegetation Types



Ken Caryl Ranch Open Space Vegetation Types

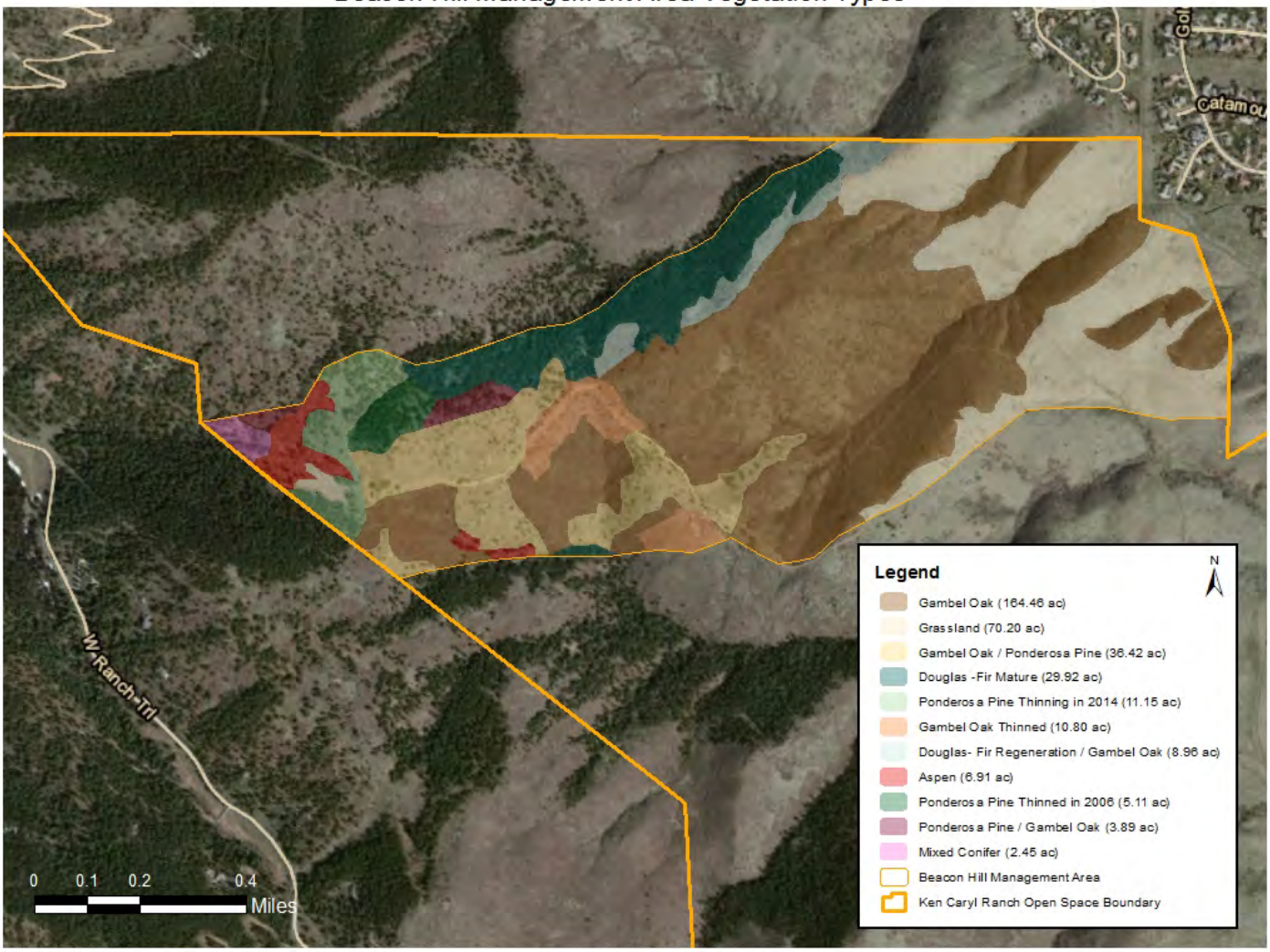


Tin Cup Management Area Vegetation Types



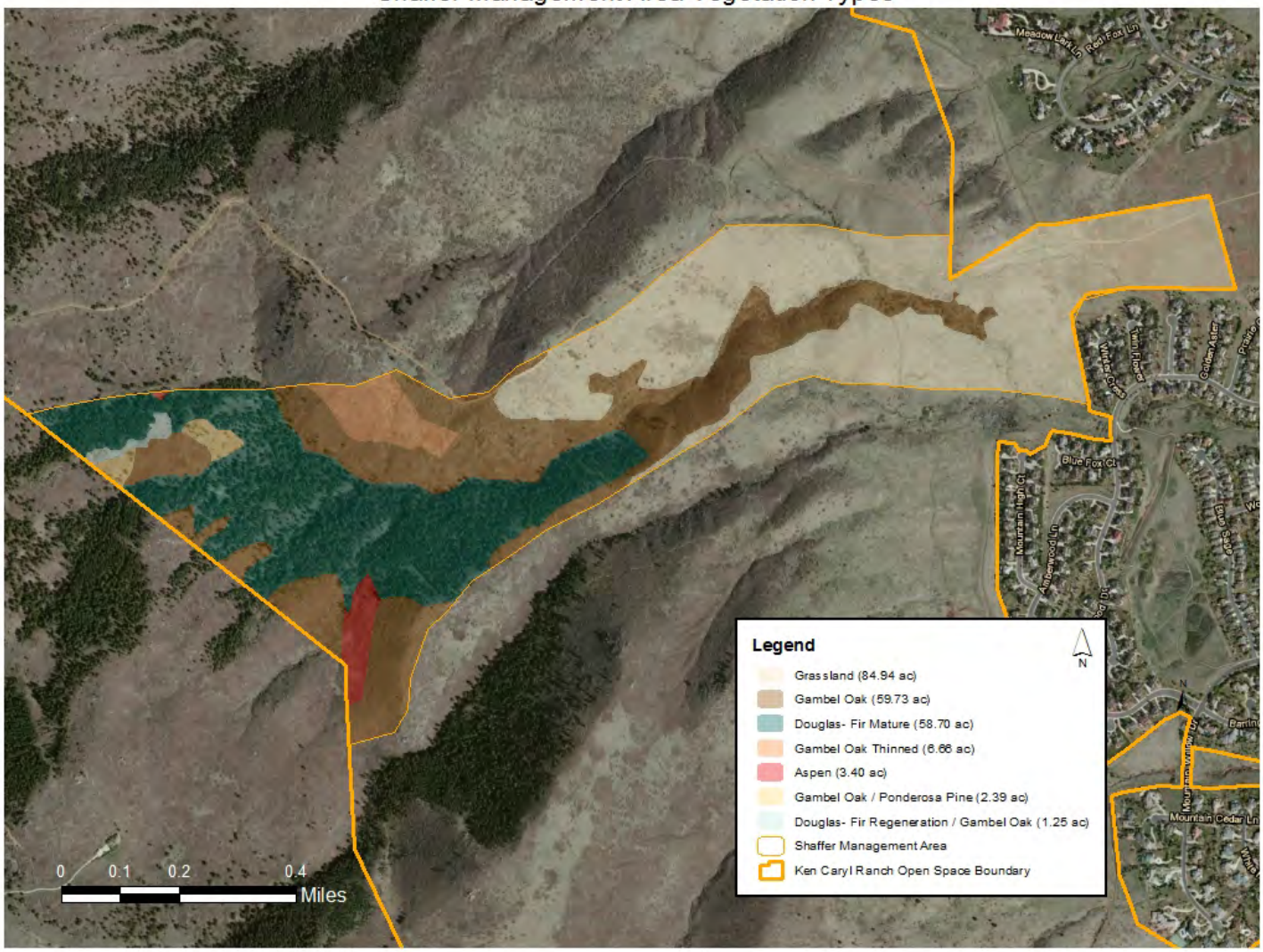
Tin Cup Management Area	
Gambel Oak / Ponderosa Pine	64.67 acres
Gambel Oak	45.39 acres
Douglas- Fir Mature	35.45 acres
Ponderosa Pine Mature	30.95 acres
Ponderosa Pine / Gambel Oak	20.25 acres
Mixed Conifer	4.92 acres
Ponderosa Pine Thinned in 2014	4.34 acres
Ponderosa Pine Thinned in 2006	2.23 acres
Aspen	0.19 acres

Beacon Hill Management Area Vegetation Types



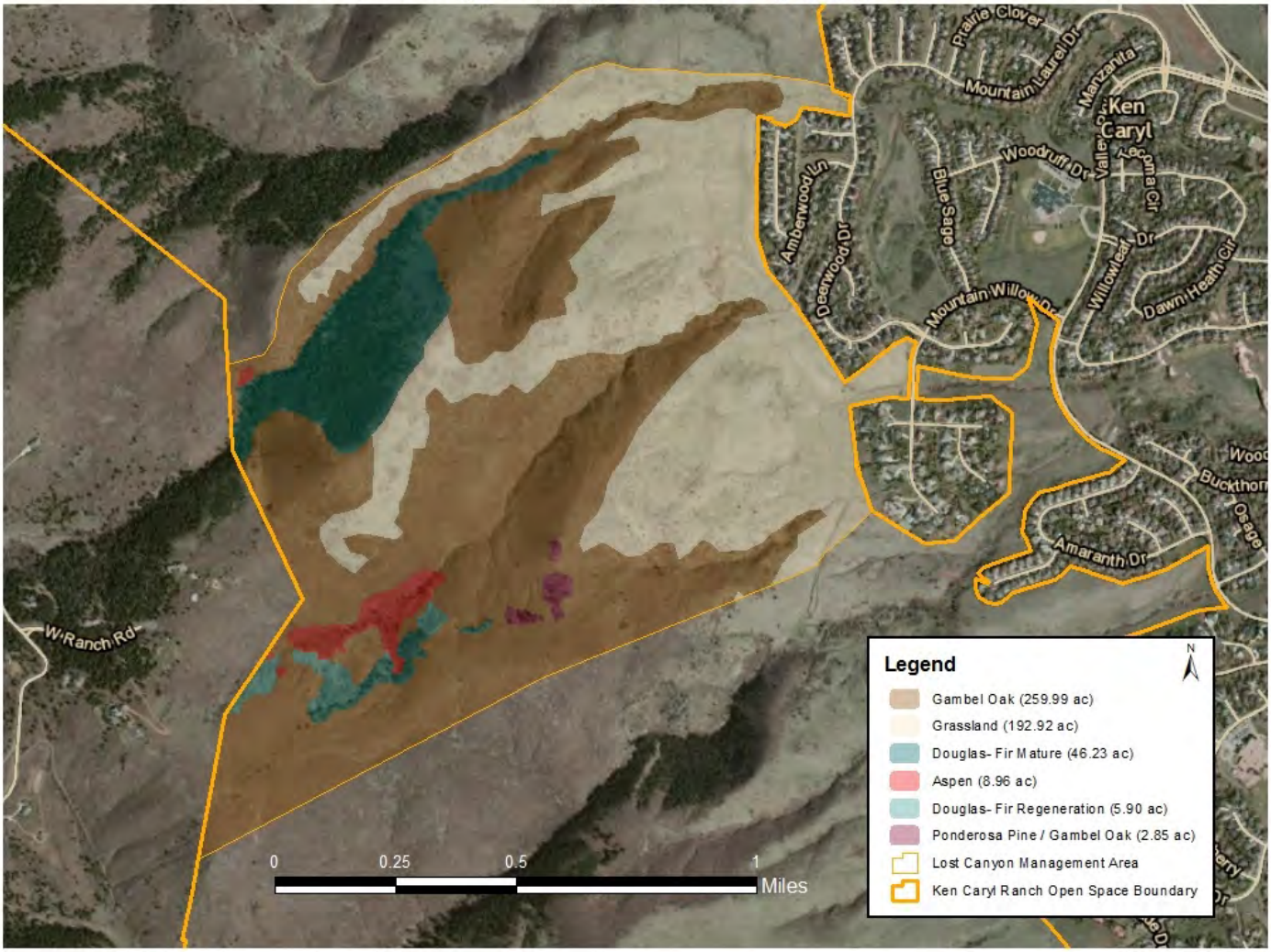
Beacon Hill Management Area	
Gambel Oak	164.46 acres
Grasslands	70.20 acres
Gambel Oak / Ponderosa Pine	36.42 acres
Douglas- Fir Mature	29.92 acres
Ponderosa Pine Thinned in 2014	11.15 acres
Douglas- Fir Regeneration / Gambel Oak	8.96 acres
Aspen	6.91 acres
Ponderosa Pine Thinned in 2006	5.11 acres
Ponderosa Pine / Gambel Oak	3.89 acres
Mixed Conifer	2.45 acres

Shaffer Management Area Vegetation Types



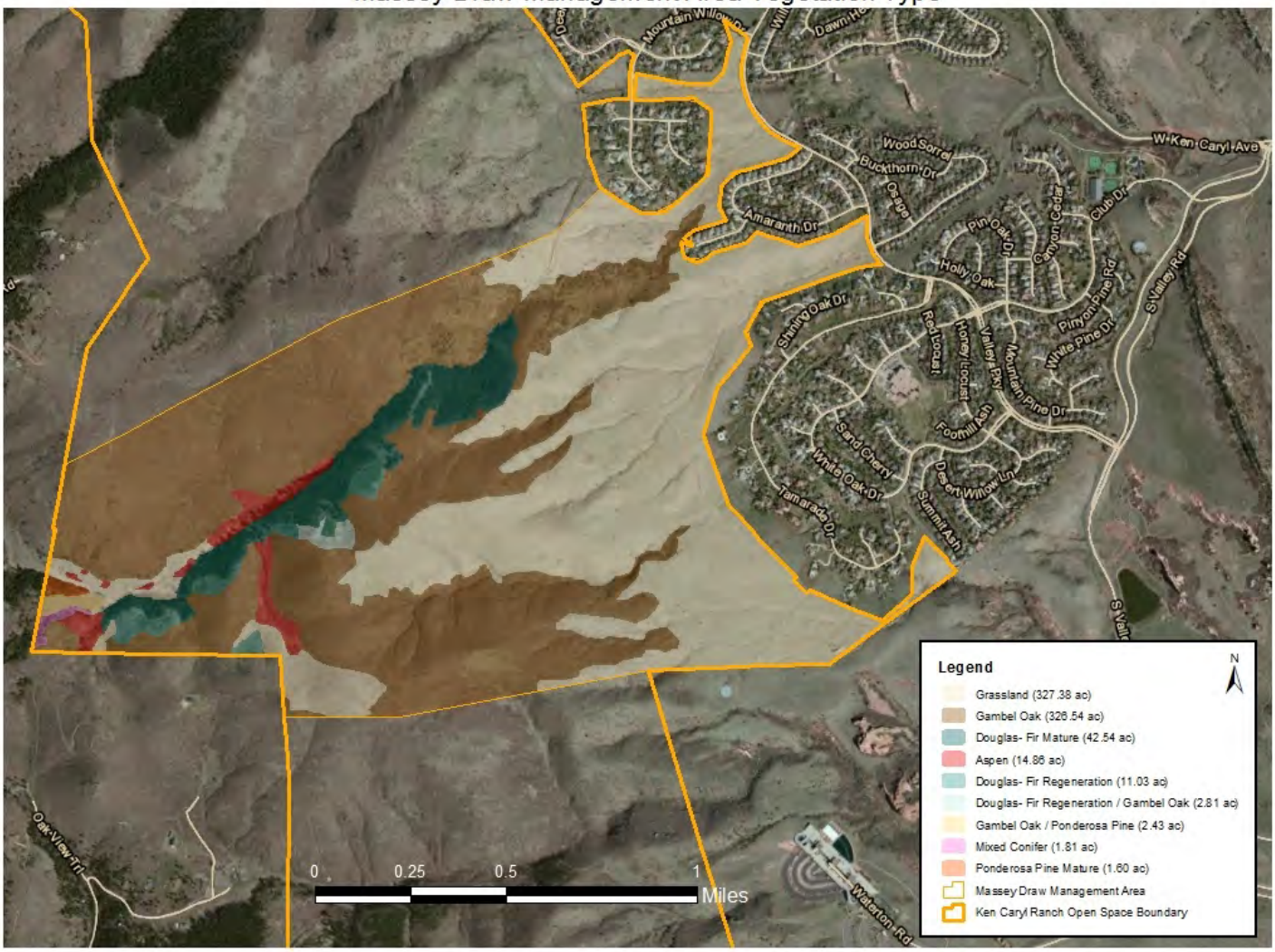
Shaffer Management Area		
	Grasslands	84.94 acres
	Gambel Oak	59.73 acres
	Douglas- Fir Mature	58.70 acres
	Aspen	3.40 acres
	Gambel Oak / Ponderosa Pine	2.39 acres
	Douglas- Fir Regeneration / Gambel Oak	1.25 acres

Lost Canyon Management Area Vegetation Type



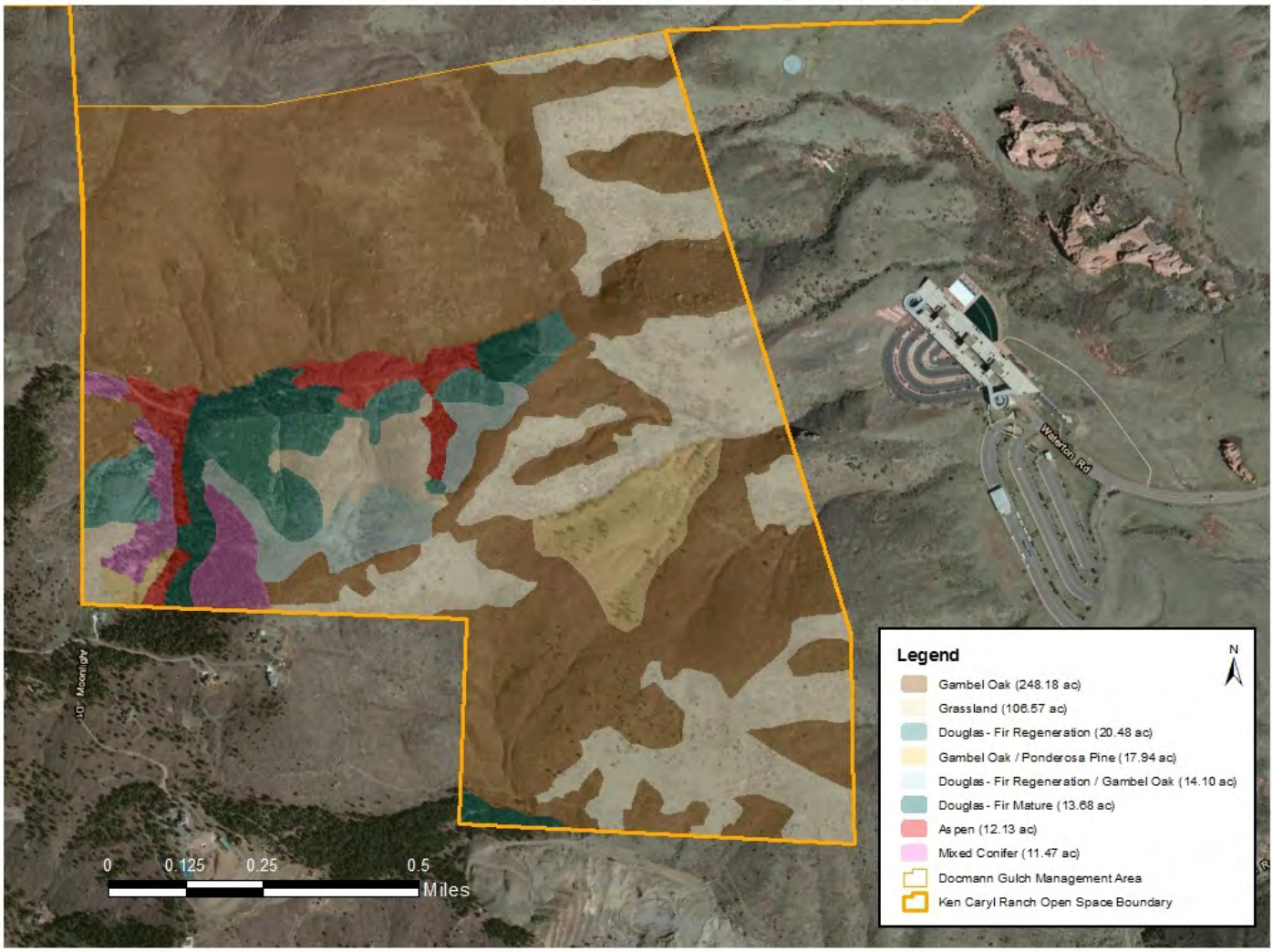
Lost Canyon Management Area		
	Gambel Oak	259.99 acres
	Grasslands	192.92 acres
	Douglas- Fir Mature	46.23 acres
	Aspen	8.96 acres
	Douglas -Fir Regeneration	5.90 acres
	Ponderosa Pine / Gambel Oak	2.85 acres

Massey Draw Management Area Vegetation Type



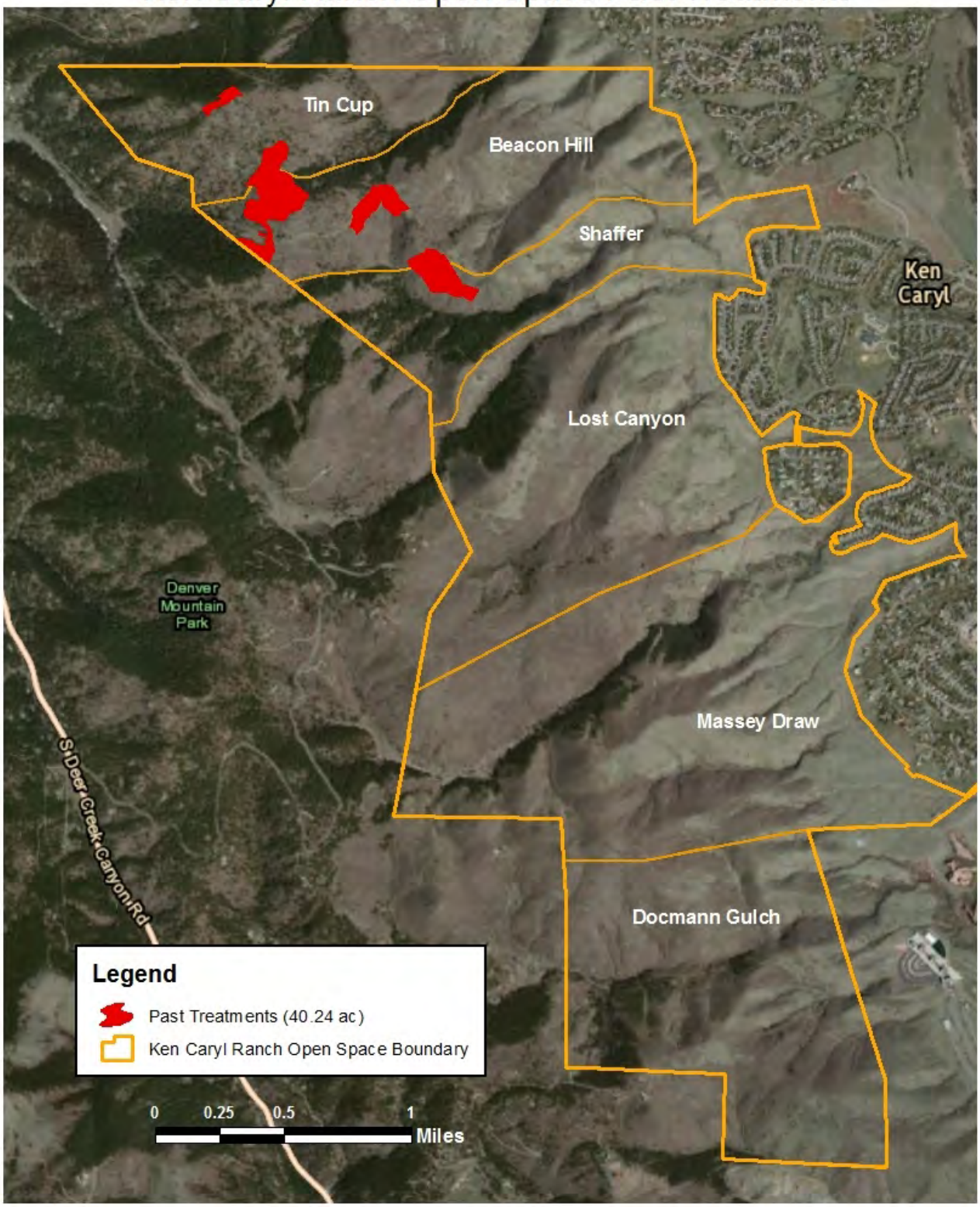
Massey Draw Management Area		
	Grasslands	327.38 acres
	Gambel Oak	326.54 acres
	Douglas- Fir Mature	42.54 acres
	Aspen	14.86 acres
	Douglas -Fir Regeneration	11.03 acres
	Douglas- Fir Regeneration / Gambel Oak	2.81 acres
	Gambel Oak / Ponderosa Pine	2.43 acres
	Mixed Conifer	1.81 acres
	Ponderosa Pine Mature	1.60 acres

Docmann Gulch Management Area Vegetation Type

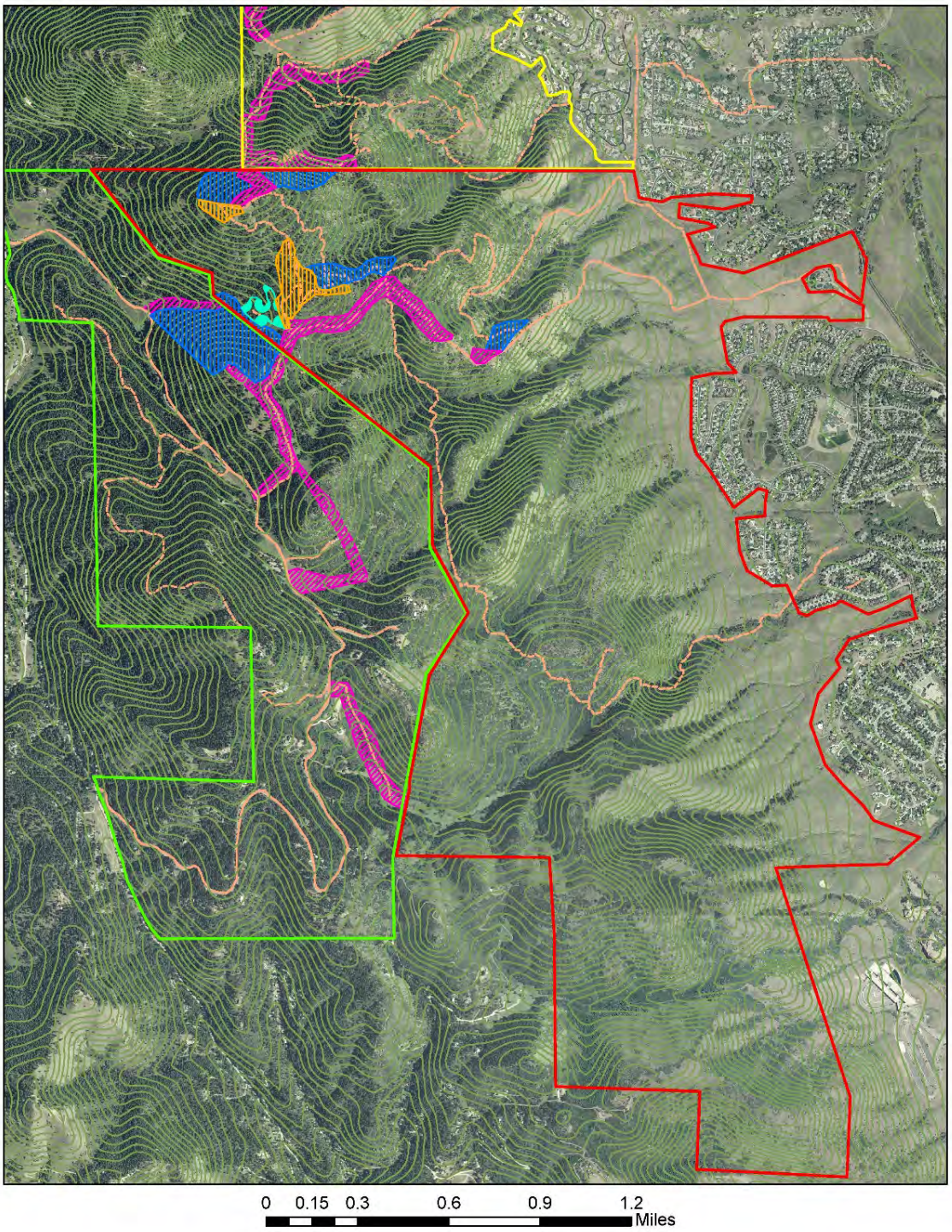


Docmann Gulch Management Area	
Gambel Oak	248.18 acres
Grasslands	106.57 acres
Douglas -Fir Regeneration	20.48 acres
Gambel Oak / Ponderosa Pine	17.94 acres
Douglas- Fir Regeneration / Gambel Oak	14.10 acres
Douglas- Fir Mature	13.68 acres
Aspen	12.13 acres
Mixed Conifer	11.47 acres

Ken Caryl Ranch Open Space Past Treatments



Area-Wide Forest Management Projects



Colorado State Forest Service

N W E S 1:20,000

K. Berggren 2/20/06

Ken-Caryl Ranch Boundary
Willow Springs Boundary
West Ranch Boundary
Roads & Trails

Fuelbreak
Douglas-fir Thinning
Ponderosa Thinning
Aspen Restoration

Forest Access Roads

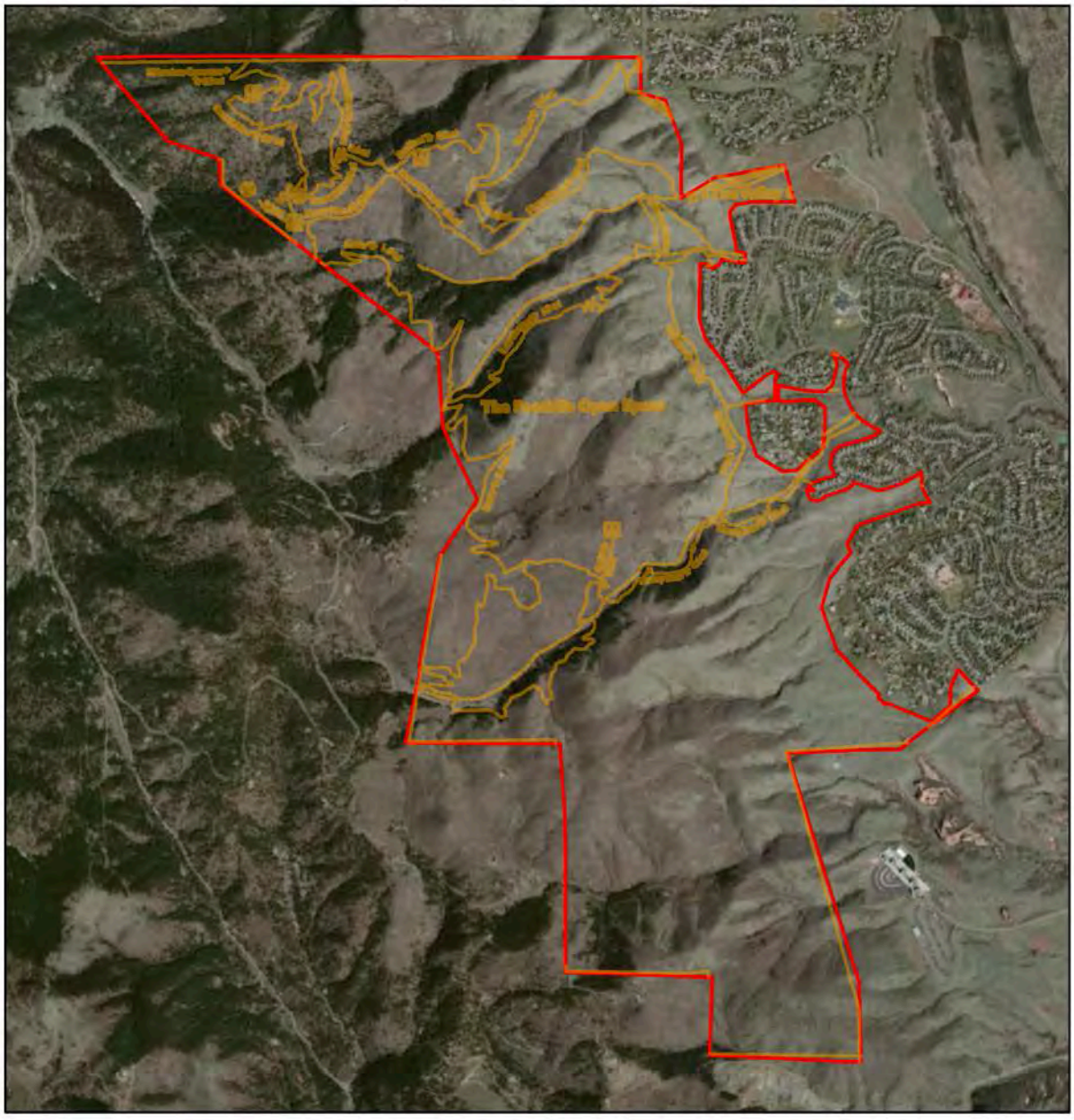
Miles
0 0.25 0.5 1

1:27,294

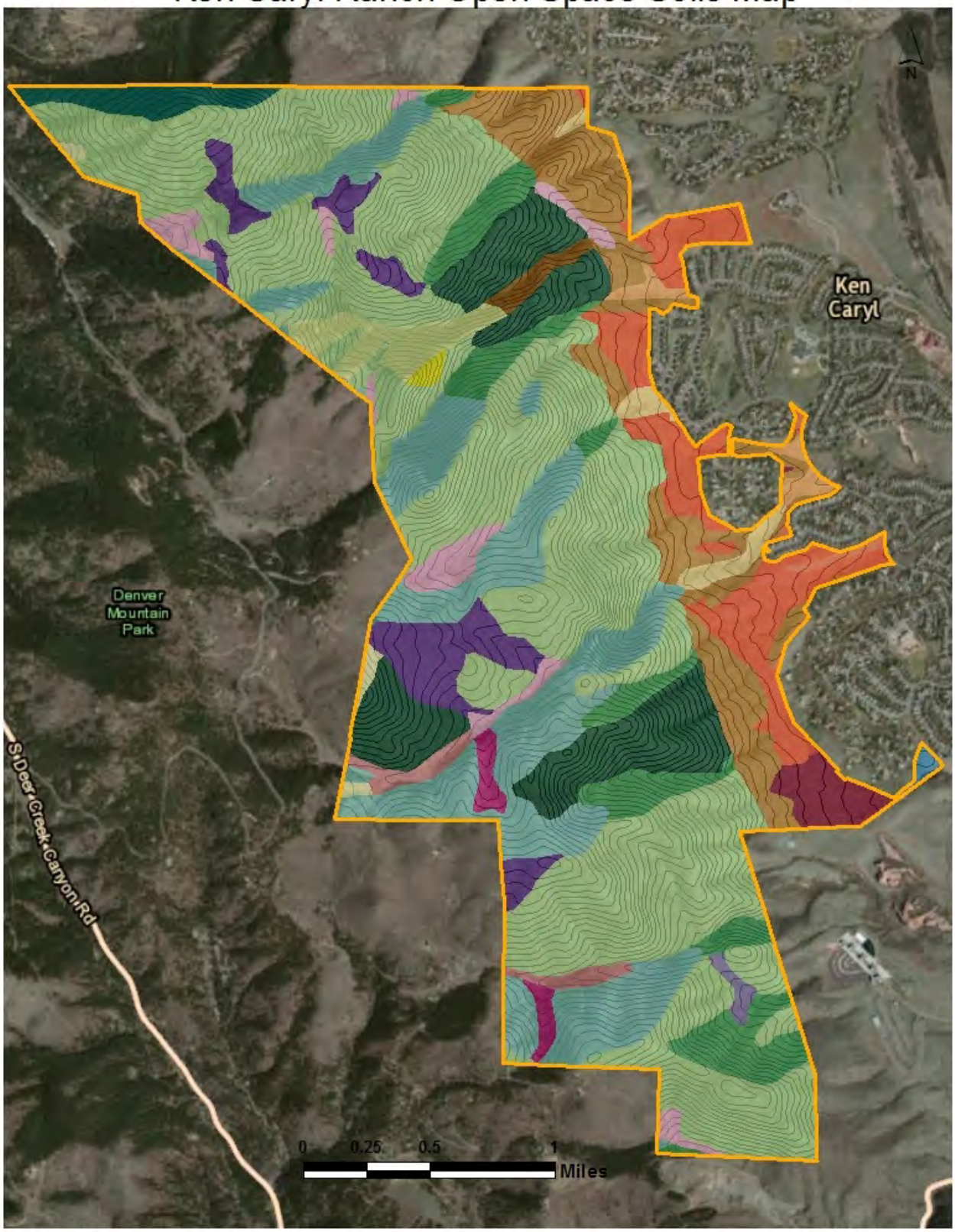
Legend

- Open Space Boundary
- 4WD Access Roads
- Potential Access Roads
- Maintained Access Roads

Open Space Trails



Ken Caryl Ranch Open Space Soils Map

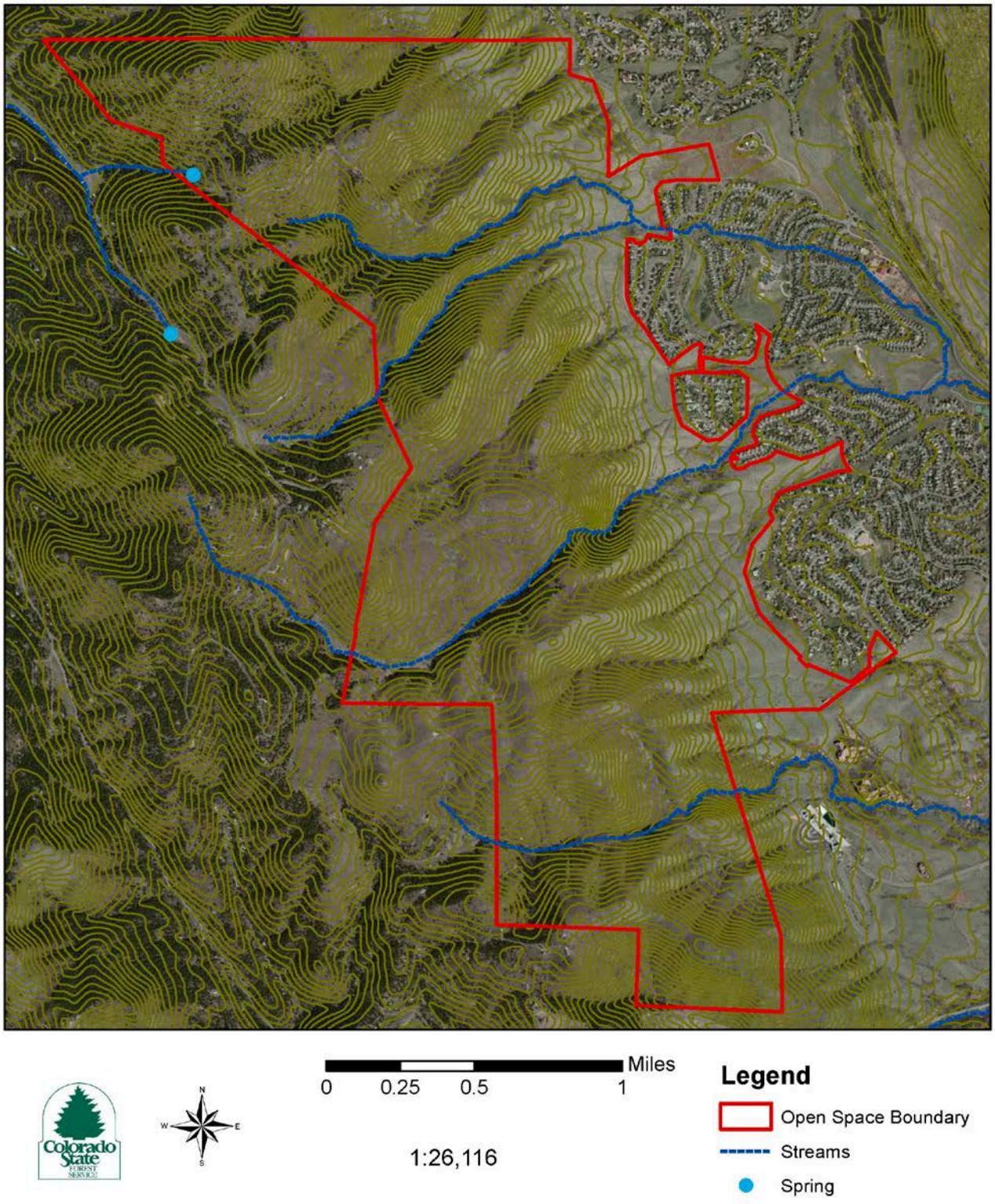


Legend

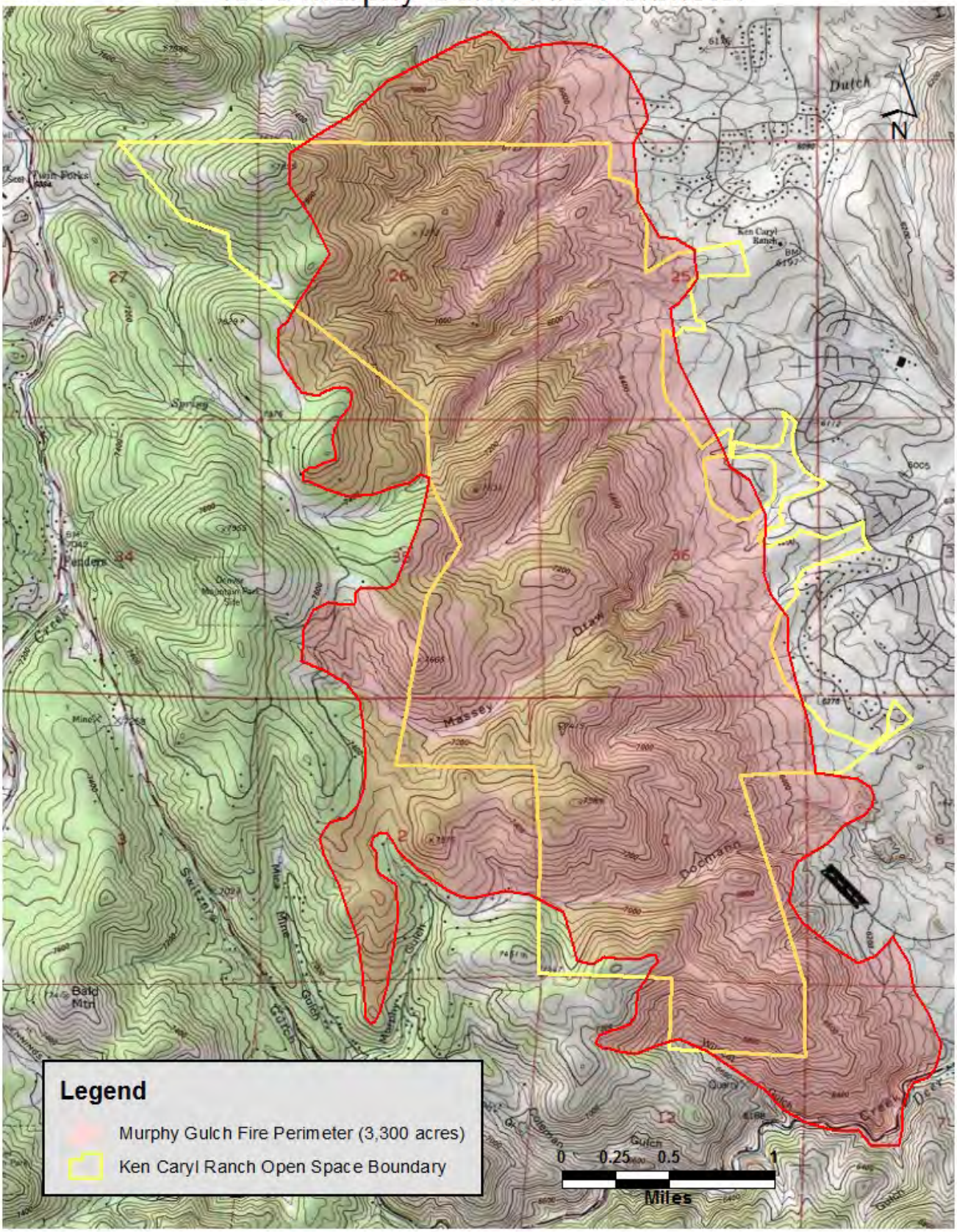
Soils Data Description

- Allens Park variant-Ratake-Rock Outcrop Complex, 30 to 50 percent slopes
- Argiustolls-Rock Outcrop Complex, 15 to 60 percent slopes
- Earcree Gravelly Sandy Loam, 9 to 15 percent slopes
- Grimstone-Hiwan-Rock Outcrop Complex, 30 to 60 percent slopes
- Grimstone-Peeler-Rock Outcrop Complex, 15 to 30 percent slopes
- Grimstone-Peeler-Rock Outcrop Complex, 30 to 50 percent slopes
- Hargreave Sandy Loam, 3 to 9 percent slopes
- Hargreave-Bernal Sandy Loams, 9 to 15 percent slopes
- Haverson Loam, 0 to 3 percent slopes
- Haverson Loam, 3 to 9 percent slopes
- Lavate-Bernal-Rock Outcrop Complex, 15 to 30 percent slopes
- Legault-Tolvar-Rock Outcrop Complex, 50 to 70 percent slopes
- Lininger-Ratake Complex, 15 to 30 percent slopes
- Lininger-Trag Sandy Loams, 9 to 20 percent slopes
- Ratake-Cathedral Very Stony Sandy Loams, 25 to 60 percent slopes
- Ratake-Cathedral-Rock Outcrop Complex, 25 to 60 percent north slopes
- Ratake-Cathedral-Rock Outcrop Complex, 25 to 60 percent slopes
- Ratake-Lininger Stony Sandy Loams, 30 to 60 percent slopes
- Rednun Clay Loam, 3 to 9 percent slopes
- Rednun-Chapin Variant Clay Loams, 9 to 15 percent slopes
- Rock Outcrop, Igneous and Metamorphic
- Trag Sandy Loam, 3 to 9 percent slopes
- Trag Sandy Loam, 9 to 25 percent slopes
- Ken Caryl Ranch Open Space Boundary

Streams and Riparian Area



1978 Murphy Gulch Fire Perimeter



9.0 GLOSSARY

Abiotic: Damage such as snowbreak, windthrow, or drought injury; not caused by a living agent.

Aspect: The compass direction toward which a slope faces.

Basal Area: The cross-sectional area of a single stem, including the bark, measured at breast height (4.5 feet).

Basal Area Factor: A designation of the type of prism used to determine basal area. Also, the numerical factor used to calculate basal area per acre.

Blowdown (also "windthrow"): Uprooting by the wind. Also refers to a tree or trees so uprooted.

Bole: The trunk of a tree.

Canopy (crown) closure: The progressive reduction of space between crowns as they spread laterally, increasing canopy cover.

Crown: The live branches and foliage of a tree.

Crown Ratio: The ratio of the [vertical] length of crown to the total length of the tree.

Defensible Space: An area around a structure where fuels and vegetation are treated, cleared or reduced to slow the spread of wildfire towards the structure

Density (of trees): A measurement of how numerous trees are in a given area, such as trees per acre.

Density-Dependent Mortality: Trees which die as a result of other (usually larger) trees being able to out-compete them for light, water, and nutrients.

Diameter at Breast Height (DBH): The diameter of the bole of a tree at 4 ½ feet above the ground.

Doghair: An extraordinarily dense area of trees. A term often given to lodgepole pine, where the trees may number in the thousands per acre.

Forb: Herbaceous, non-woody vegetation.

Flagging: Individual branches whose foliage has been killed. So called because foliage often turns bright orange when dying, which appears like a flag amidst the green foliage.

Forest Floor: The ground underneath the trees in a forest, which includes the organic soil

horizon (decomposing organic material), fallen pine needles and leaves, herbaceous vegetation (usually less than 2 feet high), rock outcroppings, and more.

Fuel Loading: The oven-dry weight of fuel per unit area. Generally used to describe the amount and live and dead vegetative material that would contribute to the heat/intensity of a wildfire.

Fuel Model: A classification given to each type of fuel, based on a wildfire's expected behavior under certain conditions in that fuel type.

Fuel Type: A classification on forest fuels in relation to wildfire hazard, based on the density of live and dead trees, shrubs, herbaceous vegetation, and the composition of the forest floor (thickness and continuity of pine needles, dead grasses, etc.)

Fuelbreak: A strategically located strip of land, depending on fuel and terrain, in which fuel density is reduced, thus improving fire control opportunities. The stand is thinned and remaining trees are pruned to remove ladder fuels. An open, park-like appearance is established.

Intermittent Stream: A small waterway which flows periodically in the form of a stream, generally after heavy rains or during spring snowmelt.

Ladder Fuels: Vegetative materials with vertical continuity that allows fire to burn from the ground level up to the branches and crowns of trees.

Leave Tree: A tree which is not cut during forest management activities.

Litter: The surface layer of a forest floor that is not in an advanced stage of decomposition, usually consisting of freshly fallen leaves, needles, twigs, stems, bark, and fruits.

Multi-Storied Stand: A stand which has trees with a wide variety of heights.

Noxious Weed: A plant specified by law as being especially undesirable, troublesome, and difficult to control.

Overstory: That portion of the trees in a forest forming the uppermost canopy layer.

Perennial Stream: A stream which flows at all times of the year.

Pitch Tube: A pocket of sap, seen on the outside of the tree that is indicative of past or current pine beetle infestation.

Riparian Area: Wet area with characteristic vegetation adjacent to a body of water.

Sapling: A young tree with a DBH greater than one inch but less than five inches.

Seedling: A young tree, from the time of germination to the sapling stage, having a DBH equal or less than one inch.

Shade-Tolerant: a tree which can grow underneath the canopy of other trees. Does not require full sunlight to thrive.

Shade-Intolerant: a tree which requires sunlight on at least two sides to germinate and thrive.

Skid Trail: a road on which cut logs are hauled out of the forest.

Snag: A standing, generally unmerchantable dead tree from which the leaves and most of the branches have fallen

Stagnant: A tree which, due to poor growing conditions, is growing very slowly.

Stand: A contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

Stressed Tree: A tree whose growth and vigor has been adversely affected by environmental conditions such as drought, competition, insects/diseases, etc.

Suckering: a method of regeneration wherein roots of an existing tree (such as Gambel oak or aspen) can break the surface of the soil and create new individuals

Thinning: A cultural treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality

Understory: Herbaceous vegetation (such as grasses and forbs) and woody vegetation (such as shrubs and small trees) which occupy the forest floor under a canopy of larger trees.

Vigor: A description of how fast the tree is able to uptake soil and nutrients, which (if it has "good" vigor) will lead the tree to grow faster, live longer, and be more resistant to damaging agents like bark beetles.

Woody Debris: Fallen material from trees that is located on the forest floor, such as dead branches, twigs, and dead trees themselves.

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APPENDIX A: TIMBER STAND INVENTORY

APPENDIX B: SOIL DESCRIPTIONS

The following is a brief description of each soil type and any special management considerations:

- **Soil Type 3: Allens Park Variant-Ratake-Rock outcrop complex, 30 to 50% slopes.**
  This soil complex is found on north-facing mountain side slopes and summits that are vegetated by ponderosa pine, Douglas-fir, mountain mahogany, grasses, and forbs. The soil, which is gravelly-loamy, was formed by weathering of metamorphic and igneous rocks and is moderately deep and well-drained. Rooting depth is 20-40". The surface of the soil is typically covered by an inch-thick mat of partly decomposed needles, leaves, and twigs. Permeability of the soil is moderate, and available water capacity is low. Runoff is rapid and erosion is a severe hazard. Due to the erosion hazard, it is especially important to maintain ground cover during forest management activities. Access roads and trails should be constructed with care— attention to grade and the use of culverts will help to prevent erosion.

- **Soil Type 5: Argiustolls-Rock outcrop complex, 15 to 60 percent slopes.**
  This soil type is found on escarpments and hills and consists of colluvium derived from sedimentary rock. It has a rooting depth of 10-40 inches and is well drained with moderately low to moderately high permeability. It has high runoff potential, and available water capacity is low. Erosion of the soil is a severe hazard, so it is important to maintain ground cover during forest management activities. To help prevent erosion, access roads and trails should be constructed with careful attention to grade and the use of culverts.

- **Soil Type 37: Earcree gravelly sandy loam, 9 to 15% slopes.**
  These soils are found on mountain toe slopes, drainages, and alluvial fans. It is deep and well drained, with moderate permeability, moderate water capacity, and moderate speed of runoff. Erosion is a severe hazard. The native vegetation on this soil is Douglas-fir, aspen, and lodgepole, with an understory of shrubs and grasses. The ground cover is typically a 2" thick mat of fallen pine needles and leaves. Due to the erosion hazard, it is especially important to maintain ground cover, as well as construct roads with culverts (instead of creating fords across the drainages).

- **Soil type 55: Grimstone-Hiwan-Rock outcrop complex, 30 to 50% slopes.**
  This complex is on north-facing mountain side slopes and ridges. Grimstone soil makes up 35 percent of this complex, Peeler soil makes up 30 percent, and Rock outcrop makes up 20 percent. The Grimstone soil is moderately deep and well drained. Permeability of the Grimstone soil is moderate. Runoff is rapid, and water erosion is a severe hazard. The Hiwan soil is shallow and well drained, the permeability is rapid, and the available water capacity is low. Runoff is rapid, and water erosion is a severe hazard. Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces. The native vegetation on this soil includes Douglas-fir, lodgepole pine, kinnikinnick, common juniper, forbs, and grasses.

- **Soil type 56: Grimstone-Peeler-Rock outcrop complex, 15 to 30% slopes.**
  This complex is on north-facing mountain side slopes. Grimstone soil makes up 40 percent of this complex, Peeler soil makes up 25 percent, and rock outcrop makes up 20 percent. The Grimstone soil is moderately deep and well drained. Permeability of the Grimstone soil is moderate. Runoff is rapid, and water erosion is a severe hazard. The Peeler soil is deep and well drained, the permeability is moderate, and the available water capacity is high. Runoff is rapid, and water erosion is a severe hazard. Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces. These soils are in the Douglas-fir/Lodgepole Pine woodland group.

- **Soil type 57: Grimstone-Peeler-Rock outcrop complex, 30 to 50% slopes.**
  This complex is on north-facing mountain side slopes. Grimstone soil makes up 40 percent of this complex, Peeler soil makes up 25 percent, and rock outcrop makes up 20 percent. The Grimstone soil is moderately deep and well drained. Permeability of the Grimstone soil is moderate. Runoff is rapid, and water erosion is a severe hazard. The Peeler soil is deep and well drained, the permeability is moderate, and the available water capacity is high. Runoff is rapid, and water erosion is a severe hazard. Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces. These soils are in the Douglas-fir/Lodgepole Pine woodland.

- **Soil type 58: Hargreave sandy loam, 3 to 9% slopes.**
  This deep and well-drained soil is found on hill slopes. It is a reddish, loamy material derived from sedimentary rocks. This native vegetation on this soil is western wheatgrass, blue grama, and Sandberg bluegrass. Rooting depth is 20 to 40", permeability is moderate, and water capacity is moderate. Runoff is slow, and erosion from wind and water is moderate. This soil supports rangeland that is useful for wildlife.

- **Soil type 59: Hargreave-Bernal sandy loams, 9 to 15% slopes.**
  This soil is very similar to Hargreave sandy loam. The inclusion of the coarser Bernal soil causes this soil to have a lower water capacity and increased permeability. Vegetation and other characteristics are the same as soil type 58.

- **Soil Type 60: Haverson Loam, 0 to 3 percent slopes.**
  This soil type is found on floodplains and low terraces and the parent material consists of alluvium. Rooting depth is greater than 60 inches and it is well drained with moderate permeability. Runoff potential is negligible to moderate depending on slope and available water capacity is moderate. Hazard of erosion is slight. Characteristic vegetation on this soil is cottonwoods, brush and a variety of grasses including western wheatgrass, green needlegrass, switchgrass and blue grama.

- **Soil Type 61: Haverson Loam, 3-9 percent slopes.**
  This soil type is found on floodplains and low terraces and the parent material consists of alluvium. Rooting depth is greater than 60 inches and it is well drained with moderate

permeability. Runoff potential is negligible to moderate depending on slope and available water capacity is moderate. Hazard of erosion off roads and trails is slight and is moderate on roads and trails. Characteristic vegetation on this soil is cottonwoods, brush and a variety of grasses including western wheatgrass, green needlegrass, switchgrass and blue grama.

- **Soil type 72: Lavate-Bernal-Rock outcrop complex, 15-30% slopes.**
  This soil is found on hill slopes. Like the Hargreave soils, it is reddish in color and derived from sandstone. Permeability is rapid and available water capacity is low. It is shallow and well-drained, and rooting depth is 8 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Native vegetation is similar to that of the Hargreave soils. Maintenance of vegetative cover is crucial for the prevention of erosion.

- **Soil type 78: Legault-Tolvar-Rock outcrop complex, 50 to 70% slopes.**
  This complex is found on side slopes and ridges, and is composes of 35 percent Legault soil, 30 percent Tolvar soil, and 20 percent rock outcrop. The Legault soil is shallow, well drained, and rapidly permeable. The Tolvar soil is deep, well drained, and moderately permeable. The water capacity for both soils is low. Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. Runoff is brapid. Water erosion is a slight hazard on most rock surfaces, but it is a severe hazard on Legault and Tolvar soils. The native vegetation on this soil includes Douglas-fir, lodgepole pine, kinnikinnick, common juniper, forbs, and grasses.

- **Soil type 85: Lininger-Ratake complex, 15 to 30% slopes.**
  These soils are found on mountain side slopes, ridges, and stable summits. Lininger soil makes up 45 percent of this complex and Ratake soil makes up 40 percent. The Lininger soil is deep and moderately permeable. The Ratake soil is shallow and moderately permeable. Both soils are well-drained, have low water capacities, and have medium to rapid runoff. The potential for erosion is severe. The native vegetation on this soil is ponderosa pine and various grasses.

- **Soil type 87: Lininger-Trag sandy loams, 9 to 20% slopes.**
  These soils are on stable summits, mountain toe slopes, and side slopes. Lininger soil makes up 50 percent of this complex and Trag makes up 35 percent. The Lininger soil is moderately deep and well-drained, moderately permeable, and the available water capacity is low. Trag soil is deep and well drained, and the available water capacity is high. Runoff in the complex is moderate to rapid, and the possibility of erosion is severe. The native vegetation is grass with scattered ponderosa pine.

- **Soil type 122: Ratake-Cathedral very stony sandy loams, 25 to 60 percent slopes.**
  These soils are on mountain side slopes and ridges that have an east, west, or south aspect. Ratake soil makes up 50 percent of the complex and Cathedral makes up 35 percent. Both soils are shallow and well-drained. The Ratake soil is moderately permeable and has a low available water capacity. The Cathedral soil is rapidly permeable and has a low water capacity. This complex has the potential for severe water erosion. The native vegetation is Gambel oak, scattered ponderosa pine, and various

grasses. Plant cover is often difficult to establish and maintain because of the shallowness to rock and low water capacity.

- **Soil type 123: Ratake-Cathedral-Rock outcrop complex, 25 to 60% slopes.**
  These soils are on mountain side slopes and ridges that have an east, west, or south aspect. Ratake soil makes up 35 percent of the complex, Cathedral makes up 30 percent, and rock outcrop makes up 20 percent. Both soils are shallow and well-drained. The Ratake soil is moderately permeable and has a low available water capacity. The Cathedral soil is rapidly permeable and has a low water capacity. Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. Runoff is rapid, and water erosion is a slight hazard on most rock surfaces. This complex has the potential for severe water erosion. The native vegetation is Gambel oak, scattered ponderosa pine and Rocky Mountain juniper, and various grasses. Plant cover is often difficult to establish and maintain because of the slope, shallowness to rock and low water capacity.

- **Soil type 124: Ratake-Cathedral-Rock outcrop complex, 25 to 60% north slopes.**
  These soils are differentiated from type 123 because they occur on *north*-facing mountain side slopes and ridges. Their composition and characteristics are identical to the above soil. Vegetation is similar, although it lacks the Gambel oak component. Again, plant cover is often difficult to establish and maintain because of the slope, shallowness to rock and low water capacity.

- **Soil type 125: Ratake-Lininger stony sandy loams, 30 to 60% slopes.**
  These soils are on mountain side slopes and ridges that face east, south, or west. Ratake makes up 55 percent of this map unit and Lininger makes up 30 percent. The Ratake soil is shallow and well drained, with moderate permeability and low water capacity. The Lininger soil is deep and well-drained, also with moderate permeability and low water capacity. Both have rapid runoff and the potential for severe water erosion. The native vegetation is grass with scattered ponderosa pine.

- **Soil Type 129: Rednun clay loam, 3 to 9 percent slopes.**
  This soil type is found on alluvial fans and valley filling side slopes. The parent material is alluvium derived from sandstone and shale. Rooting depth is greater than 60 inches. The soil is moderately well drained and slowly permeable. It has very high runoff potential, and available water capacity is very high. Rednun clay loams are often used as native pasture land or as cropland. Characteristic vegetation on this soil is blue grama, oak brush and cactus. Hazard of erosion is light off roads and trails and is moderate on roads and trails.

- **Soil Type 131: Rednun – Chapin variant clay loams, 9-15 percent slopes.**
  This soil type is found on alluvial fans and valley filling side slopes. The parent material is alluvium derived from sandstone, shale and residuum. Rooting depth ranges from 20 to greater than 60 inches, and water availability ranges from low to very high. The soil is moderately well drained and slowly permeable. It has slow to very high runoff potential. This soil type is often used as grazing, recreation or cropland. Native vegetation is

Gambel oak, pinyon, juniper, western wheatgrass, blue grama and junegrass. Hazard of erosion is slight off roads and trails and can be severe on roads and trails. Use of culverts and special attention to grade during construction of roads and trails will help prevent erosion.

- **Soil type 138: Rock outcrop, igneous and metamorphic, 15 to 100% slope.**
  Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. Runoff is rapid, and water erosion is a slight hazard on most rock surfaces.

- **Soil type 152: Trag sandy loam, 3 to 9% slopes.**
  This soil is found on fans, toe slopes, and drainageways. It is deep and well drained, moderately permeable, and has a high water capacity. Runoff is slow, and water erosion is only a slight hazard. The native vegetation is grass. If disturbed, the grass may take some time to come back due to the short growing season.

- **Soil type 153: Trag sandy loam, 9 to 25% slopes.**
  This soil is found on fans, toe slopes, and drainageways. It is deep and well drained, moderately permeable, and has a high water capacity. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. The native vegetation is grass. If disturbed, the grass may take some time to come back due to the short growing season and slope.

APPENDIX C: PLANTS AND WILDLIFE NATIVE TO KEN-CARYL RANCH

APPENDIX D: SUPPLEMENTAL INFORMATION

Fact Sheets and Brochures in this Appendix:

1. Noxious Weeds—Descriptions and Treatments
    a. Canada Thistle
    b. Musk Thistle
    c. Russian Knapweed
    d. Leafy Spurge
    e. Cheatgrass
    f. Common Mullein
    g. Yellow Toadflax
2. Insects and Diseases
    a. Mountain Pine Beetle
    b. Mountain Pine Beetle Q & A
    c. Preventative Spraying for Mountain Pine Beetle
    d. Solar Treatment of Mountain Pine Beetles
    e. Diesel Fuel Treatment of Mountain Pine Beetles
    f. Douglas-Fir Beetle
    g. Western Spruce Budworm
3. Forest Management
    a. Landowner Guide to Thinning
    b. Creating Fuelbreaks for Forested Subdivisions
    c. Colorado Best Management Practices for Water Quality
    d. Forest Restoration Guidelines
4. Gambel Oak Mitigation
    a. Herbicide options and applications
    b. Pronone Article
    c. Arsenal Advertisement
    d. Round-Up memo
    e. Using Goats for Fire Mitigation
    f. Misc. Goat publications
5. Wildfire Mitigation
    a. Defensible Space guidelines
6. Prescribed Fire
    a. Pile Burning Guidelines

APPENDIX E: CO-WRAP REPORT, KEN-CARYL RANCH OPEN SPACE

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APPENDIX F: COLORADO NATURAL HERITAGE PROGRAM, THREATENED AND ENDANGERED SPECIES