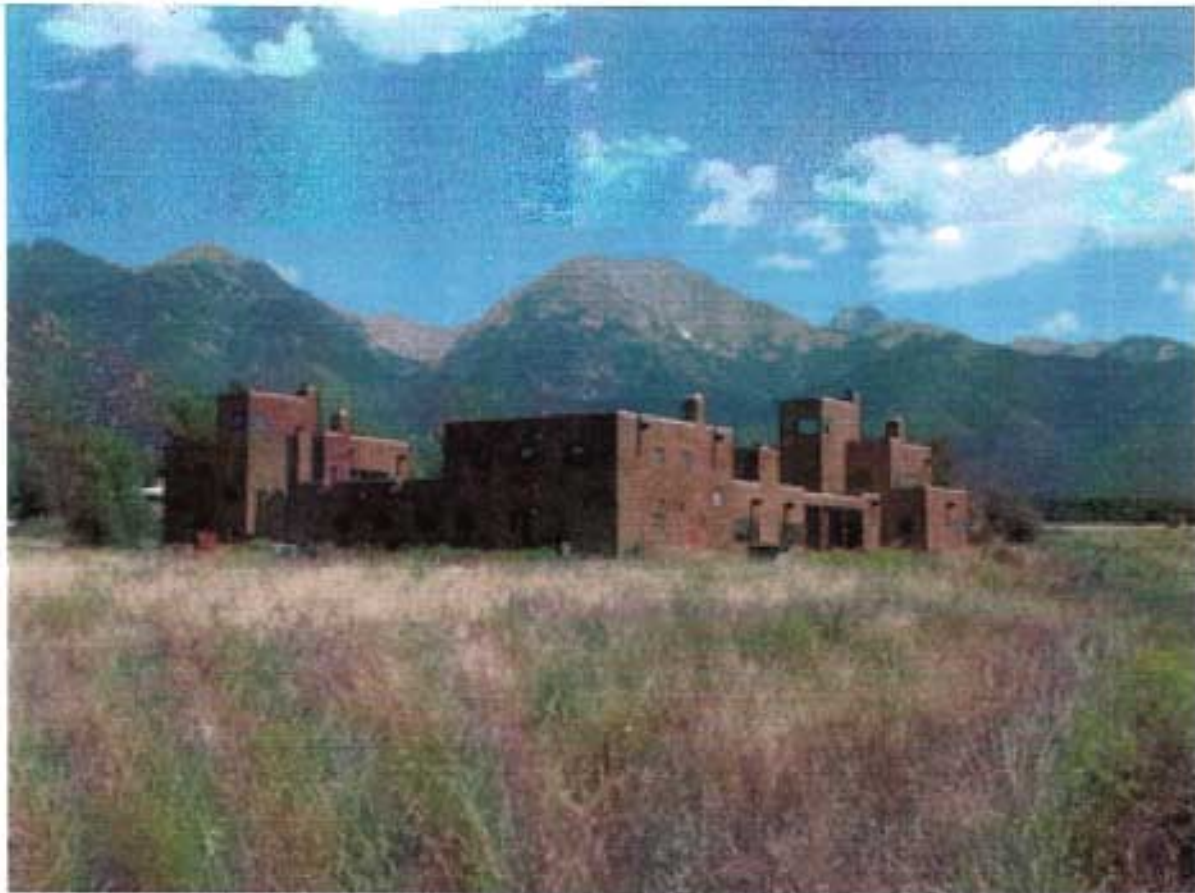


**LAND MANAGEMENT
PLAN
THE COLORADO COLLEGE
Baca Campus**



Prepared by

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And

The Colorado College

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Introduction:

Colorado College's Campus at Baca is located on approximately 300 acres near the town of Crestone, Colorado, along the west side of the Sangre de Cristo Mountains. Its buildings are situated primarily adjacent to the South Crestone Creek drainage. Several different vegetation zones exist within these 300 acres, including a narrowleaf cottonwood/rocky mountain juniper riparian zone, a shrub/grassland zone, and a pinyon/juniper/ponderosa zone. Within each zone there are different fire regimes, elemental balances, and biodiversities. This land management plan is designed to be adaptive in nature, and reflect sensitivity to each zone. At least, yearly reviews are recommended to determine if management objectives are being fulfilled. In addition, participation and integration of the faculty, staff, and student body is encouraged, as this location offers significant opportunities for study of successful human participation with the natural world.

Land Management Plan Priorities

Life safety is the first priority, followed by incident stabilization, and property conservation. This system is referred to as LIPs. It is instituted when making decisions regarding land management strategies both during emergencies, non-emergencies, and daily activities. The most likely emergencies to occur at The Colorado College Baca Campus are fire and flooding. These two types of events could pose significant threats to life safety.

Work Completed, Objectives Met:

Significant amounts of standing and fallen dead narrowleaf cottonwood were removed in order to decrease hazardous fuel loading in the Baca Campus area, thus, reducing the overall fire danger in the area. This large diameter material was organized for firewood and seats at the campus fire pit. The smaller material was chipped and piled to the west, about ½ mile from the campus buildings.

Future Management Goals

- Increase life safety on campus by removing hazardous standing trees (snags), decreasing accumulated living and dead hazardous wildland fuels, and educating users of the Baca Campus about fire safety and landscape health.
- Provide opportunities to adapt our human presence to and with this landscape and the elemental effects thereon and therein.
- Continue student participation and increase program offerings at Baca Campus.
- Utilize Baca Campus as a field laboratory and provide for successful land management.
- Create and sustain monitoring program.
- Integrate use and stewardship of Baca Campus into curriculum of The Colorado College.
- Incorporate element training program into student curriculum to provide foundational basis for successful land stewardship efforts.
- Create land management plan for the other vegetative zones on the campus.
- Complete status reports for each of the other identified vegetation zones
- Determine management objectives; implement strategies to fulfill objectives
- Utilize adaptive management.

Fire and Safety Issues

- Develop fire management plan that includes both structural and wildland fire strategies and tactics.

Water and Safety Issues

- Support vegetation of area to be resilient to flooding through thinning and prescribed fires, native seeding and planting of decadent and locally extinct species.
- Develop flooding safety protocols.

Wind and Safety Issues

- Identify, locate, and make known areas for shelter in case of high winds and/or tornadoes.

Earth Movements and Safety Issues

- Identify, locate, and make known areas for shelter in case of significant localized earthquake activity.

Forest Health Issues

- Set up monitoring and implement ongoing program.
- Continue thinning standing dead cottonwood to reduce hazardous fuel loading, leaving habitat trees and snags as appropriate.
- Ascertain historic stand structure and balance of narrowleaf cottonwood/rocky mountain juniper vegetative matrix.
- Determine vegetative objectives utilizing natural range of variability and Colorado College's goals for landscape management.
- Thin, according to determined vegetative objectives.
- Plan and execute low intensity prescribed fires to increase biodiversity of area, decrease hazardous fuel loading, and improve resilience of landscape to disturbance.
- Utilize ongoing adaptive management strategies, incorporating programs and courses that involve students, faculty, and staff of Colorado College.

Noxious Weeds

Two invasive species are known to exist on the Colorado College Baca Campus, Russian knapweed and Canada thistle. Integrated management strategies are recommended to reduce the coverage and presence of these two species. These strategies may include mowing, burning, goat grazing, native seeding, and hand pulling. It is important that strategies be implemented as soon as possible in order to minimize the invasion and effects of these noxious weeds.

Work Along South Crestone Creek – 2007 (Photolog provided on a separate disk)

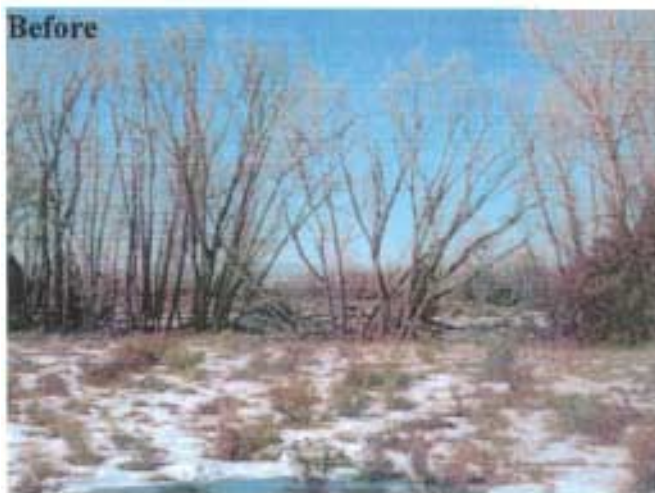


FIGURE 1: THE COLORADO COLLEGE LOCATION

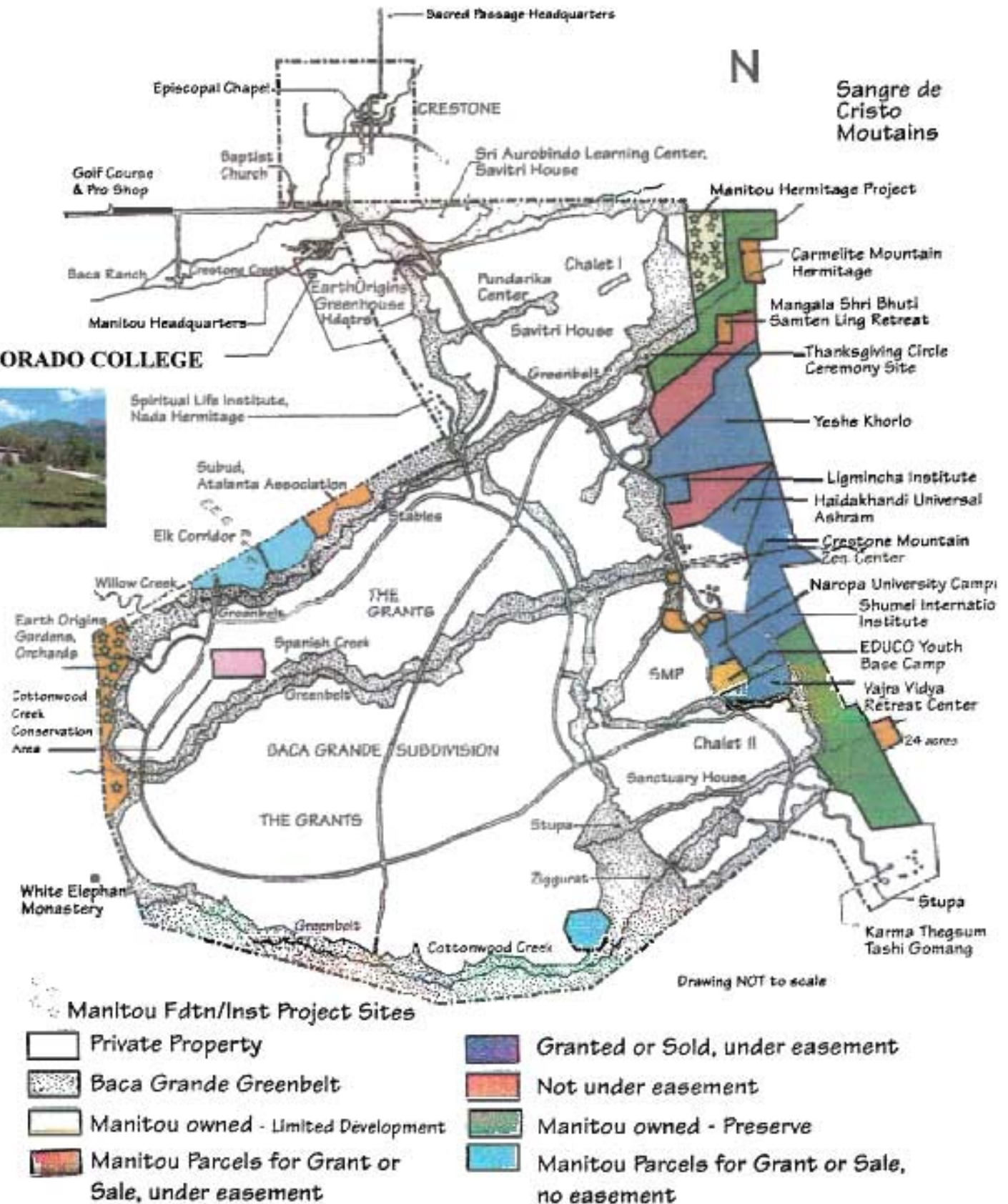
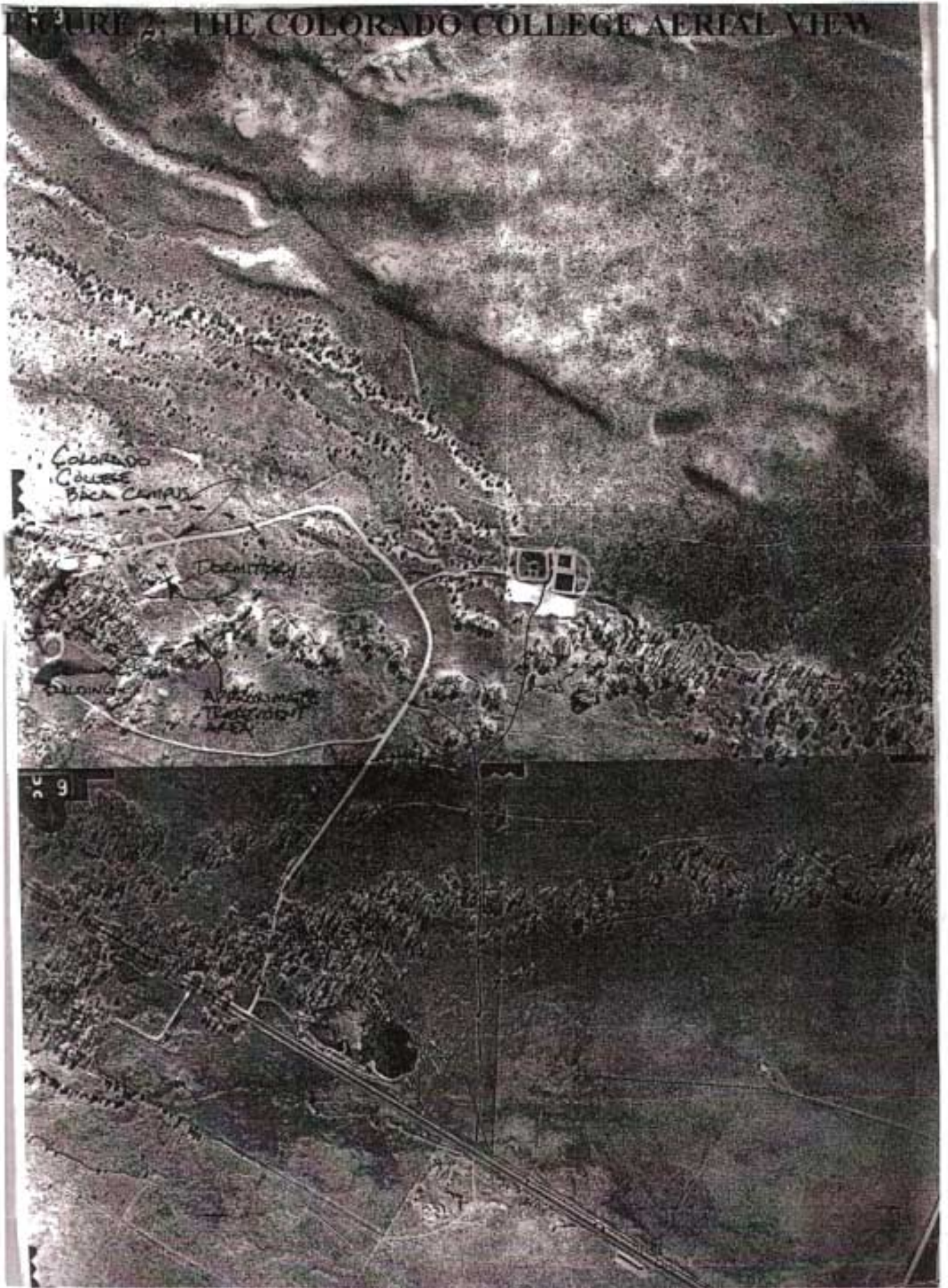


FIGURE 2. THE COLORADO COLLEGE AERIAL VIEW



South Crestone Creek Riparian Corridor: Status Report and Strategies for fire management and biological diversity

This riparian corridor is characterized by an overstory of narrowleaf cottonwood (*Populus angustifolia*) and Rocky Mountain juniper (*Juniperus scopulorum*). Much of the cottonwood component is decadent, with little regeneration, while the juniper component is quite regenerative. In many areas, these conifers are taking over the riparian corridor, which could change both the intensity of fire regime and biological diversity of the area. If there is no fire occurrence, the cottonwoods may be lost.

To date, most of the hazardous fuel reduction has been focused on dead standing and downed cottonwood. In order to keep the narrowleaf cottonwood population viable and sustained, the thinning of junipers, especially the regeneration is recommended in areas where dense juniper stands have taken over in order to maintain the stands of both the established narrowleaf cottonwood *and* Rocky Mountain juniper. Also, the thinning of some shrub cover as well as young junipers, especially where dense stands exist in the understory of the riparian woodland, will help reduce hazardous fuel loads and ladder fuels below larger cottonwoods and junipers. This action will help to prevent the loss of the larger established trees in the event of a fire. This fuel reduction effort will also open areas where young cottonwoods could regenerate if soil moisture is adequate.

Narrowleaf cottonwood regeneration may also be accomplished by low intensity prescribed burns in this riparian zone, as this species tends to resprout when exposed to sunlight and mineral soil. Care should be taken when using fire as to not damage other species, which may be fire intolerant. Other species, though, which may be fire tolerant, fire adapted, or fire dependent, may benefit from the presence of low intensity fire. Some species, which may have not been seen for many years, may resprout and add to the biological diversity of the zone.

Invasive Species

To date there are two identified invasive species in the riparian zone. They are Canada thistle (*Cirsium arvense*) and Russian knapweed (*Acroptilon repens*). The Canada thistle is found adjacent to the creek bed, while the Russian knapweed is found in areas away from the creek, within a few hundred yards. These two species are highly invasive and tend to displace native species. It is recommended that a program be initiated to control and/or eliminate these two species from the zone. As this riparian area may be sensitive to chemical influences, and the local community is very concerned about chemical use, extreme care should be taken when using chemical treatments, or alternative methods should be used. **Please see Appendix A – Management of Invasive Species.**

The Colorado College's Land Management Plan

Ongoing Maintenance

Note: This land management plan is a work in progress. While fire is emphasized in this plan, its presence and effects are inextricably connected with the other elements of earth, water, air, and space, and their effects. When using this plan, it is recommended that the process of adaptive management be used. Landscapes and elements are dynamic factors that need to be continuously evaluated if we hope to live sustainably in places like the Colorado College Baca Campus, near Crestone, Colorado.

Develop Emergency Warning System.

Install siren system to notify residents of emergencies.

Maintenance of Buildings: Buildings should be checked annually for hazardous conditions, especially those of flammable nature. Buildings that are made of combustible materials should be transformed into more fire resistant buildings utilizing non-combustible materials. Fire extinguishers in each building should be checked and refilled as necessary.

Maintenance of Water Systems: The entire water system, including and not limited to the hydrant(s), pumps, hoses, etc., should be checked for operability at least twice annually: once in warm conditions, and once in cold conditions. Any non-functioning or limited functioning components should be repaired/replaced as soon as possible. The creek corridor should be checked annually for effective flow, especially at road crossings and culverts. Remove all blockages as soon as possible.

Maintenance of Landscape: Hazardous fuel reduction efforts should continue as staffing and funding allows. Emphasis of action should be first: adjacent to structures, within and below the campus area, along the access roads, and in the drainages leading to the campus; then, along the sides of the campus, and above the campus.

Low intensity prescribed burning may be introduced to the Colorado College Baca Campus landscape, provided that it can be done safely. The goal of these low intensity planned fires is to decrease accumulations of hazardous fuels, which may help unplanned wildfire events and planned prescribed fires to be more self-limiting in nature. Other objectives for these prescribed fires are: to increase biodiversity, to provide training and educational opportunities for the students, faculty and staff of the Colorado College, and to increase the resilience of the landscape to disturbance, such as high intensity fire, flood, disease, etc. A monitoring program should be put in place to insure that management objectives are being successfully accomplished, and that an elemental balance, conducive to the objectives of the Colorado College Baca Campus, is supported.

Proposals for Integration of Activities with Students, Faculty, and Staff

There is a responsibility in managing the 300-acre Baca Campus. This is an opportunity to share this management responsibility, *this land stewardship*, with the students, faculty, and staff of The Colorado College, in a win-win situation.

As the orientation wildfire mitigation workdays at the Baca Campus were quite successful this past year, it is recommended that this student involvement continues and expands into the future. This program helps to steward the landscape, to keep maintenance costs down, and to integrate educational activities. Other educational opportunities that would help to steward the Baca Campus include: field monitoring through the use photo-points and acoustic-points, long-term biological studies, fire effects, human adaptation to fire and the landscape, and fire and ethnobotany.

The Colorado College Baca Campus offers a field laboratory in which to explore the relationships between humans and nature. By developing relationships with the elemental forces of earth, water, fire, air, and space, a more effective and sustainable stewardship program is possible. This campus provides the context.

A new program is available to CC students. It may best fit into the freshman orientation course. It is called *Discovering the Language of the Elements*. It is intended to support people who are involved with land stewardship efforts. **See appendix D.**

Faculty and staff participation are needed to implement these proposed programs.

Freshmen Orientation Wildfire Mitigation Work Days – January 2007



Canada Thistle

by K.G. Beck¹

Quick Facts...

- Canada thistle is a creeping perennial that reproduces from vegetative buds in its root system and from seed.
- It is difficult to control because its extensive root system allows it to recover from control attempts.
- Combining control methods is the best form of Canada thistle management.
- Persistence is imperative so the weed is continually stressed, forcing it to exhaust root nutrient stores and eventually die.

Canada thistle (*Cirsium arvense*) is an aggressive, creeping perennial weed that infests Crops, pastures, rangeland, roadsides and noncrop areas. Generally, infestations start on disturbed ground, including ditch banks, overgrazed pastures, tilled fields or abandoned sites. Canada thistle reduces forage consumption in pastures and rangeland because cattle typically will not graze near infestations.

One plant can colonize an area 3 to 6 feet in diameter in one or two years. Canada thistle grows in a variety of soils and can tolerate up to 2 percent salt content. It is most competitive in deep, well-aerated, productive, cool soils. It usually occurs in 17- to 35-inch annual precipitation zones or where soil moisture is adequate. It is less common in light, dry soils. A survey conducted in 1998 showed Colorado has about 400,000 acres infested with Canada thistle.



Figure 1: Canada thistle (*Cirsium arvense*).

Phenology

Emergence. Canada thistle develops from seed or vegetative buds in its root system. Horizontal roots may extend 15 feet or more and vertical roots may grow 6 to 15 feet deep. Canada thistle emerges from its root system in mid- to late spring (late April through May) and forms rosettes (Figure 1).

The greatest flush of root-derived plants occurs in spring, but another flush occurs in fall. A flush can occur anytime during the growing season when soil moisture is adequate. This is particularly a problem when Canada thistle growth is disturbed by tillage or herbicides. This feature can be manipulated to the land manager's advantage.

Plants that germinate from seed do so at about the same time as root-derived shoots. Seedlings grow slowly and are sensitive to competition, particularly if shaded. Canada thistle seedlings develop a perennial habit (the ability to reproduce from their root systems) about seven to eight weeks after germination.

Reproduction and spread. Canada thistle begins to flower in late spring to early summer in response to 14- to 16-hour days. Plants are male or female (dioecious) and

grow in circular patches that often are one clone and sex. Female flowers produce a sweet odor and insects readily pollinate different sexed patches up to 200 feet apart.

Canada thistle develops seed sparingly. It may produce 1,000 to 1,500 seeds per flowering shoot. Generally, vegetative reproduction from its root system contributes to local spread and seed to long distance dispersal. Seed may be transported long distances by water, or attached to animals, clothing, farm equipment and other vehicles, and in contaminated crop seed. Also, wind may help disseminate seed, but most often, the feathery pappus breaks off, leaving the seed attached to the parent plant to be disseminated by other means. Seed can remain viable in soil up to 20 years, and deep burial promotes survival longevity.

Canada thistle allocates most of its reproductive energy into vegetative propagation. New shoots and roots can form almost anywhere along the root system of established plants. Tillage segments roots and stimulates new plants to develop. Shoots emerge from root and shoot pieces about 15 days after disturbance by tillage. Small root pieces, 0.25 inch long by 0.125 inch in diameter, have enough stored energy to develop new plants. Also, these small roots can survive at least 100 days without nutrient replenishment from photosynthesis.

Management

The key principle to Canada thistle control is to stress the plant and force it to use stored root nutrients. Canada thistle can recover from almost any stress, including control attempts, because of root nutrient stores. Therefore, returning infested land to a productive state occurs only over time. Success requires a sound management plan implemented over several years.

Cultural control. Grasses and alfalfa can compete effectively with Canada thistle if their growth is favored by good management. Maintain fertility and, if possible, moisture at optimum levels to favor grass or alfalfa growth. Soil analysis can easily determine fertility needs. Be cautious with nitrogen fertilizers, because excess available soil nitrogen may favor weed growth.

These are essential management steps to ensure optimum desirable plant growth and competition. However, competition alone seldom is effective against Canada thistle.

Chemical control. Read the label, follow directions and use precautions. Research at Colorado State University shows that Tordon 22K (picloram), Curtail (clopyralid plus 2,4-D), Transline (clopyralid), Banvel/Vanquish/Clarity (dicamba), 2,4-D and Telar (chlorsulfuron) are effective against Canada thistle. These herbicides are most effective when combined with cultural and/or mechanical control.

Banvel/Vanquish/Clarity, and 2,4-D may be used on pastures, rangeland and non-crop areas. Tordon, Curtail, Telar and Transline may be applied on noncrop areas only. Colorado State University data indicates that Banvel/Vanquish/Clarity or Telar are effective when combined with 2,4-D as a split-season application.

Apply 2,4-D, 2 quarts per acre (A), in spring when Canada thistle is 10 to 15 inches tall, in pre-bud to early bud growth stages. Re-treat in fall with Banvel/Vanquish/Clarity (2 quarts/A) or Telar (1 ounce/A) to re-growth. Use a surfactant (0.25 percent to 0.5 percent v/v) with Telar for adequate control. Banvel/Vanquish/Clarity also may be applied in early spring at 2 quarts/A when Canada thistle is in the rosette stage. Tordon (1 quart/A) or Tordon plus 2,4-D (1 quart + 1 quart/A) is effective whenever Canada thistle is actively growing. Fall applications are especially effective.

Curtail and Transline are effective when applied in spring after all Canada thistle plants have emerged. Apply Curtail (2 to 3 quarts/A) when the oldest Canada thistle plants are entering the bud growth stage and the youngest are in the rosette to bolting growth stages. Apply Transline (2/3 to 1 pt/A) when Canada thistle is in the rosette to bud growth stages. Transline at 1 pt/A also is effective when applied in fall.

Recent research at Colorado State University shows that the performance of Curtail to control Canada thistle can be improved when preceded by two or three mowings. When Canada thistle infestations occur in situations where root growth would be restricted, such as habitats with high water tables, begin mowing when it is 12 to 15 inches tall. Repeat

mowings at about one month intervals. Apply Curtail at 2 to 3 quarts/A in October or about one month after the third mowing. Follow this regimen for two consecutive years.

Mechanical control. Mowing hay meadows can be an effective tool if combined with herbicide treatments. Mowing alone is not effective unless conducted at one-month intervals over several growing seasons. Always combine mowing with cultural and chemical control. Mowing at hay cutting stimulates new Canada thistle shoots to develop from its root system.

In irrigated grass hay meadows, fall herbicide treatments that follow mowing can be an effective management system because more Canada thistle foliage is present after cutting to intercept herbicide. Additionally, root nutrient stores decrease after mowing because the plant draws on them to develop new shoots.

If a Canada thistle infestation exists in a field that will be rotated to alfalfa, control the weed before seeding alfalfa. Alfalfa is an effective competitor only after it is established. It will not adequately establish in a well-developed Canada thistle infestation. A Canada thistle management system can start with crop or grass competition combined with herbicides, with the field rotated to alfalfa when the management plan ends.

Biological control. *Ceutorhyncus litura* is a weevil currently used as a biocontrol agent in Colorado. The female lays eggs underneath the Canada thistle leaves in early spring. Larvae bore into the main leaf vein, then down into the plant's crown area. If the population is high enough, plant death can occur, otherwise Canada thistle is stressed and less vigorous.

Ceutorhyncus alone will not effectively control Canada thistle. It must be combined with other methods to be successful. Combine the weevil with cultural techniques that allow for maximum desirable plant competition. Research to combine *Ceutorhyncus* with herbicides or mowing has not been conducted. Research has shown that biological and chemical controls are compatible for musk thistle. This is most likely true for Canada thistle as well. *Ceutorhyncus litura* is available through the Colorado Department of Agriculture.

Urophora cardui is another biocontrol insect available from the Colorado Department of Agriculture. Females lay eggs on apical meristems of developing shoots. Larvae burrow into shoots. Their feeding triggers huge galls to form that stress the plant, perhaps killing it. Galls that form near the terminal meristems (e.g., where flowers develop) keep the weed from flowering and reduce seed set.

¹Colorado State University Extension weed science specialist and professor, bioagricultural sciences and pest management. Revised 3/03.

Russian Knapweed

by K.G. Beck¹

Quick Facts...

- Russian knapweed is a creeping perennial that reproduces from seed and vegetative root buds.
- Russian knapweed emerges in early spring, bolts in May to June, and flowers through the summer into fall.
- Russian knapweed is toxic to horses.
- The key to Russian knapweed control is to stress the weed and cause it to expend nutrient stores in its root system.
- The best management plan includes cultural controls combined with mechanical and/or chemical control techniques.

Russian knapweed (*Acroptilon repens*) is a creeping, herbaceous perennial of foreign origin that reproduces from seed and vegetative root buds. Shoots, or stems, are erect, 18 to 36 inches tall, with many branches. Lower leaves are 2 to 4 inches long and deeply lobed. Upper leaves are smaller, generally with smooth margins, but can be slightly lobed. Shoots and leaves are covered with dense gray hairs. The solitary, urn-shaped flower heads occur on shoot tips and generally are 1/4 to 1/2 inch in diameter with smooth papery bracts. Flowers can be pink, lavender or white. Russian knapweed has vertical and horizontal roots that have a brown to black, scaly appearance, especially apparent near the crown.



Figure 1: Russian knapweed.

The weed forms dense, single species stands over time due to competition and allelopathy (biochemicals it produces that inhibit the growth of other plants). A 2002 survey conducted by the Colorado Department of Agriculture showed Colorado with more than 118,341 infested acres of Russian knapweed. Russian knapweed is toxic to horses.

Phenology, Biology and Occurrence

Russian knapweed emerges in early spring, bolts in May to June (elevation dependent) and flowers through the summer into fall. It produces seeds sparingly, approximately 50 to 500 per shoot. Seeds are viable for two to three years in soil. Its primary method of reproduction is from vegetative propagation, with seed of secondary importance. Roots from a recently established plant expand rapidly and may cover up to 12 square yards in two growing seasons.

Russian knapweed is native to southern Ukraine, southeast Russia, Iran, Kazakhstan and Mongolia. It grows on clay, sandy or rocky prairies and sunny meadows; on saline soils; or clay, rocky or sandy shores of lakes and rivers; and on rocky and clay slopes of hills and bottomlands. It is a weed of cultivated land, dry pastures and degraded noncropland (waste places) in its native land. Russian knapweed grows in most western states. In Washington, it is common on heavier, often saline soils of bottomlands and grows in pastures, hayfields, grainfields and irrigation ditches. In Colorado, Russian knapweed is not restricted to certain soils and occurs in pastures, agronomic Crops, roadsides, waste places and rangeland. Stands may survive 75 years or longer.

Management

Like other creeping perennials, the key to Russian knapweed control is to stress the weed and cause it to expend nutrient stores in its root system. An integrated management plan should be developed that places continual stress on the weed. Currently, the best management plan includes cultural control combined with mechanical and/or chemical control techniques. A single control strategy, such as mowing or a herbicide, usually is not sufficient.

Russian knapweed typically invades degraded areas, dominating the plant community and desirable plants (e.g. perennial grasses). Seeding competitive, perennial grass species (cultural control) after Russian knapweed has been stressed by other control measures (set-up treatments) is essential. Set-up treatments may include chemical or mechanical methods.

Cooperative research between Colorado State University and the University of Wyoming showed that chemical set-up treatments were superior to mowing. Curtail (clopyralid + 2,4-D), Escort (metsulfuron), and Roundup (glyphosate) were used to suppress Russian knapweed. Then perennial grasses were sown in late fall as a dormant seeding. Tillage is necessary to overcome the residual allelopathic effects of Russian knapweed. Curtail (3 quarts per acre) (A) or Escort (1 ounce/A) were applied at the bud-growth stage. Roundup was applied twice at 1 quart/A, first at the bud-growth stage and again about 8 weeks later. Curtail controlled Russian knapweed best, but Roundup failed to control it.

None of the herbicides injured seeded grasses. Grasses established similarly among herbicide suppression treatments, even though Russian knapweed control varied. However, where Escort or Roundup was used to suppress Russian knapweed, additional herbicide treatments would be necessary to achieve acceptable control.

While two mowings, eight weeks apart (first at bud-growth stage), suppressed Russian knapweed during that year, the weed recovered vigorously the subsequent season. Perennial grasses established in the mowing treatments but much less than in herbicide treatments. Two mowings per year for several years may control Russian knapweed better, but further research is needed to test this hypothesis. Currently, no biological control is available for this weed.

Chemical control. In most circumstances, an herbicide alone will not effectively manage Russian knapweed. However, there may be situations where desirable plants within a Russian knapweed infestation may compete effectively with the weed if it is stressed with a single weed management technique. When integrating chemical and cultural control, avoid using herbicide rates that injure grasses because effective competition will be reduced.

Russian knapweed is controlled with Tordon 22K (picloram) at 1 to 2 quarts/A. Tordon may be broadcast sprayed up to 1 quart/A or spot sprayed at rates up to 2 quarts/A. Tordon plus 2,4-D (1 to 1.5 pints + 1 quart/A) also will control Russian knapweed. If low rates of Tordon or Tordon plus 2,4-D are used, application for two consecutive years may be necessary to achieve adequate control. Apply Tordon any time the weed is actively growing.

For Telar (chlorsulfuron), a noncrop herbicide that controls Russian knapweed, application timing is critical. Apply (1 ounce/A) when Russian knapweed is in the bloom to postbloom stage. Earlier applications do not control the weed effectively. Fall is a good time to apply Telar, but it may injure smooth brome or other brome species. Always add a good agricultural surfactant at 0.25 to 0.5 percent v/v to the spray solution. Escort

(metsulfuron) is labeled for pasture and rangeland use. Apply it at 0.75 to 1 ounce/A with a good agricultural surfactant. Optimum timing for Escort is similar to Telar.

Cultural control. Russian knapweed tends to form monocultures and usually eliminates other plants. Therefore, sowing desirable plant species is necessary after the weed is controlled. Smooth brome will compete with Russian knapweed. Research shows that streambank wheatgrass, thickspike wheatgrass, crested wheatgrass and Russian wildrye established after Russian knapweed was suppressed with herbicides. Sod-forming perennial grasses, like streambank or thickspike wheatgrasses, help prevent reinvasion better than bunch grasses like crested wheatgrass.

If the Russian knapweed stand is not too old and grasses are still present, stimulating grass growth by irrigation (where possible) should increase grass competition with knapweed and keep the weed under continual stress.

¹ Colorado State University Extension weed specialist and professor, bioagricultural sciences and pest management. 9/98. Revised 3/03.

APPENDIX B – DEFENSIBLE ZONES/FIRE RESISTANT LANDSCAPING

RESOURCES SERIES



FORESTRY

Creating Wildfire-Defensible Zones no. 6.302

by F.C. Dennis¹

Quick Facts...

Wildfire will find the weakest links in the defense measures you have taken on your property.

The primary determinants of a home's ability to survive wildfire are its roofing material and the quality of the "defensible space" surrounding it.

Even small steps to protect your home and property will make them more able to withstand fire.

Consider these measures for all areas of your property, not just the immediate vicinity of the house.

Fire is capricious. It can find the weak link in your home's fire protection scheme and gain the upper hand because of a small, overlooked or seemingly inconsequential factor. While you may not be able to accomplish all measures below, each will increase your home's, and possibly your family's, safety.

Start with the easiest and least expensive actions. Begin your work closest to your house and move outward. Keep working on the more difficult items until you have completed your entire project.

Defensible Space

Two factors have emerged as the primary determinants of a home's ability to survive wildfire. These are the home's roofing material and the quality of the "defensible space" surrounding it.

Use fire-resistive materials (Class C or better rating), not wood or shake shingles, to roof homes in or near forests and grasslands. When your roof needs significant repairs or replacement, do so with a fire-resistant roofing material. Check with your county building department. Some counties now restrict wood roofs or require specific classifications of roofing material.

Defensible space is an area around a structure where fuels and vegetation are treated, cleared or reduced to slow the spread of wildfire towards the structure. It also reduces the chance of a structure fire moving from the building to the surrounding forest. Defensible space provides *room for firefighters to do their jobs*. Your house is more likely to withstand a wildfire if grasses, brush, trees and other common forest fuels are managed to reduce a fire's intensity.

Creating an effective defensible space involves developing a series of management zones in which different treatment techniques are used. See Figure 1 for a general view of the relationships among these management zones. Develop defensible space around each building on your property. Include detached garages, storage buildings, barns and other structures in your plan.

The actual design and development of your defensible space depends on several factors: size and shape of buildings, materials used in their construction, the slope of the ground on which the structures are built, surrounding topography, and sizes and types of vegetation on your property. These factors all affect your design. You may want to request additional guidance from your local Colorado State Forest Service (CSFS) forester or fire department.

Defensible Space Management Zones

Zone 1 is the area of maximum modification and treatment. It consists of an area of 15 feet around the structure in which all flammable vegetation is removed. This 15 feet is measured from the outside edge of the home's eaves and any attached structures, such as decks.

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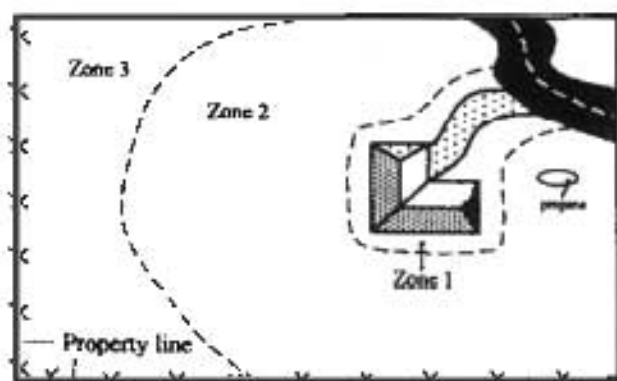


Figure 1 Forested property showing the three fire-defensible zones around a home or other structure.

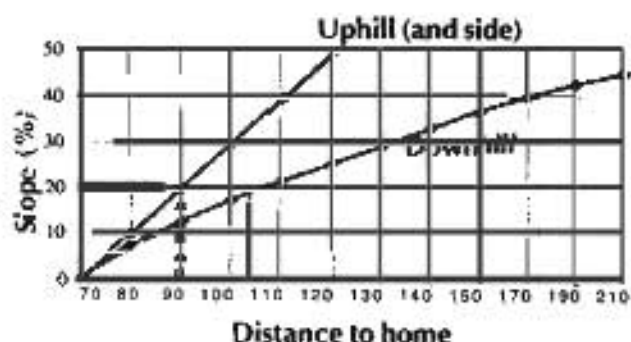


Figure 2: This chart indicates the minimum dimensions for defensible space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum defensible space dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill from the home.

Zone 2 is an area of fuel reduction. It is a transitional area between Zones 1 and 3. The size of Zone 2 depends on the slope of the ground where the structure is built. Typically, the defensible space should extend at least 75 to 125 feet from the structure. See Figure 2 for the appropriate distance for your home's defensible space. Within this zone, the continuity and arrangement of vegetation is modified. Remove stressed, diseased, dead or dying trees and shrubs. Thin and prune the remaining larger trees and shrubs. Be sure to extend thinning along either side of your driveway all the way to your main access road. These actions help eliminate the continuous fuel surrounding a structure while enhancing home-site safety and the aesthetics of the property.

Zone 3 is an area of traditional forest management and is of no particular size. It extends from the edge of your defensible space to your property boundaries.

Prescriptions

Zone 1

The size of Zone 1 is 15 feet, measured from the edges of the structure. Within this zone, several specific treatments are recommended.

Plant nothing within 3 to 5 feet of the structure, particularly if the building is sided with wood, logs or other flammable materials. Decorative rock creates an attractive, easily maintained, nonflammable ground cover.

If the house has noncombustible siding, widely spaced foundation plantings of low growing shrubs or other "fire wise" plants are acceptable. Do not plant directly beneath windows or next to foundation vents. Be sure there are no areas of continuous grass adjacent to plantings in this area.

Frequently prune and maintain plants in this zone to ensure vigorous growth and a low growth habit. Remove dead branches, stems and leaves.

Do not store firewood or other combustible materials in this area.

Enclose or screen decks with metal screening. Extend the gravel coverage under the decks. Do not use areas under decks for storage.

Ideally, remove all trees from Zone 1 to reduce fire hazards. If you do keep a tree, consider it part of the structure and extend the distance of the entire defensible space accordingly. Isolate the tree from any other surrounding trees. Prune it to at least 10 feet above the ground. Remove any branches that interfere with the roof or are within 10 feet of the chimney. Remove all "ladder fuels" from beneath the tree. (Ladder fuels are small shrubs, trees, tree limbs and other materials that allow fire to climb into the tree crown—the branches and foliage.)

Zone 2

Zone 2 is an area of fuel reduction designed to reduce the intensity of any fire approaching your home. Follow these recommended management steps.

Thin trees and large shrubs so there is at least 10 feet between crowns.

Crown separation is measured from the furthest branch of one tree to the nearest branch on the next tree (Figure 3). On steep slopes, allow more space between tree crowns. Remove all ladder fuels from under these remaining trees. Carefully prune trees to a height of 10 feet.

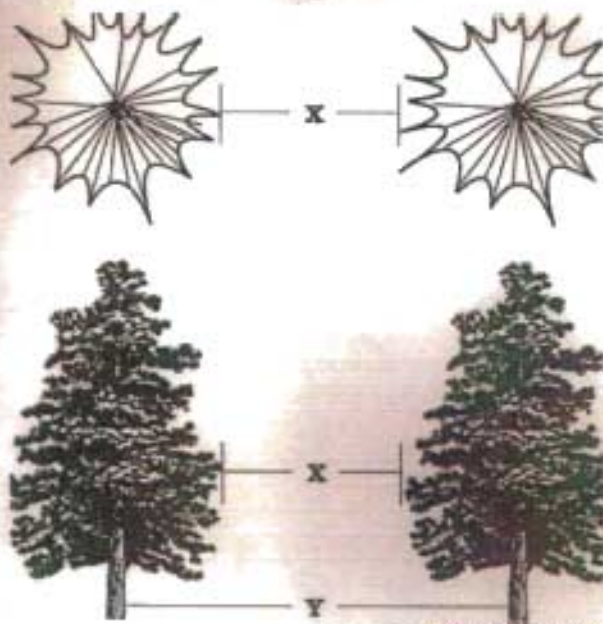


Figure 3: X = crown spacing; Y = stem spacing. Do not measure between stems for crown — measure between the edges of tree crowns.

References

Colorado State Forest Service, Colorado State University, Fort Collins, CO 80523-5060; (970) 491-6303.

- FireWise Construction — Design and Materials
- Home Fire Protection in the Wildland Urban Interface
- Wildfire Protection in the Wildland Urban Interface
- Landowner Guide to Thinning

From Colorado State University Cooperative Extension, 115 General Services Bldg., Fort Collins, CO 80523-4061; (970) 491-6198; Fax (970) 491-2961; E-mail cerc@vines.colostate.edu

- 6.303. Fire-Resistant Landscaping
- 6.304. Forest Home Fire Safety
- 6.305. FireWise Plant Materials
- 6.306. Grass Seed Mixes to Reduce Wildfire Hazard
- 7.205. Pruning Evergreens
- 7.206. Pruning Shrubs
- 7.207. Pruning Deciduous Trees

Because Zone 2 forms an aesthetic buffer and provides a transition between zones, it is necessary to blend the requirements for Zones 1 and 3. Thin the inner portions of Zone 2 more heavily than the outer portions. Gradually increase tree density as you approach Zone 3.

Isolated shrubs may remain, provided they are not under tree crowns. Prune and maintain these plants periodically to maintain vigorous growth. Remove dead stems from trees and shrubs annually.

Limit the number of dead trees (snags) retained in this area. Wildlife need only one or two snags per acre. Be sure any snags left for wildlife cannot fall onto the house or block access roads or driveways.

Mow grasses (or remove them with a weed trimmer) as needed through the growing season to keep them low, a maximum of 6 to 8 inches. This is extremely critical in the fall when grasses dry out and cure or in the spring after the snow is gone but before the plants green up.

Stack firewood and woodpiles uphill or on the same elevation as the structure but at least 30 feet away. Clear and keep away flammable vegetation within 10 feet of these woodpiles. Do not stack wood against your house or on or under your deck, even in winter. Many homes have burned from a woodpile that ignited as the fire passed. Wildfires can burn at almost any time in Colorado.

Locate propane tanks at least 30 feet from any structures, preferably on the same elevation as the house. You don't want the LP container below your house — if it ignites, the fire would tend to burn uphill. On the other hand, if the tank is above your house and it develops a leak, LP gas will flow downhill into your home. Clear and keep away flammable vegetation within 10 feet of these tanks. Do not screen propane tanks with shrubs or vegetation.

Dispose of slash (limbs, branches and other woody debris) removed from your trees and shrubs through chipping or by piling and burning. Contact your local CSFS office or county sheriff's office for information about burning slash piles. Only if neither of these alternatives is possible, lop and scatter slash by cutting it into very small pieces and distributing it over the ground. Avoid heavy accumulations of slash. Make it lay close to the ground to speed decomposition. If desired, no more than two or three small, widely spaced brush piles may be left for wildlife purposes. Locate these towards the outer portions of your defensible space.

Zone 3

This zone is of no specified size. It extends from the edge of your defensible space to your property lines. In this area, you are encouraged to manage your forests in a more traditional manner. Typical management objectives for areas surrounding homesites or subdivisions are: provide optimum recreational opportunities; enhance aesthetics; maintain tree health and vigor; provide barriers for wind, noise, dust and visual intrusions; support limited production of firewood, fence posts and other forest commodities; or grow Christmas trees or trees for transplanting.

Specific thinning requirements will be dictated by your objectives for your land. However, most thinning will be done from below (leaving the biggest and best trees) and on an individual tree basis.

Thinnings sanitize and improve the forest stand by removing trees that are damaged, attacked by insects, infected by disease, or are of poor form or low vigor.



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Tree spacing usually depends on the species being managed and factors such as susceptibility to windthrow or damage from heavy snow loading. For ponderosa pine and Douglas-fir, a good rule of thumb for stem spacing is diameter + 7. For lodgepole pine and Engelmann spruce, the stem spacing guide is diameter + 5. Measure diameter in inches at about 4 1/2 feet above the ground. Substitute feet for inches and add it to the spacing guide number for the proper species. For example, if the average tree to be left following your thinning was an 8-inch ponderosa pine, then use the formula $8 + 7 = 15$, for a spacing of 15 feet between trees as measured between tree stems. See Figure 3.

A greater number of wildlife trees can remain in Zone 3. Make sure that dead trees pose no threat to power lines or fire access roads.

While pruning generally is not necessary in Zone 3, it may be a good idea from the standpoint of personal safety to prune trees along trails and fire access roads. Or, if you prefer the aesthetics of a well-manicured forest, you might prune the entire area. In any case, pruning helps reduce ladder fuels within the tree stand, thus enhancing wildfire safety.

Mowing is not necessary in Zone 3.

Any approved method of slash treatment is acceptable for this zone, including piling and burning, chipping or lop-and-scatter.

Maintaining Your Defensible Space

Your home is located in a forest that is dynamic, always changing. Trees and shrubs continue to grow, plants die or are damaged, new plants begin to grow, and plants drop their leaves and needles. Like other parts of your home, defensible space requires maintenance. Use the following checklist each year to determine if additional work or maintenance is necessary.

Defensible Space and FireWise Annual Checklist

- Trees and shrubs are properly thinned and pruned within the defensible space. Slash from the thinning is disposed of.
- Roof and gutters are clear of debris.
- Branches overhanging the roof and chimney are removed.
- Chimney screens are in place and in good condition.
- Grass and weeds are mowed to a low height.
- An outdoor water supply is available, complete with a hose and nozzle that can reach all parts of the house.
- Fire extinguishers are checked and in working condition.
- The driveway is wide enough. The clearance of trees and branches is adequate for fire and emergency equipment. (Check with your local fire department.)
- Road signs and your name and house number are posted and easily visible.
- There is an easily accessible tool storage area with rakes, hoes, axes and shovels for use in case of fire.
- You have practiced family fire drills and your fire evacuation plan.
- Your escape routes, meeting points and other details are known and understood by all family members.
- Attic, roof, eaves and foundation vents are screened and in good condition. Silt foundations and decks are enclosed, screened or walled up.
- Trash and debris accumulations are removed from the defensible space.
- A checklist for fire safety needs inside the home also has been completed. This is available from your local fire department.

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FORESTRY

Fire-Resistant Landscaping

no. 6.303

by F.C. Dennis¹

Quick Facts...

More people are moving into Colorado's rural areas, increasing the chances of wildfire.

"Defensible space" is the primary determinant of a structure's ability to survive wildfire.

Native species are generally the best plant materials for landscaping in defensible space, but others can be grown successfully in Colorado.

To be a FireWise homeowner, plan well, plant well and maintain well.

Colorado's population is growing, its urban areas are rapidly expanding, and people are building more homes in what was once natural forest and brushlands. Newcomers to rural areas need to know how to correctly landscape their property to reduce wildfire hazards.

Improper landscaping worries land managers and fire officials because it can greatly increase the risk of structure and property damage from wildfire. It is a question of *when*, not *if*, a wildfire will strike any particular area.

Vegetative clearance around the house (defensible space) is a primary determinant of a home's ability to survive wildfire. Defensible space is, simply, room for firefighters to do their job. If grasses, brush, trees and other common forest fuels are removed, reduced, or modified to lessen a fire's intensity and keep it away from the home, chances increase that the structure will survive. It is a little-known fact that in the absence of a defensible space, firefighters will often bypass a house, choosing to make their stand at a home where their safety is more assured and the chance to successfully protect the structure is greater.

Landscaping Defensible Space

People often resist creating defensible space because they believe that it will be unattractive, unnatural and sterile-looking. It doesn't have to be! Wise landowners carefully plan landscaping within the defensible space. This effort yields a many-fold return of beauty, enjoyment and added property value. Development of defensible space is outlined in fact sheet 6.302, *Creating Wildfire-Defensible Zones*.

Colorado has great diversity in climate, geology and vegetation. Home and cabin sites can be found from the foothills through 10,000-foot elevations. Such extremes present a challenge in recommending plants. While native plant materials generally are best, a wide range of species can be grown successfully in Colorado.

Many plant species are suitable for landscaping in defensible space. Use restraint and common sense, and pay attention to plant arrangement and maintenance. It has often been said that *how* and *where* you plant are more important than *what* you plant. While this is indeed true, given a choice among plants, choose those that are more resistant to wildfire.

Consider the following factors when planning, designing and planting the FireWise landscape within your home's defensible space:

- Landscape according to the recommended defensible space zones. That is, the plants near your home should be more widely spaced and lower growing than those farther away.
- Do not plant in large masses. Instead, plant in small, irregular clusters or islands.

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The best tree species to plant generally are those naturally occurring on or near the site

Mow grass short around shrubs.

Plant low-growing, nonresinous shrubs near structures.

Keep grass mown around structures to a maximum of 8 inches.

Plant wildflowers near structures only if they are well irrigated and cut back during the dormant season.

Gravel area or mow grass short next to the structure.

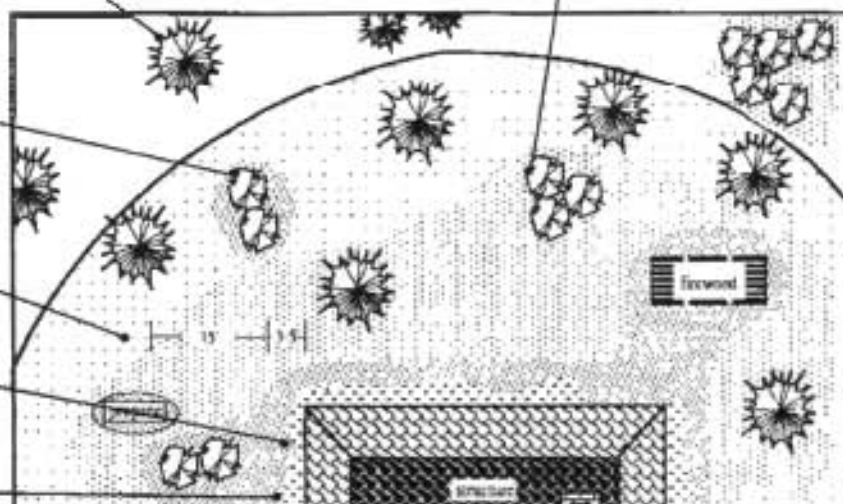


Figure 1: Forested property surrounding a homesite: shows optimum placement of vegetation near the structure.

- Use decorative rock, gravel and stepping stone pathways to break up the continuity of the vegetation and fuels. This can modify fire behavior and slow the spread of fire across your property.
- Incorporate a diversity of plant types and species in your landscape. Not only will this be visually satisfying, but it should help keep pests and diseases from causing problems within the whole landscape.
- In the event of drought and water rationing, prioritize plants to be saved. Provide available supplemental water to plants closest to your house.
- Use mulches to conserve moisture and reduce weed growth. Mulch can be organic or inorganic. Do not use pine bark, thick layers of pine needles or other mulches that readily carry fire.
- Be creative! Further vary your landscape by including bulbs, garden art and containers for added color.

References

- 6.302. Creating Wild-Fire Defensible Zones
- 6.304. Forest Home Fire Safety
- 6.305. FireWise Plant Materials
- 6.306. Grass Seed Mixes to Reduce Wildfire Hazard
- 7.205. Pruning Evergreens
- 7.206. Pruning Shrubs
- 7.207. Pruning Deciduous Trees
- 7.233. Wildflowers for Colorado
- 7.406. Flowers for Mountain Communities
- 7.407. Shrubs for Mountain Communities
- 7.408. Trees for Mountain Communities
- 7.413. Ground Covers for Mountain Communities

Grasses

During much of the year, grasses ignite easily and burn rapidly. Tall grass will quickly carry fire to your house. Mow grasses low in the inner zones of the defensible space. Keep them short closest to the house and gradually increase height outward from the house, to a maximum of 8 inches. This is particularly important during fall, winter and before green up in early spring, when grasses are dry, dormant and in a "cured" fuel condition. Given Colorado's extremely variable weather, wildfires can occur any time of the year. Maintenance of the grassy areas around your home is critical.

Mow grasses low around the garage, outbuildings, decks, firewood piles, propane tanks, shrubs, and specimen trees with low-growing branches.

Ground Cover Plants

Replace bare, weedy or unsightly patches near your home with ground covers, rock gardens, vegetable gardens and mulches. Ground cover plants are a good alternative to grass for parts of your defensible space. They break up the monotony of grass and enhance the beauty of your landscape. They provide a



Figure 2: Ladder fuels enable fire to travel from the ground surface into shrubs and then into the tree canopy

Structural Elements of a FireWise Landscape

When building a deck or patio, use concrete, flagstone or rock instead of wood. These materials do not burn and do not collect flammable debris like the space between planks in wooden decking.

Where appropriate on steeper ground, use retaining walls to reduce the steepness of the slope. This, in turn, reduces the rate of fire spread. Retaining walls also act as physical barriers to fire spread and help deflect heat from the fire upwards and away from structures.

Rock or masonry walls are best, but even wooden tie walls constructed of heavy timbers will work. Put out any fires burning on tie walls after the main fire front passes.

On steep slopes, consider building steps and walkways around structures. This makes access easier for home maintenance and enjoyment. It also serves as a physical barrier to fire spread and increases firefighters' speed and safety as they work to defend your home.

variety of textures and color and help reduce soil erosion. Consider ground cover plants for areas where access for mowing or other maintenance is difficult, on steep slopes and on hot, dry exposures.

Ground cover plants are usually low growing. They are succulent or have other FireWise characteristics that make them useful, functional and attractive. When planted in beds surrounded by

walkways and paths, in raised beds or as part of a rock garden, they become an effective barrier to fire spread. The ideal groundcover plant is one which will spread, forming a dense mat of roots and foliage that reduces soil erosion and excludes weeds.

Mulch helps control erosion, conserve moisture and reduce weed growth. It can be organic (compost, leaf mold, bark chips, shredded leaves) or it can be inorganic (gravel, rock, decomposing granite).

When using organic mulches, use just enough to reduce weed and grass growth. Avoid thick layers. When exposed to fire, they tend to smolder and are difficult to extinguish. Likewise, while your property might yield an abundance of needles from your native pines or other conifers, don't use them as mulch because they can readily catch and spread wildfire. Rake, gather and dispose of them often within your defensible space.

Wildflowers

Wildflowers bring variety to a landscape and provide color from May until frost. Wildflower beds give a softer, more natural appearance to the otherwise manicured look often resulting from defensible space development.

A concern with wildflowers is the tall, dense areas of available fuel they can form, especially in dormancy. To reduce fire hazard, plant wildflowers in widely separated beds within the defensible space. Do not plant them next to structures unless the beds are frequently watered and weeded and vegetation is promptly removed after the first hard frost. Use gravel walkways, rock retaining walls or irrigated grass areas mowed to a low height to isolate wildflower beds from each other and from other fuels.

Shrubs

Shrubs lend color and variety to the landscape and provide cover and food for wildlife. However, shrubs concern fire professionals because, as the next level in the "fuel continuum," they can add significantly to total fuel loading. Because of the woody material in their stems and branches, they are a potential source of fire brands. When carried in the smoke column ahead of the main fire, fire brands can rapidly spread the fire in a phenomenon known as "spotting."

But the primary concern with shrubs is that they are a "ladder fuel" - they can carry a relatively easy-to-control surface grass fire into tree crowns. Crown fires are difficult, sometimes impossible, to control (see Figure 2).

To reduce the fire-spreading potential of shrubs, plant only widely separated, low-growing, nonresinous varieties close to structures. Do not plant them directly beneath windows or vents or where they might spread under wooden decks. Do not plant shrubs under tree crowns or use them to screen propane tanks, firewood piles or other flammable materials. Plant shrubs individually, as specimens, or in small clumps apart from each other and away from any trees within the defensible space.

Mow grasses low around shrubs. Prune dead stems from shrubs annually. Remove the lower branches and suckers from species such as Gambel oak to raise the canopy away from possible surface fires.



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Trees

Trees provide a large amount of available fuel for a fire and can be a significant source of fire brands if they do burn. Radiant heat from burning trees can ignite nearby shrubs, trees and structures.

Colorado's elevation and temperature extremes limit tree selection. The best species to plant generally are those already growing on or near the site. Others may be planted with careful selection and common sense.

If your site receives enough moisture to grow them, plant deciduous trees such as aspen or narrow-leaf cottonwood. These species, even when planted in dense clumps, generally do not burn well, if at all. The greatest problem with these trees is the accumulation of dead leaves in the fall. Remove accumulations close to structures as soon as possible after leaf drop.

When site or available moisture limits recommended species to evergreens, carefully plan their placement. Do not plant trees near structures. Leave plenty of room between trees to allow for their growth. Spacing within the defensible space should be at least 10 feet between the edges of tree crowns. On steep ground, allow even more space between crowns. Plant smaller trees initially on a 20- to 25-foot spacing to allow for tree growth. At some point, you will have to thin your trees to retain proper spacing.

As the trees grow, prune branches to a height of 10 feet above the ground. Do not overprune the crowns. A good rule of thumb is to remove no more than one-third of the live crown of the tree when pruning. Prune existing trees as well as ones you planted.

Some trees (for example, Colorado blue spruce) tend to keep a full crown. Other trees grown in the open may also exhibit a full growth habit. Limit the number of trees of this type within the defensible space. Prune others as described above and mow grasses around such specimen trees.

Maintenance

A landscape is a dynamic system that constantly grows and changes. Plants considered fire resistant and that have low fuel volumes can lose these characteristics over time. Your landscape, and the plants in it, must be maintained to retain their FireWise properties.

- ┐ Always keep a watchful eye towards reducing the fuel volumes available to fire. Be aware of the growth habits of the plants within your landscape and of the changes that occur throughout the seasons.
- ┐ Remove annuals and perennials after they have gone to seed or when the stems become overly dry.
- ┐ Rake up leaves and other litter as it builds up through the season.
- ┐ Mow or trim grasses to a low height within your defensible space. This is particularly important as grasses cure.
- ┐ Remove plant parts damaged by snow, wind, frost or other agents.
- ┐ Timely pruning is critical. Pruning not only reduces fuel volumes but also maintains healthier plants by producing more vigorous, succulent growth.
- ┐ Landscape maintenance is a critical part of your home's defense system. Even the best defensible space can be compromised through lack of maintenance. The old adage "An ounce of prevention is worth a pound of cure" applies here.

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Appendix C

Shaded Fuelbreaks

Fuel breaks are strategic wildfire control features that are used in areas of continuous vegetation. They provide an established break in the continuity of fuels and provide a safe place for wildland firefighters to make a stand against a rapidly spreading fire.

Shaded fuelbreaks are built in forested areas where tree crowns are so close that they will support a running crown fire. Research has shown that crown cover over forty percent can promote crown fires. As crown densities approach seventy percent crown fires are much more likely. Crown closure less than forty percent is needed to bring a running crown fire out of the trees and down to the ground.

Ground fuels are also important in fuelbreaks. The more dead and down woody material there is on the site the greater the fire intensity and difficulty in control.

To be effective a fuelbreak must be wide enough to reduce the fire spread and intensity enough to bring the fire out of the tree crowns and down to the ground. Width is dependent upon topography and tree heights. Ridgelines provide good opportunities for fire control. In general the flatter the terrain the wider the fuel break needs to be. Width tends to range from 300 feet to over 600 feet depending upon the mix of factors mentioned above.

A fuel break does not need to be a clear-cut swath through the forest. It can be effective as fire control feature and also maintain a pleasing appearance. Thinning trees in a random pattern that results in crown densities dropping to forty percent or less will provide both a good place to control advancing flames and be sensitive to visual concerns at the same time.

The table below shows how many trees it takes to get a forty percent crown closure. As crowns get larger there are fewer trees per acre.

Forty Percent Crown Closure

Crown Width	Sqft/Tree	# trees/Ac	Spacing
5	20	870	4
10	78	223	8
15	177	98	12
20	314	55	16
25	490	36	19
30	706	25	23.5

APPENDIX D

Discovering the Language of the Elements

An Introduction to learning about the elements of Earth, Water, Fire, Air, and Space in an experiential education setting

Discovering the Language of the Elements is an experiential education program designed to give students an appropriate introduction to the elements of earth, water, fire, air, and space. In this course, the following five points will be presented, and expanded upon:

- The elements are always present.
- When one element is present, all five are present.
- Each element can be a “gateway” to one’s own presence as well as to the other elements.
- There are many dimensions of expression of the elements, ranging from gross to subtle.
- The elements always exist in some sort of balance with each other, and that balance can change.

The course begins with the elements physically being introduced to the students. As part of the introduction, the students have the opportunity to explore the natures of the external elements through various outdoor activities utilizing awareness and acknowledgement techniques.

The program then encourages the students to develop a personal relationship with each of the elements, and in elemental combinations. Through direct element experience, this second segment of the program gives the student numerous opportunities to develop these elemental relationships, with emphasis on using all of the senses.

The third segment of the program offers the idea of “balancing” the elements to the students. Examples of this “balance” are presented from specific historic and modern cultures, which demonstrate elegant elemental integration. The students then have the opportunity, in both theory and practice, to balance the elements in activities such as solar building design, restoration forestry, leave-no-trace backpacking, river and stream stewardship, traveling, bouldering, kite flying, working with fire for ecological benefit, natural agriculture, music, herbal medicine, art, and tsa lung, a form of yoga from Tibet.