ELECTRIC UTILITY RIGHT-OF-WAY MANAGEMENT

INTRODUCTION

Electric utility rights-of-way (ROW) are prominent features on the Pennsylvania landscape. Most notable are the 100—200 foot, 230 and 500 kV transmission lines that transport electricity from generation stations to substations across the state. These features pose challenges and opportunities for wildlife habitat management. Utility rights of way can influence wildlife habitat use within the ROW and in adjacent habitats in a variety of ways. Understanding the interactions among habitat characteristics, treatment methods, and line clearance requirements is essential to maximize benefits and minimize negative impacts of utility ROWs.

HABITAT CHARACTERISTICS

Utility ROWs are characterized by linear early successional habitats. Grasslands, goldenrod/aster and shrub communities dominate most areas. These early successional habitats are intentionally maintained by utility companies to meet their clearance needs between vegetation and transmission lines. Periodic intensive management (normally mechanical cutting, hand cutting, and/or herbicide) is common. Poor soil conditions often lead to bare ground or sparse grasslands. Where soils are higher quality, dense grass with goldenrod and aster are found. With non-selective maintenance woody shrubs and trees are sparse or non-existent. However, with selective management, shrubs and small trees can be dominant, providing shrubland habitat for a variety of species. Where hydric soils intersect the ROW, emergent or shrub wetlands may be present.

Rights-of-way can provide edge and early successional habitats but they can also fragment forest blocks and serve as corridors for invasive species.

WILDLIFE COMMUNITIES

Utility rights-of way and their early successional structure are used by many generalists and even some specialists that require young seral stages. They can provide edge habitat and forest openings, and with appropriate management can be further enhanced to create habitat diversity on the landscape.

Rights-of-way can fragment forest habitats and create extensive edge. Wildlife that require forest interiors, such as cerulean warbler and scarlet tanager, can be adversely affected by ROWs. This can also have negative consequences due to increased access to forest interior areas by nest predators (raccoons, skunks, etc.) and brood parasites like brown-headed cowbirds. However, species that thrive in edge habitats can benefit if shrub vegetation is maintained. Examples of State Wildlife Action plan species include brown thrasher, golden-winged warbler, yellow-breasted chat, Appalachian cottontail, and snowshoe hare.

Brown thrashers and other shrubland birds can benefit from utility ROWs managed to favor low growing, woody vegetation.

A limiting factor on ROW corridors passing through forest can be their narrow width, with only the widest tracts being used by early successional specialists like golden-winged and prairie warblers. Wide (>400'), shrubby ROWs that intersect other early successional habitats on the landscape can make suitable habitat for declining golden-winged warbler populations. Utility ROWs can serve as travel corridors between habitats, but this can also have negative consequences, such as increased occurrence of raccoon roundworm infection in the state-threatened Allegheny woodrat.

Regarding reptiles and amphibians, utility rights-of way and open rocky hillsides along tertiary roads account for the majority of habitat where two State Wildlife Action Plan species persist (mountain earth snakes and northern coal skinks). In short, the wildlife communities that use a ROW will depend on location, width, adjacent habitats and vegetation structure.

INDUSTRY STANDARDS AND REQUIREMENTS

The electric utility company has two primary goals on rights-of-way; maintain reliable electric service, and meet federal clearance requirements . Tall growing trees can convey electricity to the ground causing equipment damage, power loss, and wildfires. Vegetation can also hinder access to lines and delay power restoration efforts. There are extensive federal regulations regarding electric transmission and distribution, and it is important to have a good understanding of these requirements.

Following the 2003 Northeast Blackout during which millions of people lost power due to a ROW tree encroachment, the Federal Energy Regulatory Commission (FERC) tightened standards for line clearance and ROW maintenance. Obviously, FERC regulations influence ROW maintenance methods, and some previously used methods that allowed tall-growing trees to remain in wire zones are no longer permitted.

How much clearance is necessary? Tree clearance distances are based on the voltage and construction of a transmission line as well as the growth rate of trees and management cycle length. The exact clearance needed is determined by each utility in accordance with federal regulations. The key time for clearance concern is summer when lines are conducting electricity and at their maximum sag. Height of trees and large shrubs directly under lines must be controlled to prevent interference. When ground to line distance is greater due to topography, such as a deep stream valley, trees may be allowed to remain. Side clearance is also needed, but there are opportunities for more and somewhat taller vegetation along the ROW edges.

Wire Zone-Border Zone: Wire zone-border zone management, the concept of low-growing vegetation under wires (i.e., herbaceous plants, low shrubs) with taller vegetation along ROW margins (taller shrubs low-growing trees) is central to ROW vegetation management strategies (Figure 1). In fact, wire zone-border zone management has been researched and refined for over 50 years on a State Game Lands 33 demonstration site in Centre County, as well as other sites across the state.

The post-Northeast Blackout clearance requirements prompted ROW vegetation managers to further break down units within the wire zone-border zone. The “critical wire zone” is that area within the wire zone where maximum line sag is expected, especially during the summer months (Figure 2). As such, lower growing herbaceous plants and shrubs are promoted within the critical wire zone. This area can vary depending on topography.

A wire zone of grass , forbs, and low shrubs and a border zone of taller shrubs and low-growing trees can provide habitat diversity on the right-of-way while meeting the clearance needs of the utility company.

Wire zone-border zone provides an opportunity to intersperse habitats (i.e., herbaceous, shrubland, and forest) along the ROW corridor while allowing the utility company to meet their clearance needs. The distances in Figure 1 are minimum, but managers have flexibility to expand the border zone to provide additional early successional habitat. Requiring utility companies to expand the border zone is one way to mitigate habitat loss on other sections of the ROW.

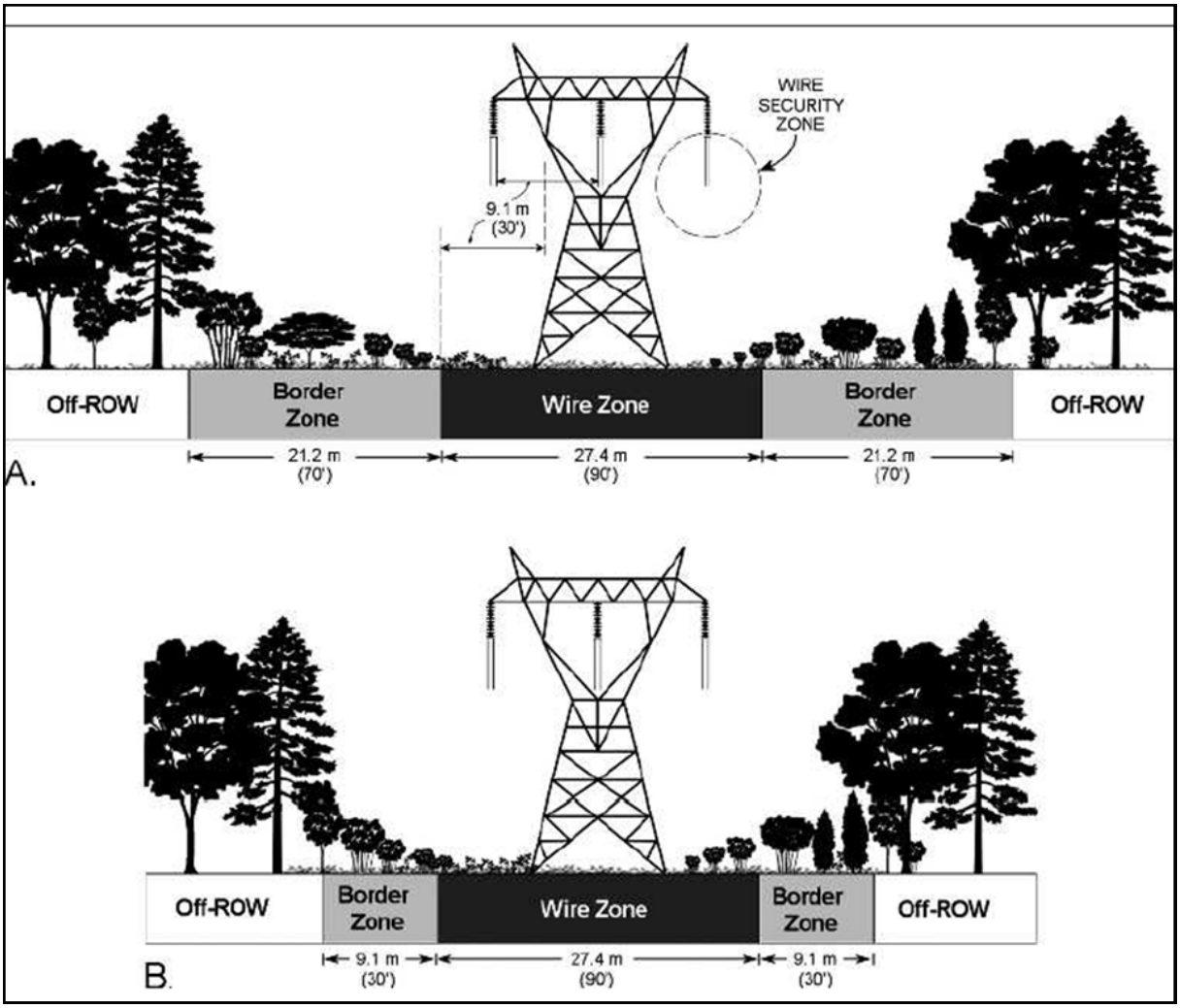


Figure 1. Site-explicit division of a powerline ROW cross-section into three zones: the border zone (BZ), the wire zone (WZ), and another BZ. (A) ROW cross-section based on Bramble et al. (1985, 1986) figure dimensions scaled for a 340 kV powerline and a horizontal conductor configuration. The WZ for both figures was determined using the distance between conductors (30 ft. in this case). Wire security zone dimensions may vary by regulatory requirements and site or ROW-specific consideration. Woody vegetation was not restricted to the BZ here, because low-growing shrubs can be compatible even in the WZ, depending on access requirements, site topography, and position relative to midspan between tower structures (see Figure 2).

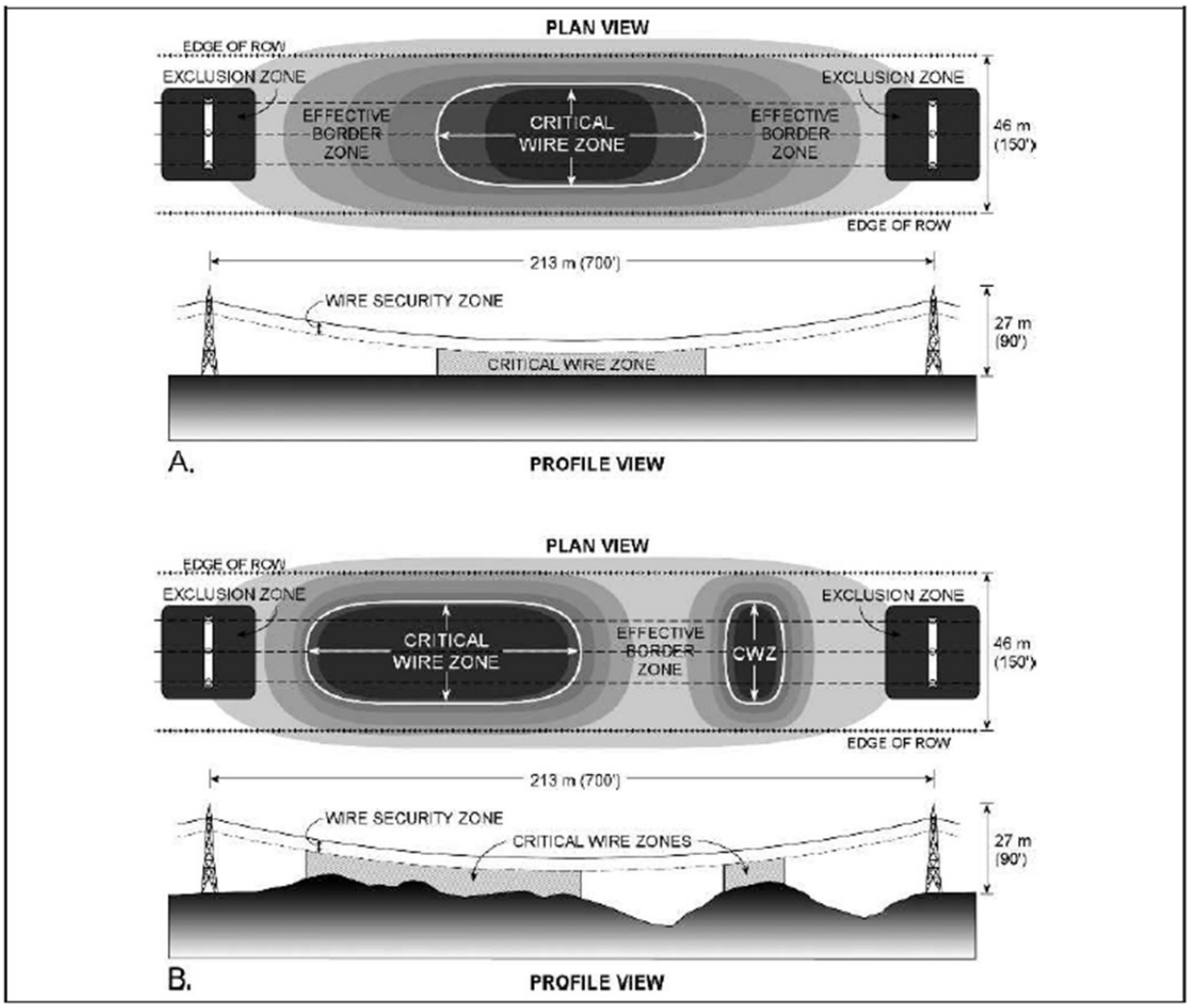


Figure 2. Plan and profile views of 345-kV transmission line rights-of-way (ROW) with a horizontal conductor configuration on (A) level topography and (B) uneven topography with contours of electromagnetic field strength at ground level (adapted from Lee et al. 1993). Greater electromagnetic field strength and corresponding shorter ground-to-conductor clearances are depicted by successively darker zones or contours. The darker zones labeled "critical wire zones" (CWZ) represent areas where tall-growing woody vegetation, shrubs or trees, pose the greatest threat to safe and reliable transmission of electricity (i.e., shortest distances between the ground and conductors or wire security zone). Border zones supporting a mosaic of shrubs and select short trees could be maintained along the edges of the ROW (i.e., border zones, as depicted in Figure 1) and in wire zones where ground-to-conductor clearances are greater ("effective border zones" or noncritical wire zones) such as positions distant from midspan or with low topography as represented by lighter gray areas outside the CWZs in both plan views. Proposed "exclusion zones" are placed around the base of tower structures to assure access for maintenance and repair and to minimize fire hazard. **(Ballard et al. 2007)**

MANAGEMENT STRATEGIES

Powerline ROW management that minimizes habitat damage and maximizes positive effects requires close cooperation among habitat managers, the utility company, and their contractors. Many issues encountered while inspecting the work of utility company contractors is due to poor communication. It is necessary to monitor contractor activity. Instances have occurred where agreed upon treatments were not met and the contractor mowed or sprayed all existing vegetation under the wires. In these cases, immediate communication with the ROW company forester is necessary to discuss mitigation terms.

Cooperation and communication is required during all phases of line maintenance (i.e., planning, access, mechanical treatment, chemical treatment, and monitoring). The utility companies must understand the need to be "prescriptive" on State Game Lands; addressing site-specific conditions span by span. Similarly, habitat managers must understand legal requirements and timelines imposed by federal regulations.

Wire Zone-Border Zone is a straight-forward concept that provides for various techniques within standard guidelines. Working from the wire zone-border zone concept provides a firm basis for cooperation because it is supported by both industry and wildlife professionals.

Critical Wire Zone

In the areas listed as "critical wire zone", vegetation is to be kept low, typically less than 6 feet in height, with no tree species. This includes many herbaceous plants such as goldenrod, asters, and native grasses as well as low-growing shrubs such as blueberry, huckleberry, silky dogwood, and managed scruboak (Table 1). As low-growing areas, the critical wire zones can be maintained in herbaceous cover needed by American woodcock for singing and golden-winged warblers for nesting. This is especially true in the context of adjacent shrub and small tree cover in the wire zone and border zone (see also Golden-Winged Warbler Best Management Practices for Forestland in Maryland and Pennsylvania).

Herbaceous critical wire zone at mid-span, surrounded by shrubs in the adjacent wire zone and border zone.

The critical wire zone is the most intensively managed portion of a utility ROW. Selective herbicide application techniques such as low volume basal applications and/or herbicides that target tree growth can maintain herbaceous cover. If a

span has not been managed for some time, non-selective herbicide use may be necessary to set back succession and tree growth in the critical wire zone.

In easily accessible areas dominated by shrubs such as scruboak, a 5—7-year mowing rotation can be used to retain low-growing shrub stature. In many cases, a combination of these techniques in the short and long-term will be necessary.

Wire Zone

Vegetation can be allowed to grow slightly taller (6 — 15 feet) outside of the critical wire zone. On Figure 2, this is denoted as darker shades of the "effective border zone." Desirable species include many shrubs such as witch hazel, shrub dogwoods, scrub oak, and elderberry, but no taller growing trees (Table 2). The shrubs provide exceptional food and cover and do not impose dangers to transmission lines.

The wire zone management challenge is to prevent encroachment by taller growing trees including birch, maples, white pine, and oak. Selective herbicide treatments using basal application or cut-stump are most effective at targeting tree growth while retaining shrub cover. Any non-selective methods such as high volume foliar or aerial applications are not compatible with retaining shrub cover; however, these methods may be necessary to reclaim spans that have not been appropriately managed in the past and are dominated by trees.

Border Zone

The border zone is the area outside of the wire zone where vegetation imposes less of a hazard to transmission lines (Figure 1). There is less risk of transmission line encroachment and, consequently, shrub height can be greater than in the wire zone. Low-growing trees can also be reserved due to low risk (Table 3). In addition to species like redbud, hawthorn, American chestnut and cedar, vegetation listed in Tables 1 and 2 are also appropriate within the border zone.

Although low stature trees are acceptable, taller trees pose a potential threat, especially during storms when they can be wind-blown onto lines. To differentiate from the wire zones where the main hazard is trees growing up into transmission lines, the threat from border zone trees is encroachment from the sides and potential wind throw.

A widened border zone on this ROW makes it more attractive to area-sensitive early successional wildlife.

Similar to the wire zones, border zone management should be selective with low volume foliar, basal, and cut-

stump herbicide as the primary treatment methods. Hand felling may also be viable where there are few unacceptable trees and ground conditions and access allow safe operations by cutting crews.

The border zone represents the greatest opportunity to improve ROWs for wildlife. As previously discussed, many utility ROWs are too narrow to provide quality habitat for species that require larger early successional areas (i.e., area sensitive species). Widening the border zone provides additional shrubland habitat and lessens the impact of frequent disturbance within the wire zones. Such habitat work can be done by the utility as mitigation for habitat loss on other areas of the ROW. In some cases, border zone widening can be accomplished through commercially viable timber sales.

Non-Native Invasive Plants

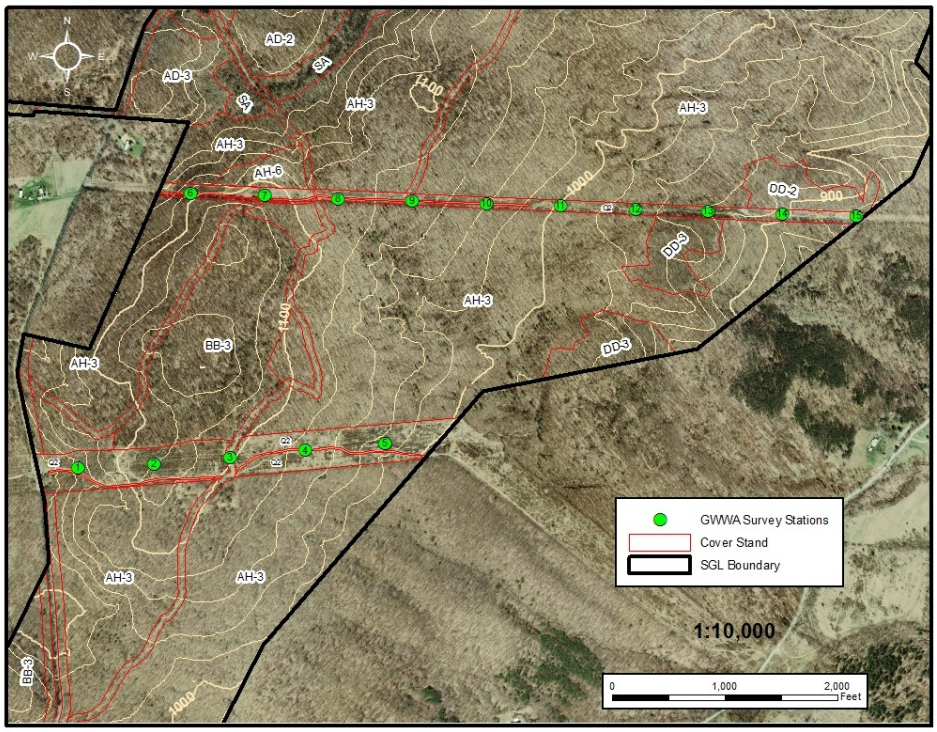
Undesirable invasive plants will undoubtedly appear in utility ROWs as a result of their frequently disturbed nature. Plants such as mile-a-minute, stiltgrass, Ailanthus, honeysuckle ,and many more (Table 4) should be targeted during ROW management. Utility companies com armed with state of the art equipment and trained crews . These resources should be utilized to target invasive species on the ROW and on other locations as habitat mitigation, where appropriate.

Identify opportunities

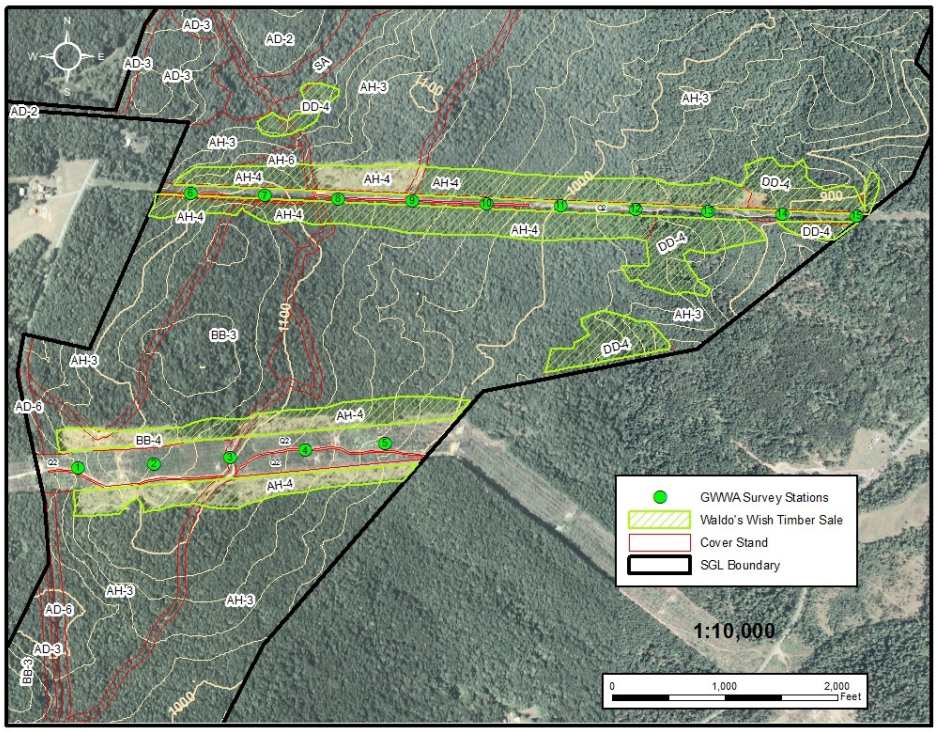
In general, the utilities examine ROWs every three years to check for vegetative encroachment. Utility foresters submit applications to chemically treat encroaching vegetation as they inspect miles of ROW resulting in an ever-revolving inspection and maintenance process. During comprehensive game lands planning and site visits with utility foresters, habitat managers should identify habitat management opportunities, both on and off the ROW Ideally, the utility forester and habitat manager can agree on methods to minimize negative impacts. In some cases, habitat mitigation is necessary to compensate for habitat loss.

HABITAT MANAGEMENT EXAMPLE

Land managers and biologists in the Game Commission's southcentral region implemented a project on ROW aimed at providing quality habitat for golden-winged warblers (GWWA)and other species that utilize this type of habitat. Managers concentrated on a narrow ROW that was considered to have fair to good habitat for GWWA however the ROW was too narrow for use. In 2006, pre-treatment surveys detected no use by GWWA on the narrow northern ROW. Conversely, GWWA were detected on the wider, southern ROW during surveys. In addition to the ROW, cover types present consisted of Dry Oak-Heath forest (AH), Northern Hardwood forest (BB), and Aspen-Grey Birch forest (DD). The northern, narrow ROW, which consisted of a large component of scrub oak, was mechanically treated in 2007. In addition to regenerating the scrub oak, timber harvests were also conducted in adjacent stands in 2008 through 2010, creating a mosaic of early successional habitat juxtaposed to the ROW.



State Game Land 322 utility right-of-way prior to habitat improvements via border zone widening.



State Game Land 322 habitat improvement project after border zone widening to increase early successional habitat. Note the timber harvest in oak stands adjacent to the ROW and in aspen stands between the two corridors.

Table 1. Preferred vegetation to be promoted in the critical wire zone.

Common Name	Scientific Name	Maximum Height (ft)
Mayflower	*Epigaea repens*	0.25
Eastern teaberry	*Gaultheria procumbens*	0.5
Greenbrier	*Smilax* spp.	1
Sweetfern	*Comtonia pergrina*	2
Meadowsweet	*Spriea spp.*	3
Native CSG spp.	*Elymus spp.*	3
Goldenrod	*Solidago spp.*	5
Native WSG spp.	*Sorghastrum* spp., *Andropogon* spp., *Panicum virgatum*	5
Aster	*Aster* spp.	5
Mountain laurel	*Kalmia latifolia*	6
Gray dogwood	*Cornus racemosa*	6
Blackberry	*Rubus allegheniensis*	6
Raspberry	*Rubus occidentalis*	6
Huckleberry	*Gaylussacia* spp.	6
Blueberry	*Vaccunium* spp.	6
Scrub oak	*Quercus ilicifolia*	6

Table 2. Preferred vegetation to be promoted in the wire zone (includes plants from Table 1)

Common Name	Scientific Name	Maximum Height (ft)
Spicebush	*Lindera benzoin*	9
Hazelnut	*Corylus americana*	10
Silky dogwood	*Cornus amomum*	10
Smooth (dwarf) sumac	*Rhus glabra*	12
Elderberry	*Sambucus canadensis Sambucus nigra, Sambucus racemosa*	12
Witch Hazel	*Hamamelis virginiana*	15
Viburnum	*Viburnum* spp.	16.0
Staghorn sumac	*Rhus typhina*	20.0
Summer Grape	*Vitis aestivalis*	----

*plants from the critical wire zone list are also acceptable to be promoted in the wire zone.

Table 3. Preferred vegetation to be promoted in the border zone (includes plants from Tables 1 and 2.

Flowering dogwood (*Cornus florida*)	Dwarf willow (*Salix* spp.)
Redbud (*Cercis canadensis*)	Deciduous holly (Winterberry;*Ilex verticillata*)
Hawthorn (*Crataegus* spp.)	Hazel alder (*Alnus serrulata*)
Crabapple, common apple (*Malus* spp.)	Speckled alder (*Alnus incana*)
Blue beech (American hornbeam; *Carpinus caroliniana*)	American chestnut (*Castanea dentata)*
Shadbush (Juneberry, Serviceberry) (*Amelanchier* spp.)	Rhododendron (*Rhododendron maximum*)
Eastern red cedar (*Juniperus virginia*)	Common chokecherry (*Prunus virginiana*)
Northern white cedar (*Thuja occidentalis*)	Elderberry (*Sambucus* spp.)
Chokeberry (*Pyrus arbutifolia*)	

Table 4. Non-native invasive vegetation to be targeted for removal on utility ROWs.

Multiflora rose (*Rosa multiflora*)	Tatarian honeysuckle (*Lonerica tatarica*)
Tree of heaven (*Ailanthus altissima*)	Royal Paulownia (*Paulownia tomentosa*)
Autumn olive (*Elaeagnus umbellata*)	Russian olive (*Elaeagnus angustifolia*)
Japanese honeysuckle (*Lonicera japonica*)	Phragmites (*Phragmites australis*)
Kudzu (*Pueraria lobata*)	Japanese knotweed (*Fallopia japonica*)
Privet (*Ligustrum* spp.)	Japanese barberry (*Berberis thunbergii)*
Buckthorn (*Rhamnus cathartica*)	Euonymous (burning bush; *Euonymus alata*)
Mile-a-Minute vine (*Persicaria perfoliata*)	Japanese stiltgrass (*Microstegium vimineum*)
Purple loosestrife (*Lythrum salicaria*)	Angelica tree (*Aralia elata*)

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