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Chapter 5: Programs

To address the threats outlined in Chapter 3, and meet the desired outcomes for Nebraska's PFLs and multi-state areas, the NFS is implementing a wide range of initiatives intended to increase the health and resiliency of forestlands. These apply to forestlands and trees in rural and community settings, and trees used for agroforestry or conservation purposes. The programs in this section are the vehicles for carrying out the 12 FAP goals and 22 resource strategies (see Chapter 8) that address the three national objectives for state and private forestry.

One purpose of this chapter is to highlight how each NFS program addresses the threats, desired outcomes, and local priorities for Nebraska's PFLs. It is also meant to provide a framework for NFS staff to think critically about how each program's objectives need to align in order to meet the long-term goals of these landscapes. The desired future condition for Nebraska's PFLs is to create and maintain healthy, sustainable forestlands that provide long-term benefits for Nebraskans. This includes a forest ecosystem that is compatible with agriculture, provides excellent wildlife habitat and recreational opportunities, contributes to economically viable communities, and provides for a well-trained and well-equipped response to wildfire.

Forest Health

Overview

A healthy forest landscape has the capacity for renewal and recovery from a wide range of disturbances, while continuing to provide public benefits and ecosystem services. Threats to the health of Nebraska's forests include insects, diseases, herbicide damage, invasive and aggressive-native plant species, air pollution, and weather extremes brought on by shifting climatic trends. By identifying forested areas that are especially vulnerable to the aforementioned threats, the NFS will be able to target management to areas that are most likely to prevent or mitigate negative impacts while restoring affected forests.

Current Condition

A number of insect and disease threats affect Nebraska's forests. Extreme environmental conditions and other abiotic stressors also impact forest health. Table 49 provides a partial list of issues that affect the health of Nebraska's forests and trees.

Table 49: Insect Pests and Diseases of Nebraska's Trees

INSECT OR DISEASE	TREES AFFECTED	STATUS	IN ADJACENT STATES
Emerald ash borer (<i>Agrilus planipennis</i>)	Ash (<i>Fraxinus</i> spp.) Fringetree (<i>Chionanthus</i> spp.)	Active, detected in 2016	Yes
Pine wilt (<i>Bursaphelenchus xylophilus</i>)	Scotch pine (<i>Pinus sylvestris</i>) Austrian pine (<i>Pinus nigra</i>)	Native, variable; mortality first noted in 1980	Yes
Asian longhorned beetle (<i>Anoplophora glabripennis</i>)	Maple (<i>Acer</i> spp.) Buckeye (<i>Aesculus</i> spp.) Birch (<i>Betula</i> spp.) Willow (<i>Salix</i> spp.) Elm (<i>Ulmus</i> spp.) Poplar/cottonwood (<i>Populus</i> spp.)	No detection	No detection
Gypsy moth (<i>Lymantria dispar</i>)	Oak (<i>Quercus</i> spp.) Apple (<i>Malus</i> spp.) Hawthorn (<i>Crateagus</i> spp.) Linden (<i>Tilia</i> spp.) Birch (<i>Betula</i> spp.) Aspen (<i>Populus</i> spp.) Poplar (<i>Populus</i> spp.) Willow (<i>Salix</i> spp.) Hazelnut (<i>Corylus</i> spp.) Serviceberry (<i>Amelanchier</i> spp.)	Past detections eradicated	Yes
Thousand cankers disease (<i>Geosmithia morbida</i>)	Walnut (<i>Juglans</i> spp.)	No detection, but host insect detected	Yes
Drippy blight; bacterium (<i>Lonsdalea quercina</i>); scale insect (<i>Allokermes galliformis</i>)	Oaks (<i>Quercus</i> spp.)	No detection	Yes
Spotted lanternfly (<i>Lycorma delicatula</i>)	Tree-of-Heaven (<i>Ailanthus altissima</i>) Grapes (<i>Vitis</i> spp.) Fruit trees (<i>Malus</i> spp., <i>Prunus</i> spp.) Maple (<i>Acer</i> spp.) Willow (<i>Salix</i> spp.) Walnut (<i>Juglans</i> spp.)	No detection	No detection
Cercospora blight (<i>Pseudocercospora juniperi</i>)	Juniper/redcedar (<i>Juniperus</i> spp.)	Native, variable	Yes
Bur oak blight (<i>Tubakia iowensis</i>)	Bur oak (<i>Quercus macrocarpa</i>)	Native, variable	Yes
Dutch elm disease (<i>Ophiostoma ulmi</i>)	Elms (<i>Ulmus</i> spp.)	Active, detected in 1960s	Yes

INSECT OR DISEASE	TREES AFFECTED	STATUS	IN ADJACENT STATES
Oak wilt (<i>Ceratocystis fagecearum</i>)	Oaks (<i>Quercus</i> spp.)	Active, detected in 1950s	Yes
<i>Verticillium</i> wilt (<i>Verticillium</i> spp.),	Various hosts Maples (<i>Acer</i> spp.)	Active, detected early 20 th century	Yes
Bagworm (<i>Thyridopteryx ephemeraeformis</i>)	Juniper/redcedar (<i>Juniperus</i> spp.) Spruce (<i>Picea</i> spp.) Pine (<i>Pinus</i> spp.) Arborvitae (<i>Thuja</i> spp.) Baldcypress (<i>Taxodium</i> spp.) Fir (<i>Abies</i> spp.) Apple (<i>Malus</i> spp.) Maple (<i>Acer</i> spp.) Honeylocust (<i>Gleditsia triacanthos</i>)	Native, variable	Yes
Cedar bark beetles (<i>Phloeosinus</i> spp.)	Juniper/redcedar (<i>Juniperus</i> spp.)	Native, variable	Yes
Pine engraver beetles, Mountain pine beetle, Turpentine beetle (<i>Ips</i> and <i>Dendroctonus</i> spp).	Pine (<i>Pinus</i> spp.)	Native, variable	Yes
Diplodia blight (<i>Diplodia sapinea</i>)	Pine (<i>Pinus</i> spp.)	Native, variable	Yes
Japanese beetle (<i>Popillia japonica</i>)	Linden (<i>Tillia</i> spp.) Norway maple (<i>Acer platanoides</i>) Japanese maple (<i>Acer palmatum</i>) Peach/plum/cherry (<i>Prunus</i> spp.) Apple (<i>Malus</i> spp.) Black walnut (<i>Juglans nigra</i>) Hazelnut (<i>Corylus</i> spp.)	Active, established infestations found in 2000	Yes
Oak rough bulletgall (<i>Disholcaspis quercusmamma</i>)	Bur oak (<i>Quercus macrocarpa</i>) Swamp white oak (<i>Q. bicolor</i>)	Native, variable	Yes
Pine and spruce needle blights (<i>Mycosphaerella</i> spp., <i>Rhizosphaera kalkhoffii</i> , <i>Stigmina lautii</i>)	Pine/Spruce (<i>Pinus</i> spp./ <i>Picea</i> spp.)	Native, variable	Yes
Scale insects (many species)	Various hosts	Native, variable	Yes
Mites (many species)	Various hosts	Native, variable	Yes
Decays (many species)	Many hosts, especially in overmature trees; often found in high numbers in communities	Native, variable	Yes

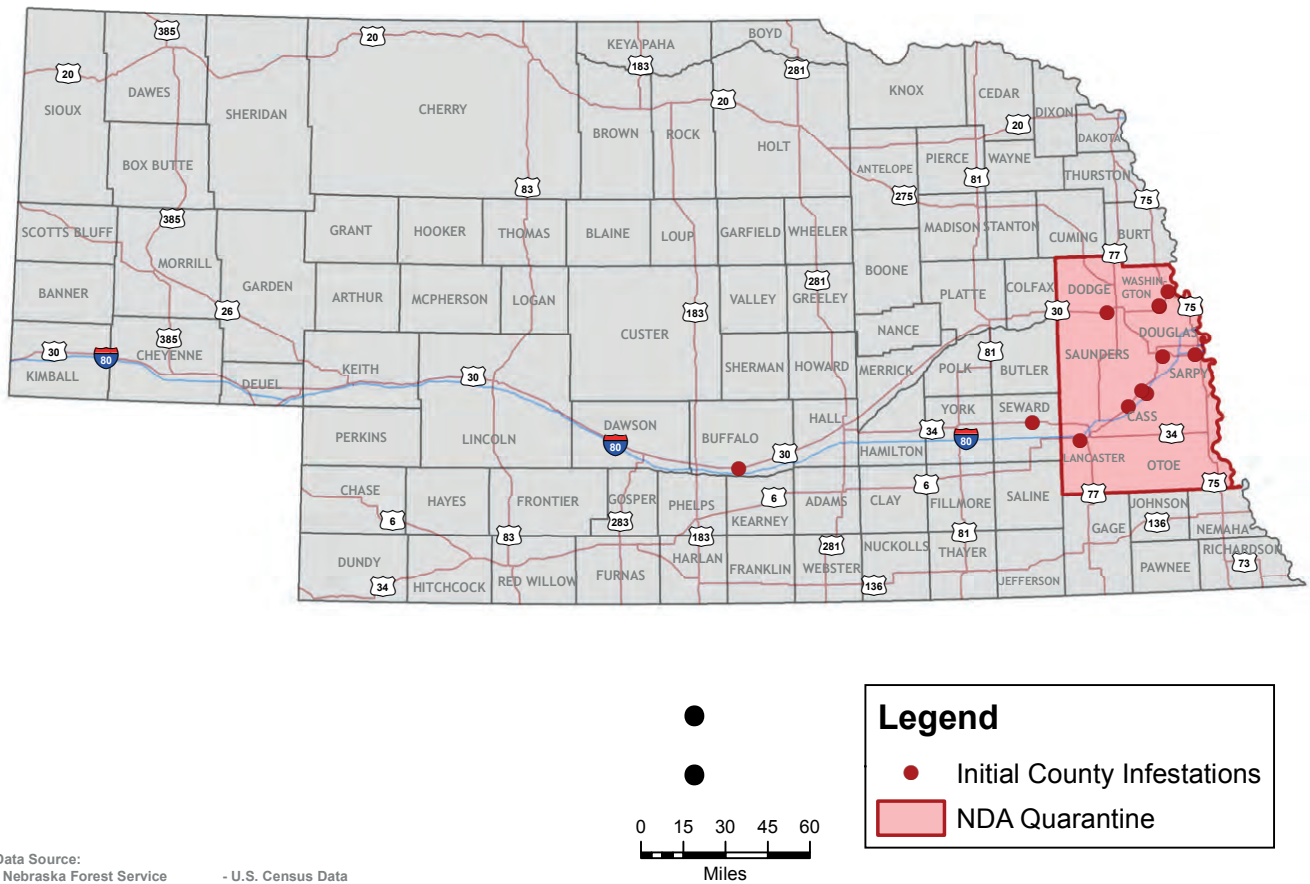
*This table is an overview of diseases, pests, and other biotic concerns for Nebraska. Many species are considered native. Annually, each varies due to fluctuations in weather, climate, and forest resiliency.

Threats and Challenges

Emerald ash borer (Agrilus planipennis)

EAB is a highly invasive insect that has killed millions of ash trees in the eastern U.S. and Canada since its discovery in 2002. EAB was first detected in Nebraska in 2016 and has now been found in eastern and central areas of the state. On its own, EAB will normally spread a mile or two each year. The transport of infested firewood, nursery stock, and ash wood products is widely accepted as the primary driver for the insect's proliferation around the country. The introduction of EAB puts Nebraska's 44 million ash trees in communities, agroforestry plantings, and native woodlands at high risk.

Figure 32: Emerald Ash Borer Detections in Nebraska as of August 2020



Typically, within four to five years after EAB is discovered in a community, ash mortality escalates. This can overwhelm municipal budgets and staff. Because trees killed by EAB are brittle and prone to failure, they can pose an immediate risk to people and property and should be addressed promptly. However, these trees are dangerous to climb and take down. The combination of these factors can greatly increase removal and mitigation costs. The NFS projects costs to remove, dispose, and replace nearly 1 million municipal and private ash trees to exceed \$961 million (Nebraska Forest Service, 2012).

Nebraska communities with limited budgets and a high density of ash trees will be heavily impacted. Additionally, many communities across Nebraska will need to address their extensive inventories of overmature trees. The NFS has promoted EAB readiness planning, species diversity, and detection

training for many years. However, the need for these activities still remains. This is apparent as the state experiences a surge in popularity and subsequent overplanting of maple species; setting the stage for a similar issue in the years ahead.

Pine wilt (*Bursaphelenchus xylophilus*)

Scotch pine, a popular tree for ornamental plantings, windbreaks, and Christmas trees, is rapidly disappearing from Nebraska's landscape. Tens of thousands of Scotch pines have been killed by pine wilt since the mid-1990s. Austrian pine is also susceptible to the disease. Management of the disease involves burning or chipping infested trees to limit its spread. Injection treatments are available to protect high-value pines but are expensive and provide limited protection. Extensive mortality has occurred in the eastern half of the state and is increasing westward. Awareness and education are needed in these areas.

Herbicide damage

Reports of herbicide damage to off-target vegetation have soared across the state and the country in recent years. In particular, trees exhibiting symptoms typical of growth regulator type herbicides, such as 2,4-D and dicamba, occur in both urban and rural areas. Leaf cupping and curling; twisted, distorted stems; and thin, pale canopies are especially common in some of the more sensitive species: oaks, elms, hackberry, coffeetree, and redbud.

Damage to trees frequently occurs in spring as leaves are emerging from buds, which coincides with spring "burndown" applications to crop fields. It also occurs during the appearance of dandelions in lawns—prompting homeowners and landscape professionals to spray. The high volatility of these herbicides make them prone to long-distance, off-site movement.

Herbicide damage is a complex issue. Nebraska's economy revolves around agriculture, and there is a strong dependence on herbicides to control weeds in crops—particularly glyphosate-resistant weeds. Ideal weather conditions for chemical application are rare, resulting in a greater chance for off-target movement via drift or volatilization. For those

with herbicide damaged trees, recompense is difficult.

Chemicals may move long distances, making it challenging to identify the source. The specific chemical responsible may be difficult to determine as well—a vast array of herbicide chemistries and product combinations exist, and there is very limited information on threshold levels in tree tissues that cause symptoms. The chemical may also degrade in tissues before testing occurs. In many areas, trees are exposed to herbicides year after year, which shortens their lifespan.

The effect on human health is yet another concern. A better understanding of changes in farming practices and trends in weather conditions is needed to help address the issue, as well as increased awareness and discussion from stakeholders in agriculture, horticulture, and natural resources.

Weather extremes

Nebraska's climate and weather extremes impact trees directly and are correlated to an increase in pest problems. Hailstorms frequently cause widespread flare-ups of Diplodia blight (*Diplodia sapinea*) in the ponderosa pines of central and western Nebraska. Drought stress makes trees more susceptible to borers, bark beetles, cankers, and root diseases. Bark beetles attack fire-stressed trees: engraver beetles (*Ips* spp.) caused significant mortality to trees surviving the 2012 Pine Ridge and Niobrara fires. Untimely freezes increase canker dieback.

Heavy rains and prolonged flooding have also resulted in dieback and mortality. The generally wetter conditions of recent years have led to more foliar diseases including needle blights in pine and spruce, *Cercospora* blight (*Pseudocercospora juniperi*) in juniper/redcedar, rust diseases of many trees, and bur oak blight (*Tubakia iowensis*). Chlorosis due to a deficiency of iron or other micronutrients is exacerbated by saturated soils and is common throughout the state.

Mitigating the effects of weather extremes is a challenge that will require adaptive

management practices over the life of this plan. It will also require increasing species diversity and testing of cultivars that can adapt to future conditions. See Chapter 6 for more information on climate and weather extremes.

Other current pests

Wilt diseases, including Dutch elm disease (*Ophiostoma ulmi*), oak wilt (*Ceratocystis fagecearum*), and *Verticillium* wilt (*Verticillium* spp.) continue to cause mortality in hardwoods—particularly in the eastern part of the state. Bagworm (*Thyridopteryx ephemeraeformis*), which is common in eastern Nebraska, is now becoming prevalent in the central part of the state. Extensive defoliation by bagworm occurs on spruce, juniper, and redcedar. Various species of scale, as well as bud/stem-galling insects, are affecting growth and vigor of a broad range of trees. High populations of cedar bark beetles (*Phloeosinus* spp.) in redcedar slash piles are targeting stressed trees in windbreaks as well. Ponderosa pine stands in the west are affected by various decays, western gall rust (*Endocronartium harknessii*), and bark beetles (*Ips* and *Dendroctonus* spp.). A general decline in oak species in the east may be due to a combination of conditions including site disturbance, herbicides, insects, and diseases.

Potential pests

A number of pests not yet known to occur in Nebraska have the potential to cause decline or mortality if introduced. Asian longhorned beetle (*Anoplophora glabripennis*) and gypsy moth (*Lymantria dispar*) are exotic species with broad host ranges. Thousand cankers disease (*Geosmithia morbida*) affects black walnut, which is valued for its wood, nuts, and attractiveness to wildlife. Drippy blight is a disease/insect complex affecting red oaks and

is caused by a bacterium (*Lonsdalea quercina*) and a scale insect (*Allokermes galliformis*). Spotted lanternfly (*Lycorma delicatula*) feeds on a wide variety of trees, shrubs and woody vines, causing reduced vigor and occasionally shoot dieback. These and other potential damaging pests are still largely unfamiliar to many of the state's natural resource and green industry professionals and the public.

Invasive and aggressive native plants

Forest health is also affected by invasive and aggressive native plants, which can outcompete native vegetation, lower forest productivity, and alter wildlife habitat. Many problem plants are woody species originally planted in communities and shelterbelts that naturalized in forests, riparian areas, and grasslands. A challenge for community landscapes and working forests is finding species that are tough and adaptable but don't pose an ecological threat of invasiveness. Invasive and aggressive native plants are discussed in Chapter 6.

Human and Urban Conflicts

People are often hard on trees, especially in urban and agricultural settings. Poor pruning, soil compaction, poor management, construction and conflicts, vandalism, pesticides, and other actions exact heavy tolls on trees. One of the larger concerns is the lack of knowledge and connection between people and nature. Exacerbated by modern living, people are excluded from plant and animal communities and often fail to understand the inherent aesthetic, environmental, and ecological value they possess.

The following table ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs.

Table 50: Forest Health Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
PESTS				
1	Declining forest health due to insects and disease (including EAB)	State; Federal; Local government; Private; Tribes	CF, FH, RF	1, 2, 3
2	Invasive and aggressive native plants	State; Federal; Local government; Private; Tribes, NRDs	CF, FH, RF	1, 2, 3
WEATHER EXTREMES				
3	Nebraska's severe weather conditions impact trees directly, as well as contribute to an increase in pest problems	State; Federal; Local government; Private; Tribes, NRDs	AF, CF, FH, RF	1, 2, 3
HERBICIDES				
4	Herbicide damage to off-target vegetation	State; Federal; Local government; Private; Tribes, NRDs	AF, CE, CF, CFPT, FH, RF	1, 2

*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire
 **National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests

Trends

The year 2020 marks four years since EAB was discovered in Nebraska, which is typically when ash mortality becomes apparent. In a matter of a few years, mortality will rise substantially in infested areas, and new outbreaks throughout the state will be discovered. Other pests, whether native or exotic, are also likely to arise.

Incidence of herbicide damage to trees will likely increase as more acres are planted to herbicide-resistant crops. If warmer conditions prevail, herbicide volatility will also increase. There is limited research focusing on long-term effects of herbicides on trees, but it is likely that chronic exposure will result in tree decline and mortality.

Climate variability and extreme weather conditions are expected to become more common in the future. An average of several climate models indicate the state will become warmer, with hotter summers, warmer winters, and a fourfold increase in weather “anomalies,”

presumably including extended and intensified droughts, more frequent heat waves and heavy rainfalls (Karl, Melillo, & Peterson, 2009). The increase in number and severity of weather events will have a direct impact on tree health, and will increase incidence of many pest problems. For example, wetter springs and drier summers in the Pine Ridge will likely lead to more fire events, which can be followed by bark beetle attacks on the residual trees.

Finally, many arborists are turning to trunk injections as their treatment method of choice. Most injection methods require the drilling of multiple holes around the trunk to deliver the pesticide. Both the holes and the chemical itself can damage tree tissues. In general, the larger the holes and the more chemical injected, the greater the damage. Repeated injections over several years can lead to tree decline and death. This may lead to an uptick in mortality of trunk-injected trees in the future.

Impacts

Invasive insect and disease pests are a threat to Nebraska's forests because of their potential to essentially wipe out entire species within the state. In communities, dead and dying trees create a hazard and must be removed at tremendous cost to municipalities and private individuals. In both urban and rural areas, insect and disease pests can result in the loss of many millions of dollars of ecosystem services provided by trees.

Desired Outcomes

Increase Knowledge and Understanding of Current and Future Pest and Environmental Problems

Forest Health goals for the next several years include gaining a better understanding of current pest problems, identifying future pest outbreaks, and developing a better understanding of the role of environmental extremes on tree health. This knowledge will then be transferred to clientele to help them effectively manage current and future tree problems. One step in accomplishing this goal will be to incorporate information exchanges with new NFS staff, stakeholders, and partners.

Increase Collaboration Across Programs

By working with other programs such as Community Forestry, Rural Forestry, and Wildland Fire, the Forest Health program has the potential to help meet other FAP goals, making Nebraska's forests healthier and more sustainable.

Mitigate Herbicide Damage to Forestland and Trees

Through sampling and testing, Forest Health aims to collect data to better understand the effects of drift, volatilization, and its impacts to off-target species. This information can provide NFS staff with enhanced guidance for practitioners and stakeholders. Additionally, this information can be used by coordinating entities to effect change in practices that are contributing to herbicide damage.

Wildland Fire

Overview

Wildfire is a statewide topic of concern for landowners and natural resource agencies. The volunteers in Nebraska's 481 rural fire districts provide fire protection, fire prevention, and education programs to residents of their districts, with some assistance from state and federal resources. The NFS works closely with VFDs to provide planning, training, grant assistance, and equipment that increases districts' capacity to protect life and property and implement effective education programs. The NFS also works closely with the State Fire Marshal's Agency and Nebraska Emergency Management Agency to provide training and support for VFDs, increasing their qualifications and capacity to respond to incidents. Interagency relationships to provide future, collaborative assistance and incident management resources to VFDs are also being formalized.

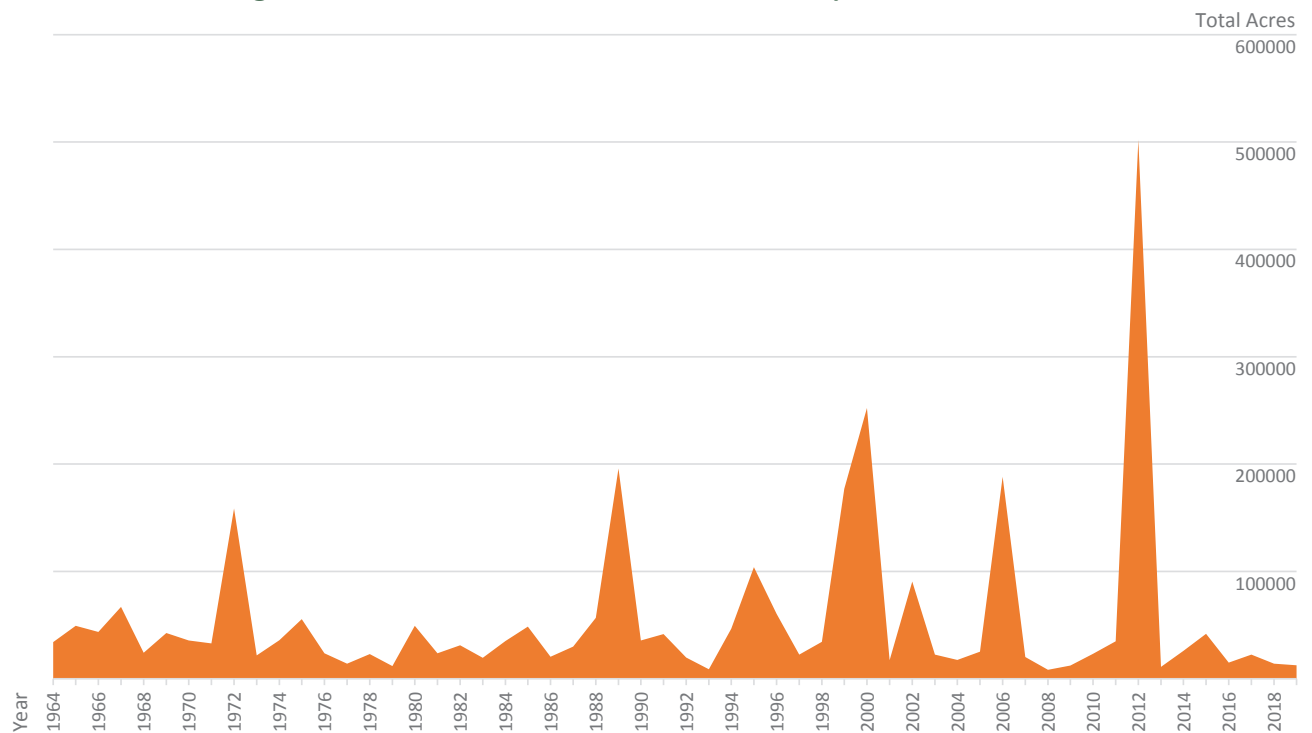
Core objectives of this program include providing fire training to build VFD's response capacity, offering fire prevention programs and materials, managing local and state contracted aviation resources, and helping local jurisdictions with incident management. The NFS currently manages over 850 pieces of wildland fire equipment, valued at over \$96 million, placed throughout the state with VFDs. NFS fuels foresters also work with landowners to implement forest management projects to reduce hazardous fuels statewide.

Current Condition

Wildfires no longer burn as they once did, which is problematic for today's growing and dispersing population. For more than 80 years, most wildland fires have been suppressed. This has resulted in fuel load increases to unnatural levels. Because of active fire suppression, pine needles, pine cones, branches and debris have accumulated on the forest floor, and brush and small-diameter trees have become established in the forest understory. This creates "ladder fuels" that serve as pathways for ground fires to spread into tree crowns. When fires reach the upper forest canopy, they behave erratically and can quickly spread and change direction.

This uncharacteristic fire behavior makes high-intensity crown fires hard to suppress. It also makes firefighters’ jobs far more difficult and dangerous. For example, when the crowns of trees are consumed by fire, a tremendous amount of energy is released. This heat energy creates powerful columns of rising air capable of carrying firebrands, such as burning pine cones or small branches. These firebrands create additional “spot fires” in front of the advancing flames and rain down on structures in the fire’s path. When a fire reaches this stage, its behavior is extremely difficult to predict—meaning that adjacent first responders, private citizens, and property are all now in harm’s way.

Figure 33: Total Acres Burned in Wildfires by Year in Nebraska



Source: Nebraska Forest Service, 2018b

Nebraska’s fire history includes several stand-replacing fires, such as the fires in 1965, 1972, 1973, 1989, 1999, 2000, 2006, and 2012 (see Figure 33). Fires in recent decades have exhibited extreme fire behavior with high intensity and severity. During the past 50 years, Nebraska has experienced an annual average of 56,946 acres burned by wildfires. In the past two decades, that figure has climbed to over 77,500 acres. The NFS considers active and lengthy fire seasons to be the new normal, in part because of the unique conditions that exist in Nebraska’s forests.

The state’s ponderosa pine forests are the easternmost occurrence of this species in North America. These forests exhibit unique characteristics that can lead to extreme fire behavior and a high rate of spread. Known for regenerating in dense, overstocked stands, ponderosa pine creates ladder fuels in pockets within the understory. In areas where there are heavy fuel loads of native grasses and eastern redcedar, this fuels arrangement can lead to fast-moving wildfires capable of burning entire forested areas.

The 2006 and 2012 fire seasons demonstrated how significant the wildfire threat is in Nebraska. In July of 2006, the Spotted Tail Fire burned through 12 miles of ponderosa pine forest in less than five hours and entered the community of Chadron. At its peak, this fire consumed more than 20 acres of forestland per minute. In a 10-hour period, the larger complex of fires burned over 23 square miles.

In 2012, dry conditions precipitated the largest wildfire season in Nebraska's recorded history. One of the first large fires was tackled in mid-March near the Nebraska/South Dakota border. Seven months later, 22 fires had started that reached over 1,000 acres in size. Two of these wildfires, the Fairfield Creek Fire and Wellnitz Fire, burned around 77,000 acres each. Cumulatively, these 22 fires burned nearly 400,000 acres in areas across central and western Nebraska (Monitoring Trends in Burns Severity, 2020). An additional 100,000 acres burned in smaller fires across state, bringing the 2012 totals to more than 500,000 acres burned (National Wildfire Coordinating Group, 2020).

The intensity of these fires and removal of large swaths of forestland have left areas with no viable seed source from which to regenerate—leading to the expansion of grasslands in some areas. Ongoing programs for forest fuels reduction in Nebraska are critical to mitigate the risk of further stand-replacing fires. These projects create fuel breaks that are essential for firefighters. It allows them not only to contain fires while they are small, but provides an opportunity for a safer suppression response.

In addition to growing forest fuel loads, another substantial risk is the increasing size of the WUI (Wildland Urban Interface) in Nebraska. As in much of the country, Nebraskans are moving to forested areas at an increasing rate, particularly in coniferous and riparian forest areas. With more people moving into rural, often forested areas, fire suppression has become more difficult and dangerous. Firefighters must now be concerned with evacuations and structure protection—all this while still actively fighting wildfires. The blending of these responsibilities is increasingly problematic because many housing developments have only one access point, and there is often little water available for suppression. With few or no zoning restrictions, countless structures and a growing number of residents are highly vulnerable to large, uncharacteristic wildfires.

WUI interface settings are common in the Pine Ridge, Niobrara Valley, and Wildcat Hills. They are also found in the Loess Hills in southwestern Nebraska, along the Republican, Platte, and Missouri Rivers, and in the Devil's Nest area of northeast Nebraska where eastern redcedar is increasingly common. Many ranches and farmsteads are also at risk.

Threats and Challenges

High-intensity wildfires are one of the greatest threats to forest ecosystems in Nebraska. When fires ignite in areas with high stocking rates or an overabundance of woody or fine fuels, fires are able to spread and quickly build in intensity. This can result in a fire that burns at extremely high temperatures and engulfs any available fuel in its path. When fires reach this magnitude, entire forest systems are at risk. The encroachment of eastern redcedar into pine, mixed-pine, and riparian forests compounds these risks as redcedar is highly combustible in dry conditions. If large forested areas are subjected to high-intensity wildfires, it is probable that the area will convert to grassland. This results in the loss of ecological diversity and economic value associated with the forests.

The 2012 wildfires in western and north central Nebraska are prime examples how these events negatively affect tourism, land values for private forest owners, and public safety. These fires also endanger the integrity of the forest system. For example, in the Pine Ridge, Wildcat Hills, and Niobrara Valley forests, *Ips* (*Ips* spp.) engraver beetles attack fire-weakened ponderosa pines. This further diminishes the ecosystem's ability to recover, exacerbating the decline of the forest resource.

Table 51 ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs that are available to respond to these challenges.

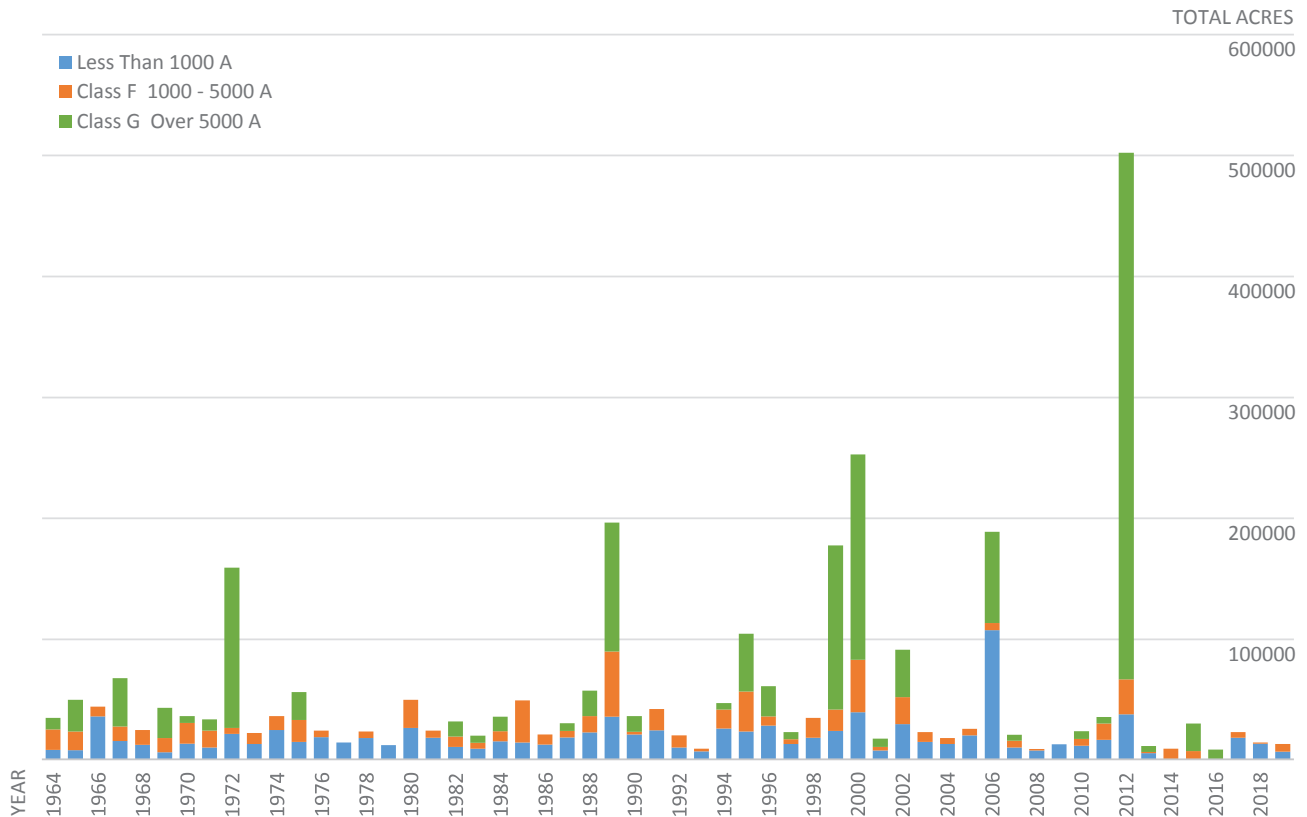
Table 51: Wildland Fire Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
UNCHARACTERISTIC & HUMAN-CAUSED WILDFIRES				
1	With more people moving into rural, often forested, areas fire suppression has become much more difficult and dangerous	State; Federal; Local government; Private; Tribes, NRDs	AF, CF, RF, WF	2, 3
2	The uncharacteristic wildfires in western and north central Nebraska have negatively affected tourism, land values for private forest owners, and safety of Nebraskans	State; Federal; Local government; Private; Tribes, VFDs	CF, RF, WF	2, 3
WILDLAND URBAN INTERFACE & CAPACITY ISSUES				
3	Poor ingress/egress	State, Local, VFDs	CF, RF, WF	2
4	New subdivisions	State, Local, VFDs	CF, RF, WF	2
5	VFD recruitment/retention	VFDs	CE, WF	2, 3
6	Limited state capacity to respond to wildfires	State, federal, local	RF, WF	1, 2, 3
FUELS				
7	Ongoing programs for forest fuels reduction in Nebraska are critical to mitigate the risk of stand-replacing fires	State; Federal; Local government; Private; Tribes, NRDs	RF, WF	1, 2, 3
<p>*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire</p> <p>**National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests</p>				

Trends

Nebraska typically experiences an average of 1,500 wildland fires each year during two distinct fire seasons. The first begins in late February and runs through spring green-up, typically in May. A second fire season begins in midsummer and runs through October, sometimes into November. Several trends exist that prolong the state’s two fire seasons: increasing forest fuel loads; the encroachment and forest-type conversion by eastern redcedar; the expansion of housing into undeveloped areas, which creates or expands the WUI; and, increasing temperatures and drier conditions may all extend or increase the severity of each fire season.

Figure 34: Nebraska Wildfires, Total Acres Burned by Size Class



Source: Nebraska Forest Service, 2018b

Impacts

Stand-replacing wildfires in Nebraska have converted large swaths of forestlands to grasslands. While not inherently negative, the resulting ecological succession and displacement of native species will have drastic impacts to the forest ecosystem. Additionally, the removal of woody species can lead to higher incidents of water and wind erosion of vulnerable soils, lowering the productivity of rangelands. The increasing intensity and frequency of wildfires in Nebraska, particularly in pine forests, may lead to the displacement or elimination of forest-dependent species. Worse yet, these conditions may precipitate the eventual collapse of the forest ecosystem.

Desired Outcomes

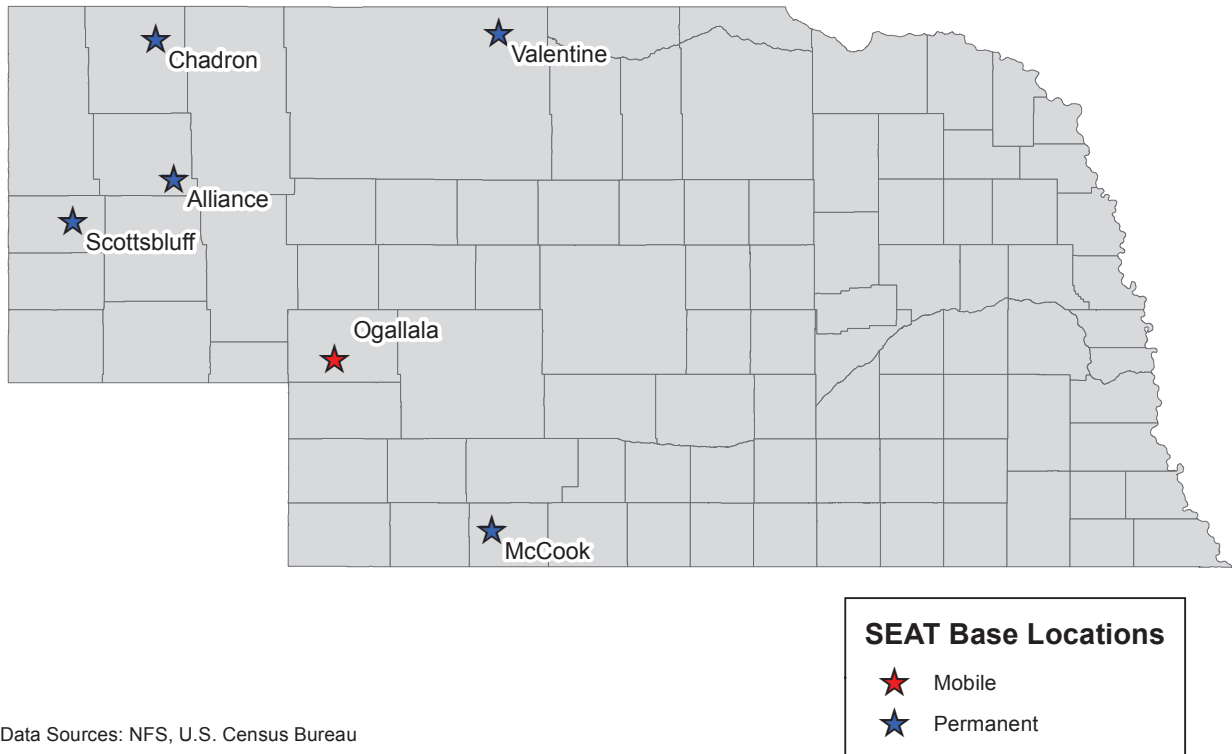
Increase Aerial Support Resources and Training

Background: Fire chiefs can request additional resources from the state during an incident. One resource is the single engine air tanker (SEAT). The airplane is under an exclusive-use

contract with the state. There are also 22 aerial applicators who can fly fires on an as needed basis. South Dakota also has agreements with SEAT contractors. However, both states have made their resources available to neighboring states during wildfires. The NFS maintains five permanent SEAT bases, with over 10,000 gallons of holding capacity of retardant at each location, as well as two mobile SEAT bases. The Nebraska Wildfire Control Act (2013) authorizes the NFS to manage these bases with two permanent staff and three on-call SEAT base managers.

Desired Outcome: As fire activity and intensity increases, adding funding to obtain a second SEAT plane and extending the contract of the existing plane during extreme conditions would provide invaluable support for the state’s VFDs. Additionally, increasing the qualifications of NFS staff would allow each to train more SEAT base managers and bolster capacity to staff bases in the future.

Figure 35: Locations of Permanent and Mobile Bases for Nebraska’s SEAT Program



Data Sources: NFS, U.S. Census Bureau

Build State Suppression Assistance for Volunteer Fire Departments

Background: The NFS and other agencies do not have hand crews or other assets available for directly attacking wildfires. This leaves a void in suppression activities as fires transition from the initial response phase to an extended attack.

Desired Outcome: Create a fuels treatment team and engine crew that provides training opportunities to NFS staff and VFD trainees while providing suppression support during large wildfires.

Collaborate with Nebraska Agencies to Form Incident Command Team

Background: Several agencies within Nebraska are charged with assisting in the development and support of an Incident Management Team (IMT). Nebraska finalized a “Type 3” IMT structure in 2020. The collaborating agencies have a responsibility to support VFDs and suppress wildfires. Each agency falls under different laws and requirements, but all have a responsibility to assist with wildland fire protection in Nebraska.

The State of Nebraska will accept All-Hazard or National Wildland Fire Coordination Group (NWCG) qualifications. Nebraska Emergency Management Agency typically uses All-Hazard qualifications. The NFS follows NWCG qualifications as required by Federal legislation. The State Fire Marshal’s Office uses both. Teams will be formed using both qualification systems.

NEMA

According to the Nebraska Emergency Management Act, “It shall be the policy of the Nebraska Emergency Management Agency to enhance Emergency Management operations at disaster sites by enhancing local incident management functions utilizing an Incident Management Team(s) as deemed necessary by the Governor, Director or Assistant Director.”

The *National Response Framework* states that a primary role of state government is to supplement and facilitate local efforts before, during, and after incidents. This framework is FEMA’s guide to how the nation responds to all types of disasters and emergencies. It is built

on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the nation.

NFS

The mission of the NFS is to provide education and services to the people of Nebraska for the protection, utilization, and enhancement of the state's tree and forest resources. As part of carrying out its mission, the NFS "shall provide fire protection to all rural land, in cooperation with the state's rural fire protection districts."

Nebraska State Fire Marshal

This agency's Wildland Incident Response and Assistance Team provides assistance on wildland fire incidents when local organizations have exhausted all resources and strategies. The team is highly trained in Incident Command, including the capability to work large incidents, coordinate water supplies and aerial support, and provide field supervision with tactical considerations and support.

Desired Outcome: Facilitate the development of two Type 3 IMTs. Through collaborations with member agencies, staffing two teams is achievable for Nebraska. The program has the potential to help meet FAP goals of protecting and enhancing Nebraska's forests, resulting in healthier and more sustainable forests.

Increase the Volunteer Force of Nebraska's Fire Departments

Background: Nebraska is seeing a rise in wildfire occurrences and number of acres burned. Nationally, 84% of wildfires are human-caused. The length of fire seasons has tripled, and fires are occurring in areas normally too wet to carry fire naturally. A growing number of people are moving into WUI areas statewide, increasing risks to lives and property. The incidence of human-caused fire in the WUI is also increasing, straining the ability of VFDs to effectively respond. Increasing fuel loads, from species such as eastern redcedar, create an urgent need for more volunteers and prevention programs.

Desired Outcome: Develop a cadet program focused on recruitment and prevention.

Increase Statewide Capacity to Respond to Wildfires

Background: The NFS provides training to VFDs across the state. Certifications through NWCG are available to departments up to the qualifying level of the instructor. NFS staff maintain qualifications for supporting a Type 3 IMT up to and including the position of Incident Commander Type 3.

Desired Outcomes: Build on existing training curriculum to increase NWCG qualifications of NFS staff and Nebraska's firefighters. Work with partner agencies to increase overall qualification and capacity within the state.

Assist Communities with Wildfire Preparedness Measures

Background: During the 2015 update of the FAP, the NFS identified the lack of community wildfire preparedness as a weakness within the state. To improve safety and reduce the risk to life and property, the agency implemented a two-pronged approach: increase awareness of wildfire threats using the Firewise® community recognition program and develop CWPPs for any areas of the state that previously did not have plans.

Desired Outcome: Cover all WUIs in Nebraska under CWPPs; the federal WUI grant program only allows fuels reduction cost-share in areas covered by a CWPP. Creating new CWPPs allows the NFS to apply for WUI grants covering these additional areas, thus expanding the fuels reduction efforts in the state.

Desired Outcome: Garner additional state funding to match federal WUI grant funds. The federal WUI grant program provides 50% cost-share for fuels reduction. Landowners provide 25% match, and the other 25% is matched with state funds. The amount of state-allocated funding limits the number of WUI grants that the NFS can apply for each year. Increasing the amount of state funding creates more opportunities to complete cost-shared, fuels reduction projects in the state.

Desired Outcome: Increase the number of Firewise communities in Nebraska. Valentine and Long Pine are the only two Firewise

communities in the state. Creating more Firewise communities in Nebraska will help raise wildfire awareness and preparation.

Increase Hazardous Fuels Reduction in Targeted Locations Statewide

Background: The NFS uses federal, state, and NGO funds to leverage landowner investments in hazardous fuels reduction in high-risk areas. Since 2002, over 800 fuels projects have treated nearly 25,000 acres of fire-prone land, primarily in the Niobrara Valley and Pine Ridge regions of Nebraska. Projects are focused on a landscape scale in targeted areas, creating firebreaks that help firefighters respond safely and efficiently to wildfires.

While the total number of hazardous fuels projects has increased since 2002, the average size of each project has decreased (see Figure 36). This correlates to a more strategic approach by the NFS to invest in high-priority areas that will assist firefighters in suppression and containment efforts if a wildfire were to ignite. Fuels treatments within WUI areas are also an agency priority. The number of acres treated has averaged around 1,300 per year since these efforts began. However, in the last three years, treated acres have increased to over 1,700. This upward trend is expected to continue as new staff are hired and these programs are expanded.

Figure 36: Fuels Treatment Projects – Total Projects and Average Size 2002-2019



Source: Nebraska Forest Service, 2019

Desired Outcome: Increase fuels management statewide. NFS staff assist landowners in reducing wildfire hazards on their property. Currently, the NFS has fuels management staff in the Pine Ridge, Niobrara Valley, Loess Canyons, Central Platte, Elkhorn River, Republican River, and Missouri River PFLs. Although there is need for fuels management in other areas, the agency does not have the staff necessary to accommodate this expansion.

Desired Outcome: Increase collaboration by integrating deliverables from other NFS programs (e.g. Rural Forestry and Forest Health). Fuels projects, for example, have the potential to meet other FAP goals by making Nebraska's forests healthier and more sustainable.

Increase the Amount of Firefighting Equipment Placed with Departments

Background: Through the Federal Excess Personal Property (FEPP) and Fire Fighter Property (FFP) Programs, the NFS, in cooperation with the USDA Forest Service (USFS), is able to obtain certain types of equipment that are no longer needed by the federal government. This includes 6x6 trucks, 4x4 trucks, fire trucks, crash trucks, semi-tractors, and generators. This equipment is reconditioned by the NFS and loaned to cooperating rural fire districts. These programs are a tremendous asset to Nebraska as it allows rural fire districts to obtain quality firefighting equipment at a fraction of the assessed value.

At the end of 2018, there were more than 850 pieces of FEPP and FFP equipment on loan to 60% of the rural fire districts across Nebraska. The replacement value of this equipment is nearly \$96 million. Some rural fire districts, including Gracy, Rackett, Mid-Cherry, and Barley are equipped exclusively through these programs.

Desired Outcome: Build additional wildland firefighting capacity by increasing the number of vehicles on loan to departments.

Secure Additional Funding for Volunteer Fire Assistance Program

Background: Through the Volunteer Fire Assistance Program, the NFS provides grants to local fire districts for the purchase of materials or equipment to increase their capacity to effectively respond to fires and provide education about fire prevention to their communities. Fire districts may apply for up to 50% of the project cost and must be able to match the award with local funds. The grants come to the NFS through the USFS. In the past 30 years, approximately 80% of Nebraska's 481 local fire districts have received funds through this program. Since 2015, NFS has distributed more than \$1.3 million through this program.

Desired Outcome: Increase funding levels of the program to ensure VFDs are equipped to safely respond to the needs of their constituents.

Desired Outcome: Increase VFD participation in VFA grant program.

Build Prescribed Burning Capacity in Nebraska

Background: Nebraska has several burn associations in the state that use prescribed fire to manage vegetation. The NFS believes that prescribed burning is a valuable tool when utilized properly and implemented safely. While it can address several resource needs at once, it requires having trained personnel burning under ideal conditions with the proper safety resources available.

Desired Outcome: Develop a group of well-trained prescribed fire practitioners that use prescribed fire as a tool to preserve, protect, and enhance natural resources.

Desired Outcome: Increase the use of prescribed fire as a tool for managing ground fuels in existing forests.

Forest Products

Overview

The NFS provides technical and financial assistance to the state's forest products industry, businesses, organizations, municipalities, and individuals to promote and develop wood products and other utilization opportunities for the state's tree and forest resources.

Innovative and strong forest products markets provide economic incentives for landowners and foresters to ensure the health, longevity, and sustainability of Nebraska's forests. From traditional forest products (e.g., lumber) to emerging markets for items such as biochar, nuts, and woody biomass energy fuel, Nebraska's forests offer a plethora of economic development opportunities. These markets will ensure long-term forest health, diversify farm and non-farm income, and revitalize struggling rural communities.

Traditional Wood Products

Nebraska's forest resources contribute significantly to the state's economy through the harvest and use of commodities, non-market environmental services, employment opportunities, and wealth creation. Nebraska's wood products manufacturing industry employs more than 2,200 workers with an output of \$286 million (U.S. Census Bureau, 2005). Haugen, Piva, and Smith (2018) summarized a survey of all Nebraska sawmills and other primary wood products manufacturers. Their report found:

- ▶ Nebraska's primary wood-using industry includes 42 mills (38 sawmills and 4 mills producing other products).
- ▶ Primary wood-using mills processed 2.5 million cubic feet of industrial roundwood in 2014, a 34% decrease from 2009.
- ▶ Industrial roundwood production decreased by almost 40%, from 4.1 million cubic feet in 2009 to 2.5 million cubic feet in 2014.
- ▶ More than 80% of the industrial roundwood processed by Nebraska mills was cut from Nebraska forests. Cottonwoods accounted for almost 80% of the total volume processed.
- ▶ Industrial roundwood harvests were

comprised of 70% cottonwood. Eastern redcedar (18%) and black walnut (7%) were the other major species harvested.

- ▶ Nebraska sawmills processed 10.6 million board feet of saw logs in 2014, a decrease of 45% from 2009.
- ▶ The total volume of wood removed (3.3 million cubic feet) amounted to less than 1% of the total live volume of trees in forestlands.

Woody Biomass Energy

Woody biomass energy is a proven, reliable option for both heating and cooling in the state. These energy systems provide important outlets for forest management wood waste, as well as wood products manufacturing waste. Nebraska's primary wood-using industries generate 40,000 green tons annually of wood residues (slabs, sawdust, bark, etc.); 89% of which were used for fuel, mulch, animal bedding, etc. The remaining 11% of residues went unused.

Nebraska utilizes 35,000 tons of woody biomass fuel each year. Chadron State College is the largest and most recognized biomass energy system. It utilizes 8,000 tons of wood fuel each year, generated from forest management activities that reduce wildfire threats in northwest Nebraska. Other users of woody biomass include the Arbor Day Foundation's Lied Lodge in Nebraska City, a number of alfalfa dehydration plants, and, the Nebraska College of Technical Agriculture. Several other facilities, including primary wood processing facilities, are considering switching to woody biomass as a primary thermal energy source.

Nebraska's forests produce 12 million cubic feet of net growth each year. This is the equivalent of 300,000 net oven-dry tons of biomass annually. The total live-tree biomass on forestland is approximately 46 million oven-dry tons (Meneguzzo & Nelson, 2018). An estimated 36.7 million cubic feet (590,000 net air-dry tons) of woody biomass is also growing on non-forestland with trees across the state (Meneguzzo, Lister, & Sullivan, 2018). As these trees die or are trimmed, a tremendous volume of material is left to decompose or be burned in waste piles. Eighty-eight percent of live woody biomass in Nebraska grows on privately-owned land.

Woody biomass offers opportunities to produce renewable energy, develop bio-based businesses, generate energy cost savings, and create new markets for Nebraska's low-value and waste wood resources. Lane (2008) identified the annual availability of 270,000 green tons of processed and unprocessed woody biomass from forest biomass, residual byproducts, and community waste wood sources.

The biomass utilization in the Pine Ridge PFL helps illustrate the potential for other areas of Nebraska. From 2011 through 2018, fuels treatment activities conducted on 3,400 acres of forestland yielded:

- ▶ 45,000 tons of woody biomass
- ▶ \$670,000 in energy savings for Chadron State College
- ▶ 1,200 additional days of full-time employment

Biochar

Biochar is a carbon-rich, charcoal-like product produced from biological material, often woody biomass. It is an emerging wood product that has shown promise when used as a soil amendment, pollutant filtration media, or replacement for traditional activated carbon products. It provides significant opportunity as a commercial wood product as it can be produced from low-quality wood and from a variety of tree species.

There is considerable interest in Nebraska and surrounding states for incorporating biochar in the livestock industry. The NFS and the University of Nebraska-Lincoln's Department of Animal Science are investigating the use of biochar as a feed additive, exploring possible reductions in greenhouse gas emissions from livestock. Additionally, the partnership is researching the applicability to feedlot operations and if biochar can improve the health and growth of the animals.

Biochar is an innovative opportunity that not only utilizes the surplus of low-quality wood waste in Nebraska, it could address important environmental issues while providing economic opportunities for biochar producers.

Specialty Forest Products

Specialty forest products include a variety of forest-based products, such as food products, medicinals, botanicals, decorative florals, crafts, Christmas trees, and specialty woods. While most specialty forest product markets are niche in nature, they can be incorporated into traditional agricultural and agroforestry systems. In Nebraska, producers are looking to woody floral cultivars as well as commercial nut production to diversify their operations. Nebraska also has a cottage industry of talented artisans who create novelty wood items and handcrafted wood furniture.

One specific initiative of specialty forest products in Nebraska involves hybrid hazelnuts. The NFS is one of the founding members of the Hybrid Hazelnut Consortium, a partnership with Oregon State University, Rutgers, and the Arbor Day Foundation. The Consortium is developing hybrid hazelnuts as a widely adapted, high-yielding, and low-input crop that is competitive with annual crops for food, feed, or bioenergy.

The partnership has propagated two distinct cultivars that are being tested in 27 sites in seven states (NE, KS, IA, MN, WI, MO, & SD) across the Midwest. Every year, approximately 1,000 unique seedlings are planted for intense screening in research plots at NFS properties. Current plans involve establishing pilot production sites in northeastern and central Nebraska and expanding test sites to include six additional states (CO, OK, TN, AL, NY, & WV).

Current Condition

With the exception of a relatively small and valuable walnut and red oak component, Nebraska's hardwood forests are largely composed of bur oak, hackberry, red mulberry, silver maple, basswood, cottonwood, and green ash. These species have low or no economic value in traditional forest product markets, with the exception of cottonwood. There is also a very high percentage of cull trees (poor form, decayed, or damaged) in harvested forests due to improper logging practices, grazing, and lack of management. Nebraska's forests have not historically supported a large forest industry. However, the businesses and contractors

which make up the industry play a significant role in forest management, local business development, and creating new employment opportunities in rural Nebraska. The following is a brief overview of the current condition of Nebraska's forest products industry:

- ▶ The maturing and declining cottonwood resource will continue to negatively affect the state's pallet industry, as reported by Haugen et al. (2018). Additionally, the decline in quality of cottonwood trees has become apparent and could put Nebraska's one veneer mill at risk.
- ▶ There is a resurgence in the ponderosa pine sawlog market in the Pine Ridge, yet it remains sporadic.
- ▶ Nebraska sawmill output fluctuates widely from year to year. This industry is dependent on a strong agricultural market to drive the demand for pallets, blocking, and dunnage products.
- ▶ Climate and weather events continue to affect the forest products industry. Record wildfire, winter storms, and flooding have impacted forest operations including access to timber, as well as general mortality of timber species. Some of these events have led to sawmill and forest business closures.
- ▶ Small nut processing cooperatives struggle due to lack of raw materials and low sales.
- ▶ Aging proprietors often close businesses operations due to a lack of successors.

Threats and Challenges

- ▶ Frequent and unpredictable severe weather events have led to wildfires, flooding, and storm damage which limits access and opportunities for timber harvests.
- ▶ The forest products and forest operations industry is aging, making it difficult to find loggers or maintain a quality workforce.
- ▶ A lack of timber harvests in forests has resulted in lower-quality stands, increasing tree mortality, and an increased risk of wildfires.
- ▶ Increasing insurance costs for logging operations and sawmills leads to the loss of sawmills and contractors.
- ▶ Lack of consistent investment from state and federal agencies for forest products technical assistance. This reduces the opportunities to improve industry conditions and assist with wood products development.
- ▶ Lack of collaboration and engagement in issues facing the forest products industry, reducing the industry's opportunity to voice their concerns and improve their standing within the state.
- ▶ Lack of consistent-yielding, cold-hardy, and disease-resistant nut cultivars and pollenizers.
- ▶ Changing weather patterns affect tree flowering times and can limit nut crop yields.
- ▶ Lack of cooperatives force specialty crop producers to develop processing capacity and markets.
- ▶ Decline of membership in professional networks threatens specialty crop technical transfer and the longevity of orchards in the state.

Table 52 ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs.

Table 52: Forest Products Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
ENVIRONMENT & FORESTLAND MANAGEMENT				
1	Frequent and unpredictable severe weather events have led to wildfires, flooding, and storm damage which limits access and opportunity for timber harvest	State; Federal; Local government; Private; Tribes; NRDs	FP, RF, WF	1, 2, 3
2	Lack of timber harvests in forests has resulted in lower-quality stands, increasing tree mortality and exposure to catastrophic wildfire and weather events	State; Federal; Local government; Private; Tribes; NRDs	FP, RF, WF	1, 2, 3
POLICY				
3	Restrictive highway load limits reduce the efficiency and cost-effectiveness of transporting raw material (logs, chips) to market	State	FP, RF	3
INDUSTRY				
4	Forest products and forest operations industry is aging, making it difficult to find loggers or maintain quality workforce in forest products businesses	State; Federal; Local government; Private; Tribes; NRDs	CE, FP, RF	2, 3
5	Increasing insurance costs for logging operations and sawmills leading to the loss of sawmills and contractors	State; Federal; Local government; Private; Tribes; NRDs	CE, FP, RF	1, 2, 3
6	Lack of consistent investment from state and federal agencies in forest products technical assistance reduces the opportunities for service agencies to improve industry conditions and assist with wood products development	State; Federal; Local government; Private; Tribes; NRDs	FP, RF	1, 2, 3
7	Lack of industry collaboration and engagement in addressing issues facing the forest products industry reduces the industry's opportunity to voice their concerns and improve their standing within the state	Private	FP, RF	3

*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire
 **National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests

Trends

Traditional forest products businesses have struggled with maintaining a consistent wood supply, a reliable workforce, and complying with state regulations. Nebraska's forest resource relies on an active and successful forest industry in order to continue and improve management. While traditional industry might be going through a period of decline, the interest areas below show promise for increasing wood utilization in the state:

- ▶ Wood utilization and product development as a tool for addressing eastern redcedar encroachment into forests and grasslands.
- ▶ Production of wood products from community forests as a disposal method for wood waste generated from management and forest health impacts on trees.
- ▶ Innovative uses of biochar to address environmental issues while expanding to large commercial and industrial markets.

Impacts

Identifying and promoting innovative wood product opportunities for Nebraska's tree and forest resources remains a key goal for this program area. Not only can forest products manufacturing provide an economic opportunity for rural communities and businesses, it can also catalyze forest management and improve the health, sustainability, and resiliency of forests. Traditional timber harvests will play a significant role in large-scale utilization and management of the forest resource. Additionally, woody biomass energy and other processed wood products (such as biochar) are non-traditional opportunities that may restore forests to a more diverse and productive condition with higher economic returns. Long-term demand for woody biomass may provide landowners with markets for lower-value trees, creating opportunities to improve the health, vigor, and species composition of forests and conservation tree plantings statewide.

Desired Outcomes

- ▶ Engaged forest products industry which works together to address issues and respond to opportunities.
- ▶ Increased capacity for state personnel to respond to the needs of the forest products industry and forest landowners.
- ▶ Continued development of innovative wood products which have applications within Nebraska's industries.
- ▶ Increased support for entrepreneurs working to develop wood products from Nebraska's forests.
- ▶ Increased timber harvests and forest products industry investment in the state.
- ▶ Engaged landowners increase the utilization of low-quality wood waste.
- ▶ Strong partnerships with industry, academia, and state agencies to develop wood utilization opportunities and increase forest products industry recruitment.
- ▶ Increased collaboration across NFS programs to meet stated FAP goals, making Nebraska's forests healthier and more sustainable.

Community Forestry

Overview

The NFS provides direct, on-the-ground, technical, and educational assistance to communities and green industry professionals through its Community Forestry Program. Programming investments represent a hybrid strategy of combining the resources and expertise of the NFS along with those of the nonprofit, the Nebraska Statewide Arboretum, Inc. (NSA). Through this collaborative partnership, NFS and NSA are able to provide robust green infrastructure services for municipalities, green industry professionals, and community groups.

A community forest is the interface of trees and people in private and public landscapes within villages, towns, and cities. It involves the planning, establishment, management, and protection of trees and associated plants for social, environmental, and economic sustainability. In Nebraska, there are about 489,000 acres of community forest (Nebraska Forest Service, 2018a) that improve air and water quality, assist in stormwater management, provide habitat for wildlife, and improve the quality of life in towns and communities. Currently, about two-thirds of all Nebraskans live and work inside the boundaries of a community forest.

Growing and maintaining trees, community landscapes, or green infrastructure is not an easy task. Much of the state, particularly in the west, was at one time a near treeless prairie. The stressful environmental conditions brought on by very cold winters followed by hot, dry summers can weaken and disrupt the development of any plant, especially longer-lived plants such as trees. Research and applied efforts in woody plant physiology and seed selection are continually looking for tree species that show the potential for optimal growth under such stressful conditions.

Benefits

Nowak and Greenfield (2010) demonstrated that Nebraska's community forests and green infrastructure provide many valuable benefits important to human and ecological health including:

- ▶ Storing 1.4 million tons of carbon, at a value of \$31.9 million
- ▶ Sequestering 46,000 tons of carbon/ year; at a value of \$1 million
- ▶ Removing 1,040 tons of total pollutants/ year; at a value of \$8.4 million including
 - 18 tons of carbon monoxide/year (value of \$24,600)
 - 186 tons of nitrogen dioxide/year (value of \$1.8 million)
 - 400 tons of ozone/year (value of \$4 million)
 - 62 tons of sulfur dioxide/year (value of \$150,200)
 - 372 tons of particulate matter/year (value of \$2.4 million)

Other measurable benefits of Nebraska's community forest resource include:

- ▶ Surface air temperature reduction
- ▶ Increased energy efficiency and reduced fossil fuels use
- ▶ Absorption of ultraviolet radiation
- ▶ Improved water quality
- ▶ Reduced noise pollution
- ▶ Improved human comfort, health and psychological well-being
- ▶ Increased property values
- ▶ Provision of wildlife habitat
- ▶ Improved aesthetics
- ▶ Improved community cohesion

Other Underserved Landscapes

As city infrastructure, it is important for public trees to be evenly and equitably distributed throughout the community for the benefit of all social and economic demographics. Processes that concentrate minority populations in high densities, often proximate to industrial zones, create a socioeconomic disparity in air quality that increases further when trees are absent.

Establishing quality community forests is a process where investments are made long before the ecosystem services compound to achieve significant benefits. This long-term effort disincentivizes low-income communities from planting trees and drives racial inequity to the degree that race and class are intertwined. The NFS is committed to ensuring that underserved communities have equitable access to all of the financial and educational

resources the agency provides. Furthermore, the agency recognizes the need to provide green infrastructure as a nested public good in modern cities. The NFS is further committed to providing assistance to communities that seek to equitably incorporate green infrastructure for the benefit of *all* of their residents.

Rural Community Landscapes

There are only three cities in Nebraska with more than 50,000 in population, making rural community landscapes a priority for the NFS. Because the largest communities have staff responsible for managing community canopies, most of the technical assistance is prioritized and directed toward smaller rural landscapes in Nebraska.

According to Nebraska Blue Book (2018), the state has a population of 1,929,268, with three-quarters of those residing in the eastern third of the state. Two-thirds of the population lives within communities with a population of 2,500 or more (Nebraska Blue Book, 2018). This means that trees and forests in Nebraska’s communities provide a range of valuable environmental, social, and economic benefits. On average, every dollar invested in the community forest resource returns an average of \$2.70 in net annual benefits over the lifespan of a publicly owned municipal tree (McPherson, Simpson, Peper, Maco, & Xiao, 2005).

Table 53: A Breakdown of Nebraska’s Population by Municipality Size

CATEGORY	POPULATION	# CITIES	COMMUNITY
Metro	300,000+	1	Omaha
Primary	100,000-300,000	1	Lincoln
First Class - Large	50,000-100,000	1	Bellevue
First Class - Small	5,000-50,000	26	-
Second Class	800-5,000	118	-
Village	Under 800	383	-

Source: Nebraska Blue Book, 2018

Current Condition

One challenge for community forests in Nebraska is informing and educating leaders and residents on the importance of trees and the benefits they collectively provide. There is a critical need to not only maintain and replace existing trees, but to expand the total amount of green infrastructure incorporated into the community landscape. This needs to occur despite the constant challenges posed by weather extremes, insects and diseases, herbicide damage, and general human harm. It also needs to be accomplished in situations where there are often significant financial constraints.

The extent of Nebraska’s community forest resources have steadily declined in recent years. A combination of severe weather events (1991 freeze, 1997 snow storm, 2007 ice storm, tornadoes, and high winds), chronic drought, poor planting practices, poor species selection, insect and disease pests, and a preponderance of older trees nearing or past their average life span, and growing human apathy have steadily reduced the number of trees in communities across the state. Trends gleaned from more than 200 community tree inventories conducted by NFS since 1977 indicate the state has lost approximately 50% of its urban and community forest resource since the late 1970s (Nebraska Forest Service, 2007).

Tree inventory data from the state’s communities over the last ten years reveals that the top three species are hackberry, mulberry, and Siberian elm. These three species, on average, comprise 38.5% of the overall canopy (Nowak, Hoehn, Crane, & Bodine, 2012). The largest condition class is “good”

with 69%, followed by the “fair” class with 16% (Nebraska Forest Service, 2012). Many rural communities show an abundance of mature to over-mature canopies. These canopies were further degraded by repetitive storms, drought, and flooding over the last decade. A declining canopy increases the number of defective and potentially hazardous public trees. Furthermore, the situation is compounded by a lack of species diversity and poor species selection.

Nebraska Tree City USA community data over the last ten years shows an increase in tree removals versus new tree plantings. This data is supported by a recent USFS study (Nowak & Greenfield, 2018) that suggested Nebraska had the third highest net loss of community tree cover in the country. This is due, in part, to limited budgets to manage trees and the need to concentrate on removals due to extreme environmental issues and EAB. However, in 2018, the 93 Tree City USA communities still reported investing \$6.6 million in their community trees.

Threats and Challenges

Nebraska’s community forest resources face many threats including insects and disease, herbicide damage, inclement weather, and a lack of community support. There are several urgent concerns observed by the NFS that will further reduce the ecosystem services community forests provide. The following are considered “high risk” issues to Nebraska’s community forests:

- ▶ New or continued spread of insects and diseases.
- ▶ Continued declines in community forest cover and overall tree canopy.
- ▶ Poor tree resiliency due to improper species selection and lack of age diversity.
- ▶ Diminished ability to mitigate climatic change (temperature, wind, and air quality).
- ▶ Economic, environmental, and social stress factors continue to increase in urban areas.
- ▶ Common-good environmental issues become embedded in partisan politics.
- ▶ Complex green infrastructure systems are devalued as essential services because of the finite resources of some municipalities.

- ▶ Herbicide damage from off-target drifting increases mortality or reduces tree health.
- ▶ Public indifference or general disconnect from trees: lack of knowledge, how they grow, and what resources are needed to sustain them.

Table 54 (*next page*) ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs.

Trends

State and local governments across Nebraska are experiencing a period where budgets are lean but the list of critical needs is growing. Community forests become less of a priority for many smaller villages and towns out of fiscal necessity. This is problematic when EAB detections are increasing, particularly in the east and central parts of the state. Another concern is the shift in climatic trends, increasing the frequency of damaging storms with high precipitation and strong winds. These two issues alone will present serious challenges to municipalities for current and long-term budget planning.

There is also the issue of dwindling engagement with the community forest resource. Apathy, inaction, and a general disconnect on the benefits of green infrastructure corresponds to declines in maintaining and managing these areas. This can have long-lasting implications as volunteer networks—one of the core elements in managing these areas—becomes obsolete or nonexistent.

Research also shows urban tree canopy cover is inequitably distributed by race. The NFS has an important role to play in encouraging communities to address these disparities with its outreach, grant funding, tree plantings, and other projects (Watkins & Gerrish, 2018).

When combined, the following trends exacerbate issues communities face and lead to the continued decline of Nebraska’s community forests:

- ▶ Higher prevalence of hazard trees that are not adequately mitigated.
- ▶ Increasing pest and disease problems that go unaddressed.
- ▶ Declines in overall biodiversity in the landscape.

Table 54: Community Forestry Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
ENVIRONMENTAL FACTORS				
1	Insects and diseases continue to threaten mature trees	State; Federal; Local government; Private; Tribes	CF, FH, RF	1, 2, 3
2	Change in climate that is causing more intense weather patterns	State; Federal; Local government; Private; Tribes	AF, CE, CF, CFPT, FH, FL, FP, RF, WF	1, 2, 3
3	Communities lack forest management plans to adequately address a changing forest	State; Local government; Private	CE, CF	1
4	Herbicide is a new, complex issue damaging forest resources	State; Federal; Local government; Private	AF, CE, CF, CFPT, FH, FL, FP, RF	1, 3
PUBLIC AWARENESS				
5	Decision makers place low value on complex landscapes, combined with low funding levels and other priorities	State; Federal; Local government; Private	CE, CF, FL	1, 3
6	People don't have the awareness, knowledge, or resources to properly care for trees and landscapes	State; Federal; Local government; Private; Tribes	CE, CF, FL	1, 3
7	Local professionals and landscape design/maintenance contractors don't have access to a wide variety of species and the knowledge of how to use them.	State; Federal; Local government; Private; Tribes	CE, CF	1, 2, 3
VOLUNTEERISM				
8	Decreasing engagement in volunteerism	State; Federal; Local government; Private	CE, CF, RF	1, 3
9	Lack of education and awareness of trees and the value to society	Federal; State, Local; Private	CE, CF, RF	1, 3
COST-SHARE AVAILABILITY				
10	Reduced funding for planting and management	Federal; State; Local government; Private	CF, RF	1, 3

*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire

**National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests

- ▶ Lower volunteerism to assist in community recovery efforts.
- ▶ Reduced capacity to adapt to extreme conditions, compounding the loss of benefits:
 - Economic: Heating and cooling costs increase, shorter life of critical infrastructure;
 - Environmental: Decreased water and air quality; decreased biodiversity; and
 - Social: higher crime rates, lower quality of life, diminished learning in schools.

Impacts

Loss of canopy in communities leads to higher heating and cooling costs, higher street and sidewalk maintenance, and a higher incidence of crime. People are healthier in communities with vibrant trees and a robust canopy. Students learn better when a view of nature, especially trees, is available. Stormwater is cleaner when filtered through bio-swales, and the air is cleaner because of community trees. With the decline in community tree cover, a loss in these social, economic, and environmental benefits can be expected.

Desired Outcomes

NFS staff identified the following desired outcomes for the Community Forestry Program:

- ▶ Achieve a management balance between resilience, growth, equity, and diversity specific to each community.
- ▶ Create a healthy, diverse, and resilient canopy to provide maximum community benefit.
- ▶ Increase public awareness and appreciation for value and services provided by the community forest.
- ▶ Develop sustainable landscapes to meet the current and future needs of residents.
- ▶ Diversify tree inventories to increase landscape resiliency in pursuit of healthy ecosystems.
- ▶ Increase community forest age-class mixes across communities and neighborhoods.
- ▶ Improve water quality and its conservation at a watershed or landscape level.

- ▶ Utilize high-quality, regionally appropriate nursery stock that aligns with community needs and NFS recommendations.
- ▶ Increase outreach and awareness to reach greater numbers of youth and adults.
- ▶ Recruit and engage new volunteers to assist in tree planting and tree maintenance.
- ▶ Provide funding opportunities for communities to invest in green infrastructure and sustainable landscapes.
- ▶ Include metrics of diversity and inclusivity in project impacts and programmatic reports.
- ▶ Ensure partnerships are racially diverse and focus on inclusivity throughout project development and implementation.
- ▶ Encourage trial plantings and tree inventories to facilitate tree replacement recommendations in a changing climate.
- ▶ Expand existing partnerships while creating opportunities for new projects and involvement from stakeholders.
- ▶ Improve public tree management through inventories, management plans, and improved ordinances.
- ▶ Increase programmatic collaboration with other NFS programs, such as Forest Products, Rural Forestry, Forest Health, and Wildland Fire to help meet other FAP goals, making Nebraska's forests healthier and more sustainable.

Conservation Education

Overview

Conservation Education provides both formal and non-formal educators, families, and natural resource professionals with resources to educate Nebraskans on conservation concepts and issues.

The NFS specifically focuses on developing critical thinking and decision making skills to help Nebraskans understand complex environmental issues and make informed decisions. This is accomplished through three main areas of education:

1. Providing professional development for both formal and non-formal educators;
2. Coordinating and facilitating educational field trips on NFS properties; and

3. Creating resource exchanges via class visits, festivals and workshops, and newsletters.

As the state sponsor for both Project Learning Tree (PLT) and Project WET (Watershed Education for Teachers), the primary focus of professional development is to train educators in the use of high-quality environmental curricula each offers.

Current Condition and Trends

Professional Development

PLT and Project WET professional development works. Educators who complete the workshops indicate that they use the curriculum they were trained in at least once per month. Over the last five years, there has been an increased need for these workshops. This is especially true for Early Learning Professionals, as Nebraska State Standards have become more focused on formal education. Early Learning Professionals must now show that they are completing regular, state-approved professional development surrounding a variety of educational focus areas. With science and nature being one of those disciplines, PLT and WET have found a natural fit with these instructors.

Professional development requirements for formal K-12 educators are also changing. With the rise of standardized testing, standardized professional development has followed. Many districts and schools try to ensure their teachers experience professional development in the latest techniques for teaching math, reading, and writing. One particular challenge for educators is these programs are often required. In order to attend a PLT or WET workshop, teachers need to take unpaid leave and find a classroom substitute. This makes PLT and WET workshops a less desirable option for educators.

This same focus on standardization and increased rigor is also present in non-formal education. This can be seen in a rise in after-school and summer programs focused on education. These programs are often led by non-profit organizations and staffed by part-time, non-professionals. The directors of these programs are often looking for easy-to-use

curricula that can be implemented to meet their goals of decreasing the achievement gap. Both PLT and WET fit into this niche nicely and are well-received by this audience.

Educational Field Trips

With large reductions to federal and state budgets since 2009, field trips were cut from most educational programming. Many students in Nebraska now go on one field trip per year. These trips align with specific unit curriculum and remain the same year to year for each grade. Most schools cannot find additional funds to send students off-campus for educational opportunities. The rise in non-formal education (after-school, summer, and school break programs) has increased the need for field trips that are low-cost, enriching experiences. Both the Prairie Pines Nature Preserve and Horning State Farm properties have benefited from this trend. The most popular time for field trips at these locations is currently during summer and school breaks throughout the year.

Information Sharing

With schools and other programs losing the ability to leave for field trips, more and more of these institutions are requesting non-formal educators come to them. Throughout the year, the NFS receives numerous requests for classroom visits, demonstrations, and to host a booth at natural resource themed events. While it is challenging to accommodate every request, hosting or participating in large events has helped reach audiences that might not traditionally interact with the agency.

Threats and Challenges

Professional Development

Currently, the biggest threats to providing professional development for educators are the associated costs and formalized professional development requirements. The NFS cannot currently offer PLT and WET workshops for free, which has made these workshops less accessible to Nebraska's educators. To ensure these important curricula remain available, the NFS must demonstrate how PLT and WET are critical tools for environmental education in the state. In order for professional development to count toward a teacher's continuing education

requirements, the program must be offered by an accredited institution and offer college credit. This means that for PLT or WET to meet these requirements, each must be offered as a university course, pushing the associated costs much higher. Currently, formal educators that attend a PLT or WET workshop do not receive credit for this continuing education.

In 2019, the NFS conducted a survey of all people trained in PLT and WET since 2009. Some of the challenges to using PLT and WET identified were:

- ▶ Lack of time during the school day for extra activities/lessons,
- ▶ Lack of background knowledge (especially related to complex natural resources issues), and
- ▶ Lack of resources (supplies) needed to lead the lessons.

Educational Field Trips

Just as schools have lost funding for field trips, out-of-school programs are also reallocating funding away from these activities. One reason is the high risks associated with transporting children off-campus. If this trend continues, there will be a large gap in experiential learning opportunities. Many education-focused organizations throughout the state, including the NGPC and the Nebraska Museum of Natural History, are using new techniques to bring experiences to students. The NGPC has created traveling kits and trailers that can be checked out and used for educational purposes across the state, at no cost. The Nebraska Museum of Natural History has implemented virtual field trips where classes can log on and participate in virtual tours of the museum and chat with staff and researchers. Both of these techniques have become popular with educators. While both can become easy to maintain once implemented, the start-up funds needed for the NFS to follow suit are currently not available.

Information Sharing

With people becoming busier, and schools reducing travel budgets, the best way for the NFS to reach a wide variety of Nebraskans is to participate in educational events throughout the state. A challenge in this arena is that many of these events only want to provide

organizations with booth space. While booths are excellent for handing out small bits of information, they are not ideal for transformative educational experiences. NFS participation in these types of opportunities will continue, but finding events that allow for more impactful contact time with participants will be important.

Another challenge in this area is limited staff capacity. With one staff member located in Lincoln, many opportunities must go unmet because Nebraska's geographical area and dispersed schools are difficult to travel to on a daily basis. While NFS staff throughout the state participate in these opportunities, it becomes a balancing act as their primary role is to service private landowners. Additionally, many staff feel ill-equipped to assist when professional standards and educational needs of Nebraska's students are rapidly changing.

Table 55 (*next page*) ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs.

Impacts

Forestry education, especially when started at a young age, helps people understand and develop a connection with Nebraska's trees and forests. High-quality conservation education aims to help people develop critical thinking, problem solving, and decision making skills—especially surrounding complex environmental and natural resources issues. When the public is well-informed and educated on an issue, they are more likely to be moved to action. Through a continued focus on quality educational opportunities throughout the state, generations of Nebraskans will better understand how to protect, restore, and utilize Nebraska's tree and forest resources.

Desired Outcomes

- ▶ A public that is adequately informed and feels prepared to make decisions about protecting, restoring, and utilizing Nebraska's tree and forest resources.
- ▶ Expand reach of the PLT and Project WET programs, especially into traditionally underserved communities.

Table 55: Conservation Education Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
PROFESSIONAL DEVELOPMENT				
1	Costs	State; Federal; Local government; NGOs; Tribes	CE, RF, AF, FP, CF	1, 3
2	Professional requirements; lack of background knowledge	State; Federal; Local government; Tribes	CE	3
EDUCATIONAL FIELD TRIPS				
3	Funding; funding re-allocated away from field trips	State; Federal; Local government; NGOs; Tribes	RF, CF, CE	1, 3
4	Risk; classrooms and booths are not ideal for transformative educational experiences	State; Federal; Local government; NGOs; Tribes	RF, CF, CE	1, 3
INFORMATION SHARING				
5	Time and budget limit ability to participate in educational events	State; Federal; Local government; NGOs; Tribes	CE, CF, RF	1, 3

*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire

**National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests

- ▶ Increase in experiential learning opportunities on NFS properties.
- ▶ Increase collaboration across issue areas: By working with other programs such as Forest Products, Rural Forestry, Forest Health, Community Forestry, and Wildland Fire, Conservation Education has the potential to help meet other FAP goals, making Nebraska’s forests healthier and more sustainable.

Rural Forestry

Overview

The NFS provides direct technical support to landowners and other stakeholders throughout Nebraska. This is accomplished primarily through the implementation of the USFS’ Forest Stewardship Program (FSP). This program plays a central role in managing and preserving Nebraska’s forestlands and other lands with trees. Forest landowners receive technical

assistance from staff in forest and woodlot management, windbreak establishment and management, tree planting, reforestation, and other forestry-related activities.

The FSP may also provide landowners with access to cost-share programs and forest certifications, through the preparation and implementation of forest management plans. Since 2015, foresters have provided direct technical assistance to nearly 4,000 woodland owners to help them manage their properties. NFS foresters have prepared nearly 160 Stewardship Plans, covering over 175,000 acres, to help woodland owners access financial assistance to implement stewardship practices on their lands.

Forests and forestry best management practices (BMPs) also help protect, restore and sustain water quality, streamflow, and overall watershed health. Healthy urban and rural forested watersheds absorb rainfall and

snowmelt, slow storm runoff, recharge aquifers, sustain streamflow, and filter pollutants. By identifying areas where continued forest conservation and management is important, water quality, water flows, and watershed health will be sustained and improved. This coincides with opportunities for economic development through specialty forest products, traditional forest products, woody biomass, and ecosystem services.

Current Condition

As previously discussed in Chapter 2, Nebraska has 1.5 million acres of forestland that contains nearly 383 million live trees and represents a unique mix of forest types. In addition to forestland acres, Nebraska has an estimated 1.314 million acres of rural and urban non-forestland. These areas contain approximately 119 million live trees across the state. While these areas are often not large units individually, they provide unique benefits such as rural home wind protection, snowdrift management, energy savings, livestock protection, crop protection and yield increases, water quality and soil protection, wildlife habitat, and other important ecosystem services.

Threats and Challenges

Protecting, conserving, and enhancing forestlands are critical management activities that not only allow for trees to thrive, but entire plant and animal communities to flourish. Indirectly, these actions provide recreational benefits and ecosystem services that countless Nebraskans enjoy. However, there are pressing threats to the state's forest resource:

- ▶ The decline and subsequent loss of ash trees in rural forests and urban areas due to EAB.
- ▶ Potential losses of merchantable black walnut in rural forests and urban areas due to thousand cankers disease.
- ▶ The permanent loss of naturally-occurring ponderosa pine forests after repeated wildfires convert this forest type to grassland.
- ▶ A loss of riparian forests, field and farmstead windbreaks, and agroforestry or conservation tree plantings due to the conversion of lands to agricultural purposes.

- ▶ A change in tree and forest composition, reducing species diversity, in response to shifts in weather patterns and climate.
- ▶ Encroachment of eastern redcedar into other forest types due to successional changes brought on by climatic shifts.
- ▶ The loss of sawmills and contractors due to increasing insurance costs, regulation, and a lack of raw materials.
- ▶ The degradation or removal of forestlands and habitat as fragmentation and urbanization, particularly near population centers, continues.
- ▶ Declines in Nebraska's trees and forest ecosystems as invasive and aggressive native species, insects, and diseases proliferate.
- ▶ Off-target herbicide drift damages trees and forests during critical growth periods leading to declines and mortality.
- ▶ Waning public perception of the importance, economic value, and benefits of trees and forests.

Table 56 (*next page*) ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs.

Trends

A challenging environment exists in the rural forests of Nebraska. The declines in industry and farm economies have made land management costs difficult to justify. While commodity operations are cyclical, additional management activities that cannot be directly tied to the bottom line receive heavy scrutiny. Forest management tends to be a deferred maintenance activity, and forest health and productivity often suffer during fiscal uncertainty.

Another challenge is the shift in land use in Nebraska over the past several decades. Absentee ownership has increased, and this is often associated with changes to the management of forestland. Some lands experience a dramatic increase in woody species, including eastern redcedar. In other cases, the land use changes from commodity and livestock production to recreational purposes. These areas are at higher risk

Table 56: Rural Forestry Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
ECOLOGICAL				
1	Land fragmentation, urbanization	State; Federal (S&PF, NRCS, FSA); Private	RF, WF	1, 2, 3
2	Loss of ash, black walnut, ponderosa pine, and riparian forests	State; Federal (S&PF, NRCS, FSA); Private, NRD	AF, CF, CFPT, FH, FL, RF	1, 2, 3
3	Change in forest composition & diversity due to climatic shifts	State; Federal (S&PF, NRCS, FSA); Private, NRD, NGO, Tribes	AF, CE, CF, CFPT, FH, RF	1, 2, 3
4	Invasive and aggressive native species, insects, and diseases threaten Nebraska's trees and forest ecosystems	State; Federal; Local government; Private; Tribes	AF, CE, CF, CFPT, FH, FL, RF	1, 2, 3
ECONOMIC				
5	Loss of field and farmstead windbreaks and other agroforestry practices	State; Federal; Local government; Private; NRDs	AF, CE, RF	1, 3
6	Loss of sawmills and contractors	State, Private	FP, RF	1, 2, 3
7	Herbicide drift	State; Federal (S&PF, NRCS, FSA); Private, NRD, NGO, Tribes	All	1, 2, 3
SOCIAL				
8	Waning public perception of the importance, value, and benefits of trees and forests	State; Federal; Local government; Private; NRDs	AF, CE, CF, CFPT, FH, FL, RF	1, 2, 3

*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire

**National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests

of wildfire due to the increase in fine fuels (primarily grass) as grazing animals are removed from the system.

Impacts

Land management provides the best opportunity to conserve, protect, and enhance the trees and forests of Nebraska. Proper stewardship allows landowners to create an environment where the species are diverse and the forest is productive. Further, management reduces the amount of fuel loading on the landscape.

Desired Outcomes

- ▶ Protect rare tree species that exist on the edge of their natural ranges in Nebraska such as aspen, birch, limber pine, oaks, and hickories.
- ▶ Create an informed public that understands the value and benefits of trees in rural settings.
- ▶ Empower landowners to make confident and impactful tree and forest management decisions.
- ▶ Engage landowners in the FSP to foster long-term forest management.
- ▶ Offer readily-accessible programs that provide assistance and incentives to private landowners to keep working forests working and encourage sustainable forest management.
- ▶ Increase collaboration across NFS issue areas: By working with other programs such as Community Forestry, Forest Health, Forest Products, and Wildland Fire, the Rural Forestry program has the potential to help meet other FAP goals, making Nebraska's forests healthier and more sustainable.

Conservation Trees

Overview

Trees have long been an important component of Nebraska agriculture. Strategic plantings, commonly referred to as conservation plantings, include windbreaks, shelterbelts, and riparian buffers. Although these are not large units individually, it is another critical resource that provides an array of ecosystem services to Nebraska's agriculture-dominated landscape.

Conservation tree plantings can increase crop yields, reduce soil erosion, and protect livestock from weather extremes. When used as riparian forest buffers, agricultural runoff and sediment are intercepted, protecting water quality. When planted for wildlife, these trees provide critical habitat and food sources. For farmers willing to incorporate conservation plantings into their systems, the benefits can be significant and last for decades.

Tree plantings are also valued additions around Nebraska's farmsteads and ranches, helping protect buildings, livestock, and equipment from inclement weather. Conservation trees have long enhanced the quality of life for farm families, adding beauty and value to their homes and the surrounding landscape.

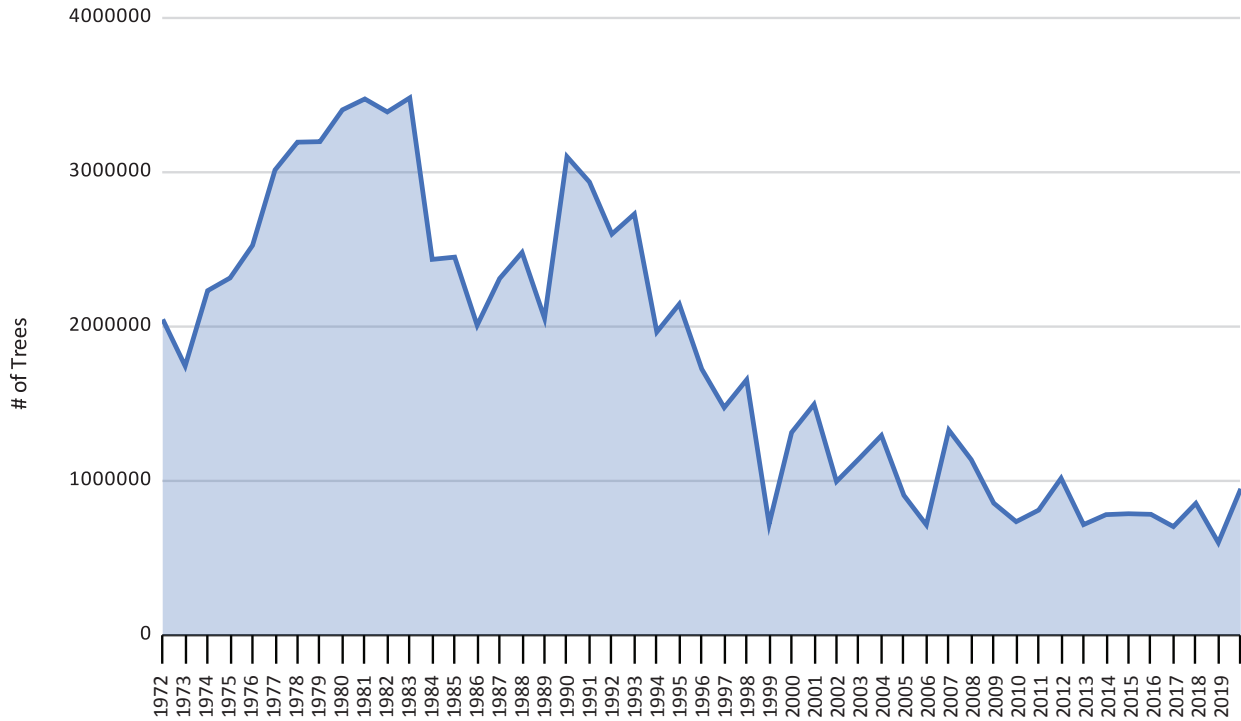
Current Condition

From 1926 through 2002, the NFS administered the state's tree seedling distribution program, which became known as Conservation Trees for Nebraska. This effort remains unique in that there are no state or private nurseries providing tree seedlings for the program. The primary source for trees is the USFS's Bessey Nursery near Halsey, Nebraska.

Since 2002, Conservation Trees for Nebraska has been coordinated by the Nebraska Association of Resources Districts (NARD), with each Natural Resource District (NRD) administering their local tree program. Annual conservation tree/shrub sales in the state have declined from a peak of more than 3.5 million in the 1980s to less than 1 million in 2019 (see Figure 37). The decline is attributed to a combination of factors: fewer but larger farms and ranches, fluctuations in commodity prices, high land values, drought, large-scale expansion of pivot irrigation systems, reduced livestock production, increased planting costs, generational differences in landowner attitudes, and new planting specifications that require fewer trees.

It is estimated that more than 80% of active farmstead/ranch headquarters in Nebraska have some type of shelterbelt planting. Inventories conducted in 2008 and 2009 through the Great Plains Tree and Forests Initiative (GPI) showed an estimated 254,832

Figure 37: Conservation Tree Sales 1972-2019



Source: Nebraska Association of Resource Districts, 2019

acres of planted and naturally occurring tree groupings in Nebraska, providing multiple conservation and environmental benefits to the surrounding areas. The Great Plains Initiative II study was conducted in 2018-2019. This survey further helped illustrate the condition and function of the state’s remaining windbreaks.

Results: Great Plains Initiative (2008-2009)

- ▶ Approximately 390,000 acres of windbreaks
- ▶ 45% of windbreaks in good condition
 - 35% in fair condition
 - 20% in poor condition
- ▶ 35% of windbreaks more than 50 years old
 - 40% between 25 and 50 years old
 - 25% less than 25 years old
- ▶ Eastern redcedar is the dominant species (approximately 25 million trees)
 - Siberian elm, hackberry, mulberry and ash round out the top 5 species

Preliminary results: Great Plains Initiative II (2018-2019)

- ▶ 30% of windbreaks in good condition
 - 65% in fair condition
 - 5% in poor condition

- ▶ 20% of windbreaks more than 50 years old
 - 45% between 25 and 50 years old
 - 40% less than 25 years old
- ▶ Eastern redcedar remains the dominant species

Threats and Challenges

Protecting conservation tree plantings from threats is consistent not only with the national priority of protecting forests from threats, but also with conserving and managing working forest landscapes for multiple uses and value and enhancing the public benefits of sustainable forests. The NFS has identified the following threats affecting conservation tree plantings in the state:

- ▶ A declining agricultural economy increases tree removals to allow for more farmable acres, despite evidence showing negative impacts to yields.
- ▶ Increased prevalence or detections of insects and pests, decreasing tree and forest health.
- ▶ Limited access to regionally important tree species used in conservation forestry plantings.

- ▶ Decreasing public support and awareness of conservation forestry practices.
- ▶ Rising costs for renovating or replacing existing windbreaks.
- ▶ Lack of alternative species for windbreaks.
- ▶ Unpredictable weather extremes resulting in increased bare-root seedling mortality.

Table 57 ties the national priorities to identified threats, resources available to address them, and the associated State and Private Forestry programs.

Table 57: Conservation Trees Crosswalk				
THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
LOSS OF FORESTLANDS				
1	Declining agricultural economy leads to an increase in tree removals to provide for an increase in farmable acres	State; Federal (S&PF, NRCS, FSA); Private	CE, RF	1,2,3
2	Declining forest health due to insects and disease (specifically EAB) & herbicide drift	State; Federal; Local government; Private; Tribes	FH, RF, CF	1,2,3
3	Extreme weather results in seedling mortality during reforestation efforts	State; Federal (S&PF, NRCS, FSA); Private	RF, AF	1, 3
POLICY				
4	Increased regulation around the species available for use in conservation forestry plantings	Federal; State; Private	RF, CFPT	1,2,3
5	Decreasing public support and awareness for conservation forestry practices	Federal (S&PF, NRCS, FSA); State, Local government; Private; Tribes	All	1, 3
6	Lack of alternative windbreak species to replace eastern redcedar; lack of research and development for replacement species	Federal (S&PF, NRCS, FSA); State, Local government; Private; Tribes	RF, CFPT	1,2,3
COST-SHARE AVAILABILITY				
7	Cost of renovating existing windbreaks	Federal (S&PF, NRCS, FSA); State, Local government; Private	RF, CFPT	1, 3
<small>*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire **National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests</small>				

Trends

Declining windbreak condition, decreased tree sales, decreasing statewide acreage of tree plantings, and anecdotal observations by retired practitioners tell a story of windbreaks disappearing from the landscape. With a declining agricultural economy, one of the first investments removed from operational activities is the planting or renovation of conservation trees. Without additional incentives or policy intervention, the NFS does not expect large investments by producers for tree planting or windbreak renovation over the life of this plan.

Impacts

The effects from the decline and loss of strategic tree plantings is already playing out in Nebraska. In the spring of 2018, for example, dry and windy conditions triggered two separate dust storms that overtook motorists on Interstate 80. These incidents led to pileups, serious injury, and one fatality. While it can't be said if trees would have completely mitigated these specific incidents, using trees to engineer ecological or environmental outcomes have been in practice since the Dust Bowl.

Tree plantings have also played an important role in shielding Nebraska's livestock industry from extreme weather. Most recently, during a rare bomb cyclone in March of 2019, livestock herds were subjected to blizzards, heavy rains, rapid snowmelt, and catastrophic flooding. While conservation tree planting may do little against flooding, landowners with windbreaks or shelterbelts reported increased survival among newborn cattle and their herds during the blizzard. This becomes important to note, given that livestock and crop losses from this single event reached nearly \$1 billion (Gaarder, 2020).

Desired Outcomes

Healthy, strategic tree plantings can increase agricultural profits in a variety of ways. The Conservation Trees for Nebraska program is an important tool that must adapt to modern-day agriculture through the following desired outcomes:

- ▶ Increase the use and demand for conservation forestry plantings statewide.
- ▶ Establish new plantings using a diverse array of tree and shrub species.
- ▶ Use innovative and progressive windbreak designs that reduce the reliance on eastern redcedar to provide conservation benefits.
- ▶ With partners and stakeholders, actively pursue opportunities to develop alternative windbreak species for landowners and practitioners.
- ▶ Increase landowner awareness of the value and benefit of conservation forestry plantings.
- ▶ Provide quality training with partners to improve conservation planning across Nebraska.
- ▶ Provide high-quality, container-grown seedlings as alternatives to traditional bare root seedlings.
- ▶ Increase collaboration with other programs such as Community Forestry and Rural Forestry, increasing the potential to meet additional FAP goals.

Agroforestry

Overview

Agroforestry provides a unique opportunity to integrate trees and shrubs into crop and animal production systems. The interaction of these components creates practical and viable opportunities for landowners to foster environmental protection and, concurrently, access the economic and social benefits associated with agroforestry.

As the seat of the USDA's National Agroforestry Center (NAC)—a partnership between the United States Forest Service and the Natural Resources Conservation Service—the state of Nebraska is opportunistically placed as a leader for agroforestry practice in the United States. The goal is to advance the health, diversity, and productivity of working lands, waters, and communities through the incorporation of agroforestry practices.

This program is core to fostering the adoption of agroforestry efforts in the PFLs. It also is essential to building on the relationship

between Nebraska's farm, ranch, and working forest landscapes.

Current Condition and Trends

A typical agroforestry system in temperate areas of the U.S. has five distinct practices: windbreaks, riparian buffers, alley cropping, silvopasture, and forest farming. Regional variations in ecosystems, climate, and land use predispose certain practices to specific regions. Although there may be the potential for the existence of all of these systems statewide, certain practices may be better suited for particular areas.

The state's fertile and productive soils provide many opportunities to incorporate agroforestry systems into agricultural land-use practices, including farming and ranching. There is potential to grow and develop agroforestry systems in the state, leading to diversified revenue streams for farm and ranching families. Agroforestry also presents an opportunity to avert and mitigate—to a considerable degree—the undesirable consequences of a changing climate on agriculture and forestry in Nebraska.

Threats and Challenges

As discussed throughout this document, there are a variety of conditions that exist that make establishing trees difficult. From an agroforestry perspective, these include issues such as shifts in climate and weather; limited staff capacity for training or assistance in the development of new systems; and limited financial support to incentivize the incorporation of these practices. Table 58 (next page) discusses the threats in relation to the national priorities, resources available to address them, and the associated State and Private Forestry programs.

Impacts

Land management provides the best opportunity to conserve, protect, and enhance trees and forests in Nebraska. Agroforestry systems allow landowners to create an environment where the species are diverse and the forest is productive. Practitioners are also afforded an array of revenue streams as they expand their base of marketable goods.

Desired Outcomes

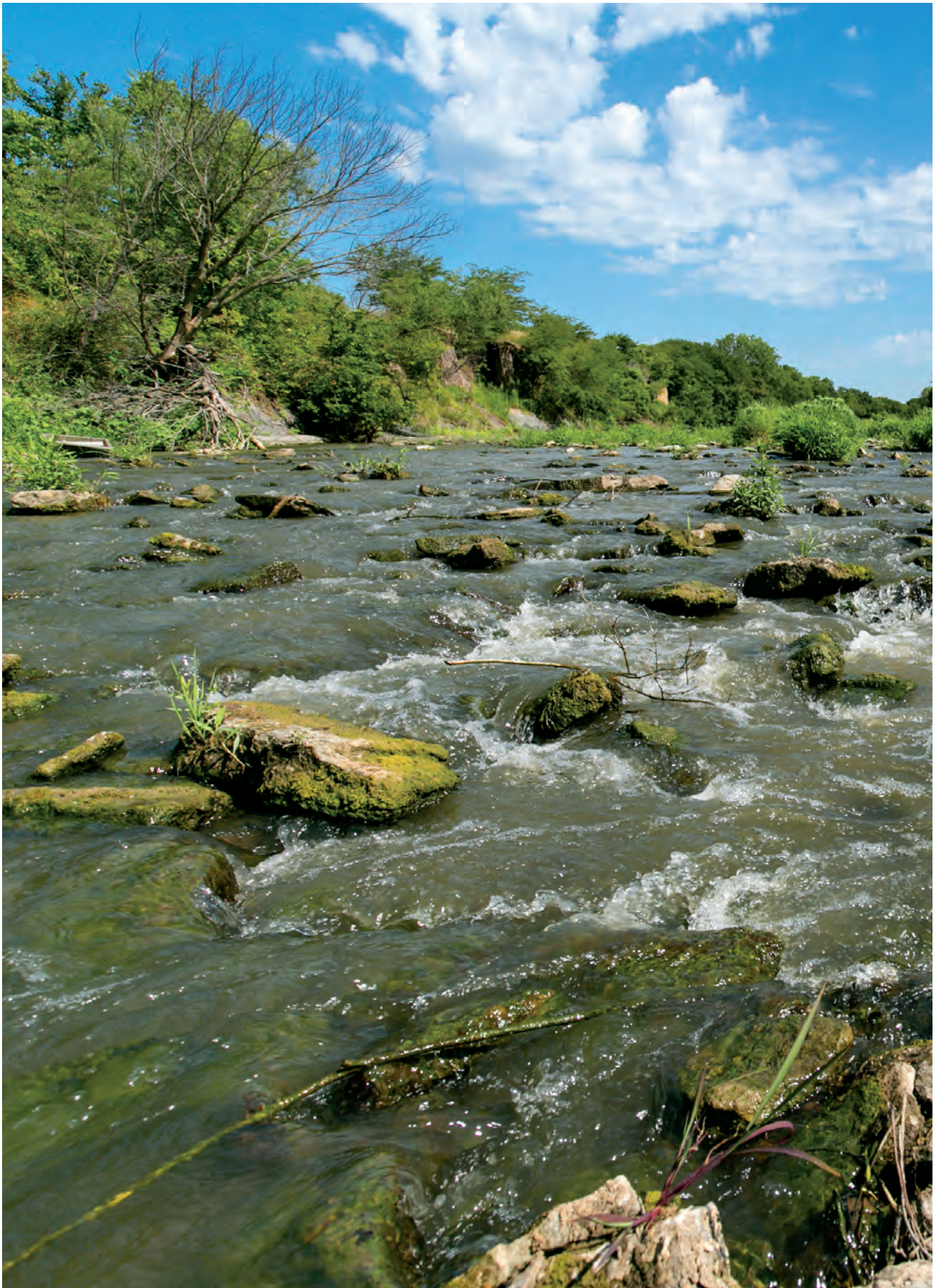
- ▶ Strengthen the relationship between NRCS/NAC and NFS on agroforestry related issues/activities.
- ▶ Conduct a statewide assessment and inventory of all agroforestry-related practices.
- ▶ Incorporate Trees Outside Forests (TOF) methodology into state level inventories of agroforestry landscapes.
- ▶ Develop a repository of all practicing agroforestry landowners in Nebraska, leading to the creation of a state agroforestry working group.
- ▶ Use innovative strategies to adapt successful agroforestry models to the environmental and agricultural conditions in the Great Plains.
- ▶ Strive for an inclusive and diverse agroforestry working group (e.g. tribal nations, refugees, etc.).
- ▶ Develop a state-specific handbook with funding opportunities for agroforestry landowners.
- ▶ Organize annual agroforestry information and experience-sharing workshops for landowners.
- ▶ Develop, in collaboration with the University of Nebraska-Lincoln, a yearly annotated bibliography of all agroforestry related research.
- ▶ Engage researchers at the University of Nebraska-Lincoln on integrating climate mitigation (e.g. carbon sequestration) in agroforestry practices.
- ▶ Pursue opportunities to undertake graduate-level research and secure funding for agroforestry.
- ▶ Conduct a survey of public interest into agroforestry products.
- ▶ Increase collaboration across NFS issue areas: By working with other programs such as Community Forestry, Rural Forestry, and Forest Products, the Agroforestry program has the potential to help meet other FAP goals, making Nebraska's forests healthier and more sustainable. 🌿

Table 58: Agroforestry Crosswalk

THREAT	RESOURCES AVAILABLE	ASSOCIATED S&PF PROGRAMS*	SUPPORTS NATIONAL PRIORITY (1, 2, 3)**	
WEATHER				
1	Difficulty in extreme weather prediction could render some significant level of vulnerability within systems	Federal (S&PF, NRCS, FSA); State, Local government; Private; Tribes	AF, CF, RF	1
POLICY & OTHER				
2	Existing programs and policies favor traditional agricultural activities	State, Local government; Private	AF, CE, RF	1, 2, 3
3	Limited regional production and financial information on agroforestry limits rates of adoption	Federal (S&PF, NRCS, FSA); State; Private; Tribes	AF, RF	1, 2, 3
4	Regional focus of practices and concerns may undermine the efficacy of local working groups	Federal (S&PF, NRCS, FSA); State	AF, RF	1, 3
5	Lack of versatility and flexibility could lead to difficulties in understanding the systems which may foster lack of interest on the part of landowners	Federal (S&PF, NRCS, FSA); State, Local government; Private; Tribes	AF, CE, RF	1, 2, 3
6	Lack of landowner understanding of applicability of specific agroforestry practices	Federal (S&PF, NRCS, FSA); State, Local government; Private	CFPT, RF	1,3
7	Absence of regional demonstrations or models that showcase productive and profitable agroforestry systems	Federal (S&PF, NRCS, FSA); State, Local government; Private	CFPT, RF	1,3
FUNDING				
8	Short-lived funding	Federal (S&PF, NRCS, FSA); State, Local government; Private; Tribes	All	1, 2, 3

*AF=Agroforestry; CE=Conservation Education; CFPT=Conservation Forestry Planting & Trees; CF=Community Forestry; FH=Forest Health; FL=Forest Legacy; FP=Forest Products; RF=Rural Forestry; WF=Wildland Fire

**National Priorities: (1) Conserve and Manage Working Forest Landscapes for Multiple Values and Uses; (2) Protect Forests from Threats; (3) Enhance Public Benefits from Trees and Forests





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Chapter 6: Other Statewide Concerns and Topics

Climate

Overview

Nebraska is already a difficult place to grow trees. The state is characterized by hot summers and cold winters, late spring and early fall freezes, fluctuating rainfall and growing seasons, frequent strong to severe winds, early snows, and ice storms. A changing climate presents additional, unique challenges to Nebraska's trees and forests. It is important that the NFS considers climate-related issues as it strives to implement the FAP, its current programs, and builds new initiatives that will serve Nebraskans in the future.

Current Condition

Average annual precipitation in Nebraska (1981 to 2010 climate normals) ranges from 15 inches in the west to 36 inches in the southeast, but can vary markedly from year to year. Precipitation is also received disproportionately throughout the year. Many locations see 75% of their annual average between the months of April and September, oftentimes in the form of rain from thunderstorms. Snowfall throughout the state ranges from 20 to 40 inches yearly, and can be heaviest in the middle of winter or in the spring, depending on the location. The growing season in Nebraska ranges from 120 days in the extreme northwest to 170 days in the southeast.

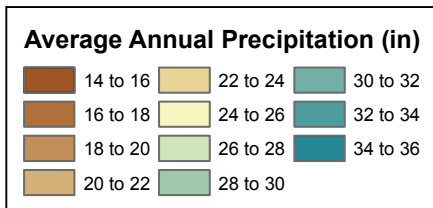
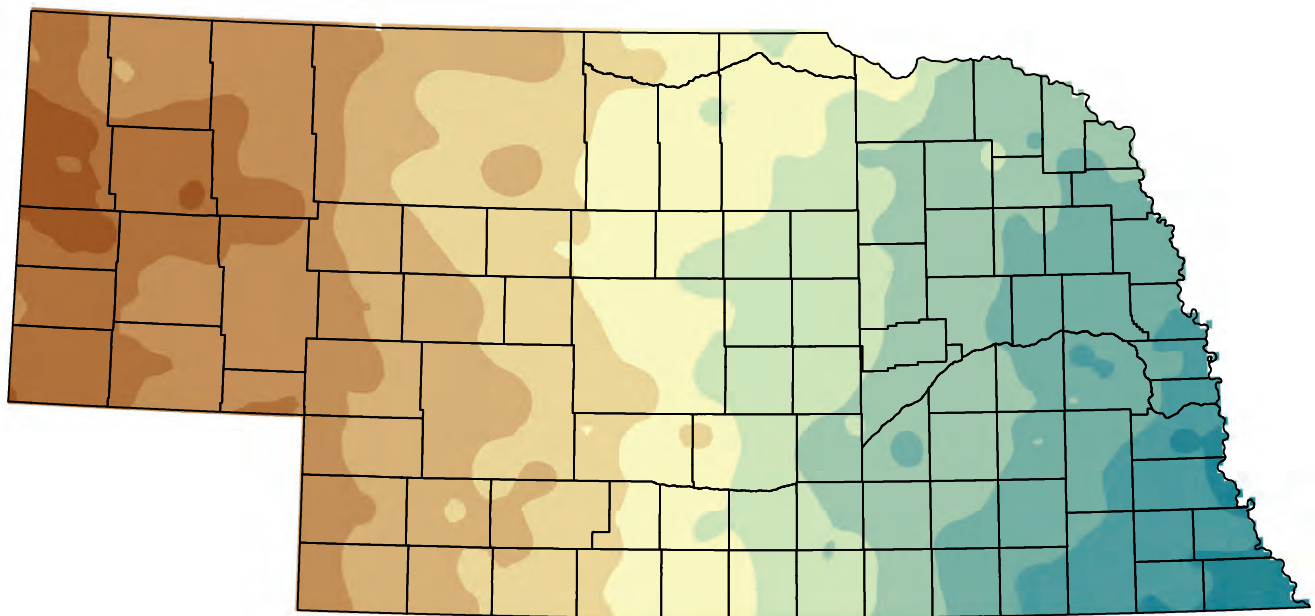
Drought is a regular occurrence in Nebraska, resulting in significant agricultural losses and stress on the state's tree and forest resources. In 16 of the last 20 years, a portion of Nebraska has been impacted by severe drought (D2) or worse, as indicated by the National Drought Mitigation Center's US Drought Monitor. The Panhandle and Sandhills have been hit especially hard, having seen prolonged periods of drought in recent years.

Torrential downpours, severe straight-line winds, tornadoes and hail are common. Tornadoes occur yearly, in varying number and intensity. Hailstorms can be very severe, particularly in western Nebraska, which reportedly has one of the highest hail frequencies in the country. During dry years, dust storms occasionally develop in the Panhandle and in the southwestern part of the state.

Nebraska's variable climate is the result of a combination of geographic features:

1. Nebraska's interior location, far from the moderating effects of large bodies of water; and
2. Nebraska's position on the leeward side of the Rocky Mountains.

Figure 38: Nebraska Average Annual Precipitation, 1981 – 2010



Nebraska Average Annual Precipitation, 1981-2010
Data Source: PRISM Climate Group at Oregon State University

Source: PRISM Climate Group, 2015

Projections

A 2014 report (Pryor, et al. 2014) suggests the Great Plains region can expect to see several changes in climate over the next several decades:

- ▶ Rising temperatures,
- ▶ Changes in growing season and crop cycles,
- ▶ Slow adaptation of species across a fragmented landscape,
- ▶ Stressed communities due to extreme weather events, and
- ▶ A magnitude of change exceeding the capacity of resources and planning.

Nebraska-centric research by Shulski & Williams (2020) further defines expectations for what

changes in climate will mean in the state. The report specifically identifies the following concerns:

- ▶ Average annual temperature is expected to rise 2-5 degrees F by 2050.
- ▶ Annual number of extreme heat days (over 95 degrees F) is expected to double from about 15 to 30 by 2050.
- ▶ Growing season length is expected to increase by several weeks by 2050.
- ▶ Winter and spring precipitation is expected to increase by 15-25% while summer precipitation is expected to decrease by 5 to 15%. Fall precipitation will not change much.
- ▶ Heavy precipitation events could increase by 25%.

Trends

A changing climate is expected to have significant impacts on the Great Plains. Scientists project that temperatures will continue increasing during this century, with summer changes in the southern and central Great Plains projected to be larger than winter changes (Frankson, Kunkel, Stevens, & Shulski, 2017). Some studies indicate that average temperatures in the Great Plains have increased 1.5 degrees Fahrenheit relative to a 1960 to 1979 baseline (Karl, Melillo, & Peterson, 2009), and that temperatures in Nebraska have increased 1.6 degrees F since 1895.

An average of several climate models indicates the entire state will become warmer, with hotter summers, warmer winters, warmer overnight temperatures, and a fourfold increase in weather “anomalies,” presumably including extended and intensified droughts. Other anticipated long-term climatic changes include more frequent heat waves and heavy rainfall that will impact many aspects of life throughout the Great Plains (Karl, Melillo, & Peterson, 2009).

Impacts

Nebraska’s nearly 1.5 million acres of forestlands are unique in that they generally exist on the eastern, western, or southern edges of their native ranges, and grow under stressful conditions more conducive to prairie ecosystems rather than forests. However, these tree and forest resources provide critically important economic and ecosystem services. The 2014 report “Understanding and Assessing Climate Change, Implications for Nebraska” suggests climatic change has and will continue to substantially and negatively impact the state’s tree and forest resources. Increased incidence and severity of drought and severe weather events, and higher day and night temperatures will seriously affect the health, vitality, and resilience of trees and can be readily observed (Bathke, Oglesby, Rowe, & Wilhite, 2014).

The increase in droughts and temperature is raising the prevalence and intensity of wildfires in the state. Compounded by excessive forest fuel loads, wildfire events have increased in frequency and size over the past 50 years. For

example, wildfires in the ponderosa pine forests of the Pine Ridge in northwestern Nebraska have reduced forestlands by thousands of acres since 1994. These forests burned so intensely that nearly all living trees were eliminated across large areas, converting native forests to grassland. The removal of these trees also eliminates the sequestration of atmospheric carbon. Given that these forests represent the easternmost extension of ponderosa pine in North America, their loss would eliminate unique genetic adaptations to low elevation, hotter conditions.

Temperature fluctuations also negatively impact a tree’s ability to withstand insect and disease pressure. Higher temperatures, especially at night, reduce carbohydrate reserves essential for vigorous growth and pest resistance, often for several years. Nebraska’s pine forests lost thousands of trees in the 2000s to Ips engraver beetles (*Ips* spp.), part of the 35 million acres of forests killed recently by bark beetles in North America. Increasing temperatures and drought also affect community forests, disproportionately killing non-native tree species (e.g., white pine, spruce, etc.) that are poorly adapted to these changing conditions. Reduced vigor and increased mortality of trees in communities will further decrease the capacity of urban forests to mitigate higher urban temperatures, compromising human health.

While Nebraska has historically experienced a wide range of severe weather events, the predicted increases in frequency and intensity will clearly alter tree and forest composition statewide. Unprecedented flooding and other severe weather events common to the Great Plains (tornadoes, straight line winds, ice and early winter snow storms, early fall and late spring freezes) damage Nebraska’s trees and forests. An increase in frequency and intensity of these events will likely increase tree mortality in some areas of the state. The loss of windbreaks and riparian forest buffers—coupled with more frequent severe weather events—will increase soil erosion, impair air and water quality, and decrease crop yields across Nebraska.

Desired Outcomes

Because of the wide ranging implications of climate variation to not only trees and forests, but to ecological communities throughout Nebraska, the following desired outcomes are actions agencies like the NFS can undertake to theoretically stem the windfall of negative effects that will certainly result from a shifting climate.

- ▶ Increase locally-appropriate species and seed source diversity to enhance resilience of community and conservation plantings.
- ▶ Thin coniferous forests to reduce competition for water, improve tree vigor, protect remaining islands of live forest stands isolated by previous wildfires, and decrease the risk of future wildfires.
- ▶ Foster the development of new products and markets for wood, especially for bioenergy applications, that create market drivers to support expanded forest thinning operations and offset the use of fossil fuels and further releases of ancient CO₂.
- ▶ Undertake large-scale tree plantings, with locally-appropriate species, to encourage the replacement of trees and forests damaged or killed by severe weather events and other conditions brought on by climatic shifts.

Threatened and Endangered Species

Overview

There are 30 species that have been listed as endangered or threatened in Nebraska (Schneider et al., 2018). The PFLs described in Chapter 3 are managed as critical habitat for these and many other species of wildlife. The responsibilities for the preservation of threatened or endangered species is clearly defined for the NFS through the Endangered Species Act (ESA) and the Nebraska Nongame Endangered Species Conservation Act. According to the U.S. Fish and Wildlife Service (2013), the ESA:

“...Protects endangered and threatened species and their habitats by prohibiting the “take” of listed animals and the

interstate or international trade in listed plants and animals, including their parts and products, except under Federal permit...Federal agencies must consult with the FWS about an endangered or threatened species for an activity that occurs on private land where a Federal agency funds, authorizes, or carries out an activity. Private landowners who rely on Federal lands for activities such as grazing, energy development or recreation could also be affected.”

Additionally, the Fish & Wildlife Service states the ESA prohibits the “take” of any listed animal without a permit. Take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.” Furthermore, the take prohibition includes “significant habitat modification or degradation that results in the direct killing or injury to the listed animal species.” While listed plants are not protected from take, it is illegal to collect or maliciously harm them on Federal land.

Nebraska’s Nongame Endangered Species Conservation Act (1975) or NESCA is Nebraska’s state law regarding the conservation and protection of wildlife and plants found to be threatened or endangered. The NGPC is the state agency with statutory responsibility for administration of the Act. The NESCA prohibits take of any listed threatened or endangered species. Take is defined under section § 37-802 (6):

“...Take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.”

While the law prohibits take of threatened and endangered species, exceptions to these prohibitions are outlined under section § 37-803, subsection (3), and section § 37-806 subsections (7) and (11) and also in Nebraska State Regulation Title 163, Chapter 4, Sections 001 and 004. Take may be allowed for the purpose of enhancing the conservation and survival of a species; however, further consultation with the NGPC should occur.

Within the NESCA, section § 37-807, subsection (3), it is outlined that state agencies shall consult with the NGPC in furtherance of the purposes of NESCA by ensuring that actions do not jeopardize the continued existence of these species or critical habitat. In this section, a state agency is defined as:

“... state agency means any department, agency, board, bureau, or commission of the state or any corporation whose primary function is to act as, and while acting as, an instrumentality or agency of the state, except that state agency shall not include a natural resources district or any other political subdivision.”

The NFS, through the implementation of voluntary forestry BMPs and consultation with the NGPC, is committed to ensuring the long-term survival of Nebraska’s threatened and endangered species, while continuing to foster management of Nebraska’s forests.

Current Condition

Nebraska has 30 state-listed species that are under protection, including 11 that are federally-listed as endangered (Schneider et al., 2018).

There are a number of conservation success stories in regard to the recovery of threatened and endangered species in Nebraska. One recent example is the North American river otter. While it’s currently listed as threatened in Nebraska, its population has been growing in the state’s waterways since its reintroduction in 1986. New data, expert input, and a successful recovery program, has prompted NGPC to propose removing the river otter from the state threatened species list (Panella & Wilson, 2018).

As the NFS provides financial and technical assistance on both state and federal lands, in addition to private lands, navigating compliance with both state and federal law, can be cumbersome. In situations where the agency collaborates with partners on federally-held public lands, ESA supersedes state law. When working with state agencies or private landowners, NESCA becomes the standard when assessing forest management projects. Additional guidance from both state and federal partners would be advantageous as the NFS grows its services to serve more forestland and tree owners across Nebraska.

Table 59: Threatened and Endangered Species Commonly Present in NFS Project Areas

Priority Landscape	Whooping Crane	Interior Least Tern	Piping Plover*	River Otter	Northern Long-eared Bat	American Burying Beetle	Timber Rattlesnake
Pine Ridge					X		
Niobrara Valley	X	X	X	X	X	X	
Loess Canyons	X	X	X	X		X	
Wildcat Hills				X	X		
Missouri River	X	X	X	X	X		X
Central Loess Hills	X	X	X		X		
Nemaha River					X		
Big/Little Blue Rivers	X				X		
Platte River (E, Central, & W)	X	X	X		X		
Republican River	X				X		
Loup Rivers	X	X	X		X	X	X
Elkhorn River	X	X	X		X	X	X

(*X” indicates species range overlap with operational area)

*Piping plover is federally listed as endangered under the Endangered Species Act.

Before work begins in an area, the NFS completes an assessment to determine which, if any, species may be affected prior to implementing projects. If it is determined that the project may have an adverse effect on a listed threatened or endangered species, further consultation with the appropriate agency occurs. Table 59 (previous page) represents species most commonly present in PFLs. Not all species included directly or indirectly impact the work of NFS field staff. To find a reference to Nebraska's current threatened or endangered species, please see Appendix C.

Impacts

Endangered and threatened species are animals and plants whose continued existence in Nebraska is in jeopardy. By officially designating a species as endangered or threatened, plans can be put in place to mitigate extirpation, restore the species, or prevent extinction. While the NFS does not manage wildlife in Nebraska, forests play an important role in the life cycle of many species across the PFLs. Ensuring trees remain healthy and resilient, through the use of forestry BMPs, can make significant contributions to the recovery of protected species in the state.

Desired Outcomes

NFS projects and initiatives will strive to improve the resiliency, health, and sustainability of trees and forests. These, in turn, will create healthier landscapes for threatened and endangered species. This will be achieved through adherence to state and federal law, utilization of forestry BMPs in consultation with landowners and managers, and seeking partnership opportunities that increase the stewardship of forestlands for species recovery.

NFS staff, programs, and projects will continue to consider threatened and endangered species impacts throughout planning and implementation. The agency will maintain frequent communication and collaboration with state and federal wildlife agencies to ensure continued compliance with threatened and endangered species regulations.

Invasive & Aggressive Native Plant Species

Overview

The USDA Natural Resources Conservation Service (n.d.) defines invasive species as species that are non-native to an ecosystem, or species whose introduction to an ecosystem causes or is likely to cause harm to the ecosystem's economy, environment, or human health.

Invasive species can be plants, animals, or other organisms such as microbes. About 400 of the almost 1,000 threatened and endangered species classified under the ESA are considered at risk primarily due to competition or predation by non-native species. In the United States, damages and losses due to invasive species total almost \$120 billion each year (Pimentel, Zuniga, & Morrison, 2005).

Aggressive, native plant species are indigenous plants that spread rapidly and can overpower other native vegetation. The USDA uses the term "opportunistic" to describe a native plant that is able to take advantage of a disturbance and spread quickly, outcompeting adjacent plants communities. Plants that are native and opportunistic or aggressive should not be classified as an invasive species. For example, treatment or management of a native species will often have supplemental or negative impacts as these individuals tend to provide at least some benefit to the greater ecological community. In Nebraska, eastern redcedar is the primary species that fits into the category of native/aggressive as it has encroached into pine and deciduous forests as well as prairies.

Current Condition

In Nebraska, purple loosestrife (*Lythrum salicaria*), saltcedar (*Tamarix ramosissima* Ledeb and *Tamarix parviflora* DC), and *phragmites* threaten the integrity of aquatic ecosystems across the state. These species spread aggressively throughout rivers and wetlands, outcompeting more desirable native species by blocking and altering the system's hydrology.

Russian olive (*Elaeagnus angustifolia*) is native to southeastern Europe and western Asia. The

tree was introduced to the United States in the late 1800s as an ornamental and windbreak species, but it quickly naturalized itself and spread throughout most of the country. In upland areas of western Nebraska, Russian olive is a valuable conservation tree because of its drought and pest tolerance, ability to thrive in a variety of growing conditions, and its use by local wildlife. However, this seed source is readily dispersed by birds throughout the landscape. Without management, particularly in bottom-land areas where moisture is abundant, Russian olive will spread vigorously and outcompete neighboring species. In many riparian areas, especially in western and central Nebraska, Russian olive is threatening native cottonwood forests.

Other non-native invasive species are becoming serious threats to the ecological stability of central hardwood forests in eastern Nebraska. These include honeysuckle (*Lonicera* spp.) and buckthorn (*Rhamnus* spp.). These particular species are able to quickly colonize unmanaged woodlands and represent one of many ongoing challenges for woodland owners today.

Native to Asia, honeysuckle is a deciduous shrub that was introduced into the United States in 1846. It escaped cultivation due to high seed production and dispersion by foraging wildlife. It forms dense understory thickets in forests, shading out other shrubs and tree seedlings while disrupting tree reproduction and forest succession. The loss of ash species due to EAB will exacerbate existing challenges with honeysuckle management. Common buckthorn is a shrub or small tree that invades open oak woods, deadfall openings in woodlands, woodland edges, roadsides, prairies, and open fields. It forms dense thickets, crowding and shading out native shrubs and herbs, often completely eradicating them.

Japanese barberry (*Berberis thunbergii*) is also a serious invasive pest in eastern hardwood forests. It typically is found in locations of partial sunlight, such as a forest edge, and can survive under an oak canopy where it shades out other understory species. One recent research study (Link, Turnblacer, Snyder, Daugherty, & Utz, 2018) suggests Japanese

barberry changes the soil chemistry in the environment it inhabits.

The invasive Callery pear (*Pyrus calleryana*) is adapted to a wide variety of environmental conditions. It has established in forest and woodland understories, open areas in many areas of the eastern US, and is becoming a problem in some eastern Nebraska communities. Other species of concern include autumn-olive (*Elaeagnus umbellata*), Amur maple (*Acer ginnala*), wintercreeper (*Euonymus fortunei*), garlic mustard, goldenraintree (*Koeleruteria paniculata*), privet (*Ligustrum* spp.), white mulberry (*Morus alba*), tree-of-heaven (*Ailanthus altissima*), and Siberian elm (*Ulmus pumila*).

Eastern redcedar, a hardy native tree species, is rapidly expanding across much of the state. Its adaptability to a wide range of conditions, the lack of fire on the landscape, changes in farm and grazing practices, drought, lack of grassland and forest management, changes in land-ownership patterns, and conservation plantings acting as seed sources are contributing factors to its expansion. Redcedar has expanded more than any other species across much of the Midwest and Great Plains, with Nebraska experiencing the greatest forest density of cedar trees/acre of any Midwestern state (USDA Forest Service, 2018). The spread of cedar in Nebraska is especially significant from west-central to eastern Nebraska.

Trends

It is anticipated the ranges of invasive and aggressive native plant species will continue to expand in Nebraska's forests, negatively affecting these ecosystems. This issue will be exacerbated by expected changes in climate, this according to the research of Bathke, Oglesby, Rowe, and Wilhite (2014) in "Understanding and Assessing Climate Change: Implications for Nebraska."

Impacts

Invasive and aggressive native species have the potential to dramatically alter ecosystems by outcompeting species within their natural range. For example, in riparian areas, invasive

species can choke river channels, altering natural hydrologic regimes. In forestlands, the conversion of forest types can displace woodland-dependent species as the habitat changes. In grasslands, the encroachment of aggressive native or invasive species reduces grassland habitat and forage production for livestock.

Eastern redcedar has received considerable attention in the past 20 years because of its rapid spread into rangeland and forests. In addition to habitat and species displacement, dense eastern redcedar stands have created a new fire hazard in many riparian forests and grassland systems. In March 2009, a fire in an eastern redcedar/cottonwood riparian forest intensely burned 640 acres along the Platte River. The fire closed Interstate 80 near Kearney for seven hours and resulted in economic losses of nearly \$7 million. If eastern redcedar continues to encroach into cottonwood forests, an entirely new fire-prone forest type will exist along hundreds of miles of river corridor in Nebraska.

Shifts in plant communities due to the spread of invasive or aggressive native species corresponds to a loss in plant diversity and productivity, a change in the water balance of the riparian forest, and a loss in availability of resources for wildlife and livestock. The high cost of managing these species is a limiting factor for many of Nebraska's landowners. In some instances, such as those involving eastern redcedar, active management can create value-added products (posts, shavings, logs, and biomass) that offset management costs or provide returns on investment for landowners. More information about eastern redcedar in Nebraska can be found in Appendix B.

Desired Outcomes

NFS programs and initiatives will increasingly address the challenges of invasive and aggressive native species in Nebraska's trees and forests over the next ten years, through the following activities:

- ▶ Make alternative species for conservation plantings available for widespread use.

- ▶ Redesign conservation plantings to provide efficiency with alternative species.
- ▶ Reduce the total number of acres affected by invasive and aggressive native species.
- ▶ Focus tree planting efforts on non-aggressive native species.
- ▶ Reduce eastern redcedar ladder fuels in hardwood and coniferous forests, lowering wildfire risks.
- ▶ Manage aggressive, native species through targeted mitigation and cost-share programming.
- ▶ Increase collaborative efforts with other agencies and landowners to address management needs.
- ▶ Develop new approaches to address the challenges of invasive species management.
- ▶ Consult with tree planters and nursery growers to discourage the planting of potentially invasive or aggressive species.

Forest Legacy

Overview

Nebraska's forests encompass an array of diverse habitats, but these areas face a wide range of serious threats. Uncharacteristic wildland fires, destructive invasive insects and diseases, a changing climate, increased urbanization, and pressure to convert to agricultural uses can all result in the loss of forests. However, conversion of land for non-forest use is a significant threat that can be addressed by landowners and the NFS.

In Nebraska and nationally, the Forest Legacy Program authorizes the USFS or state governments to purchase critical forestlands for the purpose of preventing those lands from being converted to a non-forest use. In Nebraska, forestlands that contain important scenic, cultural, recreational, fish and wildlife habitats, water, or other ecological resources that will support continued traditional and new forest uses receive priority. Lands purchased under this program must become productive and working forestlands with an active management plan.

Nebraska's Assessment of Need (see Appendix A), adopted in 2016, evaluates forested areas

Table 60: Threats to Forestlands, Forest Legacy Assessment of Need

CONVERSION AND FRAGMENTATION	PARCELIZATION	URBANIZATION
Higher value use conversion from forest to agriculture or other use	Conversion from large properties into smaller and smaller ownerships	Conversion from forest to primary homes, ranchettes, and second homes

with important environmental and conservation values for inclusion in Nebraska’s Forest Legacy Program. The assessment identifies high-value target areas, provides defined and delineated boundaries, and describes each Forest Legacy area and its reason for inclusion in the program. Table 60 highlights the threats commonly experienced on privately-held forestlands.

The public’s attitudes and behaviors toward trees are shifting, especially in agricultural areas. Changes in crop prices and land values have brought back “fencerow to fencerow” planting, where all lands must be in production for an operation to remain profitable. Recent droughts—leading to concerns about trees competing for water—have prompted many landowners to discontinue or remove trees from their lands. The rapid and widespread adaptation of pivot irrigation has spurred landowners to remove riparian and buffer trees across the state. Producers have less time to manage for conservation and opt to simplify their operations by removing trees.

While Nebraska’s population growth has been slower than other states, urbanization and parcelization is still occurring. More than half of Nebraska’s population lives in Lancaster, Sarpy, and Douglas counties in eastern Nebraska, making protection of riparian forests a critical need in these areas. The Forest Legacy Program is a tool to combat land-use conversion and keep Nebraska’s working forests productive for the benefit of Nebraskans.

Current Condition

The 460-acre Chat Canyon Wildlife Management Area is the only Forest Legacy property in Nebraska. It was named for the avid birding that past owners Jackie Canterbury and Jack Gustafson enjoyed on this property. Chat Canyon is in Cherry County and is owned by

the NGPC. The NGPC has joint management responsibilities with the NFS, which is the first partnership of this kind for both agencies. These collaborative efforts will fulfill the requirements of the Forest Legacy grant, a program designed to keep “working forests” intact, protect water quality, provide habitat, forest products, opportunities for recreation, and other public benefits.

Trends

The NFS anticipates that other areas will become eligible for the Forest Legacy Program over the next ten years. However, holding easements is a challenge in Nebraska. The NFS is unable to hold conservation easements, making its role one of facilitation and not administration. If Forest Legacy rules changed to allow conservation groups to hold these easements, several projects in the state would be eligible and likely enrolled in this program.

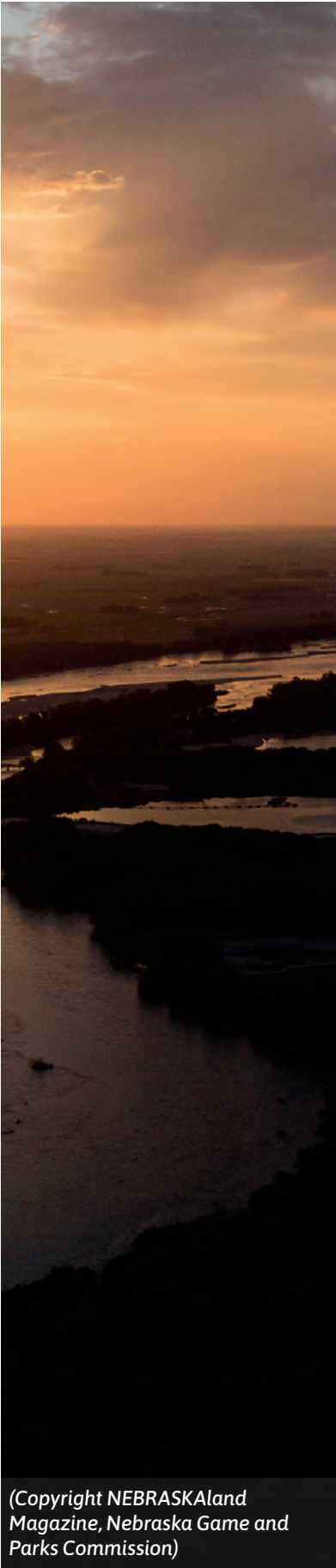
Impacts

The conversion of native landscapes for human use is a trend that has existed since the earliest days of European settlement in Nebraska. This has made both naturally-occurring and planted forestlands subject to pressure and removal. Forest Legacy provides a mechanism by which important cultural or ecological woodlands can be protected while still providing a wide array of conservation and societal benefit.

Desired Outcomes

The NFS will work with the administrators of Forest Legacy to attempt to amend rules that allow alternative entities to hold easements. This will create conditions necessary to increase program enrollment, allowing more forestlands and forested acres to become permanently protected in the state. 🌿





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Chapter 7: Partner and Stakeholder Engagement

The NFS, with its partners, provides leadership and support for Nebraska’s trees and forests. While this is specifically the mission of the NFS, it is a mission that cannot be accomplished alone. Nebraska’s conservation, environmental, and agricultural interests all play a large role in enriching the lives of Nebraska’s residents by protecting, restoring, and utilizing the state’s tree and forest resources. The contribution of external partners is critical to carrying out the goals and objectives contained within this FAP. New partnerships are also needed as the NFS moves Nebraska’s priority forest landscapes towards a desired future condition.

Collaboration between NFS programs and academic departments is also a priority. The NFS is in the process of a reorganization that will support and expand collaboration during this planning period. This will further develop and grow relationships with units at the University of Nebraska, allowing the agency to find creative and innovative solutions for the challenges facing trees and forests in the state.

The NFS works with a large number of public and private interests, municipalities, state agencies, and many others. Some of these partnerships are briefly described below. This list is meant to be illustrative, not all-encompassing.

USFS State & Private Forestry Program

State & Private Forestry provides technical and financial assistance to forestry agencies to support programs targeted to state and privately-owned forestlands. NFS partners with State & Private Forestry through four separate programs that complement NFS programs: Forest Health, Urban and Community Forestry, Wildland Fire Protection, and Forest Stewardship. The USFS’s State & Private Forestry program has long been an enormously valuable and central partner to the NFS and its programs.

USFS staff provide important feedback and guidance to state forestry agencies. As new issues emerge, State & Private Forestry continues to provide critically needed technical support to the state, including areas such as invasive species, rural and community forest inventory and analysis, forest health, and fire protection and suppression. The USFS Rocky Mountain Research Station and other research stations have conducted important studies and provided results of considerable value to the agency and its programs. This partnership will be strengthened in the future as the demands for tree and forestry-related research grow.

The Nebraska National Forest, the only national forest in Nebraska, is also a valuable partner. USFS’s staff and NFS conduct

joint planning activities and collaborate across agency missions to achieve landscape-level impacts across forest ownerships in the Pine Ridge and Bessey Unit in north central Nebraska. The USFS's Bessey Nursery in Halsey is also an important tree planting partner for the agency and stakeholders statewide.

Nebraska Natural Resources Conservation Service

The Nebraska Natural Resources Conservation Service (NRCS), which is part of the USDA, is a federal agency responsible for natural resources conservation on private lands. NRCS works in partnership with private landowners and a variety of natural resource agencies to develop and implement conservation plans that promote healthy, sustainable environmental resources. Periodically, NRCS has designated substantial Environmental Quality Incentives Program funding for forestry cost-share activities statewide.

Natural Resources Districts

Nebraska's 23 NRDs are local governmental units charged with protecting the state's natural resources, including soil, water, forests, range, recreation, and fish and wildlife habitat. Nebraska's NRDs work in partnership with state and federal agencies to implement conservation practices that protect Nebraska's natural resources.

Because of the common mission relative to conservation tree planting and forest management, the NFS has developed strong partnerships with individual NRDs and the Nebraska Association of Resource Districts. Since the inception of NRDs in 1972, the NFS has entered into a number of cooperative agreements with individual NRDs to enhance forestry activities. Although agreements vary, they all involve shared funding for NRD foresters or their activities.

All 23 NRDs administer conservation tree programs to provide low-cost tree/shrub seedlings to landowners for conservation purposes. NFS administered the Nebraska Conservation Trees program statewide from

1926 until 2002, at which time program administration was transferred to the NRDs. The NFS continues to strongly support all NRD conservation tree programs.

Nebraska Game and Parks Commission

Established by the Legislature in 1901, the NGPC works to conserve Nebraska's natural resources. The Commission establishes hunting seasons and regulates for game species; manages Nebraska's state parks, state recreation areas and other public lands; manages the fisheries at numerous public lakes across the state; helps landowners establish good conservation practices on their land; works to conserve Nebraska's threatened and endangered species; and provides hunter and boater education, as well as other resources for those who wish to learn to enjoy the outdoors. NGPC is a key partner with the NFS in implementing the state's Forest Legacy Program, reducing forest fuel loads in wildlife management areas and state parks, and in developing improved prescribed burning programs.

Nebraska Department of Agriculture

The Nebraska Department of Agriculture regulates the state's food, farming, ranching, and nursery industries. It also cultivates partnerships with public and private sector organizations to protect and grow these industries. Invasive insect and disease pests pose a substantial threat to Nebraska's forest resources. For this reason, NFS works closely with NDA to develop monitoring and detection activities and preparedness plans for mitigating the impacts of invasive species.

In 2006, the NFS began working with the Department and other partners as part of the Nebraska Emerald Ash Borer Working Group. This group developed a statewide readiness and response plan for delaying the introduction of EAB into the state and to find, contain, delimit, and minimize the impact of EAB once introduced. This preparation greatly facilitated the state's response when EAB was first detected in 2016 in Omaha. In addition, NDA and NFS have compliance agreements for

moving ash wood outside of the quarantine for pest education and wood utilization projects conducted by NFS.

Weed Management Areas

Since 1998, counties and other interested parties have joined forces to control the spread of invasive species in Nebraska. These partnerships allow for the sharing of knowledge and resources to help control the spread of invasive species. Known as Weed Management Areas, these local organizations bring together stakeholders (e.g., landowners, natural resource professionals) to develop plans for managing invasive species within a delineated area. The NFS works with three entities (Northern Dawes County Cooperative Weed Control Project, Northern Sioux County Weed Control, and Sandhills Weed Management Area) that manage lands next to or near federal properties. The NFS reviews weed management projects annually and provides federal cost-share funds to help with weed management activities.

The NFS also participates in the Governor's Riparian Vegetation Task Force and the Nebraska Invasive Species Council providing technical assistance in the management of invasive plant species.

USDA Animal and Plant Health Inspection Service – Plant Protection and Quarantine

APHIS (Animal and Plant Health Inspection Service) is the USDA agency charged with protecting Nebraska's agricultural interests through programs in animal health and welfare, plant protection, biotechnology, animal damage management, emergency preparedness and response, permitting, and regulating agricultural imports and exports. Plant Protection and Quarantine is an APHIS program that protects agricultural and natural resource interests from the entry, establishment, and spread of plant pests and noxious weeds.

Through Nebraska's Emerald Ash Borer Working Group, the NFS worked with APHIS and other groups to develop effective monitoring and detection methods for EAB and to create a

statewide readiness and response plan for mitigating EAB's impacts in Nebraska.

Rural Fire Districts

The volunteers in Nebraska's 481 rural fire districts provide fire protection and fire prevention education programs to residents of their districts. The NFS works closely to provide planning, training, grant assistance, and equipment that increases districts' capacity to protect life and property while implementing effective education programs.

University of Nebraska

The NFS is part of the Institute of Agricultural and Natural Resources at the University of Nebraska-Lincoln. Through teaching or training arrangements, NFS staff have become additional resources for student scholarship and career development. Furthermore, through unique positioning within the University, the NFS is able to align missions with other units including Nebraska Extension, Agricultural Research Division, the College of Agricultural Sciences and Natural Resources, and many others. NFS deliverables and impacts are undoubtedly amplified through collaboration with the University.

Others

As the NFS continues to build partnerships to better serve Nebraskans, an ever-growing list of collaborators, stakeholders, and technical experts have provided the agency with critical knowledge to better carry out its mission. This list includes, but is not limited to:

State Fire Marshal's Office, Nebraska Emergency Management Agency, Conservation Roundtable, Nebraska Invasive Species Council, Nebraska Drought Mitigation Center, Nebraska Environmental Trust, Nebraska Statewide Arboretum, The Nature Conservancy, National Wild Turkey Federation, Pheasants Forever, Nebraska Arborists Association, Nebraska Nursery and Landscape Association, Arbor Day Foundation, Keep Omaha Beautiful, Nebraska Community Forestry Council, Prairie Pines Partners, Nebraska Nutgrowers Association, Hybridized Hazelnut Consortium, Great Plains Tree Pest Council, and the public. 🌿