Creating prairie dog management plans

Humane World for Animals™

Formerly called the Humane Society of the United States and Humane Society International

Part three: Appendices and attachments

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Appendix 1: Non-lethal interventions

A1.1 Conflict prevention

Advanced planning can prevent human/prairie dog conflicts. Development plan should consider open space and prairie dog areas, including potential dispersal routes (see Part 2, Section 3.3 and 3.4). By analyzing dispersal routes (generally low-lying areas or drainages), land managers can predict where prairie dogs may appear in the future and have a plan in place either to prevent colonization with barriers or other non-lethal means, or to direct colonization to prairie dog-friendly areas. Prairie dogs avoid areas where they have no line of sight, so visual barriers such as fencing or tall vegetation can prevent colonization. On the flip side, manipulated grazing, mowing, or controlled burns can encourage prairie dog migration into open areas.

A 1.2 Vegetation strategies

Vegetation strategies are tools that consider how prairie dogs respond to the plants around them to achieve a desired management outcome. For example, vegetation can attract prairie dogs to certain areas, keep prairie dogs in or out of an area, or can be used as a prescriptive tool to restore the lands they occupy. Common vegetation strategies include grazing prescriptions, mowing, prescribed burning, vegetation barriers, and utilizing prairie dog resilient vegetation. Understanding how prairie dogs respond to certain vegetation conditions aids in a more efficient use of resources and provides pathways that repair prairie ecosystems and foster coexistence.

SITE ASSESSMENT AND VEGETATION

When assessing colonies, the observer must consider the interplay of prairie dogs within the overall landscape and evaluate how plants alter each situation. Prairie dogs are found in numerous circumstances where one vegetation protocol may not be applicable to others. Selecting appropriate vegetation prescriptions involves regional plant adaptations and evaluations of soils, moisture, existing weeds, availability of seeds, and the interplay of prairie dogs within the overall landscape.

Equally important is understanding that impacts on vegetation may differ among various prairie dog species (there are five species). For example, Gunnison's, white-tails and Utah prairie dogs hibernate where Mexican and black-tails do not; this may mean a diversity of vegetation will be needed year around for the latter two species. Also, unlike other prairie dog species, black-tails are naturally denser and prefer fewer obstructions than white-tails and Gunnison's prairie dogs that seem to exist within patches of taller plant communities. As black-tailed prairie dogs are generally more regionally abundant and most often encountered, vegetation strategies will focus more on the species in the document.

Additionally, black-tailed prairie dogs are generally more active year around with periodic bouts of torpor (winter and heat of the day in summer). This means ideal vegetation mixes are a diverse mix of plants that can be utilized throughout multiple seasons. Landscapes that lack plant diversity on prairie dog towns are more apt to become barren and windblown due to over utilization or single species (monoculture) of plants.

Equally important is understanding how prairie dogs naturally exist in each landscape. For example, prairie dogs are thought to overgraze an area because they cannot migrate to other areas. But prairie dogs are not migratory, nor do they behave like typical grazers (ungulates and livestock). Prairie dogs generally remain in the same area, even fixated burrow numbers, for very long periods of time. Scientific literature suggests decades to centuries of consistent occupancy! Prairie dogs are generally stationary animals, living within the same landscape for a long time; however, the area of occupancy can expand or contract relative to climate and precipitation and different vegetation responses. For example, during times when there is high precipitation and stronger tall plant response, colonies can contract, conversely when precipitation is lower, or in drought conditions, colonies can expand. In either case, areas occupied by prairie dogs alter vegetation and soils to unique islands of plant communities not typically found in tall grassy landscapes. They are ecologically important for other plant species that need increased photosynthesis and better soil porosity for survival.

In an ideal situation, vegetation for prairie dogs comprises an assortment of grasses, forbs (flowering plants), shrubs and succulents. Grasses should consist of several species each of cool and warm season varieties, forbes include prostate and dwarfs but may also include mid-height plants. Species that can Thrive and Disturbed soils and that aggressively spread through heavy seed production or rhizomes and stolons are good candidates for prairie dog colonies.

Tall and mid-height grasses are very efficient in suffocating smaller plants that do not withstand grassy competition. In some cases, prairie dogs are blamed for an onslaught of invasive plants that become evident once grass competition is removed. Invasive plants are mostly Eurasian varieties that were introduced into North American Landscapes therefore prairie dogs did not technically create the invasive weed problem, rather it is a cause of past land use practices.

For more information on site assessment and Colony analysis as a planning tool for prairie dog management, see Appendix 5: Analysis and Inventory Sheets.

EXAMPLE SCENARIOS AND PRESCRIPTIONS

Scenario 1: Prairie dogs occupy an area that has become increasingly wind blown and barren with little plant diversity.

Consider introducing plants that are resistant or resilient to prairie dog activities. This may include inter-seeding into plants stubble (to protect seeds from blowing away) and establishing seed banks into adjacent areas that are not occupied by prairie dogs. In severe cases, prairie dogs may need to be temporarily removed or it may be possible to introduce cover crops that prairie dogs avoid and interplant seeds. See Table 1 for examples of prairie dog resistant and resilient plants.

Scenario 2: Land managers want reductions in non-native grasses to restore prairie.

By clipping tall grasses and reducing their areas, prairie dogs may perform a service to remove grasses. But grass displacement should include replacement of plants resistant or resilient to prairie dog activities. In some cases, simply having prairie dogs remove these grasses will reveal an underlay of native plants just waiting for the opportunity to flourish. In other cases, inter-seeding is appropriate.

Plants within the grass stubble may be beneficial. See Table 1 for examples of prairie dog resistant and resilient plants.

Scenario 3: Land managers want to exclude prairie dogs from certain areas.

As prairie dogs are a prey species, they prefer high visibility. In this case, cessation of grazing, mowing or harvesting for several seasons may be enough for prairie dogs to move out on their own. However, they must be able to move to an area of comfort, simply make the right choice easy (low vegetation height) and the wrong choice hard (tall vegetation heights).

Living barriers can be highly effective and important for other wildlife species. Windbreaks, hedgerows and mixtures of tall forbs and a variety of tall warm and cool season grasses will provide better seasonable effectiveness as living barriers.

Other approaches in agricultural areas consist of creating a mosaic of plants within a horticulture field that focuses on plant heterogeneity in both species and heights. Techniques may include planting dense, tall crops next to prairie dog areas to discourage occupancy and growing a variety of different crops that vary in growth stages and harvest times. Inter-planting lower growing crops such as squash within taller plants allows for good harvest with less soil disturbance. By varying swaths of harvested plants with other native plants that are never harvested or tilled

Photographer/Organization REQUIRED

protects soils and discourages prairie dogs.

Scenario 4: Land managers want prairie dogs to expand into conservation areas.

Prairie dogs are known to follow grazers that reduce plant heights. This same type of idea can be duplicated by mechanical mowing and burning and intensive grazing prescriptions.

Scenario 5: Land managers want to restore prairie post plague event.

This is an opportune event to restore lands. Generous reseeding of plants could be a standard protocol for any natural areas. This includes removal of non-native weedy species that are not consumed by prairie dogs.

Scenario 6: Land managers want to reduce wildfire risk.

Prairie dogs are notorious for maintaining short vegetation and reducing fuels for wildfires. Conservation areas may want to consider how and where prairie dogs can strategically create firebreaks. Most county agricultural extension agents have lists of native fire-resistant plants that are also helpful for land use planners for any situation (urban and rural areas).

Scenario 7: Urban land use next to open space areas with prairie dogs.

Commercial or residential development next to open space, particularly with prairie dogs, may want to consider mitigations that reduce human conflicts and protect the sanctity of wildlands that will be significantly impacted by development. For example, abutting groomed parks, commercial and residential landscaping directly against a wildland area may invite conflicts. In these situations, hardscaping or working a buffer or transition into plan (parking lots, concrete, large cobble, flagstone or vegetation) could reduce conflicts. The addition of opaque fencing or modifications of existing fence can be helpful. Adding in vegetation barriers such as shrub rows and s mixture of tall grasses and forbs can be highly effective in reducing prairie dog occupancy.

Overlay zoning, a zone on top of existing zones, is a popular way for communities to have on board ways to mitigate or eliminate conflicts between urban development and wildlands. By having this proactive measure in place, developers and the public can create better planning and budgeting to exist with wild neighbors.

More on vegetation barriers

Continue to Section A1.3. Barriers and Attachment 2: An Overview of Barriers for more in-depth information and plant recommendations on how to utilize barriers and buffer zones as non-lethal intervention.

Plants resistant or resilient to prairie dogs

Plants that are resistant or resilient to prairie dogs share common traits: prickly, odiferous, milky, sticky, and low growing or prostrate. The list provided is only a snapshot of plants that coexist on prairie dog sites, hundreds of plants have been documented.

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Examples of Prairie Dog Resistant and/or Resilient Plant Species (compiled by P. Wanek).

Common name	Botanic name	Common name	Botanic name
American Vetch	*Vicia americana*	Rocky Mountain Penstemon	*Penstemon strictus*
Aster - Heath	*Symphyotrichum ericoides*	One-Sided Penstemon	*Penstemon secundiflorus*
Aster - Purple	*Machaeranthera tanacetifolia*	Palmer's Penstemon	*Penstemon palmeri*
Aster Hairy Goldenaster	*Heterotheca villosa*	Plains Vervain	*Glandularia bipinnatifida*
Bluebells	*Mertensia lanceolata*	Prairie Sage	*Artemisia ludoviciana*
Blue Flax "Maple Grove"	*Linum lewisii*	Prairie Violet	*Viola nuttallii*
Blue Grama	*Bouteloua gracilis*	Prickly Poppy	*Argemone polyanthemos*
Bracted Vervain	*Verbena bracteata*	Pricklypear Cactus	*Opuntia polyacantha*
Buffalograss	*Bouteloua dactyloides*	Primrose	*Primula spp.*
Butterfly Weed	*Asclepias tuberosa*	Primrose Pale Evening	*Oenothera pallida*
Clammyweed	*Polanisia dodecandra*	Purple Prairie Clover	*Dalea purpurea*
Curly Cup Gumweed	*Grindelia squarrosa*	Purple Three-awn	*Aristida purpurea*
Cut leaf Evening Primrose	*Oenothera laciniata*	Dwarf Rabbitbrush	*Chrysothamnus nauseosus*
Dandelion	*Taraxacum spp.*	Rayless Green Thread	*Thelesperma ambiguum*
Dotted Gayfeather	*Liatris punctata*	Rocky Mountain Beeplant	*Cleome serrulata*
Fescue six-weeks	*Vulpia octoflora*	Sand Lily	*Leucocrinum montanum*
Fetid Marigold	*Dyssodia papposa*	Scarlet Bee Blossum	*Oenothera suffrutescens*
Fleabane Spreading	*Erigeron divergens*	Scarlet Globemallow	*Sphaeralcea coccinea*
Four-wing Saltbush	*Atriplex canescens*	Sheep Fescue	*Festuca ovina*
Fringed Sagebrush	*Artemisia frigida*	Silver Lupine	*Lupinus argenteus*
Geranium	*Geranium spp.*	Snake Weed	*Gutierrezia sarothrae*
Goldenrod	*Solidago spp.*	Snow on the Mountain	*Euphorbia marginata*
Ground Cherry	*Quincula lobata*	Spreading Buckwheat	*Eriognum effusum*
Gumweed	*Grindelia squarrosa*	Stickseed	*Lappula spp.*
Hairy Golden Aster	*Heterotheca villosa*	Stiff Green Thread	*Thelesperma filifolium*
Heath Aster	*Virgulus falcatus*	Veiny Dock	*Rumex venosus*
Lanceleaf Blue Sage	*Salvia reflexa*	Velvety Goldenrod	*Solidao mollis*
Larkspur	*Delphinium occidentale*	Davis Mountain Mock Vervain	*Glandularia wrightii*
Showy Locoweed	*Oxytropis splendens*	Purple Hoary Vervain	*Verbena stricta*
Silver Lupine	*Lupinus argenteus*	Wedgeleaf Fogfruit	*Phyla cuneifolia*
Milkvetch	*Astragalus spp.*	Western Wheatgrass	*Pascopyrum smithii*
Milkvetch wooly	*Astragalus mollissimus*	Wild Parsely	*Musineon divarcatum*
Milkweed Plains	*Asclepias pumila*	Woods Rose	*Rosa woodsii*
Milkweed Showy	*Asclepias speciosa*	Wooly Plaintain	*Plantago patagonica*
Mock Vervain	*Glandulari wrightii*	Yarrow Lanulosa	*Achillea millefolium var. lanulosa*
Oppositeleaf False Bahia	*Picradeniopsis oppositifolia*		

A1.3 Barriers

Manmade and vegetative barriers can be useful to exclude prairie dogs from incompatible areas such as crops, multiple use lands, athletic fields, agricultural lands, residential and commercial areas, and trails. Be effective, barriers should provide both a physical and visual deterrent.

Key points for manmade barriers:

- Final placement should avoid splitting prairie dog family units (if absolutely necessary, the entire family unit should be relocated; see below)
- Minimum height should be three feet
- The more solid of a material or visual the barrier is, the better it will perform. Consider something opaque.
- Candidate materials include metal sheeting, PVC, wooden privacy fence, brick or rock walls. Wood slat snow fence and chain-link fence can be used with modifications. Woven electric fence and electric fence with poultry wire have promise in certain situations. Temporary barriers include solid black silt fence (very short life) or vinyl (longer life depending on installation)
- May or may not be buried into the ground. If the barrier is not buried, consider backfilling rock or soil against the bottom of the barrier to discourage light from passing beneath it
- Should include a burrowing and tunneling preventative, such as four-foot-wide, one-inch netting poultry wire anchored on top of the ground with sample six-inch sod pins, directly abutting the prairie dog side of the barrier
- Hardscaping with decorative pavers, four- to six-inch cobble or riprap as effective substrate and parking lot medians, next to walkways, a long exterior building foundations or in seating areas
- Barriers, like fences, must be maintained

Key points for vegetative barriers (grasses and shrubs):

- Effective when manmade barriers are impractical. For example, along field fence or large landscapes and open space and rural areas
- Create plant mosaics (varying plants with different growth cycles)
- Can be used in agricultural settings with crops that are directly adjacent to colonies. Plants that are dense and tall (crops such as barley, corn, winter wheat) are good candidates
- Can be used in open range settings with mixed and tall height grasses, woody vegetation, rushes and sedges as buffers zones

For detailed descriptions and examples of what does and does not work for both artificial and vegetation barriers, see “Attachment 1: Prairie Dog Barriers Overview.”

A1.4 Birth control

Two contraceptive products have been experimentally tested on black-tailed prairie dogs: DiazaCon and GonaCon™.

DiazaCon, an oral contraceptive carried in bait, works by inhibiting the cholesterol production needed to produce sex hormones. In a small study, the number of pups born was reduced by 95.5% and the contraceptive worked for one breeding season. Primary exposure to non-target species may occur if the baits are directly consumed, and secondary exposure to non-targets might occur if a prairie dog was consumed. More research will be needed before this product becomes readily available (Yoder et al., 2016). DiazaCon is not presently registered by the Environmental Protection Agency (EPA). If approved, it will be registered as a restricted use chemical that may only be applied by qualified individuals or agencies (USDA, 2010).

GonaCon™ is a vaccine that prevents the formation of GnRH, a sex hormone, for more than one year. As GonaCon™ is a vaccine, primary non-target species exposure would not occur, and if a vaccinated prairie dog was consumed the vaccine would quickly degrade. This disadvantage is that individual prairie dogs must be captured to administer the vaccine (Yoder et al., 2010). GonaCon™ is currently registered by the EPA as a restricted chemical and may only be used by USDA Wildlife Services or state wildlife agencies, or individuals working under their authority (USDA, 2010).

Using population modeling, Yoder et al. (2008) evaluated four different scenarios: no control, lethal control, fertility control, and a combination of lethal control and fertility control using GonaCon™ for black-tailed prairie dogs. To summarize their results:

1. Population models are predictions based upon the best available information and may not be applicable at large scales.
2. Modeled populations that were subject to culling (lethal control) of 50-99% of the total colony went extinct more quickly than populations that received contraceptives applied at the same levels.
3. Populations could be stabilized at their current size with 12.79% yearly culling **or** 33.25% yearly contraception.
4. Populations remained relatively stable over 100 years when 50% of the population was culled initially, followed by 85.8% contraception once every three years.

A1.5 Passive relocation

Passive relocation is a process that manipulates the habitat of prairie dogs, causing them to move out of disputed areas without handling the animal. This method can involve several approaches such as grazing and mowing management, irrigation or direct manipulation of each burrow (Reverse Dispersal Translocation™, or RDT). Passive relocation Can Be an Effective tool especially if only a portion or edge of the colony needs to be moved, reduced into a smaller area or pushed out of the way for ground disturbance. One main requirement for the success of passive relocation is that burrows must be available within a reasonable distance of the RDT site to receive the prairie dogs that are moving. The process should ideally be performed when populations are lower thereby reducing conflicts amongst individuals competing for limited natural resources (burrows, vegetation, etc.). For a detailed description of the RDT methodology, see "Attachment 2: Reverse Dispersal Translocation™ (RDT)."

A1.6 Active relocation or translocation

Active relocation is the physical removal of prairie dogs from one area (the take site) and transferal of the animals to another area (the receiving site). The term translocation is commonly used when a colony is being relocated into an area with prairie dog conservation goals on the landscape scale (i.e.: creating a complex of colonies for associated species). Relocation may be undertaken to save animals from imminent death or habitat destruction, to reestablish colonies that have succumbed to plague, or to expand large-scale conservation areas. Translocation or population argumentation of a complex of colonies is an acceptable conservation approach to reduce prairie dogs and conflict areas.

Because prairie dogs are physically handled during the relocation process, Wildlife agencies may require an intra- or inter-state permit. The permitting process may take anywhere from weeks to months, even years, depending on the species of prairie dog and the laws of individual states and local governments. Various factors are considered during the permitting process, such as whether the new receiving site is adequate for release and what mitigation tactics can be employed if there are conflicts with adjacent landowners.

Relocations should use well-thought-out strategies to maximize success and ensure that prairie dogs acclimate quickly to a receiving site. Prairie dogs should never be "dumped" into an open area. The main steps to a translocation include obtaining proper permits, evaluation and preparation of take and release sites, capture and release of prairie dogs and monitoring their acclimation to the new site. For more information, see Part 2, section 3.7 or the Humane Society of the United States' Black-tailed Prairie Dog Translocation Manual. For relocation best practices, see the City of Boulder's prairie dog working group Phase I and Phase II recommendations and IUCN Guidelines for reintroductions and other conservation translocations.

A1.6.1 Relocation best practices

The following are best practices to ensure a positive outcome from prairie dog relocations. Only trained professionals should attempt to relocate prairie dogs; these guidelines are provided to give a sense of what to expect from a relocator.

Relocate at the appropriate time of year. Populations moved in early spring and early summer may contain a high number of juveniles that would not have survived even if they were not relocated. Approximately 50% of the juvenile population typically succumbs to natural mortality in undisturbed prairie dog colonies (Hoogland, 1995; Hoogland 2006). Therefore, relocations are best undertaken 2 to 3 months after first juvenile emergence. Eurasian forbs, a restoration strategy to reverse or at least mitigate undesirable plants and increase plant diversity should be considered.

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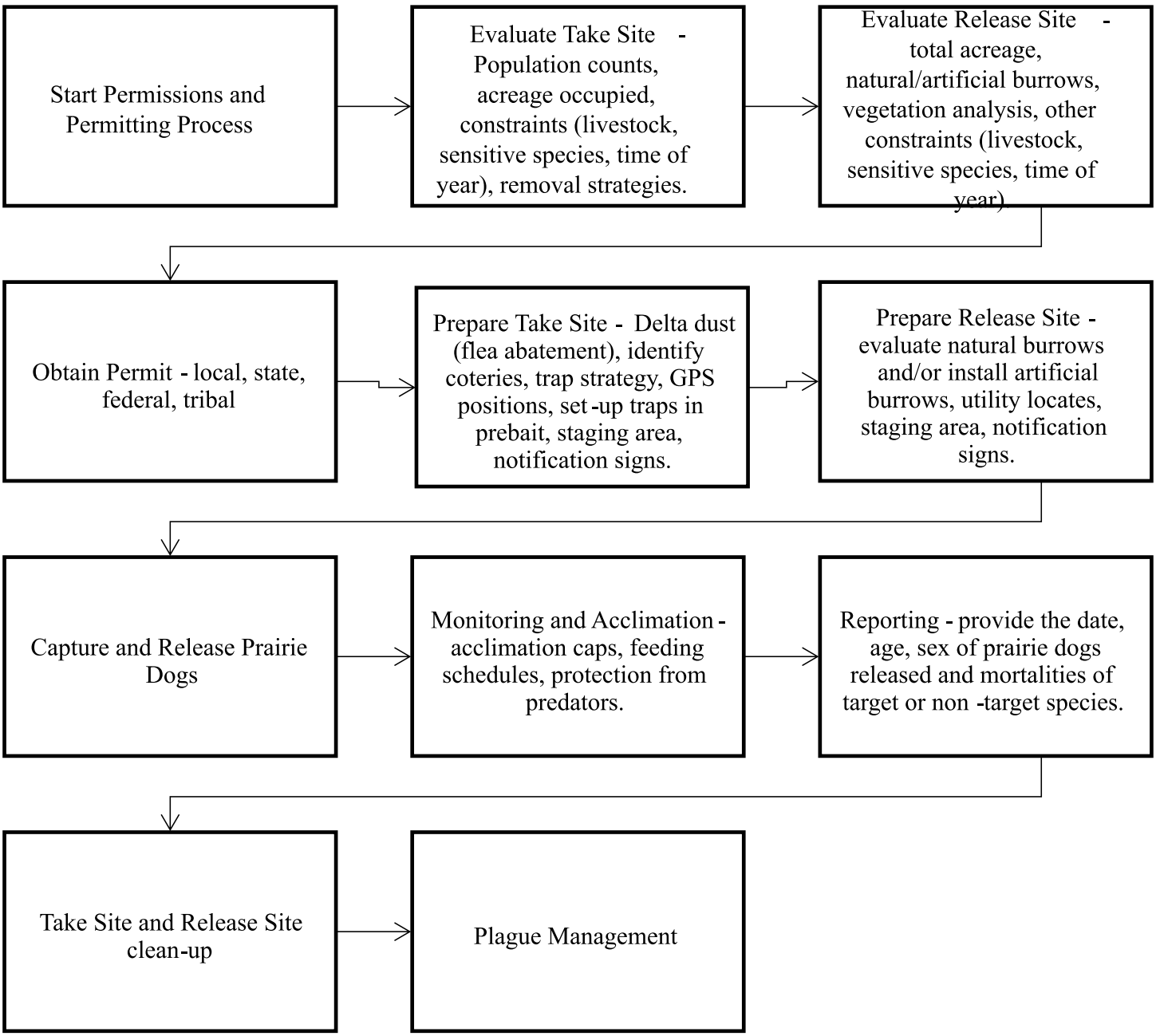
Translocation flow chart



1. Black-tailed prairie dogs should be moved with these timing conditions in mind:
    a. Birthing, weaning, and first juvenile emergence occurs March through June 1st and relocations are generally discouraged during that time. If possible, capture should be postponed until juveniles have been above-ground for at least six weeks (late June or early June for most colonies) (Long et al, 2006).
    b. Relocations are affected by seasonable conditions. Torpor (semi-hibernation) can occur in the winter, sometimes for weeks, and during hot summer days.
    c. The best relocation period is late August through mid-November, however, late fall and winter relocations should take into account the conditions of the receiving site; for example, sites with natural burrows may be more appropriate for winter relocations than sites that have no existing burrows, since the prairie dogs will not have to dig in frozen ground. Long et al. (2006) recommends cessation of capture by October in most latitudes.
2. Gunnison's, Utah, and white-tailed prairie dogs hibernate and therefore cannot be relocated year-round.
    a. Breeding occurs from mid-March to early April. Gestation lasts an average of 29 days, and the pups emerge above ground in June.
    b. Hibernation begins August/September and lasts through late February/early March.
    c. The best time for relocations is late June through late August.

Relocation is a multi-step process:

1. **Evaluation of the take (removal) site.** This generally involves three uninterrupted observations of the colony layout and a physical count of prairie dogs on separate days during the times that prairie dogs are most active (typically morning and before dusk). For best results, mapping of territorial family units (coteries) occurs at this time.
2. **Evaluation of receiving (release) site suitability.** This analysis reviews information about historical presence of prairie dogs, adequate vegetation, soil conditions, and slope gradient. Historical presence, whether one year or 200 years ago, is important because it is one of the best indicators of soil suitability. The site is further examined for evidence of existing intact burrows and whether artificial chambers will be required to accommodate all captured prairie dogs.
    a. Degraded vegetation may be a problem on some prairie dog sites. Where vegetation is very poor and predominantly comprised of introduced pasture grass monocultures and Eurasian forbs, a restoration strategy to reverse or at least mitigate undesirable plants and increase plant diversity should be considered.
    b. Human intervention may be required to control noxious weeds and reintroduce native grasses and forbs that are resilient or resistant to prairie dog grazing (see list at the end of Attachment 2). Prairie dogs do not necessarily need to be removed to restore damaged areas as they are known to survive on nonnative plant species and in some cases aid in the control of undesirable species by dead0heading weeds or exhausting nonnative grasses. In some cases, tall grasses may need to be mowed before prairie dogs are reintroduced.
3. **Preparing the take site.** All burrows are dusted with Delta Dust, family units are identified (flagged or staked) and traps are set in pre-bait (traps grained and left locked open). Pre-baiting may require one to two weeks depending on the behavior of prairie dogs around the traps and bait consumption patterns. Traps in pre-bait should be monitored every day. There should be ample traps laid out on the site to capture all individual animals.
4. **Preparing the receiving site.** In this stage, the receiving site is more thoroughly evaluated for suitable natural receiving burrows, and if needed, strategic placement of artificial chambers. Natural burrows should be a minimum of 2 to 3 feet long and approximately 4 inches in diameter. Some semi-degraded burrows can be reopened using a two-inch in diameter, two-foot-long bulb-planting bit on a hand drill (attempting to reopen burrows with larger equipment could destroy tunnel

systems). Most natural burrows initially accept two to three prairie dogs; larger burrows can accept more prairie dogs. Artificial chambers will be required if natural burrows are too degraded. An artificial chamber should be large enough for prairie dogs to sit up inside it and bring in nesting materials and structurally sound enough that it does not collapse under the weight of the soil or degrade in inclement weather. Using a backhoe or a ditch witch, the chamber is buried 4-feet below ground (or deeper depending on frost line) with two exit tubes that connect directly to the chamber and extend above ground (Figure 1).

a. Using an auger to create new burrows for receiving prairie dogs has been done with mixed success. Effectiveness is largely contingent upon the unique composition of soils on individual sites and the presence of a preexisting colony. If a preexisting colony includes the presence of burrows with some structural integrity (i.e., minimum 3' deep and 4" wide); prairie dogs can often open additional burrows with suitable time to dig them out. In these cases, releasing prairie dogs into augured burrows provides a starting point while they can re-excavate existing underground tunnel and burrow infrastructure and adopt the old burrows.
b. Some challenges associated with auguring new holes include maneuvering heavy equipment and drilling at a 45-degree angle (the recommended angle for artificial burrows), soil compaction at the end of the auger bit creating difficult digging conditions for prairie dogs, and a wide opening which allows predators to easily trap prairie dogs inside. With ingenuity, augured holes can be fitted with an acclimation cap for some protection from predators. Inclement weather may also present problems as rain can quickly fill augured holes causing flooding and rapid disintegration. Despite these issues, auguring should not be entirely dismissed, as it has been useful in select applications.

5. **Trapping**. Traps should be set when prairie dogs are the most active. Trapping must be avoided during very hot periods when temperatures exceed 80 degrees; heat stress can kill prairie dogs. Captured animals in traps are covered with a towel or sheet to reduce stress, and ideally released at the receiving site the same day or the next morning. Trap-shy prairie dogs may be flushed with soapy water. In some cases, the take site burrows are lightly covered with soil to locate active prairie dogs. If non-target animals (corvids, songbirds, and rabbits for example) are trapped, they should be released at the take site. Injured or sick target or non-target animals should be taken to a vet or licensed rehabilitator.
6. **Other important factors:**

Proper care of animals in captivity. In some cases, prairie dogs may need to be held overnight, several days, or longer. Holding facilities require special permitting and an onsite inspection by a state wildlife officer(s) who ensures the safety of the wild animals and their human caretakers. Wildlife officers have permission to enter the holding facility on a 24/7 basis. Care of prairie dogs should include:

- Adequate housing and shelter away from harsh weather or other potential conflicts (other animals, unnecessary noise)
- Separate housing for prairie dogs from different family units
- Containment so they cannot get loose or become injured inside the facility
- Daily fresh food (dry and wet sources)
- Daily freshened bedding
- Climate control
- Sickly or injured animals (very rare) should be immediately transported to a certified wildlife rehabilitator or veterinarian.

Transparency is important and restricting access at specific times is also necessary. In some cases, the public is very interested in the process and progress of the take and release sites but knowing who and when visitors are coming onto either site is important. This is to ensure that the public does not interfere during critical periods (trapping) or disturbing equipment. Trapping the first day can be hectic and is generally not an ideal time for disturbance by a large public viewing or media event. Moving prairie dogs is a lot of work and keeping animals as stress-free as possible is a priority.

Move prairie dogs as family units. Truett et al. (2001) suggests that regardless of the species, capture and

translocation of intact family units probably minimizes stress and post-release dispersal, and multiple relocators have reported prairie dogs' attempts to reestablish social unity at release sites. Prairie dogs should be placed into the release site in the same orientation they held at the take site. For example, prairie dogs on the northwest corner of the take site should be released in the northwest corner of the release site and so on.

Be conscious of predation risk. Raptors, coyotes, and badgers may rapidly prey upon newly relocated prairie dogs. Techniques to reduce predation risk include keeping acclimation caps over natural tunnel systems longer (though acclimation caps should not be kept over artificial burrows longer than 3 to 5 days) and mowing vegetation to increase predator visibility (Long et al., 2006) Wildlife managers have also trapped offending badgers and relocated them. In very remote areas, wildlife managers have camped on the receiving sites to haze off predators.

Release a sufficient number of prairie dogs. The suggested minimum is 60 to 100 individuals (Long et al., 2006). This is a cumulative total at the release site including individuals that were present before the introduction of new prairie dogs. Source populations do not necessarily need to come from one colony; prairie dogs can be removed from multiple colonies and relocated into the same area as long as family units are relocated intact, and they are not encroaching on existing prairie dog residents. Recall that colonies consist of multiple territorial family units.

Practice proactive plague abatement. Delta Dust (Deltamethrin) or other plague mitigation tools such as Fipronil or the Sylvatic Plague Vaccine should be used to pretreat fleas in prairie dog burrows at both take and release sites. On sites where colonies have succumbed to plague within the last year or two, prairie dog burrows may still be intact for reintroduction. Waiting too long post-plague may mean that artificial chambers need to be installed. While some managers may want to wait for one or two years for reintroduction post-plague, others (D. Biggins, pers. Comm., 6/3/12) think that waiting longer than two months post-plague is unnecessary. The main goal to mitigate for plague presence is to control the flea load. If fleas are managed via dusting with Deltamethrin or other tool and the newly relocated prairie dogs are pretreated, also with Deltamethrin, relocators and prairie dogs should be protected for a period of time. After treatment of burrows with Deltamethrin, prairie dogs were successfully reestablished in a colony that had succumbed to plague only several weeks earlier (Long et al., 2006).

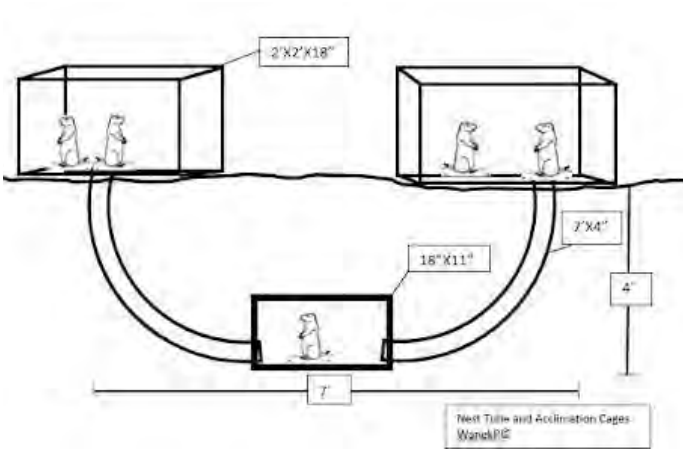
Use acclimation caps. In most cases, acclimation caps (used to help prairie dogs adjust to the new area while protecting them from predators) are fitted above ground over natural burrows or on extended nest chambers tubes (Figure 1). Animals in acclimation caps are checked and fed both dry and moist foods daily. Caps should not remain on artificial burrows more than 3 to 5 days. After acclimation caps are removed, prairie dogs from the same family group can be freely released into the same chamber without replacing the acclimation cap. It is a generally accepted practice that once the acclimation cap is removed it should not be reused on the same burrow if the chamber is still occupied by prairie dogs.

Take site analysis and set-up

The Take Site analysis involves reviewing a colony for the best approach in removal. This entails a review of colony history, timing of removal, understanding how prairie dogs occupy the landscape, vegetation, population estimates and constraints.

Sample case: Ten-acre Black-tailed Prairie Dog colony with 15-year occupancy history. Vegetation predominantly nonnative; but not a monoculture of plants with 50% cover, dryland. Relocation planned for late summer to early fall. Estimated 15 to 20 prairie dogs per acre or 150 to 200 animals.

Figure 1. Underground nest chambers connected with tubes to above-ground acclimation caps (Wanek, 2017)



This picture is a landscape perspective of how coteries might appear as misshapen polygons that can change throughout the year. Coteries are labeled from A through L for illustrative purposes.

Background: Coteries range in sizes of .12 to 2.5 acres averaging .80 acres. Average number of burrows per acre 60. Coterie family size ranges from 1 to 26 individuals with an average of 8 in the late summer: spring populations could be double or triple after first pup emergence (Hoogland, J. 2006). Spring relocations best avoided due to a higher population of animals (young-of-year) that may not survive, even in natural conditions.

Strategy: Understanding how prairie dogs occupy a landscape helps the relocator better estimate where prairie dogs are primarily located. A casual observer may see a colony as a moonscape with a lot of holes; but all holes have a purpose in a prairie dog town. As soils engineers, prairie dogs move massive amounts of soil to excavate tunnels as deep as 16 feet but averaging 6 feet that may connect underground to a network of above ground to burrows. Tunnels may lead to nursery chambers, sleeping quarters or pockets used for listening. Select burrows and tunnels are configured to move fresh air through tunnels. These are well maintained areas where most other burrows are only used as a quick escape from predators. Eyeing obvious trails, spoke-wheeled configurations and analysis of burrow types provides good clues about areas preferred by prairie dogs.

There are at least three burrow types observed on prairie dog colonies; dome, volcano and exit burrows. Dome mounds have tunnels that slant and may or may not connect to another underground tunnel. Volcano mounds have sharp vertical walls and exit burrows are flat with no soil mound but both types have almost directly vertical tunnels and always connect to underground tunnels.

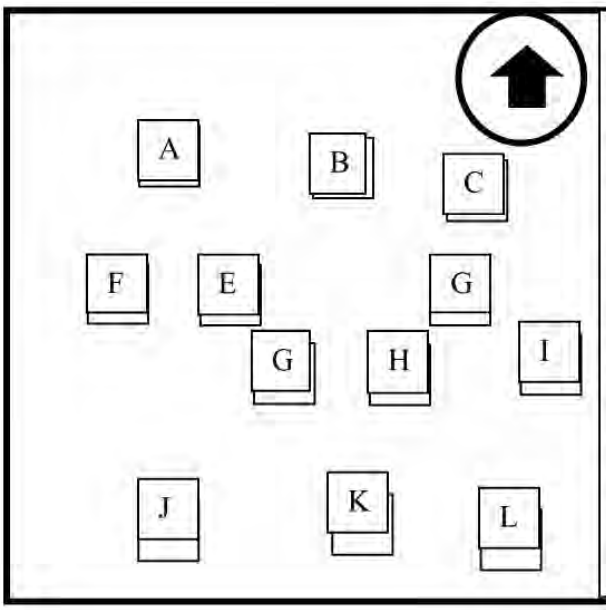
Locating these unique systems provides clues in finding whole family groups that can be trapped together all at once; members not trapped may be very difficult to capture later. Once identified, a wood stake with a unique number or letter (D) is placed into the ground. The traps are clustered, a method that groups 4, 6, 8 or more about 4-feet from the tunnel entrance around one burrow. Single coteries that occupy a larger land area may require multiple trap clusters (sub-bait stations), label D, D1, D2.

Once traps are in place, they are locked open and baited, known as “pre-bait” allowing animals to freely move in and out of traps for the “reward”. This is a good time to observe if the number of traps is sufficient to capture all coterie members. When prairie dogs are readily taking bait, the next step is to activate traps.

Release site analysis and set-up

Release sites are evaluated for adequate burrows, vegetation or any constraints that need to be addressed prior to releasing animals. As prey species, prairie dogs will immediately leave an area (flight) if they are stressed; hence, they must be acclimated to a site with adequate receiving burrows. If natural burrows are unavailable, then artificial chambers may need to be installed or auguring new tunnels may work well if soils are adequate and monsoon seasons have passed. Most release sites have insufficient burrow quantities, recall that on average there are 60 burrows per acre in an active town. Replicating this burrow quantity is potentially impossible which may mean higher predation and territorial disputes could occur after release. Prairie dogs need the best reasonable protection and providing them a safe burrow with supplemental feed helps maintain body fat and the energy needed to excavate a new prairie dog town. Additionally, relocators need to know that release burrows are safe and dependable. For example, a torrential downpour of rain would quickly damage augured burrows.

Vegetation can greatly influence how comfortable prairie dogs feel at a new site. If vegetation is above 12-inches, prairie dogs cannot see each other very well and predators can hide in the rough. In this case, mowing or intensive livestock grazing could be done first before reintroduction. Diverse vegetation is also important for providing prairie



The Release Area footprint is reduced to ½ the size of the Take Site. The minimum distance between coteries should be 60 or more feet. Distances between sub-bait stations within a single coterie should be 30 feet. If augmenting an existing active colony, 100 feet away.

This approach greatly simplifies translocation. The "A" coterie from the Take Site goes to the "A" area on the Release Site and so on.

Maintaining the original coterie positions within both Take and Release Sites help retain neighboring coteries together and can help a coterie member find its correct family if accidentally released into the wrong area.

dogs forage throughout the year. Sites that are primarily monocultures should evaluate a revegetation plan that includes an assortment of forbs.

Some sites have constraints that include sensitive species, predators, livestock, or human conflicts. Nesting birds, badgers, existing prairie dogs, livestock grazing and avoidance where neighboring properties are incompatible with prairie dogs should be addressed.

The Release Site footprint is where prairie dogs will be directly relocated, this differs from the total Release Site area which should be one-half to two-thirds larger. The purpose of reducing the Release Site footprint is to keep prairie dogs closer together so they can see, and hear other prairie dogs as safety in numbers, and to reduce the human footprint on grasslands.

Coterie placement at the Release Site footprint is best done by following the coterie mapping survey at the Take Site. Simply review the Take Site coteries (GPS unit is invaluable here) and set this down directly as a map for the Release Area footprint. Use wood stakes to identify release burrows; this stake will also be used to record releases (date, sex and age) in conjunction with a hard copy record.

A1.7 Augmentation

In some cases, there may be a need to augment existing colonies. This is most likely to occur on isolated colonies that are not expanding as expected. As with any colony that has a plague history, all active and inactive burrows should be dusted with insecticide. Even if the receiving colony succumbed five years prior, dust all burrows because many other rodent species—mice and voles that may be plague resistant—could still carry plague-infected fleas.

When augmenting post-plague sites that have active populations of prairie dogs present, new prairie dog transplants should be reintroduced 100 feet away from existing core active burrows. This same guideline is used if artificial chambers are installed. Artificial chambers are used as anchor points; once prairie dogs are free to roam, they will reestablish their own territories and open up old, degraded burrows and tunnel systems. If vacated burrows are being used, focus on periphery burrows, and use passive relocation techniques prior to population augmentation through relocation (see Attachment 2) to protect releasable burrows and help establish new territory.

Animals for augmentation can be brought in from different sites. If prairie dogs are being removed from a single source colony, but the goal is to retain the source colony, long et al. (2006) recommend removing no more than 25 percent of adults (at least one year old) and juveniles in late summer as a "sustainable harvest."

Photographer/Organization REQUIRED

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Appendix 2: Lethal control

A2.1 Overview

Lethal control of prairie dogs is the deliberate killing of these animals by humans. Prairie dog management plans should always require applying non-lethal techniques at the outset of a management issue, and the best non-lethal management is conflict prevention (Appendix 1). By predicting where conflicts with prairie dogs will occur in the future, managers can reduce or, ideally, eliminate lethal control. The organizations authoring this document do not support lethal control (Part 2, Section 3.8).

Most lethal control methods are not considered euthanasia. Euthanasia is generally understood to mean ending a sick or dying animal's suffering. Healthy prairie dogs are therefore not technically "euthanized." Sikes & Gannon (2007), in contrast, describe euthanasia as "the act of killing animals by methods that induce rapid unconsciousness and death without pain or distress." While it may be difficult to assess whether an animal is in pain, it is generally accepted that whatever would cause pain to a human would cause pain to an animal (Sikes & Gannon, 2007).

While eliminating all sources of distress may not be practical or possible, under Sikes and Gannon's definition of euthanasia, the selected method of lethal control should minimize sources of potential distress. Wild-caught animals should be handled and killed in the manner least stressful to the animals. Termination of life dictates that the most humane, rather than the most convenient, methods be used (AVMA, 2013). Table 1 elaborates on the relative humaneness of common methods currently in use and the potential consequences to both target and non-target wildlife.

Individuals applying pesticides must comply with federal laws as well as each individual state's laws concerning pesticide use and labeling. As with many federal regulatory programs, FIFRA cedes primary compliance, monitoring, and enforcement power to states. Typically, a state's department of agriculture has the primary responsibility to regulate certified pesticide applicators.

A2.2 Donations to wildlife recovery centers

Prairie dogs are sometimes donated to black-footed ferret or raptor recovery centers to serve as a food source (carcasses) or as live prey. While donations may be considered a better option than wasting (poisoning) an important food source, particularly in this case of black-footed ferrets, this practice is not immune to criticism. This issue for many species in recovery programs is a lack of prairie dog complexes. Both ferrets and raptors need wide open ranges with live wild prairie dogs to fulfill their true function in the grasslands. Therefore, conserving prairie dogs where they live is ultimately a better solution to the problem of declining ferrets and raptors.

A2.3 Reducing risks to non-target species

Rodenticides and other lethal control methods have inherent risks to non-target species. Both the landowner and hired applicators must exercise due diligence to prevent or reduce killing of non-target wildlife. While the label instructions on rodenticides are considered the law, some state wildlife departments provide additional protocols. For example, Colorado Parks and Wildlife (CPW) has prepared additional recommendations to avoid non-targets in a document titled "Controlling Prairie Dogs: Suggestions for Minimizing Risk to Non-Target Wildlife Species" (2007). The entire document is available here. Some of these protocols (truncated below) may be useful in to consider in local management plans

Consult with wildlife agencies. Contact the state wildlife agency and the U.S. Fish and Wildlife Service to determine if federal or state endangered, threatened, or species of special concern are in the area.

Inspect area prior to treatment. Rodenticides pose different threats to different species, and nontarget wildlife should be considered when selecting control methods. This should

include an interview with the landowner or site manager and at least one on-site inspection. The interview should include what species have been observed, and when during the day and season non-targets are present, as non-target presence can be influenced by the time of day, time of year, weather, and disturbance. Site inspections should include review of tracks, scat, pellets, feathers, burrow type, calls, etc.

The applicator is responsible for following the label directions, which includes only applying rodenticides to active burrows. Any failure to abide by label directions is a violation of state and federal laws.

Applicators should conduct a post-application site inspection of all treated areas to determine possible impacts to non-target wildlife species. Any take of non-target wildlife species should be reported to the state wildlife agency.

A2.4 To consider

As a matter of protecting the public's health, safety, general welfare, and the environment, local governments should be keenly interested in when, where, and why pesticides are applied. Many local governments have adopted pesticide management plans that provide details about application and require permitting.

- Adopt ordinances and policies that reduce the use of toxicants on public and private lands and require a permitting process that clearly states penalties imposed for non-compliance. Penalties could include fines, jail time, suspension of development permits, etc.
- Local governments may not be able to entirely prohibit pesticide use, but they can place restrictions on landowners requiring them to seek non-lethal control services first before permitting lethal control.
- Engage in conflict prevention strategies to predict and prevent prairie dog conflicts before they come an issue in as many locations as possible.
- Adopt a notification period to review alternative actions before toxicant use. A 12-month waiting period is reasonable.
- The intentional extermination of any declining species is a poor management choice; however, the understanding that prairie dogs feel pain too, and that care during the death of any animal is important, is a better approach than inhumane killing. Consider the most humane option first.
- Support private landowners that want to conserve prairie dogs or are willing to pay into mitigation funding programs for lost occupied habitat.
- Track and record the number of animals killed or burrows treated.
- Local governments cannot require additional posting and warning requirements on state licensed applicators, but they could require additional restrictions on the landowner; for example, larger signs and longer posting periods.
- Local governments should read the label of each pesticide considered.
- Fumigants (gas emitting agents) may travel through tunnels causing unintentional death or harm to occupants (humans or animals) in buildings. Read label instructions for special precautions about aluminum phosphide and carbon monoxide.

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Product	Product form and method of use	Certification required?	Effect on animal	Euthanasia	Humaneness categorization	Affects non-target species?	Secondary poisoning?
Aluminum Phosphide (brand names: Gastoxin, Phostoxin, Fumitoxin)[1, 3, 5, 8, 9, 11, 15 & 14]	Tablet or pellet placed into burrow	Yes	Emits hydrogen phosphide gas upon contact with moisture. Gas is absorbed through respiratory passages, entering the bloodstream. Causes internal hemorrhage leading to convulsions, paralysis and coma. Efficacy affected by burrow moisture, temperatures and soil porosity. Length of death from time of exposure is unknown in field conditions.	Not approved by AVMA[3]	Severely inhumane: Should never be used.	Yes. Kills most animals within burrow. Primary exposure possible for any animal or human that reopens burrow while gas is still active or where soils are highly porous and dry.	No. Gas dissipates from carcass of target or nontarget species with no bioaccumulation.
Burrow Blocker ™	Pumps a slurry of water and sand into the burrow	No.	Animals are trapped in filled tunnels, leading to death by suffocation.	No.	Severely inhumane: Should never be used.	Yes. Kills most animals within burrow.	No.
Carbon Dioxide (CO_2)[1, 3, 7, 10, & 12]	Animal is live-trapped and placed in a sealed chamber into which gas is delivered.	No.	Causes anxiety to animal due to live capture and handling concerns about overcrowding in tanks and release of stress pheromones. Animal suffocates and may exhibit signs of seizures, compulsive chewing, nasal hemorrhage and excessive salivation. Neonates require extended exposure	Not approved by the Humane Society.[5] Conditionally approved by AVMA[3]	Less inhumane.	No.	No.

Product	Product form and method of use	Certification required?	Effect on animal	Euthanasia	Humaneness categorization	Affects non-target species?	Secondary poisoning?
			times. Death by asphyxiation may take as long as 5.4 minutes. Difficulty in determination of death. Decapitation recommended after first application to ensure animal does not revive and require repeat application.				
Carbon Monoxide (CO) gas cartridge[1, 3, 4, & 14]	Ignited gas cartridge placed into burrow or pressurized exhaust rodent controller (PERC™).	Yes, in Colorado	In controlled conditions, CO rapidly induces lethargy, loss of consciousness and eventual death from suffocation with minimal discernable discomfort. Death occurs rapidly when appropriate concentrations are used but concentrations are difficult to control in field conditions. In some cases, gas may only take partial effect and animals could become sick and disoriented, not immediately dying. Efficacy affected by burrow moisture. Use of clean and cooled CO causes less agitation and irritation on rodents.	Conditionally approved by AVMA[3]	Less inhumane	Yes. Kills most animals within burrow	No

Product	Product form and method of use	Certification required?	Effect on animal	Euthanasia	Humaneness categorization	Affects non-target species?	Secondary poisoning?
Chlorophacinone	Treated grain bait placed inside of burrow. Seasonal restrictions	Yes	Anticoagulant causing widespread internal hemorrhaging. Death prolonged over a period of days or weeks.	No. Causes significant suffering	Severely inhumane: should never be used	Yes. Kills any animal that consumes bait	Yes, if nontarget animal consumes poisoned animals
Live Burial	Bulldozing prairie dogs into the ground	No	Animals are crushed or trapped in collapsed tunnels, leading to death by suffocation. Lacks scientific data.	No	Severely inhumane: should never be used	Yes. Kills most animals within burrow	No
Shooting	Shooting, generally with high-powered	Some states require a hunting license.	Animals may die instantly or if maimed may die a prolonged death.	Very inhumane (Shooting may be considered humane if the shot kills the animal instantly, but in practice this is rare, poor marksmanship will inevitably lead to suffering.)	No	No	Yes, if lead bullets are used. Lead fragments are easily digested and can lead to lethal or sublethal effects.
Vacuuming [3]	Street sweeper modified to vacuum prairie dogs out of burrows	No	Removed animals may be killed with carbon dioxide or relocated. Scientific studies unavailable.	No. Highly likely to be distressing to prairie dogs	Very inhumane	Yes. May vacuum up other species within the tunnel system	No

Product	Product form and method of use	Certification required?	Effect on animal	Euthanasia	Humaneness categorization	Affects non-target species?	Secondary poisoning?
Underground gas explosives (brand name: Rodenator™ or Varmitgetter™)	Oxygen and propane mix injected into burrow and then ignited	No	Animals may die instantly or become trapped in collapsed tunnels. Partial dismemberment likely. Lack of published scientific data.	No. Likely causes significant suffering	Severely inhumane: Should never be used.	Yes. May kill and/or maim most animals within burrow	No
Zinc phosphide[1], 10 & 14.	Treated grain bait	Yes	Grain bait releases phosphide gas in the stomach, which is absorbed into bloodstream. Causes internal hemorrhage, convulsions, paralysis, and coma. Time of grain consumption to death is unknown under field conditions.	Not approved by the AVMA[3]	Severely inhumane: should never be used	Yes. Kills all animals that consume bait	Yes, if nontarget species consumes animals when toxicant is still active in gut

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Appendix 3: Mitigation

Voluntary and collaborative conservation will help secure the long-term future of the prairie dog and the unique ecosystems that these keystone species make possible. When losses of habitat are unavoidable, mitigating those losses can be a crucial tool for the long-term sustainability of species conservation and also serve as a means to incentivize responsible development. Any entity that cannot avoid damaging prairie dog habitat should protect or enhance existing prairie dog populations elsewhere, either through direct participation in restoration activities or through depositing money into a fund used for restoration activities or land purchasing. The value of the restored or purchased habitat, or the money deposited into the mitigation fund, should be greater than or equal to the value of the habitat destroyed

Monetary valuation of lost occupied habitat is a complicated process. Prairie dog habitats plau unique roles in both urban and rural settings. Some areas may have value for species of concern, threatened species, or endangered species, while other habitats provide recreation and tourism benefits. To help streamline the process, a Habitat Quantification Tool (HQT) can be used to determine what the habitat is worth through a designation of “functional” acres (the habitat required to support prairie dogs). The Prairie Dog Coalition (PDC) along with a Science Team made up of agencies and experts created a HQT for black-tailed prairie dogs that is similar to the Colorado Habitat Exchange. The HQT is ready for use and has been implemented in a pilot transaction. Contact the Humane Society’s Prairie Dog Conflict Resolution Team Program Director Lindsey Sterling Krank at 720–938–7855 or lsterlingkrank@humanesociety.org or the Prairie Dog Coalition at coordinator@prairiedogcoalition.org for more information. These transactions may help curtail the net loss of prairie dogs by identifying willing prairie dog ecosystem creditors who create credits through restoration and conservation activities that can be purchased by prairie dog ecosystem debtors. Furthermore, the transactions can help provide a voluntary conservation to landowners and may be a useful tool in keeping a species from warranting listing under the Endangered Species Act.

In addition to the HQT, it is possible to take a simpler approach to mitigation: paying directly for replacement of occupied habitat. There are three direct costs potentially associated with habitat replacement:

1. Cost of prairie dog relocation
2. Cost of land set aside for conservation purposes
3. Cost of maintaining already occupied habitats.
4. Direct contribution to one or more of these costs could be written into any wildlife management plans and offset destruction of occupied acres.

Typical actions to consider:

1. Incorporate prairie dogs directly into development plan; this may be feasible depending on the size of the development and its location relative to other natural areas. No mitigation fees.
2. Translocate prairie dog to public lands. Impose public land use fees determined by the local government.
3. Translocate prairie dog to other private lands. No mitigation fees.
4. Remove prairie dogs and donate to black-footed ferret or raptor recovery programs. This can be time consuming and expensive (see Appendix 2). Charge a reduced fee for net loss of prairie dogs.
5. Lethal control of prairie dogs with restricted-use pesticides. Charge the full fee for loss of prairie dog occupied acres. Charge higher fees for use of more dangerous or inhumane toxicants to encourage use of less toxic chemicals and avoid inhumane practices (see Appendix 2).
6. Violation of any ordinances. Charge the full fee plus penalties (see below).

One complication with local government mitigation is that technically the language in an ordinance must be

habitat-based rather than population or animal based. It is more difficult to assign value to an occupied acre than it is to calculate the cost of moving one prairie dog. Prairie dog populations can vary erratically from season to season and year to year, making evaluation of occupied acreages difficult. For example, spring translocations will yield almost double the population of prairie dogs (due to new pups) as compared to fall translocations. When HQT is not available, the best choices include charging replacement values or charging the cost of relocation.

Enforcement of mitigation plans is crucial and breaking the law must be more costly than compliance. Since state and federal goals include protection of occupied acres, penalties for infractions should be based upon number of occupied acres destroyed.

Infractions might mean:

1. Reckless disregard of natural resources
2. Violation of permitting and failure to follow due diligence procedures
3. Physical damage to occupied acreage

Penalties might include:

1. Withholding building permits
2. Withholding land use changes
3. Cease and desist orders
4. Injunctions
5. Requiring specific performance
6. Judicial actions (civil and criminal) (Seavy & Design, 2008)

A3 Bibliography

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Appendix 4: State designations of prairie dogs

State, prairie dog species	State Wildlife Action Plan designation	State fish and game department designation	Department of Agriculture designation
Arizona			
Black-tailed	Species of Greatest Conservation Need	Non-game	None
Gunnison's	Species of Greatest Conservation Need	Non-game	None
Colorado			
Black-tailed	Species of Greatest Conservation Need	Small game	Destructive rodent pest
Gunnison's	Species of Greatest Conservation Need	Small game	Destructive rodent pest
White-tailed	Species of Greatest Conservation Need	Small game	Destructive rodent pest
Kansas			
Black-tailed	Species of Greatest Conservation Need	Non-game	None
Montana			
Black-tailed	Species of Concern	Non-game	Vertebrate pest
White-tailed	Species of Concern	Non-game	Vertebrate pest
Nebraska			
Black-tailed	None	Non-game	Injurious rodent
New Mexico			
Black-tailed	Species of Greatest Conservation Need	Non-game	None
Gunnison's	Species of Greatest Conservation Need	Non-game	None
North Dakota			
Black-tailed	Species of Conservation Priority	Non-game	Pest species

State, prairie dog species	State Wildlife Action Plan designation	State fish and game department designation	Department of Agriculture designation
Oklahoma			
Black-tailed	Species of Concern	Non-game	None
South Dakota			
Black-tailed None	Predator/varmint, None	species of management concern	
Texas			
Black-tailed	Species of Concern	Non-game	None
Utah*			
Gunnison's	Species of Greatest Conservation Need	Vulnerable	Depredating animal
White-tailed	Species of Greatest Conservation Need	Vulnerable	Depredating animal
Wyoming			
Black-tailed	Species of Greatest Conservation Need	Non-game, special concern	Pest
White-tailed	Species of Greatest Conservation Need	Non-game, special concern	Pest

Appendix 5: Examples of inventory sheets for colony analysis

Colony analysis

Colony analysis and behavior is an early-stage planning exercise that helps managers understand species behavior and colony dynamics, such as size, historical presence and occupancy, adjacent colonies, pressure, migration corridors, competing land uses, and reproduction and attrition rates. This phase is important because by understanding current and historical colony dynamics, we can more accurately and effectively predict colony behavior and mitigate accordingly. Managers can analyze a colony by pairing GIS technology with on the ground analysis to understand the landscape to aid in determining potential management applications.

Assessment items:

1. Size.
2. Historical presence and occupancy.
3. Dispersal corridors and routes. For example, prairie dog dispersal off of colonies are generally along open roads and through open riparian corridors in search of another colony.
4. Reproduction and attrition rates.
5. Vegetation.
6. Irrigation.
7. Land use – past and present.
8. Land ownership.
9. Past management of colony – including chemical control or other artificial means.
10. Colony state – expanding, contracting, or stable. What makes a colony stable?
11. Plague presence and management.
12. Carrying capacity.
13. Adjacent properties and potential / existing conflicts.
14. Other observations made on site.

Creating a map either from Google or other GIS technology and analyzing the above factors is a great tool to help get an overall understanding of what is happening on the colony so the best management approaches can be determined.

Behavioral observations

Behavioral observations are used on colonies where populations are anticipated to be removed through active or passive relocations. The purpose is to understand what family groups belong to each other.

Behaviors indicating the same family include:

- Friendly interactions —gentle chortling sounds as if talking to each other in a calm tone, pitch or frequency.
- Play, mouth-to-mouth contacts such as kissing (keep in mind that kisses are not always friendly and fighting could ensue), all grooming and foraging together.

Behaviors indicating unrelated families include:

- Tooth chattering, staring, and making rattle snake sounds, flared tails, bluff charges, defensive barks, fights and chases.

Prairie Dog Colony Inventory	Available Information	Source of Information
Date:		
Name and Address of Property:		
Gross acreage and how it was measured:		
Prairie dog occupied acres		
Public (local, state, or federal) or private:		
Is this property currently occupied by prairie dogs? If known, how long has it been occupied?		
Historically occupied (last known colony)		
Proximity to nearest colony (miles):		
Is nearest colony public (local, state, or federal) or privately owned?		
Dispersal corridors distance from colony roads or FEMA, dry stream bed		
Is colony connected or contiguous to other jurisdictions?		
Are there any existing or potential conflicts associated with the colony?		
Is the colony part of a complex?		

Inventory of prairie dog colonies

Colony identity number	Total acreage	Total occupied acreage	Estimated population size	Date of site visit	Ownership	Planned use*	Vegetation **	Sustainability status***	Species of conservation need present

KEY

*Planned use

1 = open space

2 = commercial

3 = residential

4 = agricultural

5 = other

**Vegetation

1= Predominantly native

2 = Introduced grasses

3= Bare ground with introduced weeds

***Sustainability status

0 = Not within jurisdiction

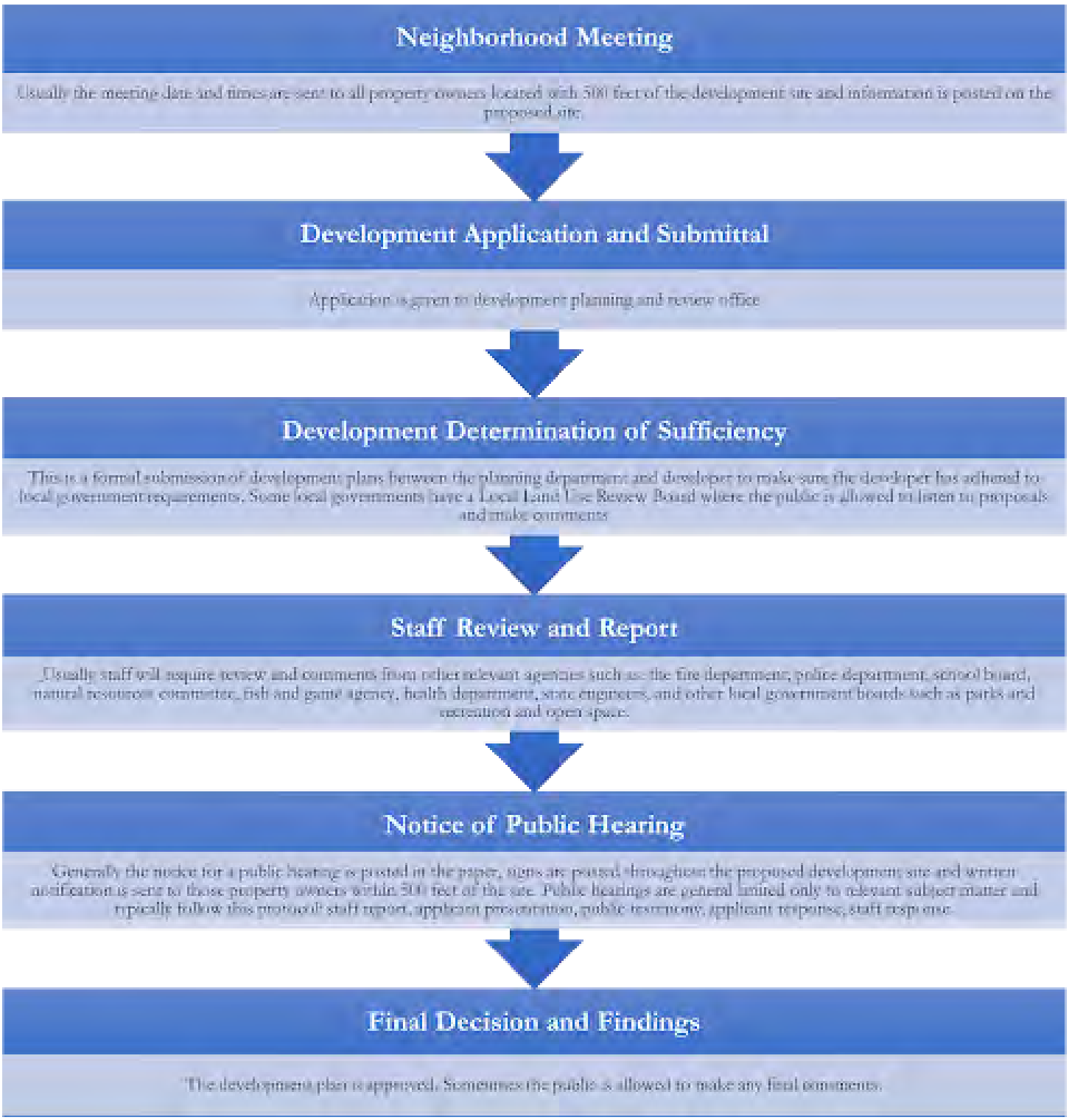
1 = Incompatible

2 = Retain with management

3 = Retain as preserve

Appendix 6: Development review process

Counties and cities generally have a development review process; in fact, many states require such reviews by law. The process includes opportunities for citizens of the community to voice concerns over a particular proposal; it is key to provide comments on prairie dog management into the planners and decision makers. While all stages of the process are important, the earlier the input the better. Written comments are also beneficial.


Neighborhood Meeting
Usually the meeting date and times are sent to all property owners located with 500 feet of the development site and information is posted on the proposed site.
Development Application and Submittal
Application is given to development planning and review office
Development Determination of Sufficiency
This is a formal submission of development plans between the planning department and developer to make sure the developer has adhered to local government requirements. Some local governments have a Local Land Use Review Board where the public is allowed to listen to proposals and make comments
Staff Review and Report
Usually staff will require review and comments from other relevant agencies such as: the fire department, police department, school board, natural resources committee, fish and game agency, health department, state engineers, and other local government boards such as parks and recreation and open space.
Notice of Public Hearing
Generally the notice for a public hearing is posted in the paper, signs are posted throughout the proposed development site and written notification is sent to those property owners within 500 feet of the site. Public hearings are general limited only to relevant subject matter and typically follow this protocol: staff report, applicant presentation, public testimony, applicant response, staff response
Final Decision and Findings
The development plan is approved. Sometimes the public is allowed to make any final comments.

Appendix 7: Center for Disease Control Procedure for Visual Evaluation of Prairie Dog Colonies for Plague in the Southwestern United States

The *Center for Disease Control Procedure for Visual Evaluation of Prairie Dog Colonies for Plague in the Southwestern United States* (cited in Luce, 2003), provides the following guideline for evaluating colonies for the presence of plague and when to take samples from colonies for testing:

A. HEALTHY COLONY

OBSERVATION: Most burrows show signs of recent use, unless it has rained within the past 24 hours—in which case the colony should be reexamined following a period of at least 24 hours without precipitation. Active prairie dogs are observed during periods of acceptable weather conditions. Only a few (<10%) of burrow openings appear inactive (lack of disturbed dirt, presence of cobwebs or wind-blown vegetation over the entrance). An occasional carcass or dried bones may be present because of nonplague death or predation.

EVALUATION: Unless recently (days) introduced, plague is not likely to be present. Fleas are not likely to test positive.

SAMPLE RECOMMENDATIONS: No samples recommended

B. DEAD COLONY

OBSERVATION: The colony appears completely inactive. Burrows show no signs of recent use (reexamine if it has rained within 24 hours). An occasional desiccated carcass and bones may be present and have likely been scavenged.

EVALUATION:

1) Make inquiries to determine if the colony was poisoned. This is especially likely if it appears that dirt was shoveled into the burrows.

2) If there is no evidence of poisoning and the food supply appears ample, it is likely that plague or some other zoonotic disease killed the colony. An experienced observer can usually make an estimate (recently, one season or two seasons) on how long the colony has been inactive, considering the soil type and degree of burrow degeneration.

SAMPLE RECOMMENDATIONS: Sample only if there is no evidence of poisoning. A recent (same season) die-off might produce many fleas through burrow swabbing. Older die-offs will likely produce few or no fleas. Typically, many burrows (dozens or even hundreds) may be swabbed, with only a few producing fleas. If burrowing owls are using the inactive burrows, small black stick-tight fleas may be present in large numbers (in contrast to the larger reddish-brown prairie dog fleas). Fresh or desiccated prairie dog carcasses may also be collected for analysis.

C. SCATTER PATTERN

OBSERVATION: Inactive burrows constitute an unusually high percentage (typically 20%-90%) of the total burrows. Active burrows, however, are clear, and active prairie dogs are observed during periods of acceptable weather. Active and inactive burrows are scattered amongst each other in no pattern (see below), keeping in mind that family units may have multiple burrow openings, and hence an inactive unit may produce a small cluster of two to five inactive burrow openings. An occasional carcass (fresh or desiccated) may be present.

EVALUATION: Several scenarios could account for these observations—and more than one scenario may be in play at the same place and time. Presented in order of likelihood:

1) Make inquiries to determine if the colony was poisoned. This is especially likely if it appears that dirt was shoveled into the burrows. This scatter pattern could be produced if the application of poison was scattered and not comprehensive.

2) If there is no evidence of poisoning, assess the available food supply. Such a pattern of death could also be attributable to a population crash because of lost carrying capacity of the site or overpopulation.

3) If there is no evidence of poisoning or population crash, hunting by humans or excessive predation by carnivore or birds of prey are highly likely. Human hunting usually produces physical evidence such as footprints, tire tracks and spent ammunition shells. Depending on local culture, human hunters may collect their prey (many Native American groups regard prairie dog as a delicacy) or leave it for scavengers. Experienced observers can often spot carnivore tracks and recognize hunting and attack patterns in these tracks near burrow entrances.

4) Finally, a zoonotic disease could be responsible, but given this mortality pattern, a disease with a lower mortality rate than plague is more likely.

SAMPLE RECOMMENDATIONS: If there is no evidence of poisoning, population crash or excessive human hunting, collect fleas by swabbing burrows—especially inactive burrows—and collect fresh or desiccated prairie dog carcasses if available.

D. DEAD ZONE

OBSERVATION: Within a colony that otherwise appears healthy, there is a zone of inactive burrows. This zone may encompass a relatively small or large proportion of the colony and may be located anywhere in the colony. Eventually it spreads to encompass a section of the colony and appears to be spreading along a discernible line of demarcation over the remaining section of the colony. Experienced observers can often clearly distinguish and mark (flagging tape) this demarcation line between active and inactive regions. Marking allows for periodic reexamination to assess the rate of spread and facilitates sampling. Fresh or desiccated carcasses may be present. Near the demarcation line, recently inactive burrows may reveal the odor of decaying carcasses, and flies may be common at burrow entrances.

EVALUATION:

1) There is a high probability that plague is active in such a colony. Although other zoonotic diseases are possible, plague is most likely.

2) Depending on the location of the dead zone with respect to other human activity (homes, barns, etc.), poisoning is also a possibility that should be investigated.

SAMPLE RECOMMENDATIONS: Collect fleas by swabbing burrows immediately along both sides of the demarcation line, concentrating most of your efforts immediately along (within 10 meters) the inactive (dead) side of the line. Fleas are likely to be numerous. You may wish to apply extra insect repellent, but be extremely cautious not to directly or indirectly get repellent on your burrow swab! (If this happens, discard it, wash your hands and start with a new one.) If others in a group are getting fleas and you are not, and you are swabbing in essentially the same area, you likely have repellent on your swab. Collect any available rodent carcasses (fresh or desiccated, prairie dog or other rodent) for testing.

Additional notes: Please include GPS coordinates for all samples. One set of coordinates per colony is acceptable. Specify the type of inactivity pattern noted for each sampled colony: dead colony, scatter pattern, dead zone. Analysis of samples from "dead zone colonies" will receive laboratory priority.

The above activity patterns are typical for the warm months. Visual examination during winter months is more difficult due to decreased daily activity among even healthy animals.

One of the few ways to minimize plague is killing the fleas who host the plague. One commonly used product is deltamethrin (Delta Dust, Bayer Corp.), a powdered insecticide applied inside prairie dog burrows. Delta Dust is in the chemical class of pyrethroids, synthetic chemicals modeled after natural insecticides found in chrysanthemum flowers. Some communities have expressed concern about Delta Dust's impact on nontarget arthropods, other nontarget species such as birds, and potential pet or human exposure. Recent research indicates that Delta Dust effectively reduces flea populations "with minimal and non-lasting negative effects on arthropod populations" (Dombro, 2016). Delta Dust is low in toxicity when it is touched or breathed in and is low to moderately toxic if eaten. The EPA classifies Delta Dust as "not likely to be a human carcinogen" by all routes of exposure (NPIC, 2010). There may be negative impacts to arthropod and arthropod-dependent species from dusting, but currently dusting is the only tool publicly available to protect prairie dogs from plague.

Another approach to plague management is the use of sylvatic plague vaccine. While still in the testing stage, SPV has shown promising results for protecting prairie dogs against plague for up to nine months and is delivered to the prairie dogs by way of oral bait (USGS, 2012). Potentially a single drone could deliver bait to more than 60 acres per hour (USFWS, 2016). Additional plague management strategies are under evaluation. The defensive toolbox against sylvatic plague is growing, although continued efforts to provide sylvatic plague abatement measures will be essential to ensuring the persistence of prairie dogs on the landscape as the eradication of the plague-causing bacteria does not seem likely at the present time.

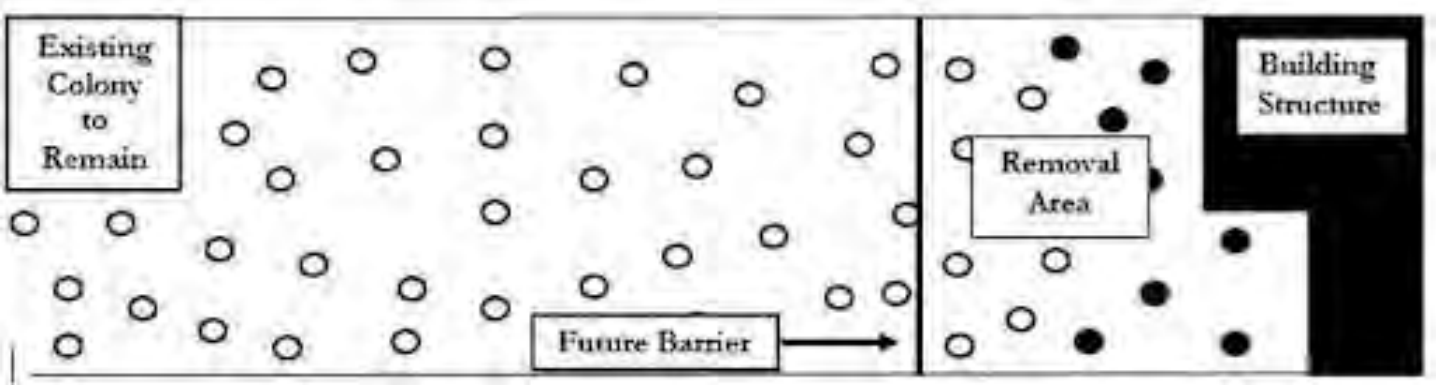
Attachment 1: Reverse dispersal translocation

Reverse Dispersal TranslocationTM is a passive prairie dog relocation method developed by Pam Wanek

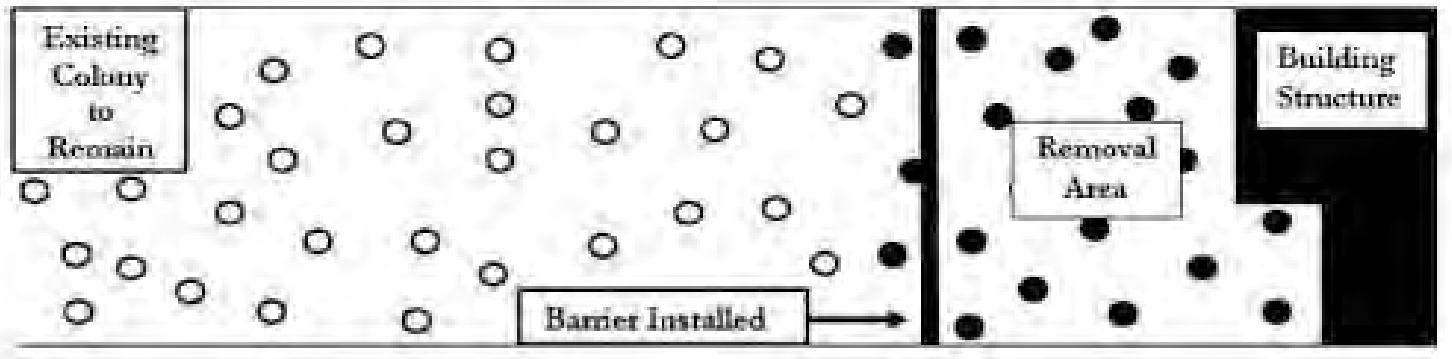
1. RDT is a habitat-based prairie dog relocation method that manipulates the burrow system, causing prairie dogs to leave conflict burrows
2. In RDT, prairie dogs are not handled, instead they must acclimate themselves into territories with preexisting burrows.
3. RDT requires access to an existing active colony that is connected to and substantially larger than the removal area
4. In most cases, barriers (physical structures or vegetative) should be employed after all prairie dogs are removed
5. RDT is best used after the breeding, birthing, and pup reading periods (or other time periods that present biological stressors) have passed and when overall population densities are lower, thus reducing competition for limited resources (these periods of time may vary from state to state and species to species). For example, in Colorado, RDT is best used from mid-August through mid-November (except in the cases of single dispersers) for black-tailed prairie dogs and August through mid-September for Gunnison's prairie dogs. Other factors such as hibernation, torpor, and poor weather conditions should be considered.
6. The technique is useful for building and road expansions, utility installations, solar array installation, removal of prairie dogs from developed neighborhoods, parks, athletic fields, commercial building areas, or dams; barrier maintenance; revegetation projects; supporting active relocations; and controlling colony expansions (for example, new burrows established in neighboring yards or commercial areas and parks).
7. Non-target species impacts should be considered during any alteration of prairie dog burrows.
8. In practice, the process can take anywhere from one week to one month depending on the site involved.
9. If spring construction is likely, RDT should be performed during the recommended periods of time (see #5 above) and then periodically monitored throughout the rest of the season up to and sometimes during the construction project.
10. If proper guidelines are followed, RDT can be employed by any able-bodied person; however, project difficulty varies on a site-by-site basis. Any site that contains more than 10 burrows should be reviewed first by someone that is either trained in the technique or has a solid working background with prairie dogs.
11. There are two types of RDT: "The Roll" and "Part the Sea"

The Roll is used when prairie dogs need to be permanently excluded from an area. In this case, prairie dogs are gradually "rolled" out of the conflict area using the process described below and acclimated into the acceptable area. Rolling may require several stages (Note: for large conflict areas, prairie dogs must be progressively rolled to discourage them from reopening originally closed burrows).

Stage 1: Progressively begin closing active burrows farthest away from the receiving prairie dog colony.



Stage 2: Close remaining burrows and burrows within 15 feet of the barrier on the side where prairie dogs will remain to discourage prairie dogs from going through underground tunnels. When complete, install barrier.



Part the Sea is useful for moving prairie dogs during temporary impact projects such as construction or maintenance of utility lines, trails, or solar energy arrays. Close burrows within entire construction footprint. In some cases, a temporary barrier may need to be installed to keep prairie dogs away from the impact zone.

Required equipment: cart (for carrying equipment), shovel, two-foot-wide one-inch poultry (chicken) wire, metal baseball bat, garden hose marked off in one-foot increments (for measuring tunnels), hammer, box cutter, spring-loaded tin snips (to cut poultry wire), bamboo skewers or sticks, six-inch or larger sod staples, softball sized rocks, bucket (for hauling equipment), flags or wooden stakes to mark burrows.

Step #1: Cut the wire.

A. Roll out two-foot-wide one-inch poultry wire and anchor both ends with sod pins.

B. Using spring-loaded tin snips, cut directly down the middle of the poultry wire seem.

C. Overlay one long cut piece directly over the other and secure both ends with sod pins.

D. Cut two 12-inch wire pieces at a time (use your foot to prevent recoiling).

Step #2: Set up the wire door.

A. To monitor burrow activity, wedge two sticks in a crossed position roughly three inches outward from burrow surface (use more sticks if the diameter exceeds four inches).

B. Place two pieces of cut wire (match curve pattern and seams) together. Notice curvature in wire pieces. Place wire over burrow entrance so that the curvature faces outward from burrow and covers the entire burrow opening.

C. Check tension on wire door. Hold the bottom of the wire against the burrow entrance point with one hand and with the other slightly pull up on the top of the wire square; it should snap down over the burrow.

D. Secure wire square to soil with sod staple at entry point of burrow and each side of the burrow, leaving the top of the wire square unattached (this is where the prairie dog will exit).

E. Mark each burrow with a flag or wood stake (preferred for long-term projects) and labeled with a unique number. The finished product should look like this: crossed sticks 3 inches below burrow surface, wire door placed over burrow and held in place by one sod staple at arrow points.

F. Adding a softball sized rock at the burrow entrance further impedes the prairie dog from digging under wire to regain access; the rock will be used later to close the burrow.

Step #3: Monitor burrow activity

A. Burrows should be monitored daily for sticky activity. If the sticks have moved, replace and monitor again. If sticks have not moved for 72 hours, then close the burrow. Note: Three days is necessary to ensure apprehensive prairie dogs challenge the stick and wire rather than just moving the sticks. Inclement weather may prolong waiting period.

Step #4: Close burrow

A. Remove all wires, then dig back from tunnel entrance at least 6 inches deep below soil line.

B. Using a bat and hammer, backfill tunnel with soil 8 inches below soil line.

C. Mold one cut square of wire around bat.

D. Insert wire with bat into tunnel. Hammer to secure the wire in tunnel. Remove bat, leaving the wire in place. Place rocks and soil inside molded wire and tamp down firmly.

E. Flatten wire above ground to form a skirt and anchor with 6-inch sod staples.

F. Secure second wire with 5 to 6 6-inch sod staples, around the edge of the wire: this wire may remain permanently or removed after project completion.

Step #5: Dryer vent door installation (if needed)

In rare cases, using wire doors to deactivate burrows may be difficult and a modified dryer vent door may be necessary.

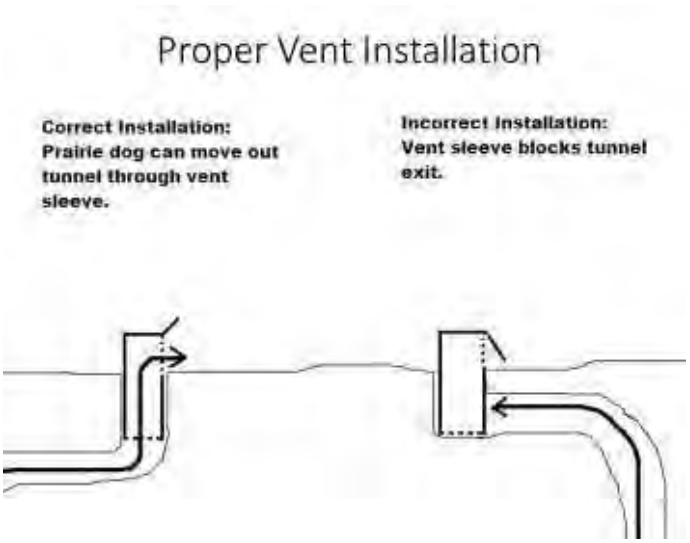
Required equipment: single-flap four-inch-diameter dryer vent, four-inch-diameter corrugated plastic tubing, duct tape, one-inch poultry wire, sod staples, box cutter, hammer, shovel.

A. Determine the length of the black tube. The tube should be long enough that it is tightly wedged within the interior wall of the tunnel, forcing the prairie dog to use the black tube rather than move between the tube wall. Make sure the tube configuration does not block off the tunnel. After determining the needed length, add 8 inches so that when installed, the black tube extends 8 inches above soil line. This step is necessary so the prairie dog cannot reopen the door flap at ground level. Cut the black tube with a box cutter and install tube in tunnel; this may require twisting the tube for a snug fit.

B. Remove manufacturer's sleeve from dryer vent. Attach the black tube to the collar of the vent using duct tape.

C. Cut one 2 x 2' square of one-inch poultry wire to use as a skirt at the base of the tube to prevent prairie dogs digging back into tunnel. Cut hole in middle of the skirt for black tube opening. Secure skirt to ground with 6-inch sod staples at base of black tube and skirt edge (see black lines).

Use a stick to prop the flap of the dryer vent slightly open so there is light at the end of the tunnel (this provides the prairie dog with visual direction to exit the tube. Position stick so it moves as prairie dogs leave the tube.



D. Daily monitoring is important to track activity. Burrows with dryer vents may take longer to deactivate simply because the apparatus is visually foreign to the prairie dog. In some cases, the prairie dog may peer out of the flap without fully emerging. IF the stock moves, reset and monitor until there is no activity for at least four days. After 100% certainty that all prairie dogs are gone, remove vent, cut black tube to the ground or remove if possible, and fill in the hole with soil.

Prairie dog emergence

Full emergence, see two prairie dogs

Stick moved; reset and monitor for four additional days

Step #6: A chart for monitoring

For large projects, using a chart to indicate progress is helpful; it may also be shared on Google Spreadsheets.

Site Name: ACME PROJECT 2008										
Date	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep	21-Sep	22-Sep	23-Sep	24-Sep
Temp	60	60	70	75	80	65	75	80	60	70
Time	10:30 AM	10 A.M.	10 A.M.	12 P.M.	3 P.M.	10 A.M.	11 A.M.	3 P.M.	10 A.M.	11 A.M.
Stake #1	WS	WAS	WAS	WIS	WIS	WIS	C	C	C	C
2	WS	WAS	WAS	WIS	WIS	WIS	C	C	C	C
3	OAR 1	S	AS	WS	WAS	WIS	WIS	WIS	C	C
4	S	AS	AS	WS	WAS	WAS	WIS	WIS	WIS	C
5	S	WS	WAS	WAS	WAS	WAS	VS	VAS	VIS	VIS

Legend: W=wired, S=Sticked, A=Active, I=Inactive, C=Closed, OAR = Open Active Receiving Burrow, V=Vent

Note: #5 the wire is replaced with a dry vent.

P. Wanek

Final notes

Successful passive relocation requires seeing the site from the prairie dog's point of view. Are there enough existing burrows in the adjacent colony? Is the timing within the recommended window; after the young are mobile populations are lower (naturally), and before hibernation?

Attachment 2: Overview of barriers

Prairie Dog Barriers: An Overview **Prepared by Pam Wanek**

The use of barriers for non-lethal control of prairie dogs have been at the forefront of best management practices for at least two decades. Non-lethal control is a paradigm shift towards stressing co-existence with wildlife rather than extermination. For over 100 years humans have relied on the use of highly toxic chemicals to indiscriminately resolve wildlife conflicts. These toxicants come with risks to humans, the environment, and non-target wildlife, and most are considered inhumane. Their economic sustainability is also questionable, particularly where taxpayers are seeking alternatives that humanely manage wildlife through habitat modification rather than repeated extermination of animals.

We offer suggestions for barriers, but this document is not exhaustive. When selecting barriers, it is important to consider the specific site, costs, and maintenance. Environmental factors such as wind, the water table, and soil composition are also important. The occupancy history of the site is relevant because the longer prairie dogs have occupied an area, the more extensive their tunnel systems. More established tunnel systems may be difficult to block off, impacting where barriers should be placed (for example, away from the tunnels instead of splitting tunnels). In general, barriers to exclude prairie dogs are installed after prairie dogs are removed from a conflict zone. But in some cases, barriers can be installed in conjunction with other relocation methodologies such as active relocations. Barriers, like most outdoor installations, require maintenance, and many are not 100% effective; however, the type of barrier and installation techniques can reduce maintenance and increase efficacy.

Aesthetics, multi-functionality, and zoning regulations are also important to consider. For example, existing fencing around a yard containing livestock or pets could potentially be modified to exclude prairie dogs. Barriers in urban areas are generally subject to more stringent regulations related to aesthetics. Rural areas may be less strict.

There are two types of barriers: physical and vegetative. Physical barriers are generally compromised of manmade fencing, masonry walls, metal, rock, PVC, or vinyl for example. Tests of physical barriers suggest that they should stand at least 3 feet tall, be opaque, and include deterrents that discourage prairie dogs from climbing over or digging underneath the barrier. Prairie dogs are not necessarily inclined to climb, but they are great diggers, so light should not be allowed to penetrate underneath the barrier in order to discourage digging.

Creating an effective vegetative barrier requires a review of plant opaqueness, density, and whether the foliage is evergreen or deciduous; potentially using plants that are odiferous; and analyzing water needs. The best vegetative barriers are opaque, dense, and diverse plantings adapted to local conditions; contact the local county extension office for plants that are adapted to your community.

Vegetative barriers may include trees, shrubs, mid- to tall-height grasses, various forbs (flowering plants), or a combination. All vegetative barriers should include a heterogeneous variety of plants as protection against single species plant diseases and to ensure multi-season effectiveness. Some hardy shrubs to consider; dwarf and tall rabbitbrush, big western sage, four-wing salt brush,

three-leaf sumac, spirea, and juniper varieties. Shrub planting width is dependent on the species selected but generally 10- to 20-foot-wide dense swaths are adequate if there is good plant composition.

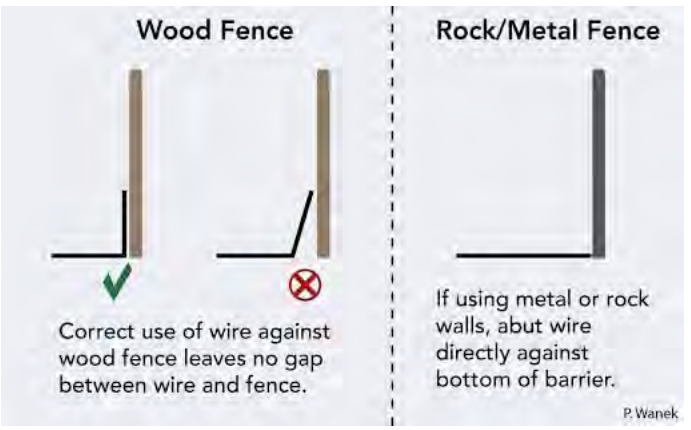
Grassy barriers should include an assortment of cool and warm season species where growth patterns vary over spring, summer, and fall seasons. Suggested with is 200 to 300 feet.

Finally, combining vegetative with physical barriers can be aesthetically pleasing and may increase the efficacy of both barrier types.

Physical barriers

1. Skirting

Skirting is used to fortify physical barriers. Skirting inhibits prairie dogs from tunneling underneath or chewing directly through barriers. The application involves butting 4- to 5-foot-wide one-inch poultry (chicken) wire against the barrier horizontally with one-foot lip that extends vertically against the barrier. The one-foot vertical lip should be attached to the barrier, typically using a staple gun. Skirting should be adequately tacked down to the soil to discourage prairie dogs from tunneling under the wire; usually 6-inch sod staples suffice. Install pins in a zig-zag pattern, roughly 6- to 8-inches apart, along the edge of the poultry wire. Stagger another row of pins at roughly one-foot increments along the midline of the skirt parallel to the fence. In some applications, laying 6- to 8-inch diameter rock cobble or riprap on top of the skirting will help with aesthetics and fortify the skirt.



A note about trenching: trenching involves partially burying barriers in the ground. This technique provides a solid seal along the bottom of the barrier and adds strength to certain selected barrier materials. Trenching also has faults, as it creates a soft soil line and an opportunity for soil erosion along the barrier, which creates conditions where prairie can easily dig. There have been quite a few situations where skirting was necessary to fix trenching problems.

It is important to understand that prairie dog tunnels can be very deep below the soil surface and that trenching will not necessarily resolve all problems with barrier breaching. Tunnel depth is variable and probably contingent upon, water tables, soil porosity, climate, and other factors. Some studies have suggested tunnels may go as deep as 16 feet, but they probably average around 3 to 6 feet below the soil surface. In some cases, trenching 3 to 6 inches is beneficial for a good seal but will not block all tunneling under the barrier and in other instances barriers have been trenched more than 2 feet underground and were still not 100% effective.

The point here is that trenching is not always necessary for prairie dog barriers and in some cases may needlessly drive-up barrier construction costs. The choice of barriers is site specific, and pros and cons of each application should be reviewed based on site conditions.

2. Metal barriers

Metal barriers are made from metal sheeting (for example Pro-panel) and are typically trenched 2 to 4 feet underground.

Pros: The slick surface is difficult for prairie dogs to climb. Metal is a strong material, significantly decreasing maintenance costs over long periods of time. These barriers create an opaque visual deterrent both from the horizon and beneath the barrier (no light penetration). It can withstand high winds, hail, flooding, and heavy snow loads. The metal is factory painted and offered in a variety of colors that resist color fade and chipping.

Cons: Requires some experience for installation and there may be few or no experienced contractors in your area. Materials may be difficult to find. Repair is expensive (for example, if damaged with landscape or snow removal equipment). Can prevent water drainage. Requires trenching. Soil erosion next to barrier can create gaps, allowing prairie dogs to circumvent the barrier by unearthing soft dirt caused by trenching. Gaps can be filled in with sand and skirting installed if needed.

Non-prairie dog side of metal barrier

Prairie dog side of barrier. Note safe caps on metal posts and elongated cap along top of metal fencing.

Metal barrier at park separates human and prairie dog activities.

3. Fencing

Many types of fencing with modifications such as skirting can work well as prairie dog barriers. prairie dog exclusion. In one application (Figures A-D below) a wood fence was installed to exclude prairie dogs from a large townhouse project that was built adjacent to a prairie dog colony. When the property added turf grass, prairie dogs were interested in taking up residency. After removing the prairie dogs using non-lethal passive relocation techniques, privacy fence was installed with skirting.

PVC fence

Pros: Contractors and materials are easy to find. Wood fence is more likely to be accepted by city or county code and be more aesthetically pleasing. Does not require trenching; wood fence should not be buried. If there are breaches by prairie dogs, single slats can be removed to encourage prairie dogs to move to the correct side of the barrier. Incorporating cobble at the bottom of the fence will help with water drainage and fortifies a light-free bottom seam.

Rock wall

Cons: Wood can rot over time. Prairie dogs can chew through the bottom of the fence; however, this can be discouraged by attaching skirting. Too much light can show through the bottom of the fence, especially where the fence does not align with contour of the land.

Self-closing swing gate for pedestrians (springs on each side of gate). Metal culvert pipe at threshold blocks light.

Gate for vehicle access. Culvert pipe blocks light.

Wooden fence

A. Townhomes next to colony (prairie dog side).

B. Non-prairie dog side.

C. Skirting attached to prairie dog side.

D. Long view.

Wood fences with gates: to inhibit light when the gate is closed, add 6-inch metal culvert pipe at the threshold and a vertical lip wood piece on gate. Overlay board at edge of gate so when closed there is no light penetration.

Add 6-inch diameter steel culvert pipe to seal bottom of gate. Note chicken wire abutting culvert pipe on prairie dog side of barrier to discourage digging under the pipe.

Large wood gates for heavy equipment access: the choice of large gates for heavy vehicle access can make a big difference for prairie dog exclusion. Swing gates are easier to modify than those that slide into a pocket mechanism.

This swing gate was modified in three ways.

1. Buried 6” diameter culvert pipe.

2. Welded strip of metal at the bottom of the metal gate frame (used as a light and physical barrier).

3. Skirting installed against threshold.

Wide-spaced vertical wood slat fence with modifications: prairie dogs circumvented wide slat openings into an incompatible area. After prairie dogs were passively relocated, the fence was modified by tacking black silt fence directly to the wood fence and then adding chicken wire skirting against the silt fence.

Note: this is not a permanent solution but was used given limited funds and unknown future land use.

Existing fence before modification

Modified to exclude prairie dogs by adding black silt fence and skirting.

Exclusion area no is longer prairie dog occupied.

4. Vinyl barriers

Vinyl barriers were one of the first approaches used for prairie dog exclusion. The material is tough woven opaque vinyl that withstands weather for long periods of time if properly installed. It is commonly sold by Reef Industries in Texas. There are two heights, 36” or 42” (for trenching) with grommets positioned at 3-foot intervals along the top and bottom of the barrier. The barrier is sold in 300’ length rolls.

Example 1: Long-term construction project using a temporary vinyl

Vinyl was trenched into the ground and held up by T-posts and smooth wire running through the top grommets. This project involved using non-lethal passive relocation methods to move prairie dogs out of the way of a large concrete path and trail installation. Once the project was completed, the barrier was removed.

Temporary vinyl barrier used during construction project.

Example 2: Application of vinyl barrier to chain-link fence

On the prairie dog side of fence, use 5-foot wide one-inch netting poultry wire, attach one foot of wire vertically to the chain-link and anchor remaining 4 feet to the ground using 6-inch sod pins. Using 36” wide vinyl barrier, attach top grommets to fence with clips or use smooth wire to weave grommets into fence links. Anchor bottom grommets by inserting two 11-inch edging pins per grommet into the ground.

Prairie dogs non-lethally removed from developed park. (non-prairie dog side).

Example 3: Vinyl barrier attached to T-posts

T-post and single strand wire (inserted through grommets to hold up the vinyl barrier) can sag without proper supports. Wooden “H” brackets are recommended every 100 feet to help with retightening (use as pull posts with wire tightener).

The illustration below has at least two flaws:

1. A slack line may cause too much wind pressure causing metal grommets to rip.

2. There is no protection along the bottom of the barrier to inhibit prairie dogs from chewing directly through the barrier or digging underneath.

Non-prairie dog side

Prairie dog side

Modified existing chain-link fence to inhibit movement back into park (prairie dog side).

Flawed vinyl barrier installation

Example 4: Post and rail with vinyl

This multifunctional fence is used in many situations (parks, open space trails, fences along residential homes, and for containment of domestic pets) and can be modified to exclude prairie dogs. Using wood rails as both structure and to attach grommets (with a screw and washer) creates a good long-term barrier for prairie dogs.

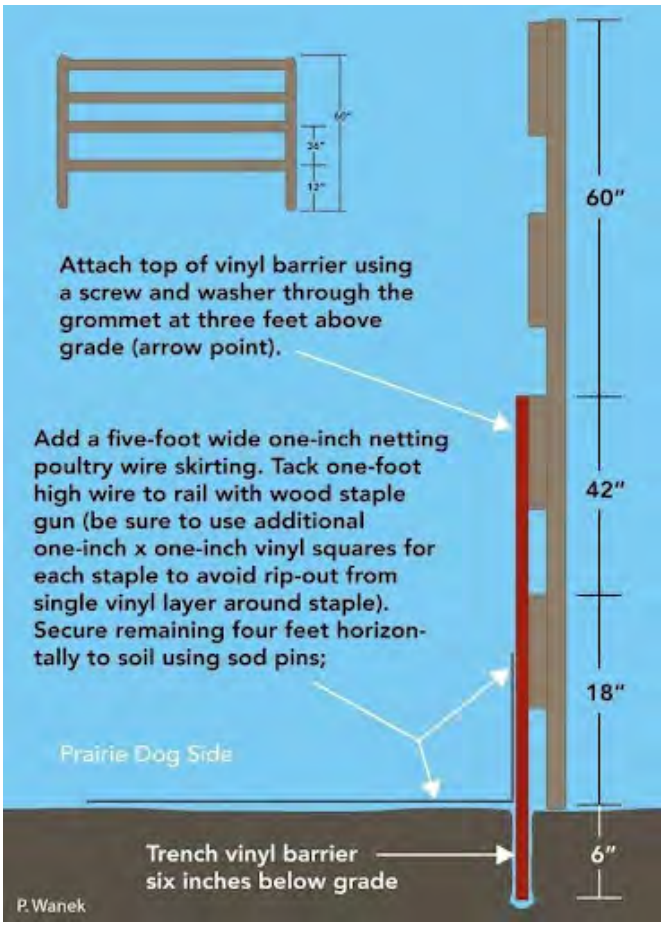
However, there are a few problems with this application (see below).

1. The vinyl barrier is not tall enough to act as a visual deterrent (see black arrow indicating gap). Barrier height should be at least 3 feet.

2. Vertical skirting on prairie dog side of barrier is too tall; prairie dogs can grip and climb over the barrier.

3. There is no horizontal skirt on the ground to discourage digging under the barrier.

Screw and washer through grommet



Example 5: Modified livestock fence

5-foot-high wood rail fence. Two options to secure vinyl:

1. Trench vinyl barrier 6-inches below grade (use 42-inch width vinyl so 36-inch-wide vinyl will stand above grade);

2. Use 36-inch-wide vinyl and attach vinyl bottom into the ground using two 11-inch landscape edging pins per grommet.

Prairie dog side

Non-prairie dog side

Example 6: Vinyl barrier backed with 4-foot-tall 2-inch by 1-inch welded wire

A 42-inch-wide vinyl barrier was trenched 6” into the ground and attached to 2-inch by 1-in by 4-foot-tall welded wire for structural support (attached to 5-foot T-posts every 10 to 15 feet). There is also 4- to 5-foot wide 1- inch netting poultry skirting installed on the prairie dog side. Poultry wire was held up vertically by thin-gauge wire inserted through the vinyl and attached to the T-post.

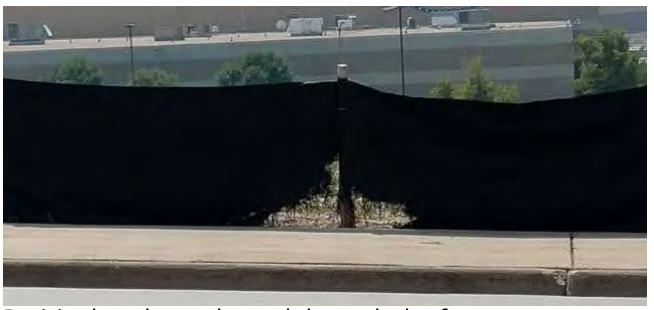
5. Silt fence

Silt fence is commonly used to control erosion on construction sites and is useful for short-term exclusion of prairie dogs. The fabric is 3 feet wide and pre-attached with staples to 3.5-foot-tall stakes at 10-foot intervals. The stakes protrude about 6 inches along the bottom of the fence for pounding into the soil. Silt fence is sold in 100' lengths. DOT-grade silt fence should be used, as the stakes are stronger than cheaper grades.

There are pros and cons to silt fence and opportunities for modifications. Advantages include the fence being easy to find in most hardware stories and installation is not too difficult. Disadvantages include weather issues and prairie dog habits. High winds can rip the fabric out of the staples and over long periods of time, prairie dogs may try to chew through the barrier. The modifications shown in the photos below will help with longevity.

Silt fence with stakes and staples exposed.

Modification: Twist fabric around stake for longevity



Prairie dogs have chewed through the fence

Modification: Using 2 foot-wide one-inch netting poultry wire, lip one foot vertically and use a staple gun to attach to wood posts. Anchor horizontal piece to ground with 6-inch pins.

Silt fence used in large field.

Silt fence used for pending construction.

6. Wood slat snow fence

This fencing is commonly used for wind and snow breaks along highways and in conjunction with vegetation rows to aid in their establishment. As the name implies, it catches snow and captures moisture while breaking harsh winds, making it useful for inter-planting vegetation and vegetative windbreak rows. Fence segments are usually 4 feet high by 50 feet long with wood slats spaced about 1.5 inches apart, woven together by very strong wire.

Pros: Easy installation with 5-foot T-post (attach to post by intertwined wire on wire, not wood slat). Relatively easy to find. Because of the slats, there is a breezeway. Slats create a partial visual barrier and protects plants. Useful as a semi-opaque visual deterrent and could be used in conjunction with establishing vegetation barriers. This barrier should not be trenched.

Cons: Slat spacing may not be adequate for full visual deterrence. Prairie dogs could chew through bottom slats or between slats.

The area pictured below needed a temporary fence that could withstand winds. To prevent prairie dogs from breaching the fence, poultry wire skirting was added with an unsecured one foot “flop” at the top edge to discourage prairie dogs from climbing over.

Prairie dog side

Non-prairie dog side

7. Straw bale barrier

Straw bales may be effective in limited situations. Pictured are large bales that are 7’ long by 4’ tall.

Pros: The bales provide an immediate visual obstruction.

Cons: The bales are held together with nylon twine that degrades, causing the bales to quickly fall apart; prairie dogs can climb or dog through bales; and they can create a mouse haven. Avoid near residential areas.

Straw bales along prairie dog side of fencing.

8. Other manmade barriers

Example 1: Recycled mining conveyor belts. Used against a horse arena fence, this barrier provides a good visual and physical deterrent. Arena kick boards could also be effective.

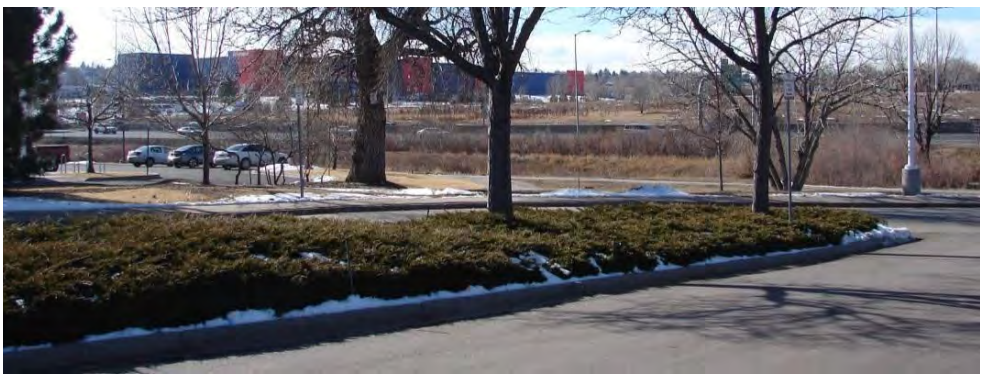
Example 2: Electric weave fence. Does not create a visual deterrent but will deter prairie dogs should they come against the fence. It is easy to install and is charged by solar power.

9. Landscaping with hardscape materials to exclude prairie dogs

Materials such as concrete, pavement, pavers, and rock are effective in impeding prairie dogs from digging. Use in medians, next to pedestrian paths, next to building foundations, or to protect developed parks.

10. Vegetative barriers

Windbreak rows and bushy living barriers provide a good option to inhibit prairie dog movement especially for large landscapes.



Juniper shrubs create a low dense mat uncomfortable for prairie dogs and can be used as low-maintenance plantings next to buildings and inside medians with other plantings.

Shrub row: includes tall green rabbitbrush, three-leaf sumac and mountain mahogany.

Windbreak rows with a combination of evergreen trees (Rocky Mountain Juniper, Colorado Spruce, Fir) on large open areas.

Mixing forb species (such as sunflowers and Rocky Mountain bee plant (prairie dogs tend to avoid both forb species) with grasses increases plant diversity and lengthens the seasonal effectiveness of the vegetation barrier.

Grassy vegetation comprised of cool and warm season grasses with varying heights. *Photo by City of Boulder.*

Using electric fence to prevent cattle grazing works well to create a vegetation buffer. *Photo by J. Proctor*.

Manipulation of vegetation can direct prairie dog expansion and contraction. During high precipitation years, when grasses and plants grow well, prairie dog colonies contract. Drought conditions create the opposite situation, causing prairie dog colonies to expand. If prairie dogs are not desired in an area, avoid clearing shrubs and mowing, at least through late spring and/or early summer (when the highest rate of prairie dog dispersal is likely to occur, depending on prairie dog species.

Controlled fire. *Photo by National Park Service.*

In areas where prairie dog expansion is desired; controlled burns, increased livestock grazing, and mowing are effective in creating inviting habitat.

City and county vegetation/weed ordinances should consider leniency on private lots next to occupied prairie dog sites. Overly stringent vegetation regulations could encourage prairie dog occupancy in conflict areas.

On landscapes where prairie dogs are allowed to exist in more natural areas, some managers deliberately reduce vegetation height to encourage expansion of prairie dog populations. Depending upon the type of vegetation involved, mowing in new areas where occupancy is desired and avoidance of mowing where prairie dogs are less desired can shift populations on the landscape over time.

A variety of plants can be effective deterrents. Use softscapes in large groupings or to soften a physical barrier. As with any vegetation component, incorporate varieties for interest and protection against single species disease.

Table 1. Examples of plants that can be used in vegetative barriers.

Common name	Latin name	Height	Width	H_2O needs*	Native/ Introduced	Plant type
Giant sacatoon	*Sporobolus wrightii*	3-6'	3-6'	XXX	Native	Warm
Switchgrass	*Panicum virgatum*	3-5'	18-24"	X	Native	Warm
Wheatgrasses	Multiple varieties	2'-4'		X-XX	Mixed	Cool
Juniper	Multiple varieties			XX-	Mixed	Shrub
Three-leaf sumac	*Rhus trilobata*	3-6'	3-6'	XXX	Native	Shrub
Gro-low sumac	*Rhus aromatica*	2-3'	6-8'	XXX	Mixed	Shrub
Big western sage	*Artemisia tridentata*	3'	3'	XXX	Native	Shrub
Four-winged salt brush	*Atriplex canescens*	3'	3'	XXX	Native	Shrub
Curl-leaf Mountain mahogany	*Cercocarpus ledifolius*	3'	6'	XX	Native	Shrub
Spirea	Multiple varieties	3'	3-5'	XX	Mixed	Shrub
New Mexico privet	*Forestiera pubescens*	8-12'	6-8'	XXX	Native	Shrub
Golden currant	*Ribes aureum*	4-6'	4-6'	XX	Native	Shrub
Alpine currant	*Ribes alpinum*	3-4'	3-4'	XX	Introduced	Shrub
Wax currant	*Ribes cereum*	3-4'	3-4'	XX	Native	Shrub
Potentilla	*Potentilla spp.*	3'	3'	XX	Mixed	Shrub
Shrub roses	Multiple varieties	5'	5'	XX	Mixed	Shrub
Coyote willow (or other varieties)	*Salix exigua*	6-12'	4-8'	X	Native	Shrub
Tall rubber rabbitbrush	*Chrysothamnus nauseosus*	2-6'	2-6'	XXX	Native	Open shrub
Dwarf rubber rabbitbrush	*Chrysothamnus nauseosus nauseosus*	2'	2'	XXX	Native	Open shrub
Maximilian sunflower	*Helianthus maximiliani*	2.5-9'		X-XX	Native	Forb
Rocky Mountain bee plant	*Cleome serrulata*	3'-4'		X-XX	Native	Forb
*X=moist, XXX=very dry						

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Together, we tackle the root causes of animal cruelty to create permanent change.

With millions of supporters and work happening in over 50 countries, Humane World for Animals—formerly called the Humane Society of the United States—addresses the most deeply entrenched forms of animal cruelty and suffering. As the leading voice in the animal protection space, we work to end the cruelest practices, care for animals in crisis and build a stronger animal protection movement.

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