2019 MANAGEMENT PLAN
Pioneer Forest, LLC

L-A-D FOUNDATION
Since 1962

Table of Contents

*(*Cover Photos*: Volunteer researcher recording cave data and information* CAVE RESEARCH FOUNDATION*; Mike Adams marking on Pioneer Forest* GREG IFFRIG*; assessing natural heritage significance at Fishtrap Hollow Fen* NEAL HUMKE*; in 2007 Ron Tuttle received Missouri's first Logger of the Year award, he was nominated by Terry Cunningham and has been working on Pioneer Forest for many years* GREG IFFRIG*; and international visitors on Pioneer Forest in 2109* GREG IFFRIG.*)*

Pioneer Forest embodies the stewardship ethic of its founder and long-time owner, Leo Drey. Much more than a working forest producing timber and jobs on a sustained basis, Pioneer Forest has contributed to the local economy, served as a working demonstration for other private landowners, cooperated imaginatively with an array of public agencies, conducted its own research and been widely available to outside researchers, and been open for a wide variety of primitive recreational pursuits.

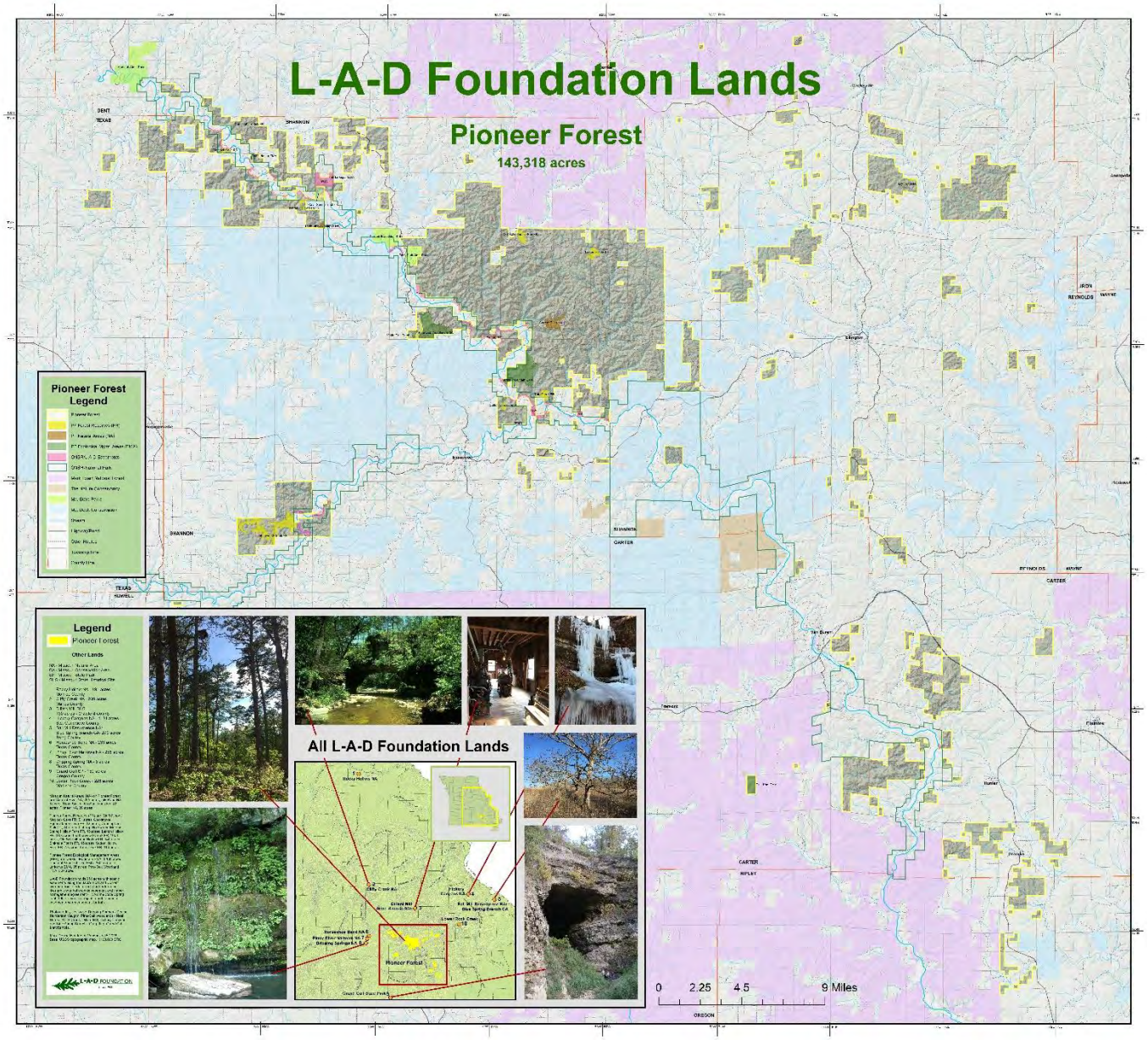
From the preface of:

Pioneer Forest—A Half Century of Sustainable Uneven-Aged Forest Management in the Missouri Ozarks (2008)

The forest was reorganized as Pioneer Forest, LLC, in 2004, for donation to the L-A-D Foundation, which Leo A. Drey had established in 1962 primarily to hold and protect areas of outstanding natural or cultural value.

The L-A-D Foundation is a Missouri private operating foundation dedicated to exemplary stewardship of Pioneer Forest and other natural and cultural areas, and to scientific research, education, public recreation, and encouragement for projects and policies that have a positive influence on the Missouri Ozarks and beyond.

L-A-D Foundation Mission Statement, 2012



EXECUTIVE SUMMARY

Pioneer Forest, LLC is a 143,318-acre forest located in six counties in the Missouri Ozarks. The forest was assembled beginning in the early 1950's by our founder, Leo Drey. Leo, and his wife Kay, donated the forest to his non-profit foundation, the L-A-D Foundation, in 2004. Pioneer Forest is well known for its large landholding and for its demonstration of conservative timber management using the uneven-aged single tree selection method. Dent, Carter, Shannon, Reynolds, Ripley, and Texas counties include lands of Pioneer Forest.

Current Management and Forest Conditions

Pioneer Forest offers many benefits including timber production, significant wildlife habitat, an educational model, several designated natural areas and forest reserves, and multiple recreational opportunities. It is composed of a mix of species that are naturally regenerated and include oaks, hickories, and shortleaf pine as the most dominant species. A wide variety of other native flora and fauna are part of the forest ecosystem.

Leo Drey began using uneven-aged single tree selection and the forest is still managed in this way today. However, the forest has undergone tremendous change in standing volume since 1951 as restoration of the forest continued, and that has required a more detailed investigation of our management and a high level of planning to ensure the forest retains its uneven-aged character in perpetuity. The staff and the Foundation Board of Directors have carefully examined historic and current management in adapting to these forest changes.

When comparing the 2012 and 2017 Continuous Forest Inventory (CFI) results there was a substantial increase in sawlog volume. This change was detected by the first-time use of sophisticated laser equipment which provided precise measurements during the 2017 inventory. Since the first CFI, standing sawlog volume, sawlog trees per acre, and basal area per acre have steadily increased. Pioneer staff have measured advance reproduction since 1992; analysis of the 2017 CFI revealed that the number of small diameter oak stems has decreased over the past 25 years. The increase in sawlog volume and decrease in oak reproduction is concerning considering the need to sustain the forest in an uneven-aged state.

Many of the stands on Pioneer Forest are currently overdue for harvest. Staff has increased the total harvested acres annually to meet the silvicultural needs of the forest. In order to maintain the forest as an uneven-aged system staff has slightly increased the volume removed from each harvested acre, to assure canopy gaps provide for regeneration and the establishment of new age classes of trees. Along with these changes it is imperative that the average harvest cycle be maintained at 20 years.

Forest Policy

This forest management plan represents a forest policy addressing management planning, silvicultural systems, environmental protection, monitoring and assessment, social considerations, recreational opportunities, cultural protections, forest ecology, and wildlife habitat. Each of these is addressed in greater detail later in this document.

Generally, the forest will be maintained using the uneven-aged single tree selection method. The forest-wide schedule will require annual harvests on 5500-7000 acres. Post-harvest spacing should allow for saplings, poles, and sawtimber to move through diameter classes over time. The overstory canopy should not close for any length of time. Wildlife habitat, water quality, and soil protection all have strong considerations during harvests. The management should also be flexible and responsive as conditions continue to change and as knowledge of the forest grows.

Objectives

The primary objectives of the forest management plan are to manage the timber resource for ecosystem health and resilience using the uneven-aged single tree selection method as a publicly available demonstration of a sustainable and productive forest that improves timber quality and generates revenue for the landowner; maintain a biologically and ecologically diverse forest; maintain aesthetic value throughout the forest, including immediately following harvests; provide social benefits to the community, supporting the local economy and providing primitive outdoor recreational activities to the public; protect and maintain ecological, geological, and cultural sites such as designated natural areas, forest reserves, caves, and natural arches, cemeteries and other cultural sites; and develop procedures that ensure the comprehensive forest management program will be easily transferred to current and future staff.

Management Actions Planned

1. Harvest between 5500 and 7000 acres annually
2. Maintain 577 miles of property line by painting approximately 125 miles of property line annually except during inventory years
3. Re-measure the CFI beginning in the fall of 2022
4. Continue to protect all recognized natural areas and forest reserves, review lands to identify other potential natural areas and forest reserves and add new areas where appropriate
5. Continue stewardship of designated ecological management areas
6. Maintain the existing recreational trail system through the forest in good condition
7. Limit public motorized vehicular access on our private access roads
8. Limit the spread of exotic invasive species
9. Work to eradicate feral hogs from Pioneer Forest and surrounding lands
10. Continue to consolidate the boundaries of the forest through acquisition of interior and adjacent tracts and relinquishment of inefficient outlying tracts

Detailed information can be found later in the document. An appendix includes our policy and performance standards, report forms, special resource designations, township maps, a sample timber sale contract, a list of agreements with various entities, tract names, and a glossary that defines terms for the general reader.

Jason Green
Forest Manager

Ownership of Pioneer Forest LLC and the L-A-D Foundation

Leo Drey's acquisition and management of the forest began in 1951. He operated Pioneer Forest as a small family business and in 2004 he and his wife Kay organized most of the lands as Pioneer Forest LLC and then donated that entity to the L-A-D Foundation, Inc. Drey remained active as board chair until his death in 2015 at age 98. The foundation will continue to manage the forest as a working forest as it has been for almost 70 years. The Foundation has provided for a successful transition of the forest land, buildings, equipment, and staff, and developed a supportive infrastructure for board oversight, ongoing management review, and policies. The permanent nature of this ownership ensures that Pioneer Forest will be a lasting demonstration of single-tree selection, uneven-aged forest management for this region and beyond. The board developed a consolidation plan to relinquish small, isolated tracts and fill in larger tracts. The acreage of the forest as of 2019 is 143,598.25 acres.

Under Leo's leadership even prior to the 2004 gift, the L-A-D Foundation and Pioneer Forest have worked closely together, sharing a fundamental interest in land and its management. The Foundation was established by Leo in 1962 and acquired title to several properties in Missouri; seven are under a donated lease agreement with the Missouri Department of Conservation (MDC) as units of the Missouri Natural Areas System and two others are under a donated lease to the Missouri Department of Natural Resources (MDNR) and managed as units of the Missouri State Park System. Since 1974 the L-A-D Foundation has also owned 951 acres of river frontage along the Current and Jacks Fork rivers in Shannon and Carter counties, most of which were once part of the forest and are under conservation easement to the National Park Service for the purpose of river corridor protection within the Ozark National Scenic Riverways (see Appendix D).

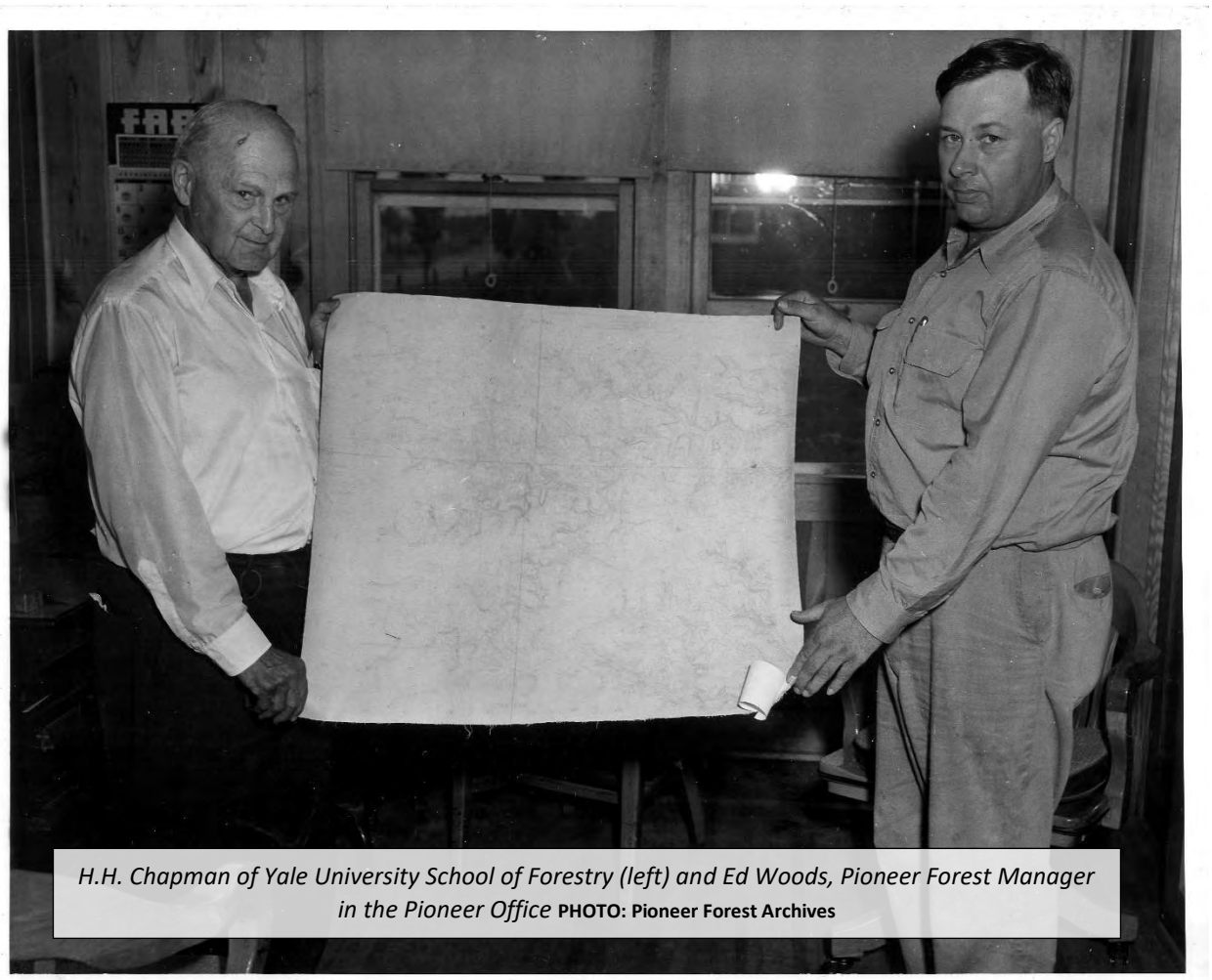
The Foundation oversees many other projects. Operation of Pioneer Forest is its largest program. The Foundation also leases the extensive Trails of the Roger Pryor Pioneer Backcountry, within the largest block of Pioneer Forest, to the MDNR to provide primitive outdoor recreational benefits. It has a long history of grantmaking in support of projects benefitting the natural and cultural resources of the Missouri Ozarks. Staff organize and lead tours and educational programs each year and participate in many natural resource-oriented organizations and meetings.

Context and History of the Lands of Pioneer Forest

From the time he acquired his first tract of land in 1951, Leo Drey recognized that the wooded landscapes of the Ozarks could be restored through conservative management. Pioneer Forest is located in the oak, hickory, and pine region of the Ozark Highlands. Other species found here include black gum, ash, sycamore, black walnut, black cherry, basswood, cottonwood, hackberry, and elm. This extensive and scenic forestland also provides recreation, water, timber products, fuel, and essential habitats for wildlife. Together, the forest and the character of the landscape are the focus of management.

Leo Drey's long-range goal, and ours today, is to restore and maintain the health and productivity of the land, demonstrate our method of harvesting trees from an uneven-aged, continuously forested landscape, and help sustain local communities and economies. For more than 65 years Pioneer Forest has not only successfully demonstrated but also researched the technical applications of a method of uneven-aged management known as single-tree selection harvest.

A large part of the forest is located in the Current River hills, in some of the topographically roughest areas of the Ozarks, and this roughness has influenced fire return intervals and likely also forest dynamics, floral and faunal species distribution and abundance, and human movement, settlement, and related disturbance patterns. Guyette and Stambaugh (2008) have used dendrochronology and other data to quantify and map mean historic fire intervals in relation to indices of topographic roughness in our part of the Ozarks and to suggest implications for forest management.



H.H. Chapman of Yale University School of Forestry (left) and Ed Woods, Pioneer Forest Manager in the Pioneer Office **PHOTO: Pioneer Forest Archives**

Guyette and Stambaugh found that the center of Pioneer's largest contiguous ownership expressed the highest values for topographic roughness in the Missouri Ozark region. There are measurably fewer instances of disturbance here. Large fires have been difficult to propagate, rubber-tired skidders have been less able to get up and down steep hollows, and there are fewer roads, most of them along ridges. This region of the Ozarks has most often been subject to small-scale rather than landscape-scale disturbance and with less frequency of wildfire (estimated at 10-50+ years rather than 5 to 10 years for flat lands).

Deciduous forests along with scattered shortleaf pineries made up most of the pre-settlement vegetation of the Ozarks, especially in areas of greatest topographic relief (Thom and Wilson 1980). From our own long-term work, as well as other references from this area, the Current River watershed of the Ozarks was and still is the most heavily forested region of Missouri.

Previous owners of the largest block of Pioneer Forest were considered good stewards during their ownership in the 1940s. They have been credited with beginning "scientific forest management practices" and "conservative use of the land" (Meyer 1949).

In July of 1946 National Distillers Products Company of New York acquired all the lands originally assembled by Pioneer Cooperage Company of St. Louis and retained its professional forestry staff (Flader 2008). The leadership team of Forest Manager Ed Woods and Chief Forester Charlie Kirk invited H.H. Chapman, a well-known professor from the Yale School of Forestry, to consult on forest conditions and management in July 1951. In six days, Chapman traveled 1500 miles, inspected 66,000 acres of land, and completed measurements from 106 of the 179 sections in which Distillers owned land.

Chapman's results and his conclusions are instructive (Chapman 1951). He was impressed with the white oak regeneration and recommended that Distillers continue sustained yield management and begin systematic monitoring through a continuous forest inventory (CFI). Included in his report is a calculation of the number of trees per acre from three diameter classes. Each acre of Pioneer Forest contained on average 30.3 trees 4-10 inches in diameter, 5.8 trees 12-14 inches in diameter, and 2.1 trees greater than 16 inches in diameter. There were nearly eight sawlog trees per acre (individual trees greater than 12 inches in diameter).

It is also important to note that the only merchantable trees noted in the Chapman report (1951) were white oak, black oak, red oak, and shortleaf pine. We speculate that Chapman's data may not have accounted for the full measure of forest timber averages, since just six years later, data from Pioneer's own CFI in 1957 shows nearly double the number of trees per acre and nearly double the number of sawlog trees per acre. Pioneer's forested acres were almost certainly in better condition than the average Missouri Ozark acre during the 1950s.

Shortly after Chapman's visit, National Distillers changed its top management and began to liquidate its timber and then sell its land holdings. Charlie Kirk, knowing Leo Drey had begun buying forested land in the Ozarks to pursue more conservative management, alerted Drey to this opportunity.

For six months Drey negotiated with National Distillers in New York before concluding his purchase of 89,906 acres on June 1, 1954. Much of the Distillers land was in a nearly contiguous block north of the Current River and just east of Round Spring. The forest office in Salem and equipment was included. The negotiation ended with Woods and Kirk and other staff working for Drey. He had sought to salvage some of the integrity of the forest by limiting the cutting to trees greater than 15 inches DBH, and by preserving 300,000 board feet of standing large white oaks in several areas of his choosing.

Nevertheless, during the ensuing 1950s, Distillers logging crews continued cutting an estimated 18 million board feet of mostly white oak. Another 12 million board feet of timber was lost to wild fire and drought. Pockets of larger trees were left farther away from the sawmills, along with the oaks smaller than 15 inches DBH. All of the non-merchantable trees remained, presumably including other native species such as black gum, hickory, ash, walnut, black cherry, elm, and other oaks.

Drey then renamed his long-range forest management effort "Pioneer Forest" and began its restoration. Today, that landscape of large areas of unbroken forest canopy is one of Pioneer's signature features in the Missouri Ozarks and represents a forested condition quickly disappearing even within remote rural areas.

European Origins of the Method of Management

Uneven-aged forest management used on Pioneer Forest was derived from methods of management originating in the mountainous regions of Europe. European private forest owners viewed forests as an important economic asset that, through careful management, could periodically be tapped for income as it was needed. In the late 1800s, more formal descriptions of the uneven-aged management harvest method known as single-tree selection were produced.

Practitioners of the uneven-aged method espouse its aesthetic and economic benefits for the private landowner. Pioneer has more than 65 years of highly successful experience with this forest management method and is one the best examples of the practice and study of uneven-aged forestry within this region of the country.

This was the forest management method used by public land managers, through the 1950s until the even-aged practice of clearcutting began in Missouri in the mid-to-late 1960s. Leo Drey adopted the uneven-aged practice, was pleased with the results, and committed to maintaining the Continuous Forest Inventory.

The following sections through The Marking Method and Guidelines for Pioneer Forest have been taken from Iffrig, Trammel, and Cunningham 2008, pages 52-57 of Describing Single-Tree Selection Harvests in Missouri Ozark Forests and adapted for this management plan.

History of Single-tree Selection as Applied in Pioneer Forest. The application of single-tree selection harvest has been described as at least as much art as it is science. From the very earliest days of Drey's ownership, the forest management philosophy was epitomized by the words of Russ Noah, former forester with Pioneer Forest: "if a tree would last for another 10 years (or until the next scheduled harvest), don't cut it." This philosophy is also expressed in a more recent and equally concise description of uneven-aged management by Guldin and Baker (1998), where markers are instructed to "cut the worst trees and leave the best within each diameter or product class."

Foresters Ed Woods and Charlie Kirk applied this method of management to the properties of Pioneer Cooperage. Infestations by insects, disease, or storm damage were all reasons to harvest a tree. Rather than removing all or a large portion of the trees from any given acre, only those trees that might be lost or were expected to significantly decline (in value, or health, or both) before the next harvest were considered for removal. The principal idea was to devise a harvesting technique that would allow selected trees to be removed periodically from the forest. Neither the expected period for this re-entry, nor the carrying capacity for these Ozark forests, were precisely known when foresters of the present-day Pioneer Forest began. Through practical experience and experimentation, the details of this technique have developed.

Overview. Uneven-aged management, and especially the single-tree selection technique, is, by nature, a highly flexible forest management tool. Single-tree selection harvesting is more consistent with the dynamic conditions within the forest, combining the biological realities with various social objectives (Becker and Corse 1997), including income, recreation, and aesthetics. The biological realities such as drought, fire, ice, and wind, as well as the many human-inspired or human-inflicted changes that have affected these forests over long periods of time, are all constant and highly variable factors. Management and experience with an ecosystem at least several hundred years old continue to leave many details of their effects still unknown. These include the carrying capacity or standing volume, maximum diameter, and a strict Q-ratio—the factor used to calculate the number of trees within individual age/diameter classes (Johnson and others 2002). Therefore, our marking prescription aims for more broadly defined age and diameter classes within the forest. Age classes must be different in both height and age and show reasonable vigor. This flexibility allows for specific targeted adjustments to be determined on-site, during each harvest, accounting for both natural and catastrophic change that may occur.

The most basic requirement of uneven-aged management is that the resulting forest shall possess at least three distinct age classes. The age class or diameter distribution of the forest then follows what has become a classic reverse J-shaped curve (Johnson and others 2002). This curve portrays the forestwide array of diameter classes beginning with a greater number of younger aged, smaller diameter trees, and then progressively reducing the numbers of trees within each diameter class to reach fewer older aged, larger diameter trees. The difference between the real curve from actual forest data and the theoretical guiding curve provides the management target. The quantitative analysis of these results and the periodic fine-tuning over long periods of time determine successful management and demonstrate how well the technique works when applied across a large forested landscape.

Markings should focus on leaving behind a high quality, vigorous stand of trees with species that are appropriate for the site. Marking should focus on improving the stand quality with each entry and leave behind, if possible, a diverse mix of species. Diverse species mixes will allow flexibility into the future in case of catastrophic events such as widespread disease and/or insect outbreaks, and/or climate change. Markings should always consider post-harvest aesthetics, taking care to leave crop trees of multiple age classes and promote varied vertical tree structure.

Merchantability Standards. The merchantability of a given species depends on market conditions within a region. Currently, minimum merchantable hardwood sawlog trees are 11 inches in diameter at breast height, with at least an 8-foot sawlog containing a 10-inch diameter at the small end. Pine sawlog trees must be at least 9 inches in diameter at breast height and have at least an 8-foot log length, with a minimum of 6 inches in diameter on the small end. Blocking logs, used for pallets and in steel mills, are trees less then 11inches dbh, with a minimum of approximately 5 inches in diameter on the small end. Cordwood trees are measured during the CFI but are not commonly sold in our current system.

Harvest Cycle. Uneven-aged management retains a forest cover on the land and thus no recognizable beginning or end to the structure of the forest. Forest management through the application of single-tree selection becomes a series of separate entries, called cutting cycle harvests, where each time a partial harvest occurs. These harvests can be thought to be analogous to the thinning used in well-managed, even-aged stands, but unlike even-aged thinning, mature, high-value trees are harvested during every uneven-aged cutting-cycle harvest. Success with single-tree selection management depends on the monitoring of canopy closure as well as a forest's structural characteristics, particularly vertical. The ability to continually monitor and measure this forest structure through time facilitates success and quantifies and characterizes forest quality.

The timing between each entry has evolved from that used beginning in the early 1950s, of about every 10 years, to a slightly longer period used today of 20 years for individual stands. Past cutting history and the current condition of the stand are used to determine the timing of each harvest entry. Exact timing depends on the condition of any given area, primarily canopy closure for the forested area under consideration. The canopy cannot be allowed to close fully for any length of time without causing a loss of desirable seedlings, saplings, and poles, and significant components of stand structure. Other factors include physical condition of the trees, growth rate, and signs of mortality.

Marking Method and Guidelines for Pioneer Forest

Marking for a single-tree selection harvest focuses on the condition and health of individual trees. When marking an area for harvest, every tree is examined and assessed as to the risk of that tree surviving through the next harvest cycle. Trees not marked are considered likely to survive, and, thus, are left to grow and gain in volume and value. The number and quality of retained, or "leave", trees found on every acre of the forested area are a distinguishing measure of single-tree selection harvesting. Leave trees are the dominant and most productive trees in each age and diameter class. As stand marking proceeds across the slope, the focus on any given area is to first determine which trees are to be left and only then to begin marking those trees that are to be cut. The best trees on each site are almost always left to be re-assessed during the next harvest. Specific considerations are age and species, physical condition, vigor, site quality, stand position and density, and den or snag trees.

The following marking guidelines have been developed to assist in the evaluation of trees during a harvest when using single-tree selection management. It should be remembered that when using this method, foresters mark and leave trees for the present harvest but also look ahead to one or more future harvests when assessing each tree's status.

Age (Size) and Species. The forester must observe characteristics of each tree to estimate its age and determine whether it is approaching biological maturity. For any given tree this requires understanding of the capability of any given species within this region. For example, a scarlet oak currently estimated to be 80 years old would be around 100 years of age at the next harvest entry used on Pioneer Forest. An age of

Dr. Dave Larsen Discussing Stand Dynamics on Pioneer Forest. **PHOTO: Greg Iffrig**

100 years would place a scarlet oak beyond the age considered to be its normal biological maturity, and, thus, would be at high risk of mortality. Such a tree would be marked for harvest. On the other hand, a white oak tree 150 years of age is well within the most productive growth period during its life cycle and could be retained for at least several more harvest entries.

Physical Condition. Each tree is examined for factors such as an unusual number of dead limbs, decay holes, percent crown spread, percent live crown, insects, and disease. For example, trees in poor physical condition or those infested with insects or diseases are considered at high risk of significant volume loss or of dying before the next entry and, thus, become candidates to be marked for removal during harvest. In addition, those trees infested with insects or disease will potentially become an infection site for the surrounding stand and should be removed.

As marking moves across the slope or up the hill, each tree is observed from all sides. It is often the case that a tree observed from several sides, and initially thought to be a leave tree, will be reconsidered when a serious defect is observed from a side of the tree not yet seen. Oaks in otherwise good physical condition, but with a basal hole as opposed to a hole somewhere up on the trunk or bole, may be candidates for leave trees if no other options for quality leave trees are available. Such a tree may grow through another harvest cycle with considerable additional increase in volume but with potentially minimal increase in the measured defect.

Vigor. The overall health of each tree is considered. To be retained, a tree must be growing well. For example, red oaks must have a tight, relatively smooth bark with little difference between the bark ridges and valleys. This indicates a strong, healthy tree that is putting on good diameter growth. In this example, the bark indicates that the tree is healthy and growing rapidly. The tree should have a good, relatively thick, healthy looking crown in relation to its size and position in the stand. A positive assessment indicates an ideal leave tree.

Site. The forester considers the conditions of the site on which the tree is growing, including slope position, aspect, soil type, and soil depth. During a day of marking, site conditions will change several times along and across a given hillside. These changes may be from a dry ridge top to a moist north cove to a warm west hillside. Marking is designed to encourage and leave those species best suited to each site condition. Therefore, marking for a single-tree selection harvest requires the continual assessment of site quality and species composition, with the goal of favoring those species that will survive adverse conditions between now and the next harvest cycle. Each harvest is directly related to growth rate as well as the standing volume. For example, a higher volume could be cut from the faster growing cove site than from the drier ridge top. Making these adjustments during marking compensates for varying growth rates and is consistent with the naturally higher stocking possible on better sites.

Stand Position and Density. Consider an individual tree's position in the stand when determining which trees to cut. Legitimate reasons exist to cut both poor and good trees, depending on localized stand conditions. There are two primary reasons why trees otherwise considered to be leave trees might be cut. Trees that have become suppressed for prolonged periods of time are often of poor quality, and do not respond well to release; as such, they are poor candidates to leave until the next harvest entry. On the other hand, a desirable tree may also be a candidate for removal via thinning in order to give other more desirable trees in proximity room to grow.

Cull and Snag Trees. Cull trees are defined as living trees where more than 50 percent of the total volume is defective from a merchantability perspective. Snag trees are standing dead trees and have no commercial value. However, maintaining a component of defective, dying, and dead trees within the forest is considered a very important measurable benefit for wildlife. Thus, no attempt is made to remove all dead and dying trees from the forest. Individual merchantable trees showing signs of use for dens or nests by forest-dwelling mammals, birds, and reptiles are almost always left. Merchantable trees with no apparent wildlife use may be salvaged or left, depending on the density and distribution of culls and snags

within the area. Trees of no merchantable value and no value for wildlife may be felled where they interfere with the growth of a desirable leave tree.

When Several Adjacent Trees Are Candidates for Removal or Leaving. When a small group of trees is under consideration for marking, and the criteria above do not make the choice clear, then choosing which trees to mark and which to leave becomes a matter of thinning. With all other factors appearing equal, this decision would prioritize the observed spacing within the group and, by removing one or more trees, would provide more opportunity for the leave trees.

Light. One requirement for successful regeneration is the presence of both direct and diffuse light. Harvest activities allow direct light to penetrate the forest canopy where a tree has been removed. Harvesting one or a few trees creates canopy gaps that vary in size but occur in an irregular pattern across the landscape. Light penetration continues for some time into the future until each canopy gap is eventually filled in. Diffuse light is also continuously present within the forest by being transmitted through smaller gaps in the canopy (such as dead limbs or spaces between adjacent trees), as well as by being reflected off the leaves, trunks, and limbs of the trees within the forest.

Both direct and diffuse light reach the forest floor as trees are removed during each harvest. The provision of light, continually shifting in space and time, is a built-in component of this method of management.

Other research on various oak species has suggested that shade tolerance may not be as fixed as often suggested (Johnson and others 2002). McGee (1976, 1988, 1997) has shown that oaks adjust to variation in light conditions by shifting the timing of their spring budbreak, based on their exposure to light during the previous year. Seedlings and saplings beneath a forest canopy begin growing earlier in the spring than open grown oaks when light and moisture conditions are the most favorable. McGee (1997) found this same response in several oaks—white (*Quercus alba*), black (*Q. velutina*), scarlet (*Q. coccinea*), post (*Q. stellata*), chinquapin (*Q. muehlenbergii*), and northern red oak (*Q. rubra*). McGee (1986) also found this same response in hickories, red maple (*Acer rubra*), sugar maple (*A. saccharum*), and white ash (*Fraxinus americana*).

Regeneration. Single-tree selection on central hardwood sites, by its nature, is sustained by the accumulated regeneration of desirable species. The ability of oaks to accumulate in the understory has been well documented. As Johnson and others (2002) have pointed out, the early development of a large taproot and delayed shoot growth are characteristic of all oaks. Previous research has shown that oak acorns sprout, grow, and then die back, repeating this response for many years while building a taproot (Johnson and others 2002). Dey and Guyette (2002) offer a brief review of oak regeneration ecology, pointing out that oaks are well adapted to repeatedly produce new sprouts from dormant buds located at the root collar. This root collar is often located beneath the soil surface and is naturally protected from such disturbances as low-intensity fire and some herbivores. With this adaptation, oak seedling sprouts can develop beneath a forested canopy for decades, capable of rapid response to changes in light availability. Their response is to reallocate energy from root into shoot development (Johnson and others 2002, Dey and Guyette 2002).

Ideally the cutting cycle used in single-tree selection harvests on Pioneer Forest should not be long enough to allow the canopy to completely close. Each cutting cycle reopens the canopy whereupon seedlings and stump sprouts, with well-developed taproots, are ready to capture the hole created in the canopy. Since the canopy gaps resulting from single-tree selection harvesting are small, the recruitment and regeneration present on the floor at any given time may number only a few saplings with perhaps a higher number of seedlings and sprouts. These numbers are small when compared to reproduction numbers using even-aged forest management. Unlike even-aged management, where establishing regeneration is a one-time event, single-tree selection harvests provide for regeneration with each entry. This maintains the range of age classes characteristic of this technique of management.

PIONEER'S 2017 CONTINUOUS FOREST INVENTORY AND RESULTS

A Brief Historical Overview. In 1952, Pioneer foresters Ed Woods and Charlie Kirk (then employed by National Distillers) sought assistance from Calvin B. Stott (often referred to as the Father of CFI), who had developed the Continuous Forest Inventory methodology for the U.S. Forest Service in the 1930s (Stott 1968). Woods and Kirk established this CFI system of forest measurement on Distillers' company lands, starting in 1952.

The CFI initiated in 1952 had 132 permanent 0.2-acre (0.08 hectare) plots, one for each 640-acre (259 hectare) section of the forest. These circular plots were located systematically in the center of every sixteenth 40-acre parcel of ownership, counting from the northwest section corner.

After Leo Drey bought National Distillers' land in 1954, hiring most of the staff in the process, he and his managers resolved to repeat the inventory every five years on his entire holdings of Pioneer Forest, with 0.2-acre sample plots to represent each 320 acres. This meant that for lands measured in 1952, one additional plot for each section was established five chains (66 feet, 20.1 meters) north of the original plot. For new lands added to the CFI, the plot locations were in similar pairs five chains apart, for a total of 384 plots in 1957. The total number of plots would increase as the acquisition of land continued. As of 2017, the CFI contains 448 plots.

In 1957, Stott helped set up a complex, 152-step system to track some 6,000 individual trees with a diameter at breast height (DBH) ≥5 inches. Data were entered on IBM punch cards and were processed by a new computer at the Ford Forestry Center in L'Anse, MI. The Pioneer Forest inventory would be a more intensive and regular inventory than that implemented over the years by the U.S. Forest Service (Flader 2004).

From 1992-1997, with help from the University of Missouri and the USDA Forest Service North Central Forest Experiment Station, the Pioneer Forest inventory was improved in two ways. It added the measurement of all saplings greater than 1.5 inches and less than 5 inches DBH on each of the 0.2-acre plots. Then, within a subset of 95 plots, smaller 1/50th acre plots were established for a count of smaller saplings and tree seedling regeneration less than 1.5 inches DBH. These smaller plots also are measured every five years, but during the following growing season for easier species identification.

Maintaining and Measuring Plots. When Pioneer Forest holdings are sold, measurement of the corresponding plots terminates. As new acreage is acquired, plots are added in pairs to maintain the ratio of one plot for every 320 acres owned. If a given acquisition is less than 640 acres, plot pairs will not be added until it and subsequent acquisitions sum to at least 640 acres. The new plots will be systematically located in the center of a specific 40-acre parcel of new ownership, counting from the northwest section corner. The ordinal number of the parcel will be determined randomly by drawing once from 16 numbered slips in a hat, representing the sixteen 40-acre parcels in a section.

CFIs begin in the fall of the nominal year and finish during the winter. No trees or seedlings are mapped, but the coordinates of plot centers are available. A CFI plot (the center of which is a point marked by a painted metal stake) is a fixed circular area with a radius of 52.7 feet. Within this plot the DBH of each tree greater than 5.0 inches DBH is measured at 4.5 feet above ground; the tree is assigned a number and is tallied as an overstory tree. Tree numbers and DBH lines are repainted on all trees during each five-year re-measurement. Data taken on each over-story tree consists of species, DBH, merchantable height, percent defect, presence of insect/disease/physical damage, crown class (mid/over/ understory), and vigor. Understory data is the tally by species of all trees with DBH greater than 1.5 inches and less than 5.0 inches in diameter. When a sapling reaches 5 inches DBH it is numbered, and full data is taken. On the 95 nested 1/50-acre (16.7-feet radius) circular plots measured the following growing season, the numbers of stems less than 1.5 inches DBH are tallied by species to provide data on regeneration of the seedlings and saplings less than 1.5 inches DBH.

When timber management occurs on Pioneer Forest, CFI plots are treated in the same manner as any other area of the forest. When a tree needs to be removed according to Pioneer's single-tree selection style of management, it is marked and cut. This allows the CFI to reflect actual volume and growth responses to single-tree selection on a forest-wide scale.

The sheer number of plots measured (448) represents a broad and representative cross-section of sites across the forest. Plots are located on a sampling of slope positions, aspects, and forest types. This allows for data to be taken from a relatively small proportion of the forest but still be representative of the land. When the area measurement of all CFI plots is totaled, it is nearly 90 acres of the forest.

The beauty of the CFI system is that, with each re-measurement, five years of growth data are taken on every tree in every plot. With the establishment of baseline data for Pioneer Forest beginning in 1952, we can track the growth and vigor of individual trees, and accurately study forest change by site quality under single-tree selection over long periods of time. From these data, accurate forest-wide volume estimates are obtained. The volumes are used to determine average yearly growth per acre. This figure is used to determine sustainability when comparing annual harvest to growth.

Pioneer Forest is recognized as having the oldest continuously maintained forest inventory dataset in Missouri, and among the largest within this region of the country. Several post-graduate-level studies have included portions of the Pioneer CFI data (for example, Jenkins and Pallardy 1993, Loewenstein 1996, and Wang 1997). More recently several other forest researchers have shown interest in doing additional in-depth analyses.

Results of the 2017 Continuous Forest Inventory. The 2017 CFI is the 14th measurement on Pioneer Forest since 1952. It encompassed 448 plots 1/5-acre in size and measured more than 14,000 individual trees. The inventory is done completely in-house and takes seven field staff nearly six months to complete (along with their regular timber sales and administrative duties). It is one of the most important tools used for resource planning on the forest and invaluable for forestry research in this region.

Sawlog Tree Volume**.** For the 2017 CFI, staff for the first time used sophisticated laser calipers and clinometers to measure merchantable tree heights, thereby creating a more reliable measure of sawlog volume. As a result, the sawlog volume showed a dramatic increase to 5814 board feet per acre. Because estimated tree height had likely been too low in previous CFIs, staff used equations for tree taper of different species to adjust tree heights and resulting volume estimates originally reported for the 2012 CFI (but not for earlier CFIs). As seen in Figure 1, this is an increase of 1096 board feet per acre (23% increase) when compared to 2012's adjusted volume of 4718 board feet per acre. Each inventory to date has shown an increase in standing volume, with the increase from the 2017 inventory greatest. Sawlog trees per acre increased from 39.6 to 43.0 for 2017.

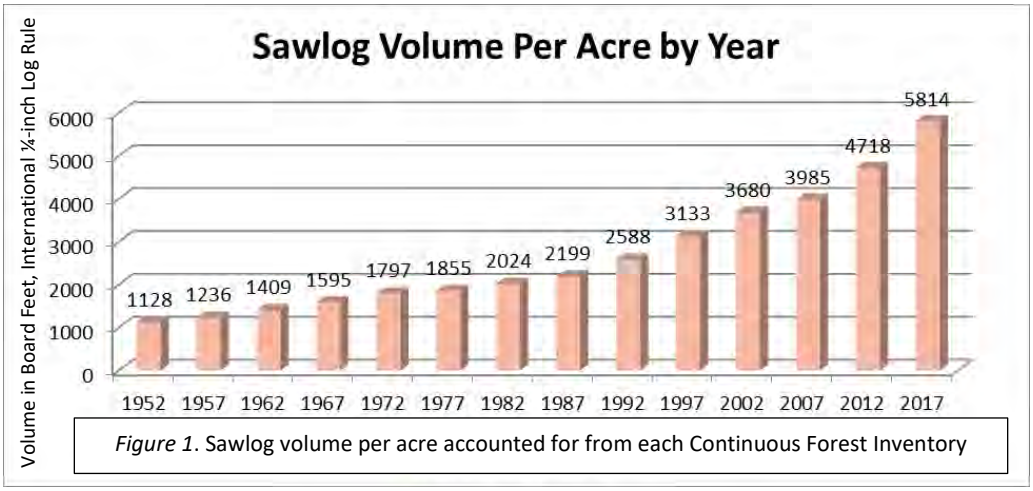


Figure 1. Sawlog volume per acre accounted for from each Continuous Forest Inventory

Species composition. Species composition by volume is relatively unchanged from 2012 to 2017. Figure 2 shows red oak species (northern red oak, black oak, scarlet oak) continue to make up most of the standing volume followed by shortleaf pine and white oak. These three species groups make up over 90% of the total standing volume of the forest.

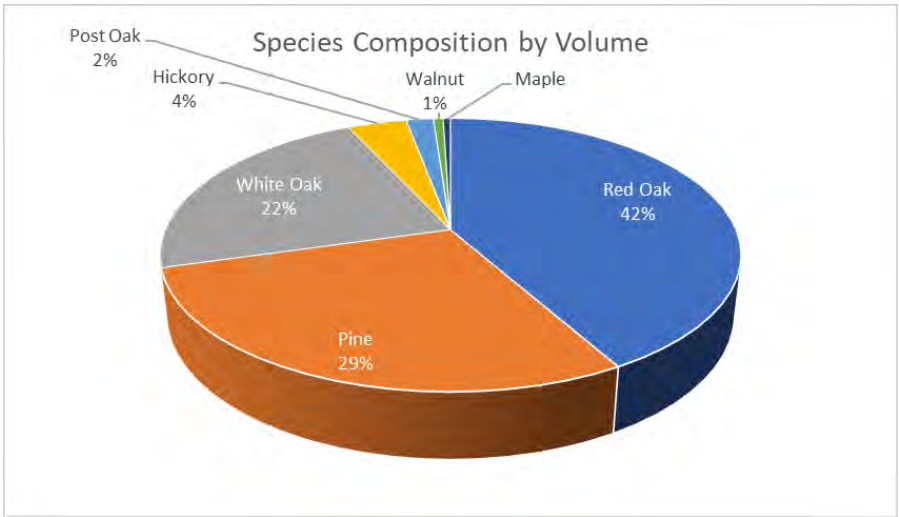


Figure 2. Species composition by percentage of total volume from the 2017 Continuous Forest Inventory

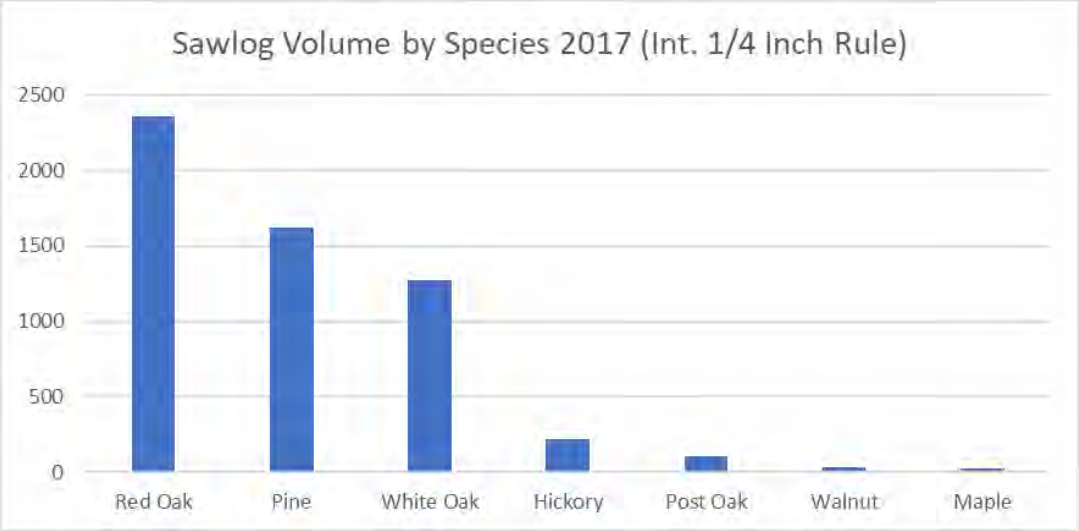


Figure 3. Sawlog Volume in Board Feet, International ¼-inch Log Rule

Growth**.** Growth is the most complicated estimate of our inventory. Growth estimates are calculated by examining how much sawlog trees increase in volume (Figure 3) from one inventory to the next, increases from trees moving from cordwood to sawlog trees (ingrowth), and losses from sawlog trees moving to cordwood, cull, or dead categories. In the simplest form, growth can be described by the following: net growth = survivor growth + ingrowth – losses. The calculation is expressed in board feet per acre per year. Since we adjusted sawlog heights for 2012 based on tree taper in 2017, we are the least confident in the growth result. However, the process used is the best available. It was based on extensive discussions with Advisory Council foresters Dave Larsen of the University of Missouri and Jim Guldin of the USFS Southern Research Station and with Forest Biometrician Steve Shifley of the USFS Northern Research Station. It was well thought out and documented throughout the pre-inventory planning period

and is the best estimate we could get. We will have much more confidence in our growth estimate once the 2022 inventory is completed. At that time the same equipment and techniques will have been used twice to precisely measure merchantable tree heights and those results can be compared directly from one inventory to the next.

Growth has been compared from one measurement period to the next. According to Schnur (1937), upland oaks on undisturbed sites can grow between 209 (site index 60) and 276 (site index 70) board feet per acre per year. As shown in Figure 4, our growth calculation is 228 board feet per acre per year (International ¼ Inch Rule), which is between these two estimates. If the growth estimate is correct, annual total growth for the forest could exceed 32.6 million board feet per year. Due to the unreliable height measurements in 2012, and the many other factors involved in growth, we have decided not to adjust the 2012 growth estimate in the graph that follows. That comparison will be made after the 2022 re-measurement when precise height will have been measured two CFIs in a row.

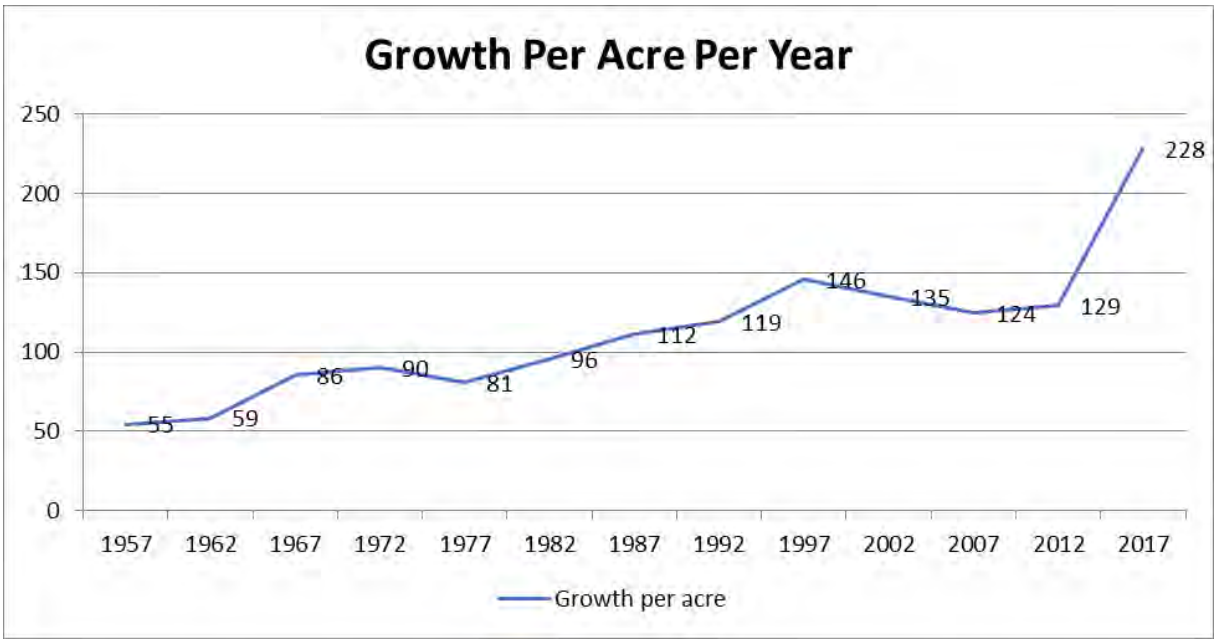


Figure 4. Average Board Feet Growth Per Acre Per Year, International 1/4-inch Log Rule

Mortality. Mortality measurements are based on tree diameters and heights from the 2012 CFI. There were no major mortality issues observed on the forest in the interim. Wind and disease comprise most of the natural mortality with 7.6 bf/acre/year and 12.8 bf/acre/year respectively. Only 28.6 bf/acre/year is lost due to natural mortality. There do not appear to be any major shifts in mortality.

Timber harvest is the single largest category of mortality on Pioneer Forest. Timber harvesting makes up 40.2 bf/acre/year in reductions as calculated from the CFI. Harvest mortality is directly controlled by foresters, so we have confidence in this category. It is important that most of our mortality comes from timber harvests. If most of our mortality resulted from other issues such as insect infestations or disease, we would be concerned about losses from these events.

Advanced Reproduction. This measurement of DBH from trees 1.6 inches to 4.9 inches has been recorded in each inventory since 1992. The data is collected using a dot tally in each 1/5-acre plot and shows how increasing density has affected these diameter classes. Since 1992 basal area has increased each year, while oak reproduction has decreased. There appears to be a strong correlation between increasing basal

area and decreasing advanced oak reproduction. This trend has also been supported by several research papers, some of which were conducted in the Missouri Ozark highlands.

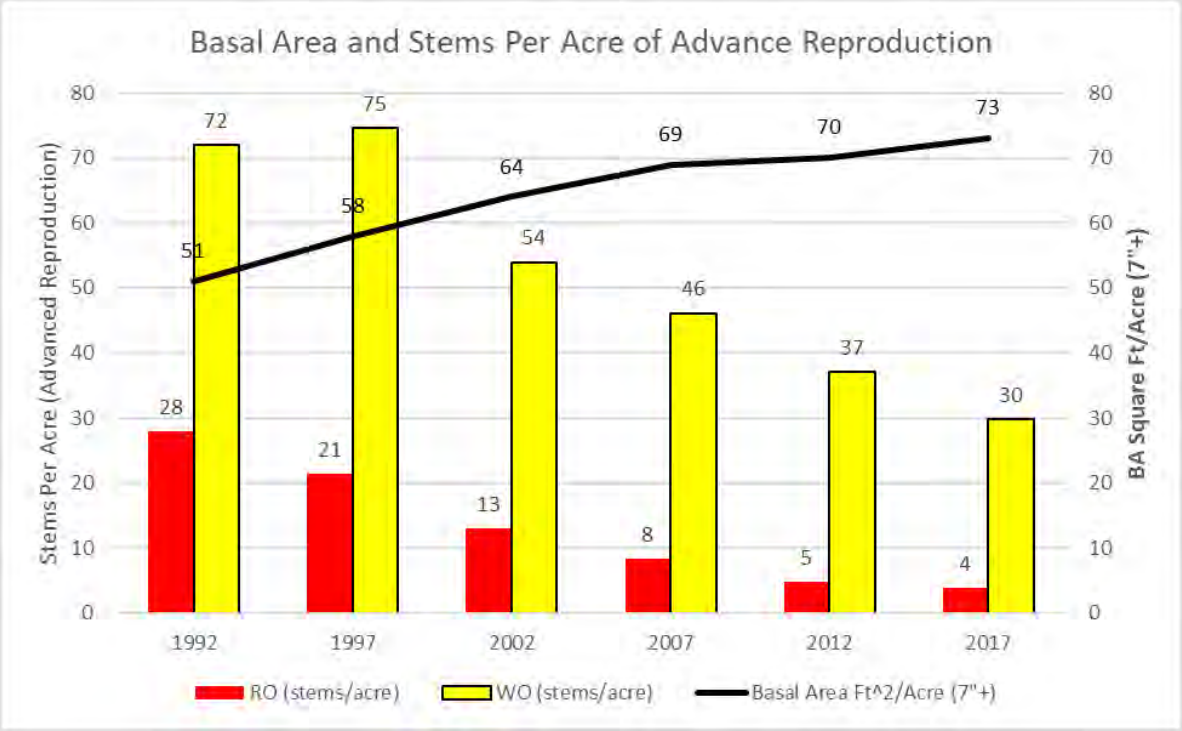


Figure 5.

Reverse-J Diameter Distribution. A reverse-J diameter distribution is typical for an uneven aged forest. However, when looking at only oak species, the diameter distribution is more linear (Figure 6). We will continue to monitor this trend through the next inventory. When all species are included, Pioneer Forest's diameter distribution follows the classic reverse J-shaped curve.

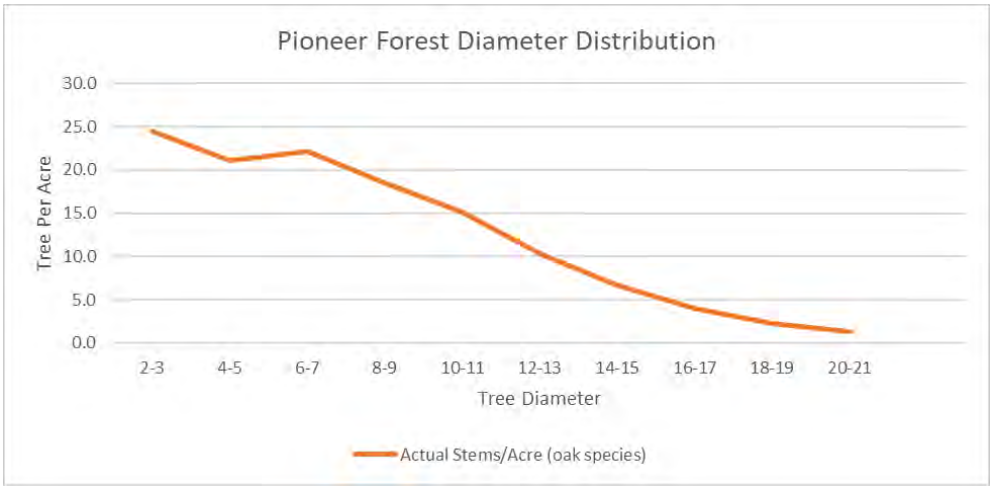


Figure 6.

IMPLICATIONS FOR MANAGEMENT

Volume Per Acre. Lands of Pioneer Forest have been undergoing forest/woodland restoration for more than half a century and today's standing volume is higher than ever. There are more options for marking timber on any given acre with many sawlogs to choose from. Decisions to leave the highest quality trees in any given stand and those best suited for the site are easier. As always, marked trees are selected for removal for a variety of reasons, including but not limited to quality, aesthetics, spacing, species, site characteristics, density, and age.

The forest is now likely fully stocked. We have higher basal area and more sawlog trees per acre than we have had in Pioneer's history. In order to continue the mission of uneven-aged single tree selection, foresters will need to mark appropriate levels of sawtimber. This will ensure the aesthetic three-age (or more) structure, continue the movement of pole timber into the overstory, and assure regeneration. Re-entry for harvest must average 20 years; we are currently cutting many stands that have not been harvested in 30-40 years. Failing to adapt to present conditions on the forest could move the forest to an even-aged structure, with a diameter distribution that has lost its reverse J-shaped curve (characterized as having a greater number of smaller diameter trees along with fewer larger diameter trees) and perhaps having two age classes, or less.

Across the forest are 833 million board feet of standing sawlog volume. Given current growth, the forest can be expected to reach more than a billion board feet of sawtimber within the next 5 to 10 years. Currently, Pioneer Forest is only cutting 1% of our standing volume annually.

Growth. Growth is the category in which we have the least amount of confidence. Since the 2012 heights were adjusted based on tree taper, there is some minor concern about the accuracy of the calculation. However, the height adjustments seem reasonable considering our observations in the field. Furthermore, the publication by Schnur (1937) gives some validation that the growth estimate is reasonable.

Assuming the calculation of growth from 2012 to 2017 is accurate, our annual growth rate is 228 bf/acre/year or 32.6 million board feet per year across the forest. Because we are only harvesting 8 million board feet, there is a net increase in standing volume of 24.6 million board feet annually. In other words, Pioneer Forest only harvests 24% of its annual growth. Since the overall mission of Pioneer Forest is to sustainably manage the forest using uneven-age single tree selection, foresters will need to continuously examine harvest levels, annual acreage covered, residual standing volume, and growth. As the forest approaches maximum capacity, sawtimber harvest must be closer to sawtimber growth.

Mortality. Currently there are no apparent issues with mortality. Most mortality is coming from harvests and we have no concerns with the level of other mortality on the forest at this time. However, the increasing volume of sawtimber may create a situation where there are more trees that lose vigor and quality, growth stagnates, and mortality increases. Staff will need to monitor stands that show signs of this situation. There are also a variety of non-native insects and diseases that have infested other parts of the United States. Staff will need to be vigilant in watching for these pests and diseases that may impact the forest. Climate change may also play a role in mortality. However, current climate models predict expansion of some species such as white oak and shortleaf pine. If this occurs in the long term, we will continue to manage tree species that are best suited to the site considering all environmental factors.

Timber Harvests. Over the past few years we have increased the harvest level to around 8 million board feet annually. We must continue to increase the annual timber volume harvested over time. Since basal area and trees per acre continue to increase, we can expect that, on average, the forest will increase its stocking level towards the A-level or overstocked on a Gingrich stocking diagram. Over time, the increase in stocking may have negative implications for maintaining a reverse-J diameter distribution and maintaining health and vigor across all diameter classes. The maximum level of stocking is based on biological limitations and the minimum stocking level is based on ability of the forested stand to develop naturally into a fully-stocked stand. Each harvest entry must thin stands to just below the B-Level which

is generally near 60 percent of full stocking. This ensures proper spacing for sawlog trees, promotes regeneration, and ensures that trees of all sizes move through diameter classes. Due to increasing basal area, Pioneer Forest is also seeing a reduction in oak reproduction. By maintaining a 20-year cutting cycle, we hope to stabilize or reverse this trend. Pioneer Forest can easily maintain a harvest regime that removes between 8-12 million board feet annually. Harvests must balance volume removed and acreage covered in order to maintain a 20-year cutting cycle. As staff learn more about the dynamics of the forest, further adaptation will be necessary.

Response to Large-Scale Disturbance Events.

The timber management program on the Pioneer Forest was interrupted in 2009 when the derecho windstorm event blew down 20 million bf across 22,000 acres of the Forest, with severe damage on 7000 acres (Vaughn 2013). A decision was made to salvage the downed timber volume, and staff foresters spent the next 2 ½ years working full time to utilize that downed material. However, harvests of healthy stands under the regular timber management program was suspended during the derecho salvage effort.

In the event of a similar catastrophic event that causes significant loss of standing volume, Pioneer Forest staff will make decisions about the priority of salvage of damaged timber and the effects of that redirected effort with respect to the active forest management program outlined in this Management Plan. Those decisions will be made in consultation with the L-A-D Board and the Advisory Committee.

Future CFI Measurements. For 2017, new measuring equipment provided accurate height measurements and significantly improved the CFI. Pioneer Forest will continue to re-measure the longest-running continuous forest inventory in the State of Missouri; its data is our most important resource for planning and monitoring long-term trends on the forest. Staff will continue to utilize the most accurate tools available. These tools will provide future generations of forestry staff with the best comparisons from one inventory to the next. They will provide the best estimates for standing volume, growth, species composition, mortality, and value. Staff should recognize the significant history and value of our CFI for planning and operations on the forest.

This could be one of the most important measurement events in Pioneer's CFI history. The resulting adjustment in total standing volume, growth, and value are substantial and will have major, long-term implications for resource planning on the forest.

BEST MANAGEMENT PRACTICES AND WATERSHED MANAGEMENT

Pioneer Forest meets or exceeds all federal, state, and local water quality standards. Loggers are required by contract to comply with best management practices (BMPs) as described in the most current Missouri Department of Conservation publication "Missouri Watershed Protection Practices," which is the authoritative watershed document in Missouri for logging practices. Forestry staff walk timber sales out weekly to ensure BMP's are being followed to contract specifications.

Streams and Riparian Zones. Pioneer Forest lands include segments of three major rivers. The Current and Jacks Fork Rivers are among the most biologically diverse rivers in Missouri. To the east and southeast is the Black River. All have a diverse flora and fauna and contribute significantly to the local economy through tourism. Watershed management and protection is of high importance for all the rivers and streams within the ownership of Pioneer Forest.

Several other biologically diverse streams flow throughout the property and include, among others, Leatherwood Creek, Blair Creek, Brushy Creek, and Big Creek. In addition, such watersheds as Leatherwood Creek, Logan Creek, and Satterfield Hollow support forest stands with old growth timber that have been monitored and protected for more than 65 years.

Current management strategy calls for the protection of these streams by keeping logging equipment outside of a riparian zone of between 30 and 100 feet from the stream bank. Individual trees may be

removed from the zone by cable. No trees will be removed from a zone within 10 feet of the stream bank to avoid bank destabilization. Fallen trees will be allowed to remain in the stream to provide needed woody structure and habitat for aquatic species.

Riparian areas provide wildlife with food and water, cover from heat and cold, protection from predators, and breeding and rearing habitat. Main haul roads will be located on ridge tops to avoid stream crossings. Skidders crossing streams will cross perpendicular to stream flow and only at locations designated by forest staff. No equipment will cross through bogs, fens, or other wetland areas.

Conservation of Biological Diversity

Pioneer Forest has a diverse population of native forest species of high quality located across the landscape. Its sheer size in continuous forest cover across the Ozark landscape is remarkable. At more than 61,000 acres, the Roger Pryor Pioneer Backcountry represents the largest contiguous piece of ownership in the state of Missouri. The forest utilizes both staff knowledge and records, but also the Natural Heritage Database and Cave Database for protection of sensitive ecological areas.

The whole of Pioneer Forest is managed using uneven-aged forest management by single-tree selection harvest. Uneven-aged forests are irregular in character due to irregular age and tree spacing within a harvest unit. Harvest units provide a mosaic of tree species, vertical structure, light regiments, standing volume, course woody debris and snags. Only 1/20th of the total acres are treated on an annual basis.

This condition provides habitat that is suitable to a wide variety of fauna and herbaceous plants. The structure includes the oldest canopy trees alongside subcanopy trees, saplings, seedlings, and cull trees (less than 50% sound), as well as standing snags or den trees (economically non-productive), and coarse woody debris decomposing on the forest floor. Together this complex of defective, dead, and dying trees in the forest is maintained to provide habitat for a variety of species of animals, including skunks, raccoons, birds, mammals, reptiles and amphibians that use hollow trees and coarse woody debris for part of the year. Dead snags provide habitat for a variety of small invertebrates as well as a food source for many forest species necessary for a healthy forest ecosystem. Some of the dead or dying sawlog-size trees may be salvaged, but no attempt is made to remove all of them from the forest.

In addition to standing snags and den trees, fallen trees, large woody debris, and logging slash are left on the forest floor to decompose and recycle nutrients.

Snag Tree Management. Snag trees are important roosting sites. Snag trees may be marked with an X and can be cut at the discretion of the logger. If they pose no safety threat, snags are not marked and are retained as standing dead. Snags do not occupy significant growing space and allow other trees to fill in growing space provided by the death of the tree. Their retention creates valuable roosting habitat and has little effect on the production of timber. They also provide important habitat structure for invertebrates and other wildlife. For more information please refer to the “Management Practices for Bats” portion of this document.

Coarse Woody Debris. Downed woody debris is an important part of forest wildlife habitat and a future source of organic material for soil structure and fertility. Such debris is lowest on poor sites where additional organic matter would be beneficial. Management has stressed retention of woody debris during harvest operations. On harvest sites where the number of snags is higher than necessary, harvest operations include the felling of some of this forest component to insure the presence of debris on the forest floor.

Understory vegetation. The forest includes a range of understory plant communities typical of upland oak/pine forests within the northern Ozark region. Native species dominate the understory with higher numbers on more mesic sites. More detailed information is in the “CFI” and “Ecological Management Areas” sections of this document.

Wildlife. The property provides diverse and suitable habitat for a variety of wildlife species. Pileated woodpecker, deer, turkey, squirrel, and other furbearers are common throughout the forest but are not at levels detrimental to forest regeneration. Neo-tropical migrant birds pass through and nest in the forest during the spring and summer months and a multitude of perennial bird species are commonly seen in the forest. Both black bear and bobcat are occasionally seen. Pioneer has been active in assisting with larger state efforts to monitor and evaluate the black bear population on the forest and offers its land as part of the state effort to restore elk.

Special Resource Stewardship Designation on Pioneer Forest

These designations were adopted as policy approved by the board April 23, 2015 to ensure that certain conservation attributes of the forest which may require protection, maintenance, and/or enhancement are assessed and managed appropriate to the scale and intensity of forest management.

Beginning with Leo Drey's leadership and interest, Pioneer has always managed its forest conservatively. It was an early leader in recognizing and protecting important places. The Society of American Foresters initiated its natural areas program in 1947 and the first area in Missouri was recognized on Pioneer Forest in 1955. Protecting important places on Pioneer lands continues to evolve (Iffrig, Karel, and Flader 2017).

Society of American Foresters Research Natural Areas. Beginning in 1947 (Shanklin, 1955) the Society of American Foresters (SAF) recognized the value of permanently setting aside certain tracts of high-quality forest types so that a library of such type areas would be available for study. The Missouri Chapter of SAF, including then Pioneer Forest Manager Ed Woods and Chief Forester Charlie Kirk, initiated the idea of recognizing natural areas in Missouri. They began on Pioneer Forest. The Current River Natural Area, representing a white oak forest type, was designated in 1955. This area contains an old-growth white oak forest type that has trees that are 350-400 years old. These trees represent some of the oldest white oak trees in Missouri.

This step by the forest owner recognized the forest's public economic and conservation values. In 1964 Leo Drey, along with his foresters, again worked with the SAF in establishing the Pioneer Natural Area (Lynch 1964), recognized for its canopy dominated by eastern red cedar. This SAF program was the first such effort to identify a system of natural areas in the United States and provided a means for Pioneer Forest and its owner to bring this way of thinking about forest and land resource management first to Pioneer Forest and then to Missouri. In the 1970s the study, evaluation, and recognition of natural areas began to take root in state resource management organizations and agencies around the country.

Pioneer Forest Points of Interest. Foresters working on Pioneer Forest kept a list of important places on the forest. These sites were identified beginning in the 1960s-1970s. The printed list, titled Points of Interest, leaned toward individual geologic features including caves, springs, and cultural resources in or near Pioneer Forest. This list included 97 separate features; 32 of these were noted specifically as caves, and all are presumably included in the more extensive inventory of caves annually updated by the Cave Research Foundation (see Cave Conservation, elsewhere in this management plan). We added a site where running ground cedar (*Diphasiastrum digitatum*, formerly *Lycopodium digitatum*) grows thick (estimated 28 yards by 15 yards) along Mash Creek, less than half-mile west of Heaton Cemetery. This once disturbed site may contribute information about the species.

Two comprehensive reports detailing recreation opportunities were prepared specifically for Pioneer Forest. One was completed by the U.S. Department of the Interior Bureau of Outdoor Recreation (1976) and a second was completed that same year by the Missouri Coalition for the Environment (Bedan and Goetz 1976). Each of these reports encouraged natural areas protection by the forest. The Bureau of Outdoor Recreation's Recreation Plan for Pioneer Forest included much of the information from the Pioneer's Points of Interest list and added several sites. The Coalition for the Environment plan suggested that several larger forested areas be set aside, including Laxton Hollow and Leatherwood Creek.

Riverways Corridor Lands. In 1970, and again in 1976, Leo Drey conveyed to the L-A-D Foundation a total of 951 acres of riverfront property in Carter and Shannon counties subject to National Park Service scenic easements. These tracts, along one or both sides of the Current River, are defined by a line parallel to and 300 feet perpendicularly distant from the low water mark of the Current River. For the most part these easement lands join adjacent Pioneer Forest property.

Missouri Natural Areas. The Missouri Conservation Department began an agency natural areas program in 1970. Then beginning in 1977 the Missouri Natural Areas Committee was established by the Missouri Departments of Conservation and Natural Resources, and designations of natural areas under a variety of public and private ownerships began. The original SAF areas, Current River Natural Area and Pioneer Natural Area, were included in 1977. Current River Natural Area was expanded in 2005, and two additional areas on the forest have been designated as Missouri Natural Areas.

- Current River Natural Area (1977, 10 acres; addition, 2005, 255 acres; total area 265 acres)
- Pioneer Natural Area (1977, 20 acres)
- Lily Pond (1975, 8 acres; acquired from The Nature Conservancy 2006)
- Triple Sink (1980, 23 acres; expanded as part of Sunklands Natural Area in 1999; total area 42 acres)

Having established the L-A-D Foundation in 1962, Leo Drey began to acquire exemplary natural and cultural areas beyond the boundaries of Pioneer Forest, most of which were subsequently designated as Missouri Natural Areas. In the 1970s, the L-A-D Foundation also began to fund county-by-county surveys of natural areas in Missouri.

GOALS DURING THIS PLANNING PERIOD

- Review Annual NA Status Reports with MDC staff each year.
- Pioneer staff will periodically visit each site.
- Investigate Pioneer Natural Area for significance and possible addition of Pioneer lands in the adjoining Big Creek valley.
- Monitor Lily Pond NA for sign of feral hog activity.
- Collaborate regarding a proposed Current River Caves natural area, to include Pioneer‘s Conglomerate and Merritt Rock caves together with NPS‘s Moss Prater Cave.

Pioneer Forest Reserves. Conceptual planning for a forest reserves program on Pioneer Forest began in 1994 and was discussed and supported by the L-A-D Foundation Board of Directors. The program, including characteristic Ozark features (caves, sinkholes, sinkhole ponds, seeps or fens, glades, etc.), typical forest features such as old-aged forest stands, and cultural sites (for example Bluff School) was adopted by Pioneer Forest staff in 1995.

Pioneer Forest Reserves could be of statewide significance but are considered also for their regional importance and for their importance to the forest. There also could be multiple reasons involved in considering any one area as a Pioneer Forest Reserve. We have developed a process that helps prioritize the development of our forest reserves program. The following outline highlights the steps we follow during the consideration and review of each suggested area.

There are several sources for information about sites on the forest, including historical natural area reports. Staff regularly consult the updated Missouri Cave Catalog, and actively search for important sites through our own outreach efforts with volunteer and professional cavers, botanists, geologists, historians, archaeologists, and the like. There are regular consultations with many other interested and knowledgeable parties about our resources, including the Cave Research Foundation, Missouri Audubon,

Missouri Caves and Karst Conservancy, Missouri Department of Conservation, Missouri Department of Natural Resources, Missouri Native Plant Society, National Park Service, U.S. Fish and Wildlife Service, Webster Groves Nature Study Society, college and university faculty, and others. Information from these sources has assisted our management.

In 2013, Nelson and others remotely assessed the distribution of 24 distinctive types of glades across eight states, including Missouri. Including that dataset within Pioneer's GIS mapping and our own forest field maps encourages their protection. They are also delineated on the regional maps in Appendix D.

Small glades are typical within the forest/woodland-dominated landscape of Pioneer Forest. Recently we began restorative actions to remove invasive eastern red cedar to open a smaller dolomite glade within the Pine-Oak Woodland Ecological Management Area and to selectively thin the more extensive natural opening of the rhyolite glade on Jerktail Mountain. Both are being managed within landscapes that are also subject to prescribed fire, which is required for their successful restoration. Smaller glades we have known about but have not mapped or provided sustainable stewardship for include along the Cave Spring Trail, several in Capps Hollow, and many others our technicians have marked around.

Our process recognizes the matrix of natural and cultural components of each area. Typically, we reserve and protect these areas from traditional forest activity. The process also recognizes changes that may occur due to effects from fire, ice, wind, drought, insects, or disease. In these instances, the staff may consider further appropriate actions to take, with the foremost consideration being the reasons for which the reserve was originally established. If the forest component of a reserve is impacted, staff may consider harvesting individual trees where that would not change the character of an individual reserve.

For individual candidate areas, the significant features are described in narrative form, photographs taken, potential boundaries considered, and management intent of the site outlined. Appropriate management for any lands surrounding the reserve may also be described. The written report on the proposed reserve is reviewed by the Salem office. With consensus, the proposal is presented to the L-A-D Foundation Board of Directors for review and approval. The consideration is the same for an area proposed during the management planning process. Each area is included in the master catalog of Pioneer Forest Reserves. All these areas are protected, and certain reserves are intentionally not publicized.

Originally there were seven forest reserve areas: Bluff School/Medlock Cave, Fishtrap Hollow and Marshy Spring Hollow Fens, Laxton Hollow, Leatherwood Creek, Old Schoolhouse Hollow Fens, Sinkhole Ponds Complex, and Sutton School Hollow Fen. Three additions, Blair Creek Hanging Fen, Cunningham Sink, and Tufa Creek were the result of the 2011 forest management planning process. In 2015, the L-A-D Foundation Board of Directors reviewed a more comprehensive special resource stewardship designation for Pioneer Forest and added another area, Cookstove/Squaredance Cave Forest Reserve. Each reserve is included in Appendix C; most are mapped.

Proposed Additions to Pioneer Forest Reserves. The following new forest reserves are considered adopted upon approval of this management plan by the L-A-D Foundation Board of Directors:

Chalk Bluff Forest Reserve, 64.75 acres (26.4 acres under scenic easement, 38.35 acres on Pioneer Forest) Shannon County. Chalk Bluff is located on the Jacks Fork River just downstream from Stillhouse Hollow. It is a sheer dolomite bluff rising 300 feet above the river. The combination of L-A-D Foundation river easement land with adjoining Pioneer Forest land includes the prominent bluff face from the river to the blufftop. Nigh (1988) noted the occurrence of *Aster furcatus* and false bugbane (*Trautvettaria carolinensis)* here. American barberry (*Berberis canadensis*) was noted by Steyermark (1963) occurring in only three counties in Missouri (Howell, Shannon—Jam Up Bluff, and Texas) and indicated it usually occurred "on north-facing upper ledges of bluffs." It has been recorded from this site. Missouri's population (several counties in the southern Ozarks) is considered disjunct. Here it is found in association with eastern red cedar (some old growth, others invasive), prairie dock, wild quinine, shortleaf

pine, and lowbush blueberry. The species is also known from Jam Up Bluff, also on the Jacks Fork. Nature Serve ranks the species as vulnerable.

Management considerations. Stewardship of the site should determine how prescribed fire might be used to sustain a healthy population of barberry. Access to the area is by way of a Shannon County Road which leads to Chalk Bluff and the national park boundary. Pioneer should maintain closure where the NPS access to easement road (5-3195) begins and the county road ends, preventing through travel to the Jacks Fork.

Area Intentionally Left Blank
for Website Version

Chalk Bluff Forest Reserve during restoration following graffiti vandalism. **PHOTO BY: Chris Figge**

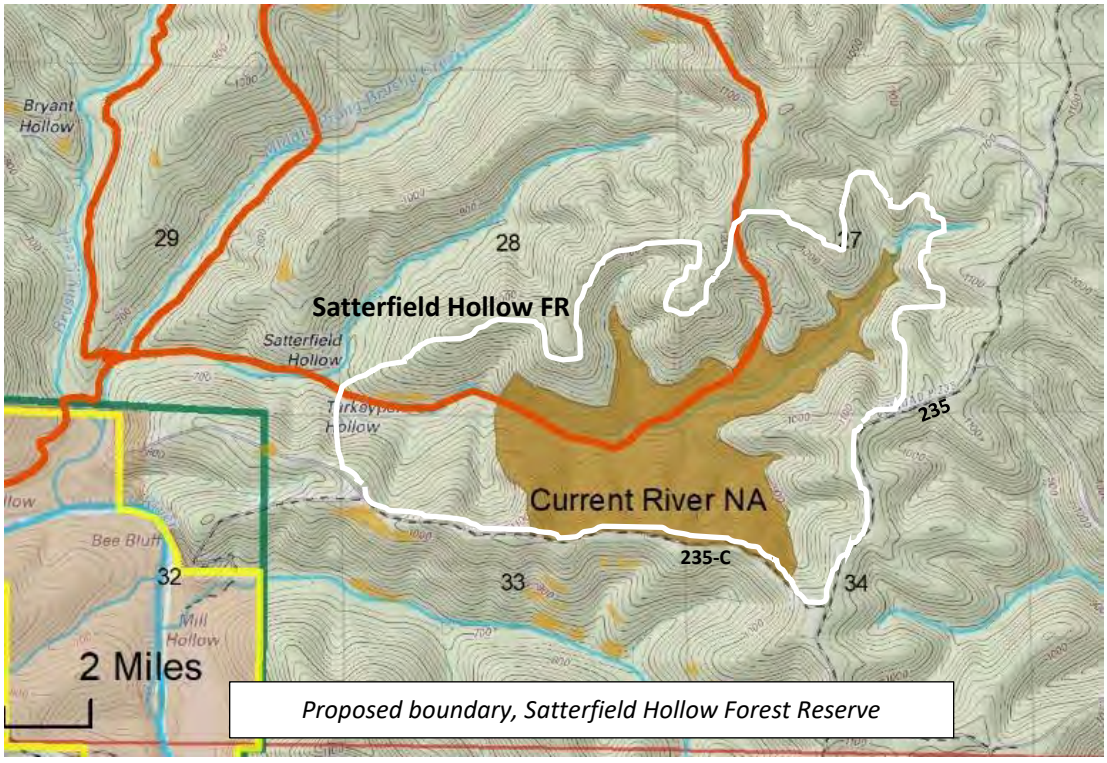
Satterfield Hollow Forest Reserve, 522 acres (existing natural area boundary includes 261 acres), total 783 acres, Shannon County. During Leo Drey's negotiations with National Distillers in 1954, he reserved 300,000 board feet of timber from atop Tick-A-Chig Ridge and extending into Satterfield Hollow where timber sales were not conducted, and old growth trees were protected. The relatively small, 10-acre Current River Natural Area (CRNA) was the first such area in the state recognized by the national program of the Society of American Foresters in 1955. Beyond the small natural area, Satterfield Hollow retained an impressive old growth forest where Pioneer staff have continued to refrain from active forest management. In 2005 an additional 255 acres were added to the Current River Natural Area establishing watershed protection across and further up the hollow. This high-quality Ozark headwater stream old growth was recognized by Nelson (2010) in his delineation of natural communities in Missouri (exemplifying dry mesic chert forest). This area is the most important example of the pre-settlement forest condition on Pioneer Forest.

We propose Satterfield Hollow Forest Reserve as buffer for the watershed surrounding Current River Natural Area. It is an important refugia for neo-tropical migratory birds. Timber rattlesnakes are found here. Except for scattered multiflora rose along the creek, no other invasive species are known.

Impressively large, black oak are scattered atop Tic-A-Chig Ridge. White oak, black oak, hickory, and gum trees of similar age and size are scattered throughout the proposed forest reserve. There are clusters of large black and red oak, with smaller shortleaf pine and snags scattered throughout, along with lowbush blueberry (*Vaccinium vacillans*), sassafras, and pinesap (*Monotropa hypopitys*, uncommon in Missouri but found here and elsewhere in rich forests and woods).

Management considerations. There will be no active forest management conducted; salvage of dead or fallen timber as a result of natural causes may be considered.

Timber rattlesnake, pinesap, and hillside woods.
PHOTOS BY: Greg Iffrig



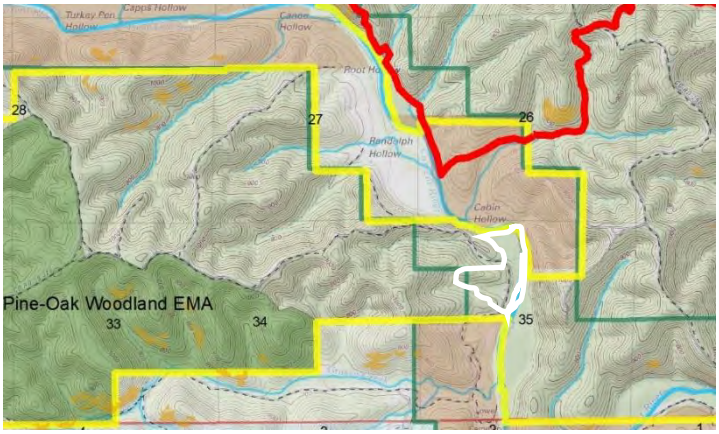
Proposed boundary, Satterfield Hollow Forest Reserve

Woods Hole Forest Reserve, 58.4 acres, Shannon County, NW/4 Section 35, T30N R4W. This area includes L-A-D Foundation land along the river within a scenic easement owned by the National Park Service, Ozark National Scenic Riverways. Pioneer land inside the National Park boundary will be studied for addition and an acreage estimated.

This area extends roughly one mile along Shannon County Road 19-225 (identified as 2-118 by ONSR). Near the southern boundary is the ONSR Grassy Camp and boat access, and to the north the bottom widens before it pinches out at a small bluff. Along this stretch there are at least twenty-five 30-inch and greater diameter, tall white oak, red oak, and hickory trees. The rich bottomland includes ginger, bloodroot, pawpaw, spicebush, and green and white ash. A portion of the contributing side hollow just across the county road is included.

Management considerations for Woods Hole Forest Reserve are that there will be no active forest management or development, and that motorized access be restricted to Shannon County Road 19-225. ONSR (1991) indicates the route leaving the county road as access to easement, private (see ONSR Map 8).

This site has great historical significance for Pioneer Forest as the site for many early black-and-white photographs of Leo Drey and of Leo with his first two foresters, Ed Woods and Charlie Kirk.



View of the Woods Hole along Current River **PHOTO: Greg Iffrig**

Ecological Management Areas. In 2015 Pioneer staff proposed and the L-A-D Foundation Board of Directors approved the designation of Ecological Management Areas (EMA) that recognized existing areas of Pioneer Forest where management was underway to target individual species or specific areas requiring prescriptive ecological management to sustain their presence on the forest. In such areas Pioneer's traditional method of selective tree harvest is modified and usually adapted to maintain certain conditions of ecological interest. Normally, some harvest is part of the management regime. Such areas are distinct from Natural Areas and Forest Reserves in that they are usually compatible with some levels of timber harvest; for this reason, delineation should be appropriate to the scale of ecological management, and sometimes larger in size than natural areas and forest reserves.

These areas are designed to maintain or restore significant natural communities as reflected in their overstory character, species represented in the canopy, and their native woody and herbaceous understory and ground cover. Controlled burning has proven beneficial and restorative. In addition, various methods of thinning may be used to encourage certain landscape conditions. The restoration phase of removing cedars and fire sensitive hardwoods often requires extensive work. Once this is completed, reoccurring prescribed fire maintains the open character of these areas. Establishing baseline vegetative data prior to management is encouraged for comparative studies and evaluation of restoration success.

Ecological management areas will be an ongoing source of information about natural history in Missouri and the Ozarks and enhance overall scientific and recreational values of Pioneer lands. Research will be encouraged, and where appropriate, Pioneer's traditional single-tree selection forest management may continue within these areas.

Pioneer Forest collaboration toward ecological management of areas extends across agency/organization boundaries. This enables scaling up to manage larger sites along with a sharing of labor costs. Pioneer's 330-acre Pineknot EMA is managed in partnership with the Mark Twain National Forest within more than 7,500 acres of a shortleaf pine restoration project on the national forest. Jerktail Mountain EMA is 1,159 acres, managed in cooperation with the National Park Service at Ozark National Scenic Riverways within a combined management area of 1,837 acres. The Tall Larkspur EMA (85 acres) in two units at Devils Well and Welch Spring, is also managed cooperatively with Ozark National Scenic Riverways.

Seasonal prescribed fire crew members have been hired since 2014. These individuals are trained in fire management and safety and work a flexible schedule to take advantage of opportune weather windows. Their focus has been to install firebreaks in the fall in order to be ready to burn anytime conditions are favorable. This has permitted L-A-D to take advantage of many more prescribed burn times such as weekends and evenings. Crews have also played a key role in glade restoration funded by a MoBCI grant, in treating exotic invasive species and trail maintenance. Volunteer groups and individuals have also played a vital role in implementing burns and in completing restoration projects. Coordination of these volunteers takes effort but also is a great way for the participants to learn about L-A-D/Pioneer Forest and help accomplish our goals.

Vegetative sampling. During the previous planning period Pioneer staff contracted the Institute of Botanical Training (IBT), a local company begun in Salem and now in Springfield, to re-sample overstory and understory vegetation information on the Randolph tract. They collected the initial baseline data in October 2008. During this planning period Pioneer also contracted with IBT to establish similar baseline data for Jerktail Mountain.

This method consists of a series of small plots laid out in grids inside specific stands. This will allow subsequent analysis of Pioneer's Pine-oak Woodland EMA, including variations of stand stocking, site treatment, and overstory and understory health, diversity, and pine regeneration.

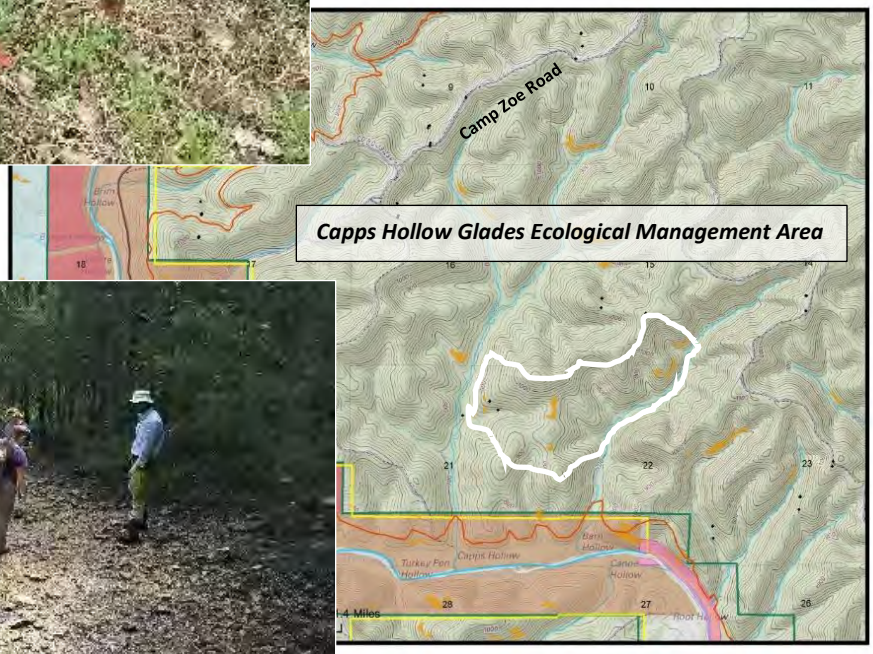
Management actions completed since 2011. A section of the 2011 Forest Management Plan titled Forest Management Favoring Retention and Re-generation of Shortleaf Pine detailed the background work conducted in advance of management at Pioneer's Randolph tract. Since the 2011 plan a series of treatment areas were developed, each with fireline construction and maintenance followed by implementation of periodic prescribed fire. Ongoing monitoring provides the opportunity to assess restoration efforts for native shortleaf pine woodland on Pioneer Forest when compared against the baseline plots established in 2009. This area has been named Pioneer's Shortleaf Pine-Oak Woodland EMA. Pioneer's work on this area is a case study in the Missouri Wildlife Action Plan (Missouri Department of Conservation 2015), see page 79.

Further considerations were developed for long-term stewardship of this area (Pioneer Forest 2017). In that document parameters for prescribed fire were that it occurs during the dormant season, typically between November and February, and according to a standard burn plan. Recommendations addressed the retention of mature and merchantable scarlet oak. Cool fires can reduce damage to the thin bark of scarlet oak. Retention of scarlet oak also has the positive benefit of canopy shading, reducing woody competition while continuing restoration of grasses and forbs on the forest floor. More specific conditions are being considered with respect to herpetofauna to reduce mortality. During the seasonal shift from winter to spring, establishing a "safe date" for burning with respect to reptiles and amphibians has much to do with soil temperature. According to Briggler (2014) soil temperatures of 45 degrees are required to bring snakes out of hibernation. Once box turtles emerge, they are highly susceptible to mortality from fire. Careful consideration of the flexibility and variability in calendaring prescribed burning from year-to-year will offer protection as well as improve habitat and natural community integrity. Cooler than average temperatures and abundant precipitation prolonged leaf-out and kept soils cool past mid-March in 2019.

Pine oak woodland ecological management area. **PHOTO BY: Greg Iffrig**

The following are proposed as additional Pioneer Forest ecological management areas.

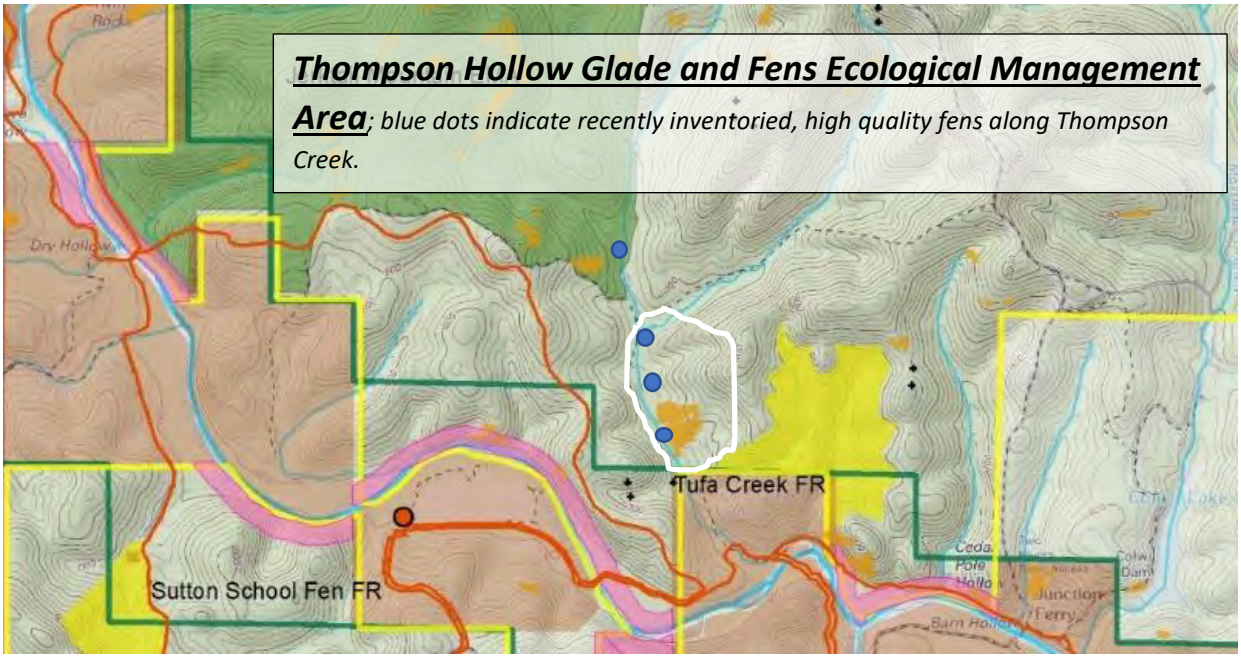
Capps Hollow Glades and Fens Ecological Management Area, 297 acres, Shannon County. Several glades are identified on south- and west-facing slopes within the Capps and Barn Hollow drainages on the west side of the Roger Pryor Pioneer Backcountry. Both are tributary streams to the Current River. In early May 2019, a field investigation of three of these areas showed a high-quality dolomite glade with old growth character cedars, a pine stump with fire scars, two marly seep fens surrounded by glade and woodland vegetation, and three closely spaced glade openings with good restoration potential. All are considered unique features of high quality. Common plants noted include Indian paintbrush (*Castilleja coccinea*), Missouri black-eyed Susan (*Rudbeckia missouriensis*), and wood betony (*Pedicularis canadensis*). *Carex tetanica*, a sedge on the state watch list was also seen. An orangetip butterfly (*Anthocharis midea*) was observed within the area, a species which is found in open areas often in dry woodland and ridgetops. The map below captures these features. Further site analysis is needed to determine acreage, fireline placement, adjustments for timber, etc.



Thompson Hollow Glade and Fens Ecological Management Area, estimated 125 acres, Shannon County.

This area is located directly south of Jerktail Mountain EMA and therefore permits effective co-management. The combination of dolomite glade, woodland transition, permanent spring fed stream and fens at this site make it extremely diverse. Disturbance to the area was largely historic, from the mining and homesteading area. The glade here is unique in that it has little or no woody encroachment on a relatively gentle slope, largely attributed to the geology. Old growth red cedars here, some more than 360 years old, have contorted lichen covered limbs and should be protected. The herbaceous vegetation is stunted in height and contains many hemi-parasitic species such as *Buchnera americana* (blue hearts), *Spiranthes magnicamporum* (plains lady's tress orchid) and *Castilleja cocinea* (indian paintbrush). Fens at this site are diverse and are only moderately effected by feral hogs.

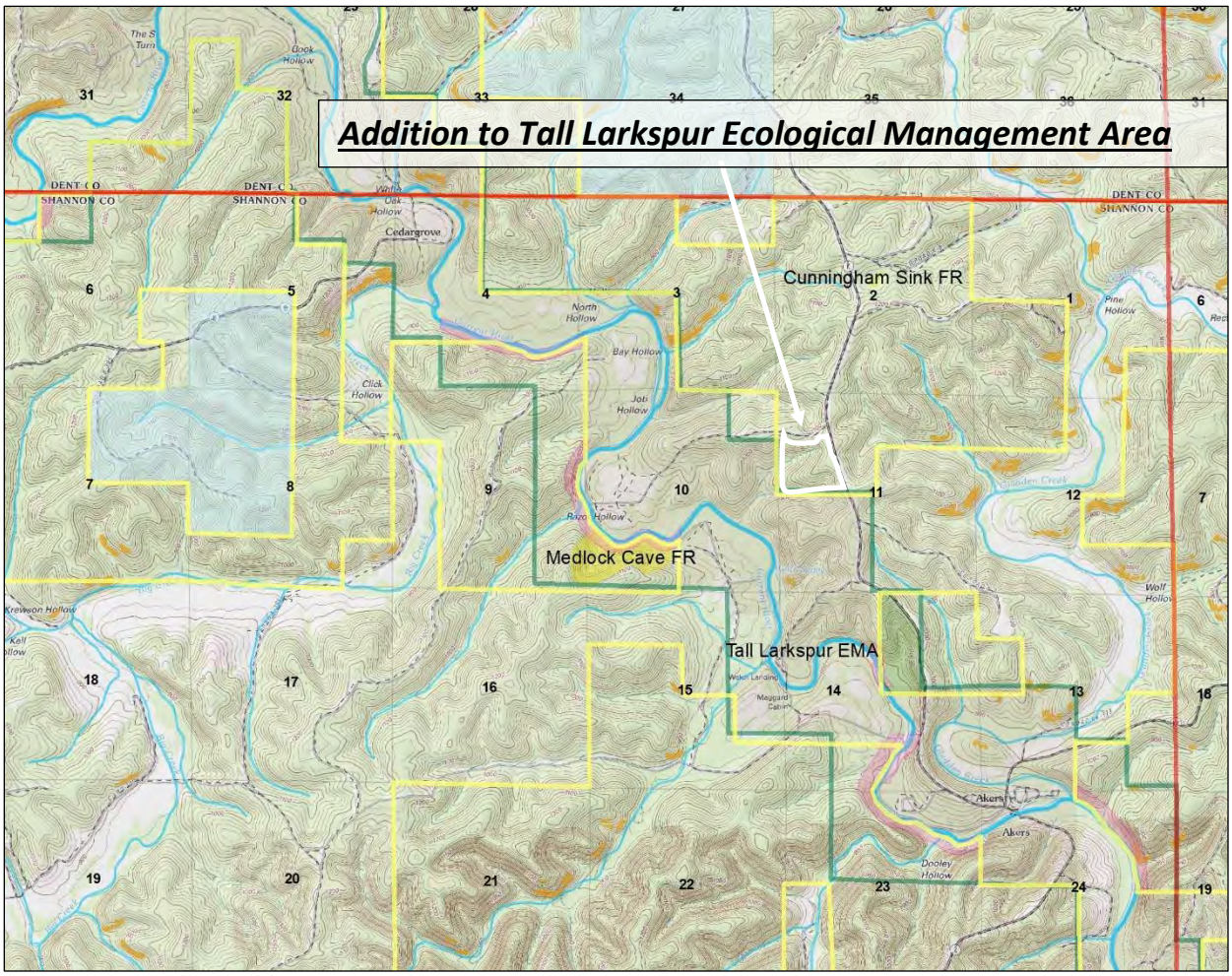
The priority for management is to assist continued recovery. Careful use of prescribed fire will more noticeably shape the woodlands but is beneficial in all of these community types. Feral hogs, feral horses, vehicle trespass, gravel from road crossing and exotic invasive plants threaten the integrity of the area. An NPS horse trail exists on the county road in Thompson Hollow.



Addition to Tall Larkspur Ecological Management Area, estimated size 56 acres, Shannon County. Within a small, unnamed hollow of the Welch Spring/Lodge area, generally SW SW Section 11 T31N R6W, on Pioneer Forest land adjoining NPS Ozark National Scenic Riverways, another population of 526 tall larkspur (*Delphinium exaltatum*) plants has been located. Most of these are found on NPS land, though a few are located on Pioneer Forest. Also, recently discovered here is eastern blazing star (*Liatris scariosa*), an imperiled species although not as rare as tall larkspur.

Both species are found in more open, woodland glade conditions. Current conditions on Pioneer Forest land are a dense understory with a closed overstory and deep leaf litter, all of which have contributed to declining populations. The bedrock here is dolomite, including old-growth pine stumps beneath a canopy of white oak, post oak, and black oak.

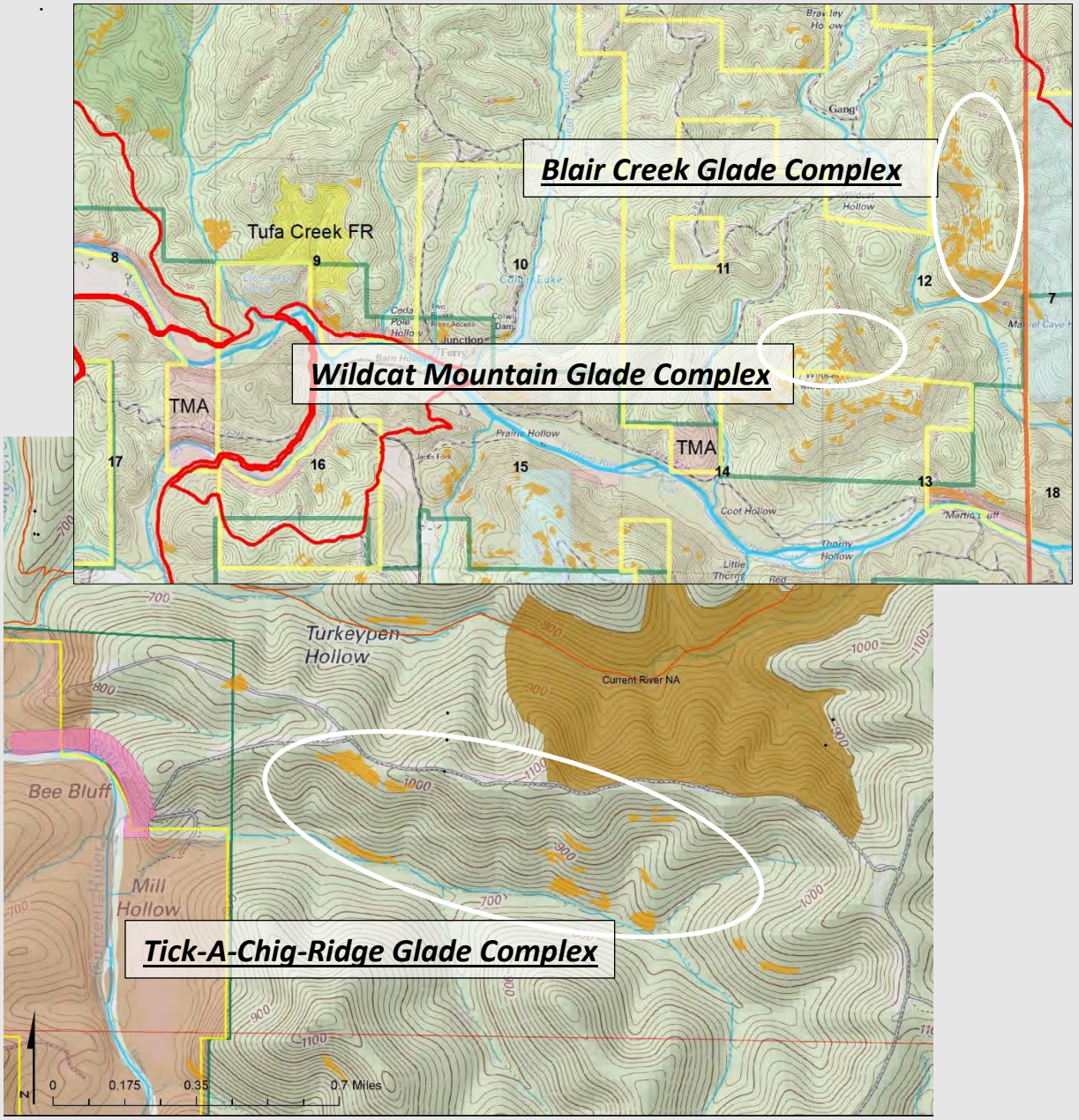
With this addition, three small sites on Pioneer Forest will be managed to improve the health of these populations and the condition of their habitat. Management underway since 2011 will continue to be conducted by NPS staff, with assistance from Pioneer Forest. Results have been very promising; the most recent count doubled the known population.

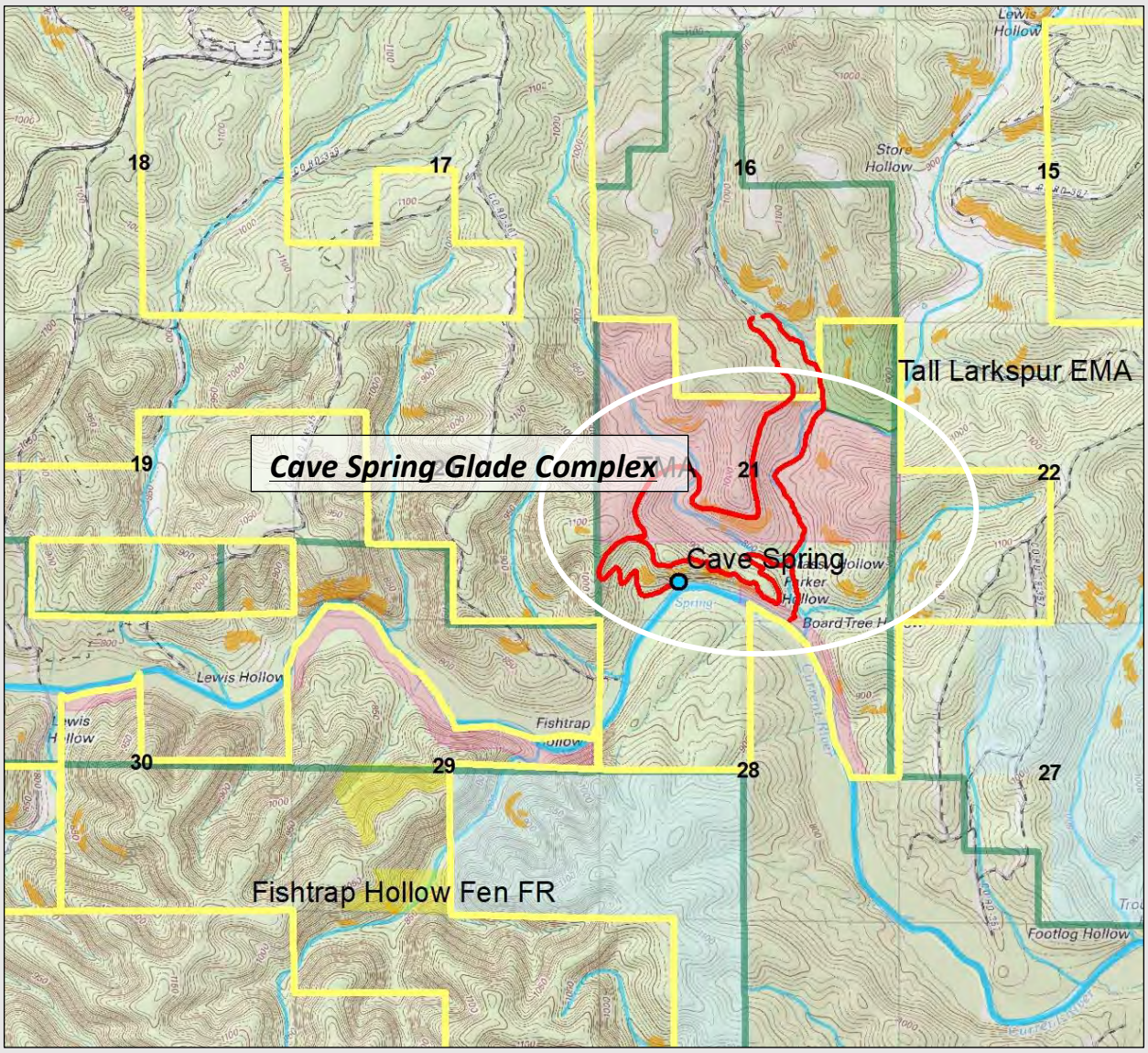


GOALS FOR THIS MANAGEMENT PERIOD:

- Evaluate other natural features and community types, including collaboration with the field inventory being conducted for fens on Pioneer Forest lands.
- Continue stewardship practices to sustain the inherent biodiversity of glade areas under management using mechanical treatment to reduce and remove eastern red cedar, and periodic prescribed fire.
- Investigate and prioritize four prominent glade complexes for possible future management: Blair Creek glade complex extending more than a mile across west- and south-facing slopes in Sections 1 and 12, T29N R3W (see below right); north slope of Wildcat Mountain (which could be combined with ongoing NRCS management on adjacent private land); lower south-facing slope of Tick-A-Chig Ridge; and Cave Spring tract near Devils Well.
- Develop management plans for the newly designated forest reserves and ecological management areas.

.




Tall Larkspur EMA
Cave Spring Glade Complex
Cave Spring
Fishtrap Hollow Fen FR
Lewis Hollow
Fishtrap
Footlog Hollow
Store Hollow
Parker Hollow
Board Tree
18
17
16
15
19
21
22
30
29
28
27

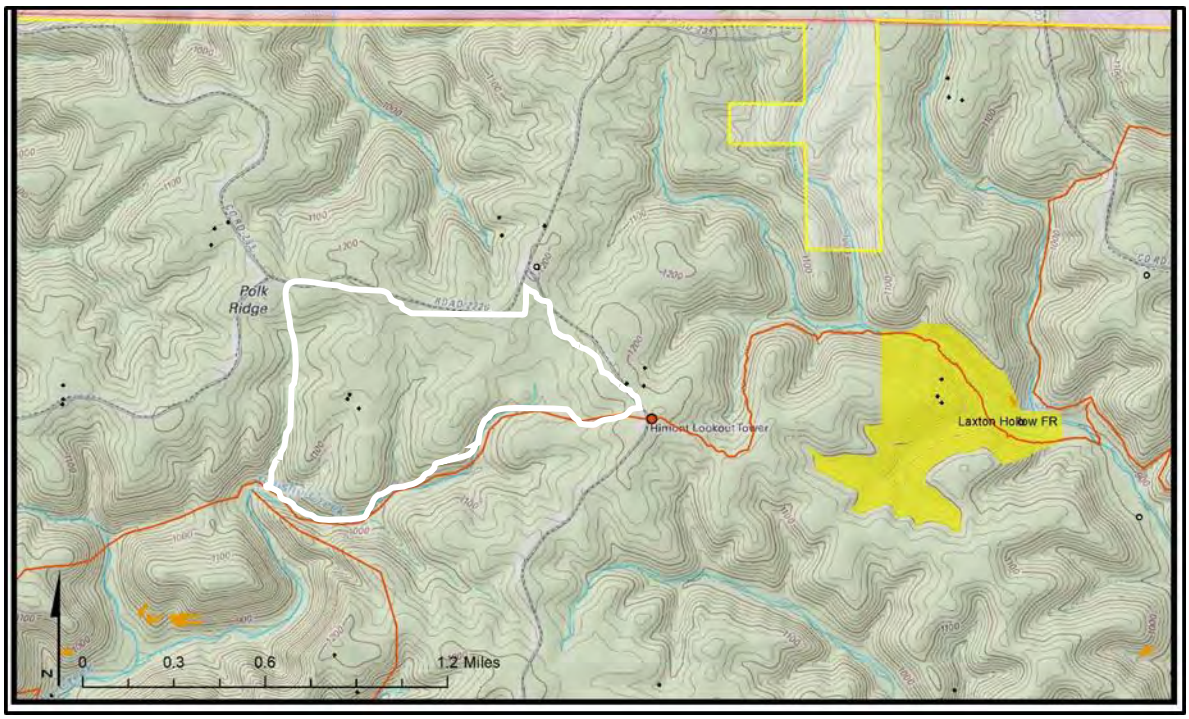
Giant swallowtail on tall larkspur. **PHOTO BY: Susan Farrington**

Sustaining Shortleaf Pine and Managing Plantings

Based on the 2017 Pioneer Forest CFI, shortleaf pine makes up 29% of the standing sawtimber volume on the forest. Most of this volume is tied up in large diameter pine sawlogs that were established when the forest was cut hard. As stocking has increased on the forest, recruitment of new pine trees has become more difficult. Uneven-aged forest management as practiced on Pioneer Forest does not lend itself to the regeneration or retention of shortleaf pine seedlings. Pine regeneration is most successful when disturbance has occurred such as fire, along road grades, and in skid trails and landings.

The total volume of shortleaf pine has declined dramatically across Missouri and much of its natural range. Therefore, pine is intentionally left when possible, as at Pioneer's Pine-Oak Woodland Ecological Management Area, which has been a focus for pine management since 2009 (see p. 77). While pine can be found across the forest, it is typically isolated on drier sites such as ridge tops and south and west-facing slopes. Pine is usually favored on these sites due to its tolerance for these growing conditions.

Thinning in heavily stocked pine stands is encouraged, leaving the best quality trees and thinning the worst, while creating adequate spacing for crown development. Some pine may also be marked to create growing space for higher quality oak timber, especially white oak. Often the ability to mark and sell pine is determined by the availability of a pine market. For many years a profitable and steady sawtimber pine market has been a major problem.



Himont Pine Management Area. The estimated 388-acre area at Himont (above) is dominated by shortleaf pine. It is located directly across the road (west) from the old Himont Mill site. It also contains a mix of quality white oak and post oak and a very poor-quality scarlet component. Logging has recently taken place across the road where any disturbance has shown tremendous potential for pine regeneration. The area is also very flat, surrounded by county road on the north and east, a log road on the west, and the head of Brushy Creek to the south. These features make fireline construction relatively easy. Timber management should focus on removing poor quality trees, especially those in the red oak group, and favoring pine, white oak, and post oak as leave trees.

Canopy openings due to the thinning process and repeated burning should provide light and site characteristics favorable to pine regeneration, which requires bare soil for germination. Promising silvicultural results here would be instructive for other sites on the forest that are conducive to pine.

Converting Pine Plantations. From 1951 to 1978 a few old fields were seeded or planted to shortleaf pine. These include a 63-acre plantation in Section 20, T31N, R7W and a plantation in the Kell Field of Section 13, T31N, R7W. The intention is to manage these plantations without using chemicals in order to perpetuate the stands or enhance their growth. Thinning will continue as individual trees achieve sawlog status.

Pine plantations were used to re-establish a wooded condition. As the planted or seeded trees mature and regeneration occurs, the resulting more natural condition will be managed in an uneven-aged manner.

RARE, THREATENED, AND ENDANGERED SPECIES

Pioneer works with state and federal agencies, various private conservation organizations, as well as respected individuals knowledgeable about Missouri's native species. With partners, our staff discover, monitor, and assist species of conservation concern. Pioneer's information and record occurrences are combined with related information from other public and private lands as part of MDC's Missouri Heritage Database. The data is digitized and maintained by shape file and Pioneer's portion has been incorporated into the forest's ArcGIS software as one of the layers of information about our lands. We regularly visit with peer professionals about the records and discuss management options.

For plant or animal species of special concern that depend on specialized habitats, Pioneer has recognized natural areas and its own forest reserves. In other cases, direct actions have been taken to discourage recognition, limit visitation, monitor and block pedestrian or motorized traffic, sign, design and maintain cave gates, actively manage certain natural communities, pursue certain acquisitions, and adjust the design of trails. Wherever Pioneer takes action, staff work in concert with others in order to best achieve the desired results. Pioneer may also consider working with volunteers or contracting with professional consultants to assist with, or add to, these efforts.

Ozark Chinquapin Plantings. Stephen Bost with the Ozark Chinquapin Foundation has planted Ozark chinquapin (*Castanea ozarkensis*) in two locations on Pioneer Forest with the goal of seed production. These sites are located in Shannon County near Cunningham Sink and in Carter County near Cave Spring on the lower Current River. The range for this native species is centered in the Arkansas Highlands with the closest wild trees found in Oregon County in the Eleven Point River watershed. The species is not currently known to exist naturally on Pioneer Forest within the Current River watershed. This project will be allowed to continue, and sites should have protection from logging.

KARST CONSERVATION

Portions of this section include information from Scott House in an e-mail attachment, June 19, 2019, the result of ongoing discussions with the Cave Research Foundation regarding inventory, mapping, monitoring, and gating of caves on Pioneer Forest.

Much of the land of Pioneer Forest occurs on soluble limestone and dolomite bedrock. This underlying bedrock is more easily dissolved by water to form individual karst features such as caves, springs, losing streams, and sinkholes. Notable examples include Cookstove Cave (Bretz 1953) and Cunningham Sink. In karst areas water flows both on the surface and underground. Surface and subsurface waters carry eroded materials such as silt, gravel, and other materials from higher to lower places. For these reasons watersheds on the forest should be managed in such a way as to protect surface water quality and not adversely affect groundwater quality.

Caves are developed in different rock units, typically termed "formations." This is not to be confused with speleothem development within caves, also called "formations" but more properly termed "speleothems." Speleothem development is one of the more attractive features of caves. Also present are typically bedrock solutional or erosional features properly termed "speleogens." All are worthy of preservation.

Forest management on Pioneer in areas where these features occur should follow general guidelines. For example, general clearing should not be done in an area that directly supplies water to a cave or spring. In general, cutting will not be allowed within a buffer zone around cave entrances. Sinkholes are normally directly linked to the subsurface and the area around sinkholes will be protected.

Sinkholes feed caves and springs more directly than normal upland topography. Losing or sinking streams also replenish the groundwater more rapidly than normal uplands. Many examples of both are found on Pioneer lands.

In Missouri, the Cave Resources Protection Act provides protection for cave resources. The federal Endangered Species Act provides protection for certain cave species that have rare, threatened, or endangered status.

Number of Caves. The Missouri Speleological Survey, in cooperation with the Cave Research Foundation and numerous other entities, maintains the Missouri Cave Database (MCD), which identifies and tracks all caves (currently more than 7500) within the state. There are 156 caves known from Pioneer Forest lands. The actual number is certain to be higher, but no systematic attempt has been made to clearly identify land ownership against cave locations.

Biologic Resources. Nearly half of Pioneer's known caves have a specific GPS location. There are nearly 1,000 faunal records from these locations, with the bulk of these from relatively few caves. For example, Cookstove Cave has more than 70 records and Medlock Cave has more than 100, while Twisting Spring Cave has only five faunal records despite being 400 feet in length.

Background, White Nose Syndrome. Since 2006 several bat species have experienced extreme population declines due to white-nose syndrome (*Pseudogymnoascus destructans*). White-nose syndrome (WNS) is a fungal disease that affects certain bat species including northern long-eared bats (*Myotis septentrionalis*), Indiana bats (*M. sodalis*), and gray bats (*M. grisescens*). WNS appears to be highly contagious and has been rapidly spreading westward from the eastern United States. WNS is the most significant threat to many North American bat populations.

Forests such as Pioneer Forest offer essential habitat and resources for bat populations, especially those affected by WNS. Forests can offer critical roosting habitat for maternity colonies, feeding areas, and migration corridors. Pioneer Forest's Roger Pryor Pioneer Backcountry is the single largest contiguous forest in the state. At 61,000 acres, the Backcountry offers a significant forested landscape, several cave systems, and diverse habitat for imperiled bat species. The Backcountry ties significant land ownership together with the Ozark National Scenic Riverways, MDC conservation areas, Missouri State Parks, and Mark Twain National Forest.

Statewide, effects of White Nose Syndrome are devastating. Populations showing dramatic decreases include the northern long-eared bat (*Myotis septentrionalis*), little brown bat (*M. lucifugus*), and the eastern pipistrelle or tri-colored bat (*P. subflavus*). Slight declines may exist in populations of big brown bats (*Eptesicus fuscus*) and Indiana bats (*M. sodalis*). The sodalis population change is difficult to judge because of the discovery of the largest known hibernaculum, which is in northeast Missouri. Some cave areas have shown a great sodalis decrease while others have not. It is also difficult to judge the population of gray bats (*M. grisescens*), since they hibernate in very large clusters and are difficult to count. However, they appear to be stable.

Mitigation of WNS is difficult and, so far, the only effective measure has been the protection of bat sites by cave closures, which prevent undue disturbance of colonies. This has only been effective with colonial bats such as grisescens and sodalis, and the effect of WNS on Missouri populations of these species is somewhat speculative. In response to the spread of WNS, Pioneer's caves have been closed.

Certain caves may contain physical or biological resources which should or must be protected. Pioneer Forest may determine that signing could help, or to assure a greater degree of security a cave gate may be necessary.

Management Practices for Bats. The White-nose Syndrome Response Team produced a document titled "Beneficial Forest Management Practices for WNS-affected Bats" (Johnson and King 2018). This document was prepared and reviewed by state and federal agencies, non-governmental organizations, and others to give detailed information, guidance, and strategies for developing beneficial forest management practices. The document will serve as a guide for providing habitat considerations for Pioneer Forest and its timber management activities.

The management of Pioneer Forest lends itself well to bat habitat conservation. Most WNS-affected species use forested landscapes for roosting, foraging, and drinking. The landscape diversity within the boundaries of Pioneer Forest provides mature stands in natural areas and forest reserves, multi-aged stands within the working forest, open areas in glades and old fields, and several Ozark streams.

Timber management. The uneven-aged silvicultural system provides habitat heterogeneity for bats and may increase use when compared to unmanaged forests. For example, large diameter roost trees, which are often preferred as roost trees, and diversity of tree species, size classes, and snags all provide important habitat needs for bats and other wildlife.

Our timber harvests produce canopy gaps within the forest that can be suitable to species that require more open foraging conditions and those that prefer a more closed canopy. Some studies have shown that single tree single tree selection harvests do not significantly alter invertebrate prey communities (Jeffries 2004 and San Diego 2001).

Maternity colonies. Pioneer Forest will rely on the Missouri Natural Heritage database, agency partners (MDC, MSP, ONSR, and USFS) and other professionals for help documenting known maternity colonies and maternity roost trees on Pioneer Forest. If known maternity roost sites are located, disturbance should be avoided until the maternity colony disperses. Pioneer will adhere to the 4(d) rule for Northern Long-Eared Bats when and where applicable, utilizing the best information available from our partners. This rule requires a buffer of 150 feet from any known maternity roost tree until the pup season is over, generally June 1 – July 31.

Monitoring and conservation zones. Pioneer has worked with both the Cave Research Foundation (CRF) and the Missouri Department of Conservation (MDC) to document cave locations and conduct annual bat surveys. Known hibernacula will require a roughly 120-acre buffer (conservation zone) around the cave entrance to provide forested habitat during swarming and staging periods (August through October). This zone may be entered for harvest during the hibernating season (mid-to-late October through early-to-mid March) provided management activities do not obstruct or alter the entrance of the cave. The size of the core conservation zone may be increased or decreased as new information becomes available.

Other Species of Conservation Concern. Many other cave species exist in Pioneer caves. Some of them are rare enough to be Species of Conservation Concern (SOCC), while sensitive or rare species have not yet been identified as SOCC. Examples of these species include the southern cavefish (*Typhlichthys eigenmanni,* formerly *T. subterraneus*) (Slay, et. al 2016) and the Ozark springsnail (*Fontigens aldrichi*).

Caves known to harbor endangered, rare, or SOCC will be managed to enhance habitat for these forms of life. Trails should not be routed near these caves, and roads or skid trails should not be constructed or maintained where traffic will have an adverse impact on them.

Caves and Cultural Resources. Many, perhaps most, caves in the Ozarks are also cultural sites. This may include historical usage such as storm shelters, storage or whiskey production, and prehistoric use as habitation or camp sites. It is likely that such cultural sites exist on Pioneer and other L-A-D lands. Incorporating information into the Pioneer GIS database and management recommendations will help land managers protect these resources.

All cave locations are included as a part of Pioneer's geographic information system. All known caves will be registered with the MCD as maintained by the Missouri Speleological Survey (MSS) and Cave Research Foundation (CRF). Pioneer's staff regularly confers with the Cave Research Foundation to maintain its cave location and record-keeping database.

Qualified groups will be encouraged to locate, record, describe, and survey caves on the forest. Qualified researchers are encouraged to study the biology, geology, hydrology, and cultural remains of caves on the forest. Wherever possible the results of these studies will be incorporated into the Pioneer Forest database and made available to the CRF and MSS.

Recommendations. Each cave is different, and specific recommendations should exist for all caves and springs. While specific management may not be called for, the following are broad management policies that apply across the forest:

- Fill in gaps in knowledge, particularly locations, descriptions, and maps of features.
- Consider individual management prescriptions and incorporate into the MCD.
- Preserve vegetation buffers around cave entrances.
- Generally, increase faunal counts and monitoring.
- Establish protocols for permitting trips into caves, particularly closed caves.
- Close nearby forest roads and reroute trails that lead to sensitive cave areas
- Protect watersheds for cave streams and springs.
- Regularly assemble a team for advice and management considerations.
- Gate caves only when necessary. Cave gates are obtrusive and require maintenance.
- Consider designation of certain caves or karst areas as Missouri Natural Areas.
- Work with agencies and other NGOs on cooperative cave management.
- Designate critical habitats for Species of Conservation Concern (SOCC).
- Expand knowledge of springs, particularly locations and flow.
- Expand knowledge of sinkholes and losing streams and take steps to protect these resources.

Management Actions Completed Since 2011.

- Cookstove/Squaredance Cave was gated in 2003 and a recent breech was repaired in June 2019. A 2017 survey reported an increase in its Indiana bat population to an estimated 6,000, one of the largest in the country.
- Holmes Hollow Cave was also gated in 2003 to protect cave resources, which had been under threat by ATV use inside the cave, and a breech there was repaired in June 2019.
- Medlock Cave (known gray bat nursery site) was gated in 2004 and recently repaired (2015).
- Wallace Well Cave has been gated for many years due to the dangerous nature of its floor and that gate was repaired in September 2018.

GOALS FOR THIS MANAGEMENT PERIOD

- Grey bats are known from Big Cave at the Leatherwood tract. Given trespass problems staff should investigate with Cave Research Foundation and Missouri Cave and Karst Conservancy the advisability of installing a protective gate at the entrance.
- Merritt Rock Cave has been in continuous use by a small swarm of gray bats (estimated at 150). The Cave Research Foundation has committed to further monitoring this cave to determine whether additional protection is warranted.
- Wind Cave was reported by Vineyard in 1985 as quite large and one of the more significant caves in the southern Ozarks. It should be further evaluated for protection needs.

Page Intentionally Left Blank
for Website Version

EXOTIC INVASIVE SPECIES

Exotic, non-native, invasive species have had an ever-increasing negative impact on our land, and we can expect this trend to continue. Not all exotic species threaten natural communities and each species can have different effects in each habitat type. This makes prioritization critical to effectiveness. Pioneer's goal should be to try to control invasive species while protecting and enhancing native species and natural communities. Collaboration across ownership and management boundaries is essential to reaching goals.

The following steps are guidelines for managing invasive species.

- Early detection and mapping
- Triage and prioritization
- Planning for most effective management (containment, total eradication, no treatment)
- Monitoring
- Adapting and follow up through time.

Feral Swine. Feral swine have been an ongoing recent problem and threaten our timber, native plants, wildlife, and unique natural features and communities. During the compilation of the 2011 Forest Management Plan there was no report of feral hogs on Pioneer Forest; it is likely that feral swine were present at that time but had not been detected. Early efforts were underway to control and eradicate feral swine at the MoDNR Johnson's Shut-Ins State Park and the adjacent Bell Mountain Wilderness Area on the Mark Twain National Forest. Now, feral swine are distributed across the forest.

Swine left uncaptured from the days of open grazing, illegal releases, and escapes from either agricultural or controlled-hunt facilities have led to the decades-long presence of this nuisance. Feral swine populations are bolstered by their high rate of reproduction. They are also mobile, capable of traveling long distances over varied terrain. Additionally, illegal releases allow for new populations to develop beyond the expected range of annual expansion. Protocol for estimating wildlife populations are ineffective on feral swine, and accurate alternative methods to estimate their populations have not yet been developed. Therefore, no sound estimate of their population in Missouri exists. One potential frame of reference is the annual removal number published by the Missouri Department of Conservation (MDC). This figure reflects the total number of feral swine dispatched statewide by multiple partner groups in association with the MDC efforts in Missouri every year. For example, a total of 6,561 pigs were killed in 2017 and 9,365 pigs were killed in 2018 by the groups and agencies that comprise the Missouri Feral Swine Partnership.

Feral swine are a concern to natural resource managers due to their destructive habits. Wild pigs will consume nearly anything that yields any nutritional value. They compete with native wildlife for forage, especially mast crops such as acorns. Rooting in search of food disturbs soil and may be deep in areas with soft soil. Swine will also cause extensive damage to glades, uprooting the rocky substrate of the glade. Feral swine select moist sites to wallow in to control their body temperature and parasite load. This can degrade wildlife ponds, seeps, springs, and fens. Damage to fens and glades is of heightened concern due to the rare plant species they contain. Such negative impacts warrant acting to control feral swine populations and reduce associated ecological damage.

Clandestine hunters using running dogs can scatter sounders and foil other efforts by disturbing pigs that are using a bait or trap location. Additionally, if an individual has hunting access to a large land holding, they may be tempted to release feral swine onto that property. Under such an arrangement the individual would be able to hunt wild pigs while bearing none of the externalities associated with the damage caused by wild swine. Thus, the MDC has banned "hog hunting" on lands it owns or manages and does not encourage hunting as a means of reducing feral swine populations. For these reasons, and to show support for eradication efforts, on October 3, 2016 the board adopted a policy prohibiting the taking and release of feral hogs on all L-A-D-owned land. Managed hunting or shooting that supports or contributes directly to eradication may be considered.

When properly applied, trapping allows for the capture of entire social groups known as sounders. While hunting tends to target individuals and scatter the others, traps can be used to catch large groups of pigs. If a sounder of pigs is willing to enter the trap, it is possible to capture the entire sounder in one catch. The number of pigs in a sounder often ranges from three to more than twenty animals. Capturing these social groups is important because removing sows from the populations does more to combat population growth than eliminating lone boars, and sows as young as 6 months can breed.

Through meetings with USDA Wildlife Services employees and other experienced trappers, staff have developed a working knowledge of the equipment and tactics necessary for feral swine trapping. This increased attention has resulted in trap design improvements and a wider knowledge base on the topic. The budget has been adjusted to allot funding for costs including corn for bait, trail cameras, hand tools, and materials for trap construction. Initially, staff attempted trapping with a "saloon door" style corral trap. These traps seldom, if ever, proved effective. The saloon door traps have now been replaced with "drop traps". Drop traps raise the entire corral structure off the ground, allowing pigs to come and go from any direction. Currently, Pioneer Forest has five drop traps. They have proven more effective than previous trap designs and are preferred for capturing feral pigs.

Upon capture feral swine are dispatched with firearms. Disposal is accomplished by discretely depositing carcasses away from high traffic or sensitive areas such as roadways, trails, and waterways. Decomposition is rapid and is often accelerated by native scavengers. These protocols are similar to those utilized by trappers for the MDC, USDA-Aphis, and US Fish and Wildlife Service.

Pioneer Forest will continue to work with agency partners toward the eradication of feral hogs across our ownership and support their effort of statewide feral hog eradication. Staff are continuing to increase their time spent toward feral hog trapping. We will also be hiring a hog trapper dedicated to feral hog eradication on the Backcountry.

GOALS FOR THIS MANAGEMENT PERIOD

Pioneer Forest has dedicated various resources to eradicate wild pigs. Due to the current abundance and distribution of feral swine, and the challenges associated with reducing their population, feral swine will continue to be a concern for the foreseeable future. Staff and a dedicated trapper will continue to seek out, trap, and remove feral swine. Pioneer Forest staff will also continue relations with other partners who are dedicated to removing feral pigs from the Missouri landscape.

Wild horses. Wild or feral domestic horses do not have nearly the impact of feral hogs but if their population continues to grow due to lack of natural predators and improper herd management, their impacts could be substantial. Currently, they do have established travel routes, but they may impact natural areas with their grazing and hoof action and spread exotic invasive plants. We should encourage proper herd management by federal agencies to maintain numbers at or below the designated maximum.

White Nose Syndrome (See also "Karst Management, White Nose Syndrome, p 27). White nose syndrome (*Geomyces destructans*) was first found in a Missouri cave in 2010. Pioneer closed its caves and Missouri state and private organizations monitored its spread. Pioneer's Squaredance Cave (with the 10th largest global Indiana Bat winter population in 2017) was gated in 2003 with funding assistance from the US Fish and Wildlife Service and labor from Missouri Cave and Karst Conservancy to provide protection for the Indiana bat population. For ten years the population count remained stable at 1,100. This was during the same period that white-nose syndrome was rapidly spreading across the eastern half of the country. We expected that count to drop. Beginning in 2013 the population began to increase. We thought that was either an anomaly, or an increase before a steep decline. The 2017 count was 6,084 and we remain hopeful. White nose syndrome remains a threat.

Tree Pathogens. Emerald ash borer (*Agrilus planipennis*) has spread across our lands in recent years and has dramatically impacted blue ash (*Fraxinus quadrangulata*), white ash (*F. americana*), and green ash (*F. pennsylvanica*). Since ash trees are a host to many insects such as tiger swallowtail butterfly, some sphinx and polyphemus moths to name a few, the loss of these trees could have profound secondary ecological impacts. Butternut canker (*Ophiognomonia clavigignenti-juglandacearum*) has affected butternut trees (*Juglans cinerea*). Staff will monitor the forest and the literature for potential action.

Exotic Invasive Plants. Exotic invasive plants spread by a variety of means and often first establish in more disturbed areas. They can very generally be grouped into two categories related to our lands, open area and forest invaders. Open area invaders grow in places such as roadsides, log deck areas, and skid trails, and the more open Ecological Management Areas where natural communities are either naturally more open or are being restored to this condition. Species that we have seen in open areas include the following: spotted knapweed (*Centaura maculosa*), Korean lespedeza (*Lespedeza cuneata*), Johnson grass (*Sorghum halapense*), Japanese stiltgrass (*Microstegium vimineum*), beefsteak plant (*Perilla frutescens*), musk thistle (*Carduus nutans*), mimosa tree (*Albizia julibrissin*), crown vetch (*Coronilla varia*), and Caucasian bluestem (*Bothriochloa bladhii*). Forest invaders include garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), winter creeper (*Euonymus hederaceus*), bush honeysuckle (*Lonicera* spp.), autumn olive (*Elaeagnus umbellata*), feral peach (*Prunus persica*), and multiflora rose (*Rosa multiflora*).

Our watch list of invasive plants found near our lands, expected to arrive, or already here without our knowledge, include kudzu (*Pueria montana*), tree of heaven (*Ailanthus altissima*), callery pear (*Pyrus calleryana*), Himalayan blackberry (*Rubus armeniacus*), privet (*Ligustrum* spp.), white poplar (*Populus alba*) and potentially many more.

Management methods in natural areas and ecological management areas should be as selective as possible and cause as little harm as possible to native flora and fauna, since encouraging natural diversity is our overall goal. To be more effective, staff will continue to work cooperatively with others, including agency partners and as part of the Scenic Rivers Invasive Species Partnership (SRISP), which covers the nine counties of the Current, Jacks Fork, and Eleven Point river watersheds.

Spotted knapweed that was pulled and removed from the Virgin Pine Area to prevent seed spread.

PHOTO: Neal Humke

Exotic Invasive Insects. Much is left to be learned about our native insect occurrences and ecological roles and the effect of exotic insects. Emerald ash borer was mentioned above. Fire ants (*Solenopsis* sp.) and Asian longhorn ticks (*Haemaphysalis longicornis*) are expected. We should encourage further study and understanding in this broad area.

All staff will monitor for exotic invasive species in the course of their ordinary duties and report location information to the Land Stewardship Coordinator who will evaluate options for treatment including mechanical treatments such as hand-pulling and mowing, herbicides, and prescribed fire to maintain natural community quality. For more information: Missouri Invasive Plant Task Force (MoIP)

moinvasives.org, Weed Control Methods Handbook, Tools and Techniques for Use in Natural Areas (The Nature Conservancy Wildland Invasive Species Team 2001), https://www.invasive.org/gist/products/handbook/methods-handbook.pdf. In addition, options for all staff for training in the identification of the most threatening invasive species will be considered.

Herbicide and Pesticide

Herbicide is used in the following ways on Pioneer Forest.

1) As one of several key options for managing exotic invasive species of plants.
2) For selective control of woody vegetation in the restoration and management of natural communities.
3) To maintain areas associated with developed facilities.

All management options, including combined treatments, are carefully considered prior to using herbicides. Biological control methods are another alternative, which Pioneer Forest has not used and would need to consider very carefully due to potential adverse effects on native species. Selective application in the form of spot treatment is the primary technique used since a primary goal in natural area management is to promote native biological diversity. Overspray on non-target areas and non-target species is counter to this goal and broadcast applications should be avoided. Usage is compliant with all laws, and product labels are followed. Additional safety and clean up tools, beyond minimum personal protective equipment, are often used to match our work environment.

Triclopyr has been a primary herbicide used for both herbaceous and woody plants, but several others have also been used such as glyphosate, Fluazifop-P-butyl, and sulfosulfuron. Details on concentrations, timing, and treated species for each herbicide application are routinely recorded, among other things.

Neonicotinoid pesticides shall not be used on Pioneer Forest due to their documented detrimental effects on insect populations.

Chemicals and application tools used during treatment.

PHOTO: Neal Humke

CLIMATE CHANGE

Research by the US Forest Service predicts that a warming climate and more extreme weather patterns will expand the range of shortleaf pine and reduce the range for white oak and scarlet oak, while the range for northern red oak will remain steady. The oak-hickory forest type is predicted to expand its range farther north as temperatures increase over time, depending on the ability for species to successfully migrate north through natural seeding and regeneration. It can be expected that pests and disease will also expand their ranges.

Pioneer's uneven-aged management by single tree selection is more adaptable, maintains structural diversity, and focuses on native tree species and a variety of age classes. All of this bodes well for Pioneer Forest. More frequent selective thinning allows the best-adapted species to compete well over time. Certain species outcompete others depending on site characteristics, weather, and climate patterns. Temperature, rainfall, and humidity changes may influence competition for growing space. Pioneer's management is responsive to natural changes and may be a hedge against pests and diseases should they expand their range and/or fecundity due to climate change.

Nevertheless, changing climatic conditions add uncertainty to sustainable forest management at Pioneer Forest. The effects most likely to be observed in the short term are altered disturbance regimes involving wildfire, damage from intense wind events (Vaughn 2013), insect outbreaks of native or invasive insects, and changing patterns of precipitation leading to drought-related tree mortality (Dale et al. 2001). Disturbance events cause mortality that alters the operational management program, as the derecho wind event did on Pioneer Forest from 2009-2011. Changing patterns of disturbance events will require that silvicultural tactics remain flexible. Suggested practices include management actions that Pioneer Forest staff are already conducting--promoting genetic diversity in natural and planted stands, encouraging species diversity as new stands develop, and considering ways to promote diverse stand structures that establish new cohorts of regeneration during every cutting cycle harvest according to ongoing uneven-aged management principles (Guldin 2019). Pioneer's frequent CFI will also help to monitor change over long periods of time.

SOCIAL CONSIDERATIONS

Pioneer Forest is unique in that it offers a variety of social benefits to the Missouri Ozark Community and beyond. Since the forest is spread over six Missouri Ozark Counties, it impacts all of them directly and in a positive manner.

Pioneer Forest offers many economic benefits for the local economy. Currently the forest provides nine full-time permanent jobs for foresters and technicians within the company. In addition, the forest contracts for at least eight timber harvesting crews which altogether support at least 24 local loggers working on the forest at any given time. These loggers sell material or have contracts with a minimum of six different sawmills, one of which is a large volume white oak stave mill. Pioneer employees and contractors account for as many as three dozen well-paying jobs in the Missouri Ozarks, which is one of the poorest regions in the state. Pioneer also hires four-to-five seasonal stewardship crew members each year, most from outside the region, who spend at least five months working on the forest.

The L-A-D Foundation board is considering contracting out the research and development of a comprehensive economic impacts study that would describe in more detail the magnification of benefit from the sustainable management of the forest. There are other ecosystem benefits and services to be considered as well.

RECREATION AND TRAILS

Since the establishment and long-term management of Pioneer Forest by Leo Drey in 1951 these lands have contributed to conservation, forestry, natural areas, and ecological stewardship in southeast Missouri. A corollary benefit of its conservative management is that the forest also provides an important recreation resource, most notably the Roger Pryor Pioneer Backcountry.

The setting is one of rugged beauty, with world class springs, a nationally famous river, and much of the watershed of the legendary Current River providing a variety of recreation benefits. Beginning in the 1920s, the first Missouri State Parks were acquired and developed here (Big Spring, Alley Spring, and Round Spring). In the 1930s the U.S. Forest Service began to acquire lands for the Mark Twain National Forest, and other significant state-owned lands were acquired by the new Missouri Department of Conservation as state forests. In 1964 the first national river was established as Ozark National Scenic Riverways. Echo Bluff and Current River State Parks have been more recently established adjacent to Pioneer lands near Round Spring.

With most of its land located in the Current River watershed, Pioneer includes approximately thirty-five miles of river frontage protected from development and logging. These, and the Pioneer lands beyond, provide an important buffer for the river and the national park. It has been the practice of Pioneer Forest to further limit its practice of uneven-aged management within view of the Current and Jacks Fork rivers. This assures more primitive float experiences and higher quality, river-based recreation, especially along the Current River between Cedar Grove and Owls Bend.

Suitable public access and enjoyment of L-A-D lands has been part of Pioneer Forest's tradition and philosophy since its founding. The intention is to continue that tradition. The foundation adopted its Recreation Policy (April 18, 2013), which encourages recreation that does not degrade or deteriorate cultural, land, or water resources. The goal is to permit natural resource-based recreation on its property that instills respect, enjoyment, and understanding of the Missouri Ozark landscape and its sensitive stewardship.

Traditional activities that are enjoyed on Pioneer Forest are hiking, paddling, caving by permission, hunting, fishing, camping, horseback riding on designated trails, swimming, photography, general sightseeing, and seasonal harvest of nuts, wild berries, mushrooms and fruits for personal use. All activities are subject to local, state, and federal regulations, and specific sites may have regulations related to particular resources or conditions such as ongoing forest management operations.

The Ozark Trail and Early Trail Development on Pioneer Forest. Leo Drey believed that the method of managing Pioneer Forest, where every acre is always forested, both before and after harvest, provides for positive outdoor recreation benefits. Throughout the fall, winter, and early spring months, high school students, scouts, staff of AmeriCorps, and members of conservation organizations such Sierra Club and Ozark Trail Association volunteer to build and maintain trails on Pioneer Forest.

Drey's careful and purposeful plan for Pioneer Forest began as the national park was beginning to develop. The 1975 State Trails Plan included an inventory of trails statewide and introduced the idea of a trail that might connect public land in the Ozarks. Drey had engaged the services of the US Department of the Interior's Bureau of Outdoor Recreation (BOR) to study and develop a plan (1976) for recreation on the lands of Pioneer Forest. Drey also asked two Missouri colleagues, Dave Bedan and Bob Goetz (1976), to further develop the most appropriate portions of the BOR document. Fred Lafser, MDNR, is credited with raising the idea for a long-distance trail through the Missouri Ozarks as he began working with Jerry Stokes, then with the Bureau of Outdoor Recreation in 1976. Drey and Pioneer staff participated in discussions about trails connected across land ownerships (Bruff 1977). In February 1977 a draft

document, Ozark Trail Concept (typewritten document, 43p.), included several references to Pioneer Forest along with trail construction guidelines and priorities. In June 1977 the first meeting of the Ozark Trail Council (OTC) included multiple organizations and agencies committed to establishing a long-distance hiking opportunity through the Missouri Ozarks. The long-term vision, then and today, is to one day connect Missouri's Ozark Trail to the Ozark Highland Trail in Arkansas.

Pioneer was one of the founding members of the OTC. Leo and Kay Drey entered into a trail agreement with MDNR in November 1978 for the establishment of a hiking trail across the forest. By 1980 the MDNR had entered into an agreement with volunteers from the Sierra Club for its maintenance, the thirteen miles of the Blair Creek Section of the Ozark Trail following the Blair Creek valley. It was one of the first completed sections of the Ozark Trail in the state. Drey's collaboration with the MDNR Division of State Parks and the Sierra Club was essential for the development of this trail.

Staff began significant expansions of foot trails on the forest in the 1990s. Sierra Club volunteers constructed the two-mile-long Laxton Hollow Trail connecting Himont to the Ozark Trail beginning in the mid-1990s. That trail was dedicated in October 2000. The 12-mile long Brushy Creek Trail was designed 1998-2000, first as a loop trail, later with the addition of an interior connector trail. Construction had begun by 2001 and later completed by Sierra Club volunteers and State Parks staff.

Rennicke (1995) described trails from the Heartland of the Midwest in Backpacker magazine including highlights from the Blair Creek section of Ozark Trail which "offers solitude, ridgewalking, Blair Creek's scenic deep valley, and great views of the Current River." The Ozark Trail was recognized as a Millenium Trail in June 2000 and named a National Recreation Trail in 2008.

Roger Pryor Pioneer Backcountry and its Mission. Beginning in 1998 Leo Drey asked Pioneer staff to define the boundaries for a large, core area of the forest where primitive non-motorized, outdoor recreation would be promoted, special features would be protected, and where existing trail offerings would be expanded.

The Roger Pryor Pioneer Backcountry was announced by Leo Drey, on October 17, 1999 at the Missouri Coalition for the Environment annual dinner in St. Louis. It has been named in memory of Roger Pryor, a St. Louis conservationist who worked for many years with the Missouri Coalition for the Environment and served on the L-A-D Foundation Board of Directors. Leo also honored Pioneer's first foresters Ed Woods and Charlie Kirk, naming the east side for Kirk and the west side for Woods.

At 61,000 acres, the Roger Pryor Pioneer Backcountry is part of the state's largest contiguous tract of land under one ownership. It extends north from Two Rivers for ten miles and west from Round Spring for 13 miles. This expansive area also is at the core of a sizeable area of public land and includes much of the drainage for Blair Creek, Brushy Creek, and Big Creek. To the north of the Backcountry is the Mark Twain National Forest and to the south is the NPS-owned river corridor Ozark National Scenic Riverways. There are significant lands owned by the Conservation Department to the east (Rocky Creek Conservation Area), to the south (Angeline State Forest), and to the south and west (Sunklands Conservation Area). Current River and Echo Bluff state parks join the Backcountry to the northwest.

Pioneer staff developed the area's first management plan in early 2001. Staff arranged for routed wooden signs naming the trailhead and had posts routed to name each trail leading from Himont Trailhead. A fire ring and metal picnic tables were added. In October 2001, Leo Drey, Pioneer staff, and foundation board members dedicated the Roger Pryor Pioneer Backcountry, at the Himont Trailhead site of the former Himont Firetower, just a few days before Pioneer staff hosted a symposium in St. Louis at the Missouri Botanical Garden and Tower Grove Park to commemorate the 50th anniversary of Drey's management of the forest. MDNR Director Stephen Mahfood announced his agency's intention to conclude a cooperative agreement for management of backcountry trails between Pioneer Forest and the Division of State Parks. That initial agreement was signed in March 2002.

Himont Trailhead, the former site of the Himont Firetower, closeup of picnic table and grill.

The L-A-D Foundation continues to partner with the MDNR's Division of State Parks to administer the Trails of the Roger Pryor Pioneer Backcountry through a donated lease. State park management of the backcountry trails is coordinated through Current River State Park. State park staff provide law enforcement, assist volunteers working in the Backcountry, develop public information for the area, map its trails, and conduct maintenance at the trailhead and along the trails. The most recent amendment (2016) is for more than 60 miles of Trails of the Roger Pryor Pioneer Backcountry and their 100-foot wide corridors (50 feet along either side).

Pioneer Forest's Management Plan for the Roger Pryor Pioneer Backcountry (2016) is to be considered part of this forest-wide management plan. Today, with its more extensive trail system, the Backcountry provides opportunity for exploring an expansive and undeveloped Ozark area relatively free of motorized intrusions, with vehicular access restricted to county roads, to appreciate the need for periodic forest management activities. The Backcountry has been dedicated to primitive outdoor recreation for such pursuits as camping, hiking, long-distance backpacking, cross-country orienteering, outdoor skills development, and nature study. It has hosted volunteers who come for the opportunity to contribute useful and satisfying service while working in the outdoors. This has included many individuals from numerous organizations including conservation groups, colleges, universities, high schools, scouts, religious organizations, and a group home, as well as members of the staff of AmeriCorps who can be found throughout the fall, winter, and early spring building and maintaining trails.

Foundation staff teamed up with John Roth, founder of the Ozark Trail Association, to develop a proposal for a long-distance hiking trail from the mouth of Brushy Creek upriver to Round Spring, named the Current River Trail. That first section of the 12-mile-long Current River Trail was completed in 2018. Construction on the second five-mile section from Round Spring to Echo Bluff State Park was completed in 2019. Pioneer staff also worked with volunteers and members of the Backcountry Horsemen of Missouri to establish the 11.7-mile Blair Creek Equestrian Trail with two trailheads, one north of Pioneer on the Mark Twain National Forest and the other south of Pioneer on MDC land. Trail construction and signing were completed in 2018. Staff also reviewed the MDNR concept for routing the Sugar Tree Hollow Trail, which crosses state park and Pioneer land has been incorporated into the donated lease of the Trails of the Roger Pryor Pioneer Backcountry.

Other Trails on Pioneer Forest. Pioneer staff completed the Virgin Pine walk and the two mile-long auto interpretive drive on Shannon County Route 19-225 in 2005. Pioneer staff began working with high

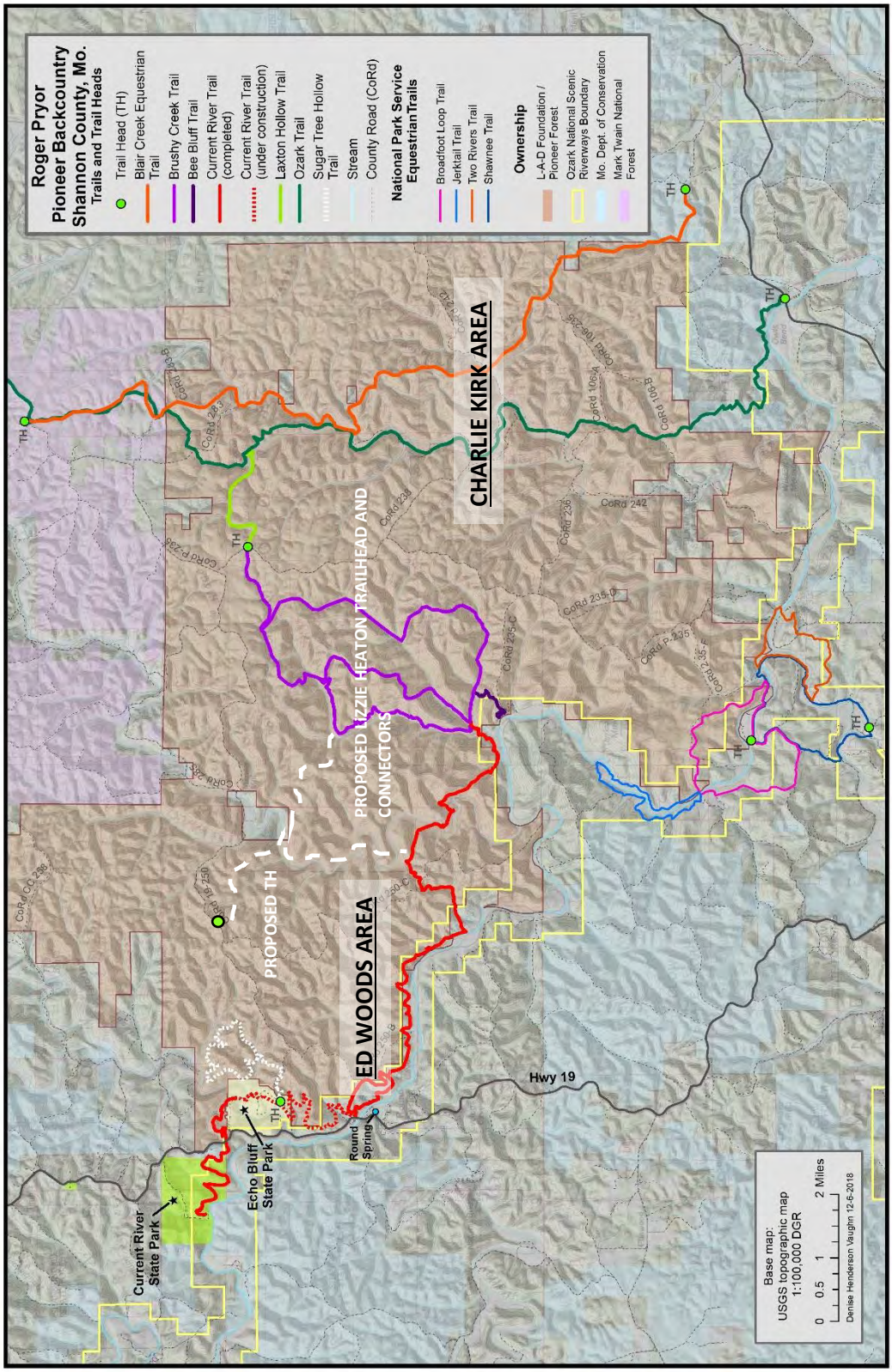
school seniors from Burroughs School in St. Louis and an ONSR AmeriCorps crew to complete the four-mile-long Cave Spring Trail across NPS-ONSR lands and Pioneer/L-A-D lands south of Devils Well. The trail was developed and the NPS had installed interpretive panels at the Devil's Well Trailhead by 2008. There are small segments of National Park Service equestrian trails that cross through portions of Pioneer Forest near the Two Rivers area of Ozark National Scenic Riverways. Today, there are more than 65 miles of walking, hiking, equestrian, and long-distance backpacking trails on Pioneer Forest.

Private motorized vehicles are prohibited on Foundation lands, though they may be used on state and county roads, which provide ample access to trailheads, streams, and hunting sites. Pedestrian travel across our property can be by marked trail, or by hiking off trail and cross-country using maps and compass. Beyond Himont Trailhead all camping is primitive and off the trail.

GOALS FOR THIS PLANNING PERIOD:

- Work with MDNR to begin construction of the Sugar Tree Hollow Trail.
- Complete a trail design for Big Creek Trail and begin construction.
- Propose and work with MDNR staff on a trail connection from a second trailhead (near the junction of Camp Zoe Road with Lizzie Heaton Ridge Road) to connect southeast to the Brushy Creek Trail and northwest to the Sugar Tree Hollow Trail.
- Expand the interpretive walking route at the Virgin Pine to extend through the larger Pine-Oak Woodland Ecological Management Area and integrate interpretation of the restoration work including thinning and use of periodic prescribed fire management.
- Continue discussions with NPS and others for extending the existing Current River Trail upriver beyond Current River State Park toward Montauk State Park.
- Continue working with NPS and others to ensure more sustainable equestrian trails in the upper Current River region, with routes along the river (on one side only) as well as loops away from the river. These efforts should prioritize reducing stream crossings and removing unsuitable and unsustainable trails along with restoration.

Hiking the Brushy Creek Trail. **PHOTO BY: Scott Merritt**



Routing of existing trails of the Roger Pryor Pioneer Backcountry. Conceptual routing of proposed Lizzie Heaton Trailhead and connectors based on the Bedan and Goetz report (1976).

STATE AND COUNTY ROADS, PRIVATE WOODS ROADS

State and hard surface county roads provide access to the forest. Most of the public roads providing motorized access through the forest are county gravel roads. Travel beyond these routes is pedestrian only.

Pioneer's private, administrative routes are haul roads that are used temporarily by semi-trailer trucks during harvest activity to access landings along ridges and then closed to re-vegetate after harvests are completed. Skid trails are reused by skidders to pull logs from the woods to the landings. Skid trails are generally 150 to 200 feet apart and these combined with the existing haul road system comprise little more than 5% of the total forest area. Where practical, poorly located roads and skid trails will be deactivated and re-vegetated and moved to appropriate locations when harvest activity moves into each new harvest area.

L-A-D Foundation submitted comments to NPS Ozark National Scenic Riverways in response to their ongoing study of roads and trails in the park. Our comments called for cooperative efforts to reduce damages from off-road, illegal motorized uses. Some of these are included in the following sections on Reducing Unauthorized Access at the Roger Pryor Pioneer Backcountry and Reducing Unauthorized Access at Leatherwood.

Reducing Incompatible Use of County Roads.

In early 2019, an auto race used the public county road across the Roger Pryor Pioneer Backcountry for an event named Ozark Rally without notifying forest managers. Pioneer staff alerted event sponsors and Shannon County commissioners that such an event was contrary to the non-motorized quiet recreational purpose of the surrounding backcountry, and staff are working with race organizers and county officials to relocate any such events to more appropriate venues elsewhere than RPPB.

GOALS FOR THIS PLANNING PERIOD:

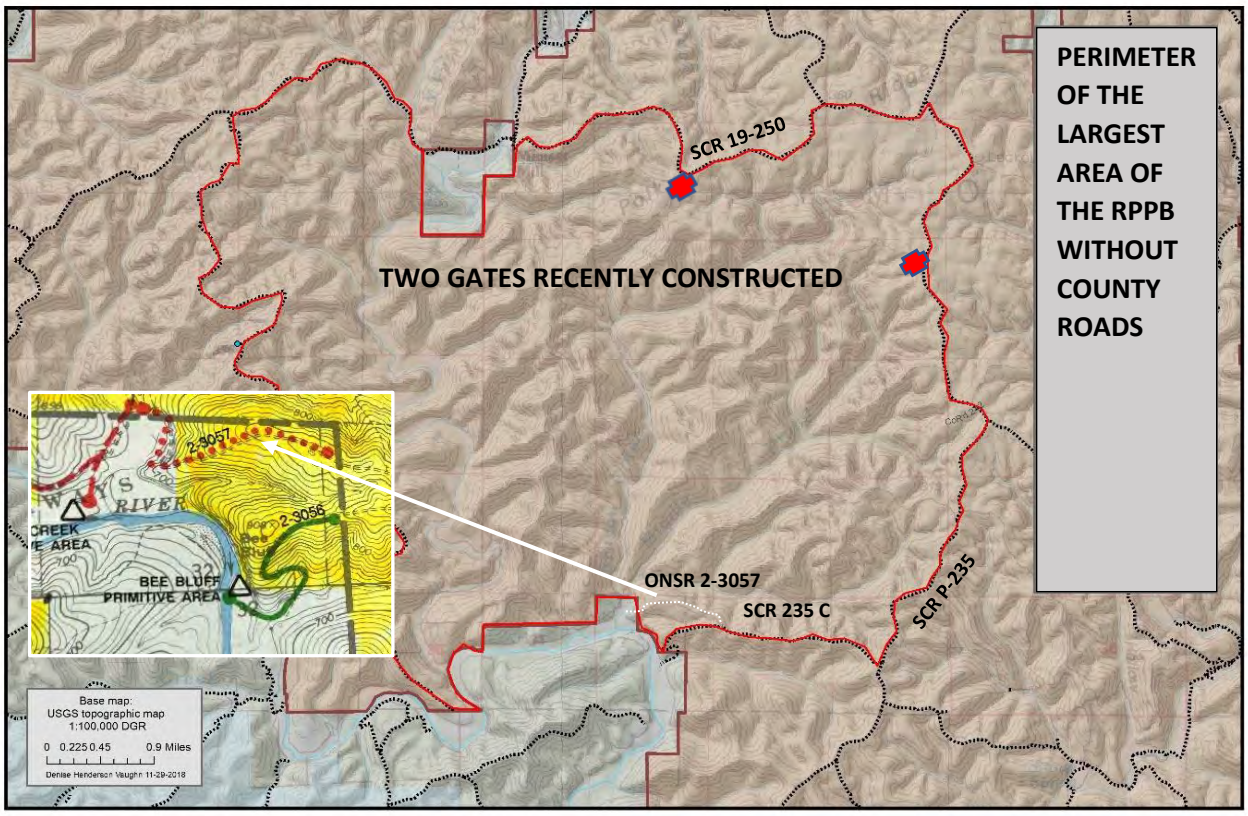
- Continue work with the Shannon County Commission, and others where possible, to relocate the Ozark Road Rally out of the RPPB.
- Coordinate with MoDNR staff at Echo Bluff State Park to monitor the backcountry for users car-camping along the county roads, particularly during busy weekends and especially during the summer when the Eco Bluff campground is full. County roads should remain clear and the trailhead at Himont (and any other trailheads to be provided) should be for those leaving for or returning from hiking, or for approved volunteer groups working on trail maintenance or construction.
- Work with MoDNR staff to assure there is no parking of horse trailers in the backcountry; equestrian trailheads and staging areas exist on USFS and MDC lands north and south side of the RPPB.
- Consider measuring the width of county roads, photographing present conditions, and recording that as a baseline against which to document future encroachment or damage.

Reducing Unauthorized Vehicular Access at Roger Pryor Pioneer Backcountry (RPPB)

- On two recent occasions, Pioneer Forest lands were trespassed by four-wheel drive vehicles and ATV's that crossed the forest to reach and drive down Blair Creek. In response, Pioneer staff took several measures to improve protection of forest resources and reduce damage to private land. Staff are now monitoring social media for word of such trespasses.
- In 2016, staff produced a management plan for the Roger Pryor Pioneer Backcountry calling for metal signs to clearly mark every private administrative route within the backcountry. Since installation some neighbors expressed understanding of our action; although a few vandalized signs have had to be replaced, this effort has been considered successful in significantly reducing trespass.
- The largest area without public roads includes the adjacent Big Creek and Brushy Creek watersheds. It is estimated at 15,000 acres and is managed to control trespass and prohibit private motor vehicle intrusion (the map of this area is on the following page). During the past year two locking gates were installed to continue reducing trespass into this area. One is just south of the Camp Zoe Road (Shannon County 19-250) on the Polk Ridge, and another is south of Himont on Shannon County P-235 at the Muddy Ridge. These allow staff and contractors administrative access and strengthen the protection for a sizeable portion of the Backcountry from motorized intrusion. Such areas are sought by wildlife, by turkey hunters, and by hikers seeking solitude.

GOALS FOR THIS PLANNING PERIOD (Roger Pryor Pioneer Backcountry):

- Maintain private road markers throughout the backcountry, especially along lower Blair Creek.
- Maintain and repair recently constructed gates, as needed.
- Reinforce natural barrier that has closed NPS 2-3057 from the Tick-A-Chig Ridge to mouth of Satterfield Hollow.
- Consider additional measures that may be necessary to continue to strengthen protection for the 15,000-acre core area of the RPPB and other areas, and especially along lower Blair Creek.
- Work with NPS to close route identified in their 1991 Roads and Trails Study as 2-3057 near Bee Bluff, a portion identified as closed trace and another portion identified as NPS owned and unmaintained (see the inset on the map on facing page (55).
- Block motorized and equestrian travel coming from access to easement route 2-3062 and Horse Trail ID-110 (ONSR 1991) onto the main management route used at Jerktail Mountain. A gate should be installed at the main county road (CRP-235). Elsewhere large boulders may be needed to prevent access, for example from Thompson Hollow.



Reducing Unauthorized Access at Leatherwood. Similar efforts were needed at Leatherwood where Shannon County Road (CR 106-425) is a well-traveled route leading to the NPS Bay Creek campground from Highway 106. Another long-standing public road is Shannon County Road WW-D which connects from Bay Creek across the long, flat ridge north of Rough Hollow leading west to State Route WW. A third county road crosses the southwestern-most section and connects to State Route O which connects to State Highway 17.

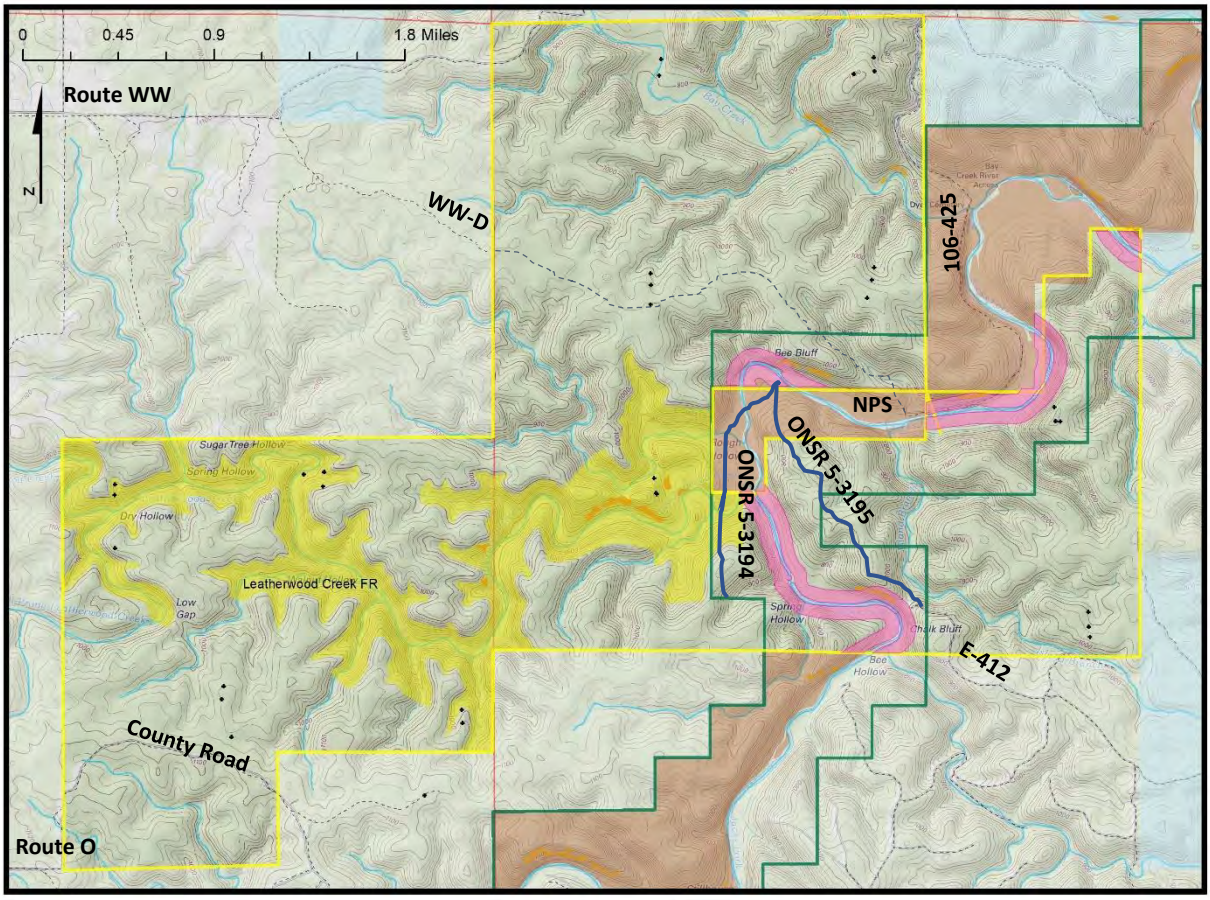
Beyond these county public roads Pioneer's management routes have been clearly posted with the same metal signs as per the previous discussion for RPPB and recommended by the County Prosecutor. All locations around the perimeter of the Leatherwood tract were signed. This provides clear and repeated notification for all private motorized vehicles turning onto Pioneer's private land.

These additional management actions have been taken at Leatherwood:

- Staff increased their visibility in the area through periodic patrols and inspection of the signing.
- MDC actively works in Leatherwood with Pioneer staff to eradicate feral hogs, which adds visibility and provides law enforcement, if necessary, for violations.

GOAL FOR THIS PLANNING PERIOD (Leatherwood):

- At Leatherwood the ONSR Roads and Trails Study (1991) labeled two private routes, 5-3194 and 5-3195 as access to easement, private land only. Historically, these routes enabled timber sale contractors to cross the river. Pioneer has not accessed its lands using these routes for more than 40 years. Working together with NPS these two routes should be appropriately gated and clearly posted as closed.



The Leatherwood Forest Reserve is highlighted in yellow inside the Leatherwood Tract outlined in yellow. The NPS Ozark National Scenic Riverways Roads and Trails Study (1991) identified two routes crossing Pioneer Forest as "access to easement" private land are labeled here (5-3194 and 5-3195). Other county roads leading into or across the area are also labeled here.

Pioneer Forest Geographic Information System

Pioneer's Geographic Information System uses ArcGIS software and includes various basemap configurations and database information for property lines and ownership of all Pioneer Forest LLC owned lands. For these lands we are compiling individual databases to delineate L-A-D owned lands that join or are part of the forest, including scenic easement lands along the rivers; designations for Forest Reserves, Ecological Management Areas, and Missouri Natural Areas; cultural resources in certain areas including homesites, cemeteries, schools, etc.; trails and trailheads; Continuous Forest Inventory plot locations; cave locations; and mapped glades (Nelson, et. al., 2013). Missouri Department of Conservation "element occurrence" records are to be incorporated into the database.

Our database identifies land ownership of The Nature Conservancy, purchase unit and fee title ownership of Ozark National Scenic Riverways, fee title ownership for Mark Twain National Forest, and fee title ownership for state-owned properties of the Missouri Department of Conservation and Missouri Department of Natural Resources-Missouri State Parks.

Township maps of Pioneer Forest including much of this information are found in Appendix D.

Property Boundaries

Pioneer Forest currently has more than 577 miles of boundary line. Each year about 120 miles of line are re-painted. The forest's entire boundary is repainted and corners re-established every six years. The exterior boundary line is checked before each harvest activity begins to ensure that contractors know where the forest property is located. Currently a backpack sprayer and sprayable boundary paint are used to remark lines.

Outreach, Education, and Research

The foundation is involved in a wide variety of outreach and education activities. Foundation board and staff work with other organizations including MDC, MoDNR, MTNF, MFPA, ONSR, Coalition of Missouri Land Trusts, CFM, OTA, Missouri Consulting Foresters Association, Society of American Foresters, and The Nature Conservancy. Forest tours have been arranged for many different groups including private citizens interested in forest management, the Sierra Club, the International Union of Forest Research Organizations, which included academics from at least five different countries, ProSilva France, ANW (German based uneven-aged silviculture group), Society of American Foresters, Forest Stewards Guild, and university students. Forest and foundation staff have also delivered presentations and posters to the Missouri Forest Resources Advisory Council, Missouri Bird Conservation Initiative, Perry and Shannon Commissions, the annual Missouri Natural Resources Conference, Dent County third graders at Beef Days, Salem Rotary Club, U.S. Bank, and Timber Fun Day. Staff often participate in local forestry workshops with the Nature Conservancy and the Missouri Department of Conservation.

The foundation maintains a bibliography of more than 200 publications and research reports regarding its work and land. We also have supported research financially, including the Rapid White Oak Mortality program. The foundation has begun funding master's level research programs through the University of Missouri School of Natural Resources. The foundation also supports and encourages other research for those interested in learning more about its lands. Those wishing to do research must fill out an Application for Research, which can be found on our website (www.ladfoundation.org), before conducting research on Pioneer Forest or L-A-D Foundation lands.

Local Community Support

Pioneer Forest has supported other organizations financially. Generally, these grants are small, ranging from $100-$500 for various community projects such as volunteer fire departments, supporting local historical societies, Stream Team projects, cemetery maintenance, or other community-minded efforts.

Each year Pioneer Forest also has a scholarship program in most of the counties in which it operates. It offers a $1500 scholarship to graduating high school seniors, with a preference to those who are pursuing a natural resources degree in college. This effort has grown from two scholarships (Eminence and Bunker) to five (Bunker, Eminence, Ellington, Summersville, Van Buren) to qualified recipients.

The L-A-D Foundation budget includes $35,000 to provide grants of up to $5,000 to organizations located in or doing work in the Missouri Ozarks.

Gravesites and Cemeteries

Pioneer Forest land includes known burial sites and several cemeteries. Native American gravesites, gravesites of more recent settlers, and cemeteries are all important places and will be protected wherever possible. Pioneer Forest policy is to provide access and permit upkeep and maintenance for anyone who may be interested.

During the past management planning period the Howell family requested permission to conduct restoration of the Howell Cemetery. The Foundation would be interested in providing financial support

for projects related to the upkeep and maintenance of the sites. The ABC Memorial Foundation Inc. Trust Fund was formed by J.L. Midyett in the 1970s with the purpose of encouraging continued care of 110 rural cemeteries in the Ozarks; that foundation could also be a source for financial assistance. Following are known cemeteries in Pioneer:

- Bay Creek Cemetery, Section 5, T28N R5W; just above the creek on the north side; it is an individual burial site, most likely of the Civil War era.
- Blair's Creek Cemetery, Section 6, T29N R2W; still active and located in the Blair Creek valley along Shannon County Road 250 at the mouth of Holmes Hollow.
- Brooks Cemetery, Section 14/15, T24N R2E, below Grandin.
- Dillard Cemetery, either Section 25 T30N R3W or Section 30 T30N R2W; this cemetery is small and located along the east side of Blair Creek 0.7 mile east of Shannon County Road 250-C. George W. and Adline Dillard have the only fenced burial plot. Visible burial markers and remaining wire fence on the south and west sides indicate a size of 45 feet by 75 feet. Noah, the son of GW and A. Dillard, was buried here in 1891.
- Heaton Cemetery (Section 1 T30N R4W; overlooking the mouth of Water Hollow just before it enters Mash Creek, located east from the Lizzie Heaton Ridge where the Camp Zoe Road (Shannon County 19-250) drops into the Mash Creek valley. Cemetery is not visible from the county road. It sits approximately 500 feet up on nearby hillside. The earliest burial noted is William Karr in 1891. Others include S. Lundry 1929, E. Meade and J.A. LaGrand 1914, and G. LaGrand 1897, and reportedly Elizabeth Heaton who died June 8, 1960.
- Howell Cemetery, Section 22, T31N R6W, located near the mouth of Howell Hollow in bottomland fields on the west side of the Current River between Welch Spring and Akers Ferry.
- Pogue Cemetery, Section 13, T29N R3W; inactive.
- Unnamed cemetery, Section 12, T29N R3W; single burial, most likely from the Civil War era.

INDIGENOUS PEOPLES

There are no indigenous tribes on the land owned by Pioneer Forest nor are there any tribal lands in Missouri. However, Pioneer Forest will document and protect any Native American cultural sites encountered on its lands. Pioneer Forest prohibits the digging or collection of any Native American artifacts on its lands by the general public. Violations will be reported to the local sheriff and prosecuted to the fullest extent of the law. Any new sites found will be reported to the Osage Nation, which was the most recent tribe that inhabited the Missouri Ozarks. The Osage Nation can be contacted using the following address:

Osage Nation
627 Grandview Ave.
Pawhuska, OK 74056

Email: HistoricPreservation@osagenation-nsn.gov

FOUNDATION STAFF TRAINING AND EDUCATION

Staff regularly attend meetings of the Missouri Consulting Foresters Association, Missouri Forest Products Association, Conservation Federation of Missouri, Society of American Foresters (SAF), Natural Areas Association, and the Missouri Forest Resources Advisory Council. All of these organizations have educational components within their regular program, and some offer continuing education credits for those maintaining SAF Certified Forester credentials. In addition to these, forestry

staff attend regular tours of stave mills, sawmills, and blocking mills to maintain their knowledge of wood utilization.

Staff regularly participate in training events with other experts in the field. These include botanical training with the Institute of Botanical Training, the Missouri Department of Conservation, and the National Park Service-Ozark National Scenic Riverways. These training events cover a variety of topics including plant and bird identification, hog trapping, firearms safety, wildfire training, and preparation for and use of prescribed fire management. Staff also have had training in first aid. Pioneer Forest also periodically hires interns who are trained in Pioneer's method of forest management.

Beginning in 2014 the Land Stewardship Coordinator has hired and trained a seasonal stewardship crew each year. These seasonal work crews come to the forest from across the country to gain experience in a variety of land stewardship practices, including the preparation for and application of prescribed fire. Land stewardship interns are being considered. The Business Manager also participates in workshops and training offered from the Land Trust Alliance oriented to best management practices for not-for-profit organizations.

In-house, staff undergo periodic field training. This is often led by the Chief Forester and Forest Manager. This type of training covers a variety of topics that include tree marking, tree selection, sale administration, best management practices, logging practices, and timber cruising. Other in-house training, especially during CFI years, includes tree identification, plot set-up and layout, measurement techniques, and use of computers for data entry. Such training is specific to the needs and operation of Pioneer Forest.

Process to Receive Information and Respond to the Public

Extensive information about Pioneer Forest and the L-A-D Foundation lands and management, including the Annual Report, is available to the general public on the website https://ladfoundation.org/about-us/. An email address is available for those with questions or who wish to provide information at info@ladfoundation.org. Email inquiries are answered within a week of submission by the Business Manager, Board Liaison, Chief Forester, or Forest Manager.

Comments or questions that require guidance by the foundation or by our attorneys are submitted to the Executive Committee by staff for deliberation and discussion. Following deliberations and discussion, a plan of action is delivered to the Business Manager, Board Liaison, Chief Forester, and/or Forest Manager to implement.

LITERATURE CITED

Becker, R.R. and T.S. Corse. 1997. Resetting the clock with uneven-aged management. Journal of Forestry 95 (11): 29-32.

Bedan, D.E. and R.E. Goetz. 1976. Pioneer Forest recreation study. St. Louis, Mo.: Coalition for the Environment. 54p. + maps.

Beveridge, T.R. 1978. Geologic wonders and curiosities of Missouri. (Vineyard, J.D., revised edition, 1990). Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, Mo. 400p.

Bretz, J.H. 1956.Caves of Missouri. Missouri Division of Geological Survey ad Water Resources, Jefferson City, Mo. 490p.

Briggler, J. 2014. Prescribed Fire Effects on Herpetofauna in Missouri. Missouri Natural Areas Newsletter 14(1): 27-30.

Bruff, G. L. 1977. Preliminary trail study for Ozark National Scenic Riverways. Van Buren, Mo.: National Park Service, Ozark National Scenic Riverways. 55p.

Burns, Russell, tech. coord. 1983. Silvicultural systems for the major types in the United States. Agricultural Handbook 445. Washington, DC: US Department of Agriculture, Forest Service. 191p.

Chapman, H.H. 1951. Report on examination of forest property in Shannon County, for the National Distillers Products Corporation, July 5-15, 1951. 8-page report on file at Pioneer Forest, Salem, Missouri.

Cunningham J.W. 1946. Missouri region. Audubon Magazine. 48(2):125.

Dale, V.H.; Joyce, L.A.; McNulty, S.; Neilson, R.P.; Ayres, M.P.; Flannigan, M.D.;.Hanson, P.J.; Irland, L.C.; Lugo, A.E.; Peterson, C.J.; Simberloff, D. 2001, Climate change and forest disturbances: climate change can affect forests by altering the frequency, intensity, duration, and timing of fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, or landslides. AIBS Bulletin 51(9):723–734.

Dey, D.D. and R.D. Guyette. 2002. Sustaining oak ecosystems in the central hardwood region: lessons from the past—continuing the history of disturbance. Pages 170-183 in R.E. McCabe and S.E. Loos, editors, Transaction of the 65th North American Wildlife and Natural Resources Conference, Rosemont, Illinois.

Flader, S. 2004. Missouri's pioneer in sustainable forestry. Forest History Today 2004 (Spring/Fall) : 2-15.

Flader, S.L. 2008. Missouri's Pioneer: A Half Century of Sustainable Forestry. Pages 9-40 in Pioneer Forest, A Half Century of Sustainable Uneven-Aged Forest Management in the Missouri Ozarks. J.M. Guldin, G.F. Iffrig, and S.L. Flader, eds. General Technical Report SRS-108. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. 123p.

Guldin, J. and J.B. Baker. 1998. Uneven-aged silviculture, southern style. Journal of Forestry 98(7): 22-26.

Guldin, J.M. and E.F. Loewenstein. 1997. Regulation in uneven-aged stands – historical development of the method and implications for current practices. Proceedings of the International Union of Forest Research Organizations (IUFRO), Interdisciplinary Uneven-Aged Management Symposium, compiled by W.H. Emmingham. Oregon State University, Department of Forest Science, Corvallis, Oregon. 713p.

Guldin, James. 2019. Silvicultural options in forests of the southern United States under changing climatic conditions. New Forests 50: 71-87.

Guldin J.M.; Iffrig, G.F.; Flader, S.L. eds. 2008. Pioneer Forest—a half century of sustainable uneven-aged forest management in the Missouri Ozarks. Gen. Tech. Rep. SRS-108. Asheville, NC: U.S. Department of Agricutlure, Forest Service, Southern Research Station. 123p.

Guyette, R.P. and M.C. Stambaugh. 2008. Pioneer Forest: In the heart of roughness. Pages 61-64 in Pioneer Forest, A Half Century of Sustainable Uneven-Aged Forest Management in the Missouri Ozarks. J.M. Guldin, G.F. Iffrig, and S.L. Flader, eds. General Technical Report SRS-108. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. 123p.

Iffrig, G., J. Karel, and S. Flader. 2017. L-A-D Foundation: A history of work with Missouri Natural Areas. Missouri Natural Areas Newsletter (17) 1: 24-26.

Iffrig, G.F., C.E. Trammel, and T. Cunningham. 2008. Describing single-tree selection in Missouri Ozark forests. Pages 49-60 in Guldin, J.M. et. al, eds. Pioneer Forest—A half century of sustainable uneven-aged management in the Missouri Ozarks. Gen. Tech. Rep. SRS-108. Ashville, NC U.S. Department of Agriculture, Forest Service, Southern Research Station. 123p.

Jeffries, J.M. 2004. Community composition, species richness, and abundance of oak herbivore insects in a chronoseries of temperate forests. University of Missouri-St. Louis, St. Louis, MO. MS Thesis. 65p.

Jenkins, M.A. and S.G. Pallardy. 1993. A comparison of forest dynamics at two sites in the southeastern Ozark Mountains of Missouri. Gillespie, A.R., G.R. Parker, and P.E. Pope,. eds. p. 327-341. In: Proceedings of the 9th Central Hardwoods Conference. Gen. Tech. Rep. NC-161. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, MN.

Johnson, C.M. and R.A. King, eds. 2018. Beneficial management practices for WNS-affected bats: voluntary guidelines for land managers and woodland owners in the eastern United States. A project of the White-nose Syndrome Conservation and Recovery Working Group established by the White-nose Syndrome National Plan (www.whitenosesyndrome.org). 39p.

Johnson, P.S., S.R. Shifley, and R. Rogers. 2002. The ecology and silviculture of oaks. CABI Publishing, New York. 503p.

Larsen, D.R., Loewenstein, E.F., and P.S. Johnson. 1999. Sustaining recruitment of oak reproduction in uneven-aged stands in the Ozark Highlands. General Technical Report NC-203. U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station, St. Paul MN. 11 p.

Loewenstein, E.F. 1996. An analysis of the size- and age-structure of a managed uneven-aged oak forest. PhD. Dissertation, University of Missouri, Columbia. 167p.

Lynch, D.W. 1964. Report of the Committee on Natural Areas. Journal of Forestry. 1964 (December): 916-918.

McGee, C.E. 1976. Differences in budbreak between shade-grown and open-grown oak seedlings. Forest Science 22:484-486.

McGee, C.E. 1988. Spring weather, canopy removal, and early budbreak threaten oak seedlings. Journal of the Elisha Mitchell Science Society 104: 108-115.

McGee, C.E. 1997. The effect of oak budbreak patterns on shade tolerance and regeneration. p. 279-287. In: Steiner, Kim C., ed. Proceedings: Diversity and adaptation in oak species; 1997 October 12-17, University Park, PA: Penn State University.

Meyer, A.B. 1949. Pioneer Forest. Missouri Conservationist. August 1949.

Missouri Department of Conservation. 2015. Missouri State Wildlife Action Plan. 161p. + appendices.

Missouri Department of Natural Resources. 1977. Ozark Trail Concept, Revision 1. Typed manuscript. 43p.

National Geographic Society. 2007. Trails Illustrated Map, Ozark National Scenic Riverways. National Geographic Maps, Evergreen, Colorado. Folded, waterproof-sheet printed on both sides.

Nelson, P. W., J. A. Fitzgerald, K. Larson, R. McCoy, A. Schotz, J. Taft, T. Witsell, B. Yahn. 2013. Central Hardwoods Joint Venture Glade Conservation Assessment for the Interior Highlands and Interior Low Plateaus of the Central Hardwoods Region. Central Hardwoods Joint Venture. http://www.chjv.org/projects.html.

Nelson, P. W. 2010. The terrestrial natural communities of Missouri. Missouri Natural Areas Committee, Jefferson City. 550 p.

Nigh, T. A. 1988. Missouri natural features inventory (Carter, Oregon, Ripley, and Shannon counties). Missouri Department of Conservation, Jefferson City. 286 p.

Ozark National Scenic Riverways. 1991. Roads and trails study and environmental assessment. National Park Service, Denver Service Center. NPS D-99A. 107 np. plus appendices and 34 maps.

Pioneer Forest. 2011. Forest Management Plan. Salem, Missouri. 79 p.

Pioneer Forest. 2015. Pioneer Special Resource Stewardship Designations: Natural Areas, Forest Reserves, and Ecological Management Areas. Policy finalized and approved by the Board of Directors, April 23, 2015.

Pioneer Forest. 2016. Roger Pryor Pioneer Backcountry Management Plan. Salem, Missouri. 32 p.

Pioneer Forest. 2017. Pioneer Forest Shortleaf Pine-Oak Woodland Ecological Management Area: Further Considerations for Long-Term Stewardship. (Contributors G. Iffrig, N. Humke, J. Green, and B. Kuhn). 40 p.

Rennicke, J. 1995. Wild at heart. Backpacker (April 1995: 48-56.

San Diego, N.M. 2001. Management regime, scale, and the diversity of leaf litter arthropod communities of an Ozark forest. St. Louis University, St. Louis, MO. MS Thesis. 56 p.

Schnur, C.L. 1937. Yield, stand, and volume tables for even-aged upland forests. USDA Technical Bulletin, No. 560. 88 p.

Shanklin, J.F. 1955. Current River Natural Area. Journal of Forestry 53(7):532-536.

Slay, M.E., M.L. Niemiller, M. Sutton, and S.J. Taylor. 2016. Cave life of the Ozarks, a guide to commonly encountered species in Arkansas, Missouri, and Oklahoma. Biology Section of the National Speleological Society, 45p.

Steyermark, J.A. 1963. Flora of Missouri. Iowa State University Press, Ames. 1,728 p.

Stott, C.B. 1968. A short history of continuous forest inventory east of the Mississippi. Journal of Forestry 66:834-837.

Thom, R.H. and J.H. Wilson. 1980 The natural divisions of Missouri. Transactions of the Missouri Academy of Science 14:9-23.

U.S. Department of the Interior. 1976. A recreation plan for Pioneer Forest, Missouri. Mid-Continent Reginal Office, Bureau of Outdoor Recreation. 41 p. + maps.

Vaughn, D.H. 2013. Derecho! The forgotten windstorm that changed the Ozarks. Forest History Today 19(1-2): 4-12.

Vineyard, J.D. 1958. The reservoir theory of springflow. National Speleological Society Bulletin 20: 46-50.

Vineyard, J.D. 1963. Origin and development of Cave Spring, Shannon County, Missouri. MA Thesis. University of Missouri, Columbia. 81p.

Wang, Z. 1997. Stability and predictability of diameter distributions in a managed uneven-aged oak forest. Ph.D. Dissertation. University of Missouri, Columbia. 147p.

White, L.C. 1993. Ozark hideaways: twenty-seven day trips for hiking and fishing. University of Missouri Press, Columbia, Mo. 244p.

Yatskievych, G. 2013. Steyermark's flora of Missouri, volume 3. Missouri Botanical Garden Press, St. Louis in cooperation with the Missouri Department of Conservation, Jefferson City. 1382p.

Appendix A

Forest Policy and Performance Standards

These guidelines were developed as part of Pioneer Forest's participation in certification and are considered an important foundation for the operation and management of the forest. These have been reviewed with staff knowledge of a broad range of certification standards. They should meet the most important aspects of certification but may not meet all the standards of any particular certification body.

I. General

A. The Pioneer Forest is managed as a sustainable working forest with efficient periodic harvest that protects and enhances the natural forest conditions and generates revenue for the owner.

B. Protecting the biological resources of the forest is accomplished by emphasizing uneven-aged management using single-tree selection silvicultural practice, light-impact harvests, and restriction of harvests to sustainable levels.

C. Management strives for a balanced approach, giving sustainable harvest levels, ecosystem protection, and community and social benefits equal consideration.

II. Community and Contractor Relations

A. Community relations: Positive relations are maintained between the Forest staff and our neighbors, whether private or public landowners, through ongoing contacts and personal communications.

a.) Boundary line maintenance will continue to follow the practice of repainting about $1/6^{th}$ of the total boundary every year. All boundary lines have been surveyed. There are currently no disputes over the location of boundary. In the event that a neighbor objects to the location of a boundary line and no other solution can be found, the policy is to allow that neighbor to have the line re-surveyed by a professional surveyor at the neighbor's expense.

b.) Logging is conducted in ways that ensure public safety and minimize neighbor conflicts.

B. Contractor relations: Harvest contractors are viewed as important partners in sustainable management.

a.) Standing timber to be harvested is marked, harvested, and the volume is determined by weighing on a certified scale at the logyard. Weight is converted to International ¼-inch Scale using a conversion factor of 12 pounds per board foot. Contractors are billed at a fair market value competitive with other timber markets in the area. All timber is sold on a contract basis. The price for the timber is determined before a contract is signed and stipulated in the contract.

b.) Harvest contractors from the local vicinity and with a record of good logging practices will be given preference. High standards of logging quality will be rewarded with continued contracts when possible.

III. Forest Management

A. Management plans: Written forest management and harvest plans document the decision-making process used to justify and schedule forestry operations.

a.) Forest management and harvest plans are written and implemented by a professional forester of the Pioneer Forest staff.

B. Adaptive management: The management plan is adaptive in character, designed to be flexible and to change over time as goals, forest conditions, and our understanding of ecosystems change.

a.) The plan emphasizes policies, silvicultural techniques and operational standards to guide management towards specific goals, and it deliberately

de-emphasizes detailed operational timetables and specific timber stand prescriptions.

C. Plan standards: Specific management plan standards follow:

a.) The plan is based on a statistically relevant Continuous Forest Inventory, which has been re-measured every five years since 1952. The CFI monitors forest resources including non-timber resources and functions.

b.) Management perpetuates or enhances the full range of forest values and functions, as possible.

c.) The management plan includes:

i. A summary of management goals and policies

ii. Management priorities project harvest operations that cover 5500 to 7000 acres annually, but these numbers will be reviewed and amended at the end of five years, to address new CFI results.

iii. Supporting information, such as general forest maps, a forest inventory summary, biological resources, and growth and yield projections.

D. Harvest plans: Specific harvest planning standards are followed:

a.) Operational plans are prepared prior to any harvest or other significant management activity.

b.) Pre-harvest plans include a map of the harvest area and a brief operational plan, harvest area boundaries, and the locations of roads, landings, and major skid trails.

E. Harvest supervision: Specific supervision standards are followed.

a.) All trees to be cut are marked or designated prior to harvest.

b.) All significant wildlife trees or legacy trees, and other protected resources are designated in the field prior to when harvest begins.

c.) All haul roads, skid trails, and landings are designated in the field prior to logging. Every effort is made to re-use existing haul roads, skid trails, and landings.

d.) A staff forester or biologist is present to supervise operations as necessary and is always present at start up and then one or two times a week during the term of the contract.

f.) Assigned staff will notify the contractor and the Forest Manager immediately in the event of an environmental infraction.

F. Data collection: Management and harvest planning and execution are used as opportunities for data collection in the field.

a.) Information collected on forest and stand conditions is recorded on section tract records and specifically includes any information on species of significance. The records are kept on file in the Manager's office.

IV. Silviculture.

A. Science-based silviculture: The silvicultural systems used to accomplish ecological and economic objectives are suited to forest conditions and are based on the best available sustainable forest science provided the ecological objective can be met. Selective thinning that promotes uneven-aged stand structure and minimizes visual and environmental disturbance is preferred.

a.) Ecosystem dynamics are addressed in silvicultural prescriptions (stage of stand development, tree species diversity, presence of gaps or clumps, special biological resources, etc.).

b.) Forest management seeks to mimic the size, type, and frequency of disturbances found in natural forests.

B. Desired future conditions: Management will actively move timber stands toward stated desired future conditions.

a.) The forest is composed of uneven-aged stands that will be maintained with the long-term objective being one of growing large diameter, high quality hardwoods and pine. In general, scarlet oak and black oak will be carried to an age of 65 to 85 years old, red oak to an age of 125 to 150 years old, white oak to an age of 200 years or more, and shortleaf pine to about 150 to 175 years of age before harvest. Regular harvests will remove younger or less desirable trees and some of the older trees, always leaving a mix of the youngest and oldest trees after harvest. A mix of minor species will be left intermixed with the more commercially valuable species.

b.) Seedlings and saplings of all species will be maintained as a significant component of each stand and will be enough to regenerate the stand.

C. Cutting Cycle: Forest stands are entered every 20 years on average.

a.) Harvest approximately 7000 acres annually with a minimum of 5500 acres and a maximum of 8000 acres.

b.) Retain 50 ft^2 of basal area per acre post-harvest to increase the likelihood of sustaining adequate oak regeneration (Larsen et al. 1999).

D. Harvest Levels and Growth: Annual harvest levels will not exceed growth except in unusual circumstances.

a.) Recent CFI data estimates growth at 32.7 million board feet annually.

b.) Current harvest levels are between 8-12 million board feet annually.

c.) Approximately 40% of the standing volume is removed during each harvest.

d.) Single-tree selection harvests will be the harvest method of choice. Clear-cutting will be permitted only after all other methods have been considered and will be used only in the specific circumstance of correcting problem conditions within the stand. In no case will a clearcut exceed five to six acres in size.

E. Reforestation: Reforestation by natural seeding is preferred, though planting may be used to help speed reversion of old fields into forest conditions.

a.) Advanced regeneration will be protected during harvest operations.

b.) Only native species will be selected when planting is necessary.

c.) Planted seedlings are kept vigorous and free to grow by judicious and economical vegetation control. Manual bush hogging or brush cutting is the preferred control method where needs are not extensive and only one or two treatments are considered necessary. Chemical control may be used to control exotic invasive species but only where manual control is ineffective. Aerial application of chemicals will not be allowed.

V. Environmental Protection

A. Protection: Protection of biological resources will be a priority

a.) Management planning includes an analysis of the impact on forest biological resources.

b.) Harvest planning includes steps to protect and enhance these resources.

B. Soils: Soils will be protected from adverse impacts associated with harvest activities, including soil erosion and loss of soil structure from excessive compaction. Soil fertility and soil microorganisms will be maintained by leaving woody debris in the forest to rot.

a.) Cull logs are left in the woods to decay (except where this practice may cause a fire hazard or safety concerns).

b.) Soil conditions on the forest permit logging all year long. Sites not suited to wet season logging will be noted and avoided until the dry season.

c.) Skidding will reuse existing skid trails established during previous harvest entries. Skid trails, landings, and haul roads will cover less than 10% of the harvest area.

d.) Skid trails will be maintained to reduce erosion and run-off and will use dips, water bars, and seeding where necessary. Haul road grades are kept under 20% grade (calculated at 20 per one hundred, so that going uphill 100 units increases altitude by 20 units) and skid trails under 40%. Road drainage structures are used or maintained where needed.

C. Riparian Zones: Special care will be taken to identify riparian resources and protect water quality. Management of riparian zones will give priority to wildlife habitat and water quality.

a.) All riparian zones are clearly identified in the field prior to harvest. A plan will be put in place to identify riparian zones on harvest maps.

b.) Timber removal in riparian zones is to be avoided within 50 feet of streams, except for restoration projects or in the event of an outbreak of insect populations or disease. Practices promote older forest structure and diversity. Reserve areas are sited to protect riparian areas, including springs and fens.

c.) Skid trails and roads will avoid sensitive areas. Equipment use in riparian zones will be prohibited, except at designated crossings.

D. Wildlife: Special care will be taken to identify and protect the full array of native wildlife habitat present, with habitats enhanced where desirable.

a.) Trees of special value to wildlife will be designated and protected during harvest activity. Wildlife trees will be allowed to die naturally to provide snags and large woody debris for soil fertility.

b.) Where not a safety hazard, standing dead trees (snags) are retained and allowed to deteriorate.

c.) Stewardship staff (at times in consultation with others) will recommend management needs as part of the management plan.

E. Legacy trees: Select trees will be retained as "linkages" to the next forest as part of the seed source for regeneration and stand structure.

a.) Trees that are unique in size, age, species, or wildlife value will be retained as part of the continuing uneven-aged stand structure.

b.) Harvest of legacy trees will be delayed providing future high-quality logs. If not suitable for high quality veneer or sawlogs, harvest may be restricted to provide snags and future coarse woody debris.

F. Coarse woody debris: CWD will be managed to promote soil productivity.

a.) CWD decomposes rapidly in the Central Ozark Region due to high humidity and warm temperatures. Therefore, coarse woody debris is retained on the forest floor when possible to ensure the perpetuation of that portion of the forest structure.

b.) Trees are cut, bucked, and delimbed in place and cull logs are left on the floor. Boundary line trees are preserved.

c.) Salvage of dead or dying timber is allowed only in cases of significant risk or loss of at least one load of logs in a landing area.

G. Special Resources: Special protection will be given to areas with steep slopes or special values for cultural resources, recreational use, wildlife habitat, geological features, plant communities or watershed protection.

a.) Special resource areas are off-limits for harvesting, especially where management seeks primarily to enhance unique qualities or resources.

b.) Special resource areas are marked on the ground prior to harvests.

c.) All remnants of the older forest (e.g. residual trees, snags, large cull trees and logs) receive the highest level of protection.

VI. Monitoring and Assessment

A. Goals: Setting of specific performance goals and regularly assessing progress towards them, and adapting the management approach to meet desired goals, when necessary, will be key parts of the planning process

a.) Progress towards achieving performance goals is assessed at 5-year intervals.

b.) The performance of the management staff is assessed every year. Performance will be based on achievement of goals and objectives.

c.) This forest management plan is a ten-year plan which will be reviewed and revised as needed at the end of five years, particularly in response to results from the re-measurement of the continuous forest inventory. These revisions will be considered amendments to this plan.

B. Monitoring: Monitoring will serve as the basis for evaluating and modifying the management plan, including how the forest changes in response to management activities, assessing the progress toward specific goals, and providing for adjustments of goals not met.

a.) Data are collected during each scheduled property inventory, or as possible during routine management operations

b.) Systematic property-wide timber inventory is conducted every five years. For consistency, the same protocols are used from one inventory to the next.

C. Indicators: Measurable indicators of key forest processes and structure will serve as the basis for monitoring and assessment.

a.) Regeneration of at least 20 trees per acre is maintained with the natural diversity and composition expected from an Ozark oak, hickory, and pine forest.

b.) At least 10 tons of CWD per acre are maintained and inventoried or estimated during pre-harvest assessments and walk-through.

c.) An effort will be made to maintain at least five wildlife, snag, and/or legacy trees per acre, with species composition dependent on site.

d.) Skid trails, roads, and landings will cover no more than 10% of the forest floor. Skid trails must be at least 150 feet apart on average. Monitoring by visual assessment is required during harvest activity.

e.) Erosion control devices are installed correctly to effectively shed water and prevent erosion. Monitor is performed by visual inspection during and immediately following harvest activity.

f.) Timber growth rates will be monitored over time. Results will be calculated with data from the continuous forest inventory every five years.

g.) Understory vegetation, natural regeneration, and ground cover are dominated by native species of desired groups. Invasive exotic species are reduced or eliminated in numbers. Monitoring by sampling during periodic property inventory if performed and visual observation during regular tract inspections.

APPENDIX B

Description of Report Forms and Associated Protocol

A variety of protocols and the following Report Forms are used by the staff to monitor and record events and activities that occur on the forest each year. This method ensures that knowledge of and information regarding current events is recorded and available in the future.

The following documents are, by reference, made part of this management plan for Pioneer Forest:

Annual Report. Beginning in 1996 the staff of Pioneer Forest began preparing an Annual Report for the L-A-D Foundation. Included is summary information on forest management, land consolidation, research, education and outreach activities, recreation and natural areas, and public policy issues. In 2008 this report became the Annual Report of the L-A-D Foundation and has been posted on our website www.ladfoundation.org. Copies are available either in Salem or St. Louis.

Application for Research. Any individual or organization desiring to use Pioneer Forest or L-A-D Foundation lands for research purposes submits an Application for Research and agrees to provide the Forest and Foundation with full and complete contact information, description of the project, as well as a copy of the results of that work and any reports or publications which result from it.

For many years we have also maintained a list of these publications along with annotations and have made that available. Copies of publications are also housed either in St. Louis or in the Pioneer Forest library in Salem.

Special Area Annual Reporting. Two areas on the forest are recognized by the Society of American Foresters (SAF) and were among the earliest SAF Research Natural Areas. Current River Natural Area recognized in 1955 (Shanklin 1955) and Pioneer Natural Area recognized in 1964 (Lynch 1964). Periodic reporting over the years is available.

The Foundation owns 12 Missouri Natural Areas that are recognized and cooperatively registered as part of the Missouri Natural Areas System. Seven of these areas are beyond Pioneer Forest and subject to lease agreements, five of the areas are located on lands of Pioneer Forest. Each year the Missouri Department of Conservation provides a status report for each area describing visitation, research activity, management activities and issues, and projects to be completed. The reports are discussed by the L-A-D Foundation Stewardship Committee and with MDC staff.

Trails of the Roger Pryor Pioneer Backcountry is managed by the Missouri State Park System under a donated lease to the Missouri Department of Natural Resources. An annual meeting between Pioneer staff, Foundation board members, and Division of State Parks staff is used to discuss trail management, maintenance, and public use, review conceptual development for new trails/trailheads, and discuss conditions and needs.

Forest reserves and ecological management areas. The inclusion of these areas and their protection is an ongoing process for forestry and stewardship staff. These are regularly visited and reported on in either an area assessment report or as part of the tract inspection and assessment report and are often discussed in the foundation's annual report.

Tract Inspection and Assessment Report. Each legally described section of Pioneer Forest land or portion of a section owned by the forest will be monitored on a regular basis by staff and the results reported to the Salem office and there kept on file. Each section, or portion thereof will be visited at least once each year to inspect for such things as insect or disease; illegal activities such as trespass, theft, or property damage; and the general health and condition of the forest. Unusual conditions may be photographed and will be reported immediately to the Forest Manager.

Harvest Area Inspection Report. A Harvest Area Report will be initiated when a new sale area is opened. The area will be inspected to determine the condition of roads and skid trails and the needs for repair, additional roads, or road closures as necessary. As each sale progresses, an ongoing inspection will be conducted during each visit with at least three recorded inspections while the sale is open. Unacceptable conditions will be immediately reported to the Forest Manager. The report form will be retained by Pioneer's Forest Technician until the sale is closed and a final inspection is completed for the area. The completed report will be sent to the Salem office with any comments.

Dispute Resolution Protocol Report. Whenever an employee becomes aware of a dispute involving Pioneer Forest with a private, state, or federal neighbor, or a contractor, the information will be reported immediately to the Forest Manager at the Salem office. Pioneer employees will then work to resolve the dispute. The Forest Manager will determine how best to resolve and if unable to do so will report the matter to the L-A-D President or Executive Committee. In no case will resolution be offered for unwarranted issues.

Exotic or Invasive Species Protocol and Monitoring. All employees will assist in the discovery and monitoring of unwanted or invasive species that are detrimental to the forest. When and where they are observed they will be reported to the Salem office. In discussion with the Forest Manager and stewardship staff, control or eradication measures will be evaluated and implemented, depending on the species and based on the recommendations of state and federal agency staff charged with their control. Every effort will be made to achieve control without the use of chemicals. When chemicals are required, appropriate safety procedures and equipment, as stipulated on the chemical label, will be followed and used. Trained eradication crews will be contracted wherever it is deemed to be appropriate.

Firewood Permits. Cutting of firewood for personal use is allowed by written permission on Pioneer Forest. These can be issued by any Pioneer Forest staff.

Hunting on the Forest. Traditionally the privilege of hunting has been extended to neighbors; the forest is not open to commercial or guided hunting. Hunting during seasons is allowed and a state hunting license is required.

Illegal or Unauthorized Activities Protocol and Monitoring. Unauthorized activities on the forest (dumping, root digging, use of motorized vehicles off the county roads, extended camping, parking of horse trailers, leaving vehicles or equipment on the forest) are prohibited throughout the forest. Pioneer staff will attempt to resolve these issues following discussions with the Forest Manager. If this fails, the Forest Manager will notify the County Sheriff immediately.

State law enforcement is available specific to the Roger Pryor Pioneer Backcountry as per the lease arrangement. Violations within the Backcountry will be reported directly and immediately to the Missouri Division of State Parks Ranger assigned to this site.

Public Presentations. Staff are encouraged to participate as speakers and panel members at conferences and meetings to discuss the forest's management, significance, and to become involved in issues of environmental or conservation concern.

Involvement of the Forest and of staff include speaking, writing, publishing articles and reports about the forest, letters to the editor, and news releases. The primary concern of the forest and the Foundation is the protection, restoration, and wise management of natural and cultural resources of the Ozark region and within the Current River watershed in particular. Each of these are noted in the Foundation's Annual Report.

Special Use Area Permits. The Leatherwood Creek Area of Pioneer Forest is recognized for its fragile nature. Motorized access off the county road is prohibited. Walk-in hunting during seasons is allowed and a state hunting license is required.

Staff Training Report. Forest management and restoration projects are difficult, technical, and can be complicated. All members of the staff are given appropriate training and during their tenure with the forest the opportunity to enhance and expand their abilities and knowledge of forests and their management within the region.

This training includes technical skills, forest and fire management, safety, health, first aid, and equipment operation, and can be taken individually or as a group.

Visits to and Tours of Pioneer Forest. Work on Pioneer Forest is being recognized across the country. There have been many who have visited wanting to see the forest firsthand and consider the applicability to other regions of the country. Each of these visits is recorded by date, name, and the number of persons. The list is maintained in the Pioneer office and reported on in the Foundation's Annual Report.

APPENDIX C

Special Resource Stewardship Designations on Pioneer Forest

Recognition of special areas on Pioneer Forest has continually evolved since the forest's acquisition by Leo Drey. These designations include SAF Natural Areas (page 21), Missouri Natural Areas (page 22), Pioneer Forest Reserves (page 22), and Ecological Management Areas (page 26). In 2015 these various designations were formally described, discussed by the board, and adopted as policy on April 23, 2015 (Pioneer Forest, 2015).

Current River Natural Area, Shannon County, 265 acres, Sections 27, 28, 33, and 34 T30N, R3W

Recognition: Original 10-acre site, recognized by the Society of American Foresters (SAF) in 1955 and in 1977 designated as a Missouri Natural Area. In 2005, on its 50th anniversary, an addition of 255 was included as part of the Missouri Natural Area.

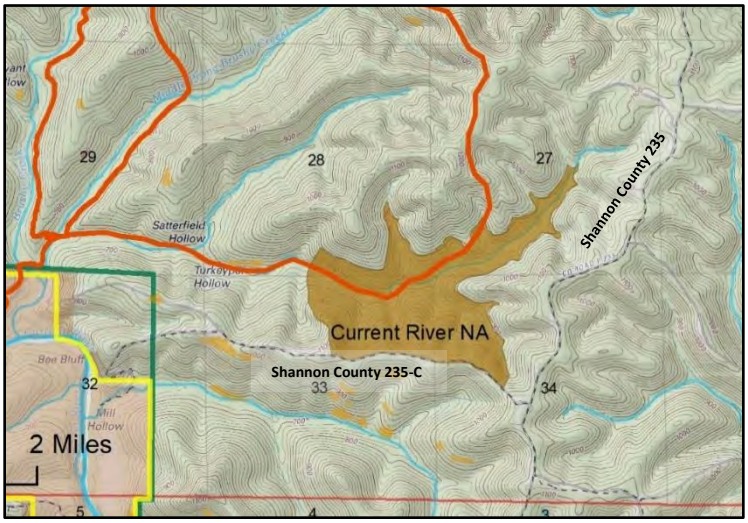
Description. The natural area is situated within Satterfield Hollow, which flows into Brushy Creek, a tributary to Current River. The north-facing slope is one of the most impressive forested hillsides in Missouri. Leaving from the Tick-A-Chig ridge is an abandoned woods road leading down the hill through large black oak and hickory, into red oak and white oak, with many of the trees exceeding 30 inches in diameter.

Core sampling conducted here in 1993 by Richard Guyette, dendrochronologist of the University of Missouri-Columbia, found canopy trees here at between 300-400 years old. He estimated that the canopy trees today originated from a closed canopy condition, indicating the slow and successive regeneration underway here for hundreds of years. Tall, quiet, and moist, this site is instructive of the original Big Woods; the white oaks were highly prized and sought after for their staves used in the manufacture of barrels.

This site was visited by and known to many early Missouri conservationists including Dr. Julian Steyermark who included the site on his list of Missouri's most important places during the 1950s as part of the earliest efforts of the Missouri Chapter of The Nature Conservancy. The larger area has been the subject of a great deal of research on the canopy trees continued by the SAF, and by other researchers on the salamanders, invertebrates, and insects.

Management. This site is monitored to prevent vehicular access from the county road atop Tick-A-Chig Ridge; a southernmost section of the Brushy Creek Trail extends up Satterfield Hollow and is periodically maintained.

Directions to the Site. The site is reached by travelling south from Himont about 4-5 miles, then turning west on County Road 235-C, known locally as the Tick-A-Chig Ridge Road. Continue west on 235-C about ½-mile. On the right is an abandoned woods road, now a footpath which descends past a routed wooden sign that recognizes the 2005 boundary adjustment. This trail follows down the hill into the hollow where you may see the original SAF routed wooden sign.



Lily Pond Natural Area, Reynolds County, 8 acres, Section 23, T31N, R1E

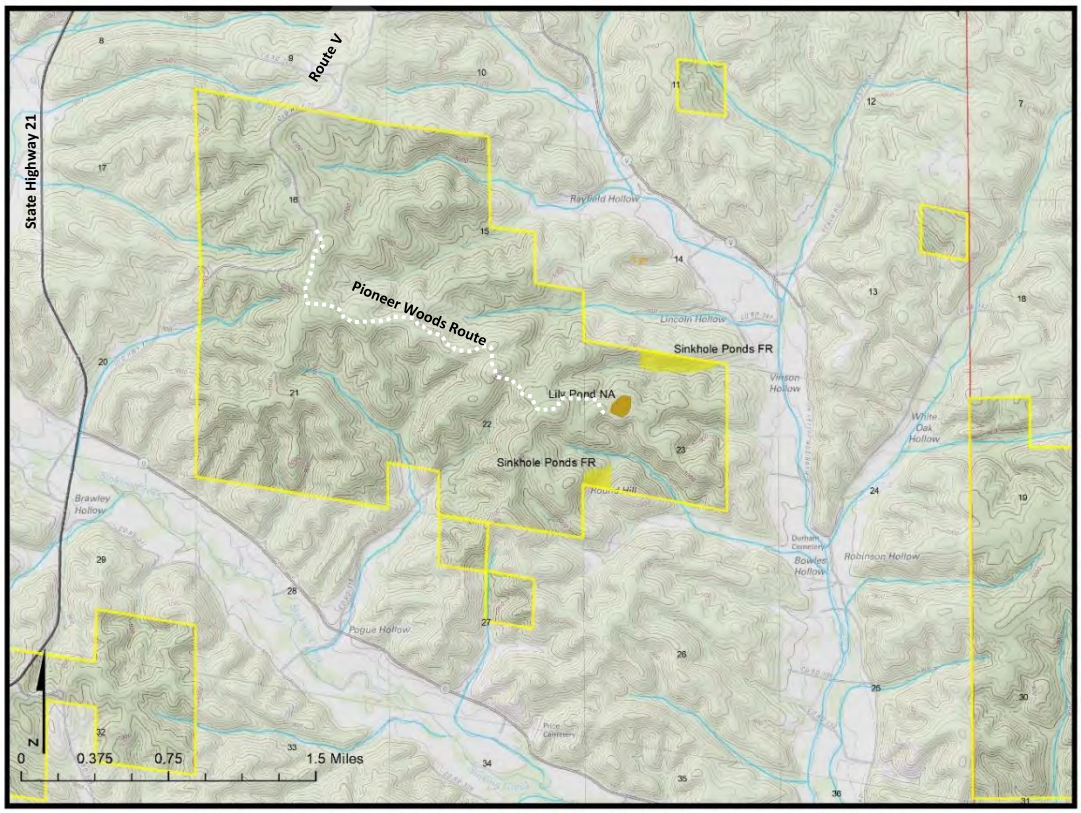
Recognition. Julian Steyermark, author of Flora of Missouri (1963) visited the site in 1949, as noted from his herbarium collections. He encouraged early leaders of The Nature Conservancy (TNC) to acquire the site and it was designated a Missouri Natural Area in 1975. More recently in 2006 the Lily Pond Natural Area site was acquired by the L-A-D Foundation as a result of a donation from The Nature Conservancy.

Description. This is a small sinkhole pond in the Lower Ozarks Natural Division and was noted by Nelson (2010) as representative of a pond shrub swamp. For example, buttonbush dominates the perimeter with the pond sitting within a shallow basin just off the ridge.

In discussing swamp loosestrife (*Decodon verticillatus*) in his 1963 flora, Steyermark noted that species as occurring in only two sinkhole ponds in Reynolds County, both within Pioneer ownership. Other species found here, including water violet (*Hottonia inflata*), swamp rose (*Rosa palustris*), and beggarticks (*Bidens discoidea*) are also found in lowland swamps of southeastern Missouri. Characteristic sinkhole plants include a manna grass (*Glyceria acutiflora*) and a sedge (*Carex decomposita*).

Management. A requirement of the donation is that a sign recognizing the contribution of The Nature Conservancy be maintained at the perimeter of the pond. More recent sign of feral hogs has been observed in the area and will require attention.

Directions to the Site. Take State Highway 21 north of Ellington to old route 21 – now Route V - north about a mile and a half where a woods road (dashed white line) takes off to the east and quickly turns south (about two miles), leading back through Pioneer's Lily Pond tract to Section 23.



Lily Pond NA and Sinkhole Ponds FR Base Map: USGS 1:24,000 Topo, 6/13/2019 DHV

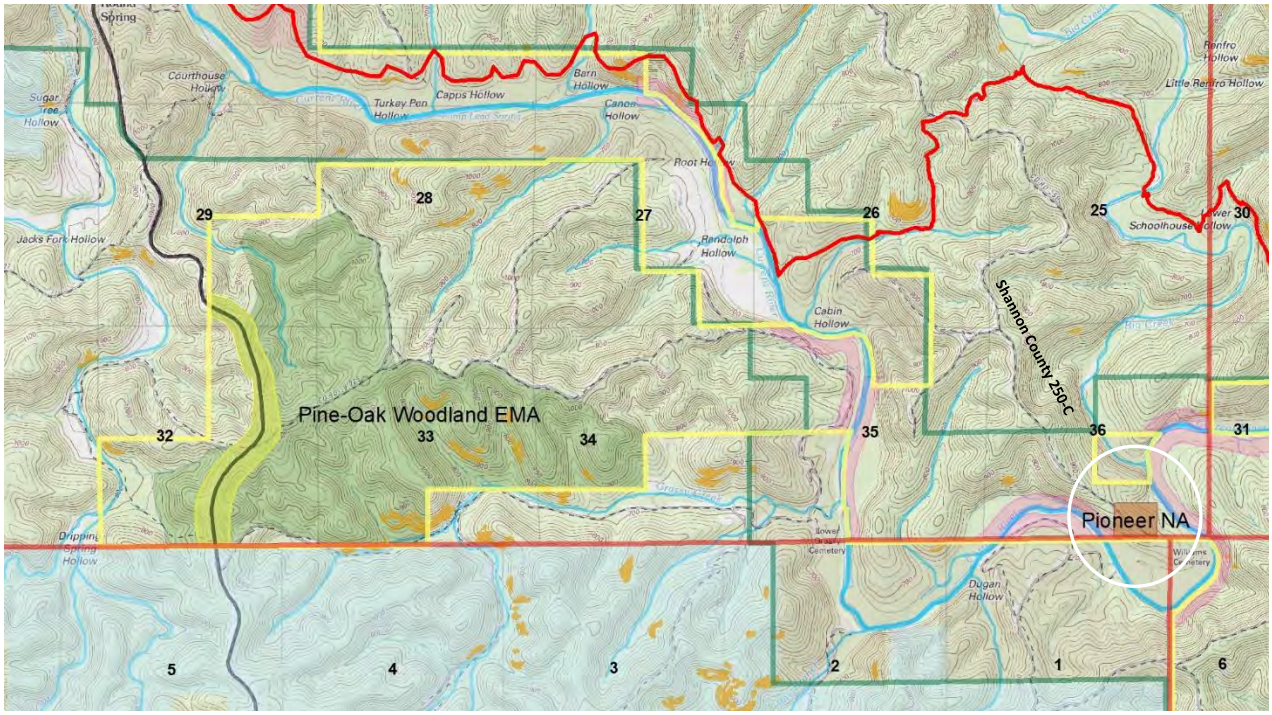
Pioneer Natural Area, Shannon County, 20 acres, Section 36, T30N, R4W

Recognition. This small area was originally recognized by the Society of American Foresters in their national natural areas program in 1964. The site includes some of the lands under scenic easement by the National Park Service. It was designated a Missouri Natural Area in 1977 by the Missouri Natural Areas Committee.

Description. The site is situated between a strong bend in the Current River which nearly touches the southwest and northeast corners of the area. It features an old-growth stand of eastern red cedar and associated hardwoods. Eastern red cedar here is co-dominant in the canopy along with a diverse list of other species including white oak, scarlet oak, walnut, black oak, and cherry. Also found on the northeast hillside are leatherwood, spice bush, maidenhair fern, Christmas fern, and hepatica. The cedar found in the canopy occurs on less than 10 acres of the site.

Management. The site is monitored, and Pioneer staff maintain the boundary. MDC and Pioneer staff anticipate visiting the area to assess site quality, perhaps adding qualifying adjacent Pioneer and NPS lands.

Directions to the Site. Follow the Zoe Road (Shannon County 19-250) from state highway 19 for about 3.8 miles east to Shannon County 250-C (also known as the Lizzie Heaton Ridge). To reach the natural area drive the length of this road, about eight miles south, nearly to the Current River. The county road passes through the natural area, a routed wooden sign is found beside the road at the south boundary. Along the Current River it is located at river mile 42.



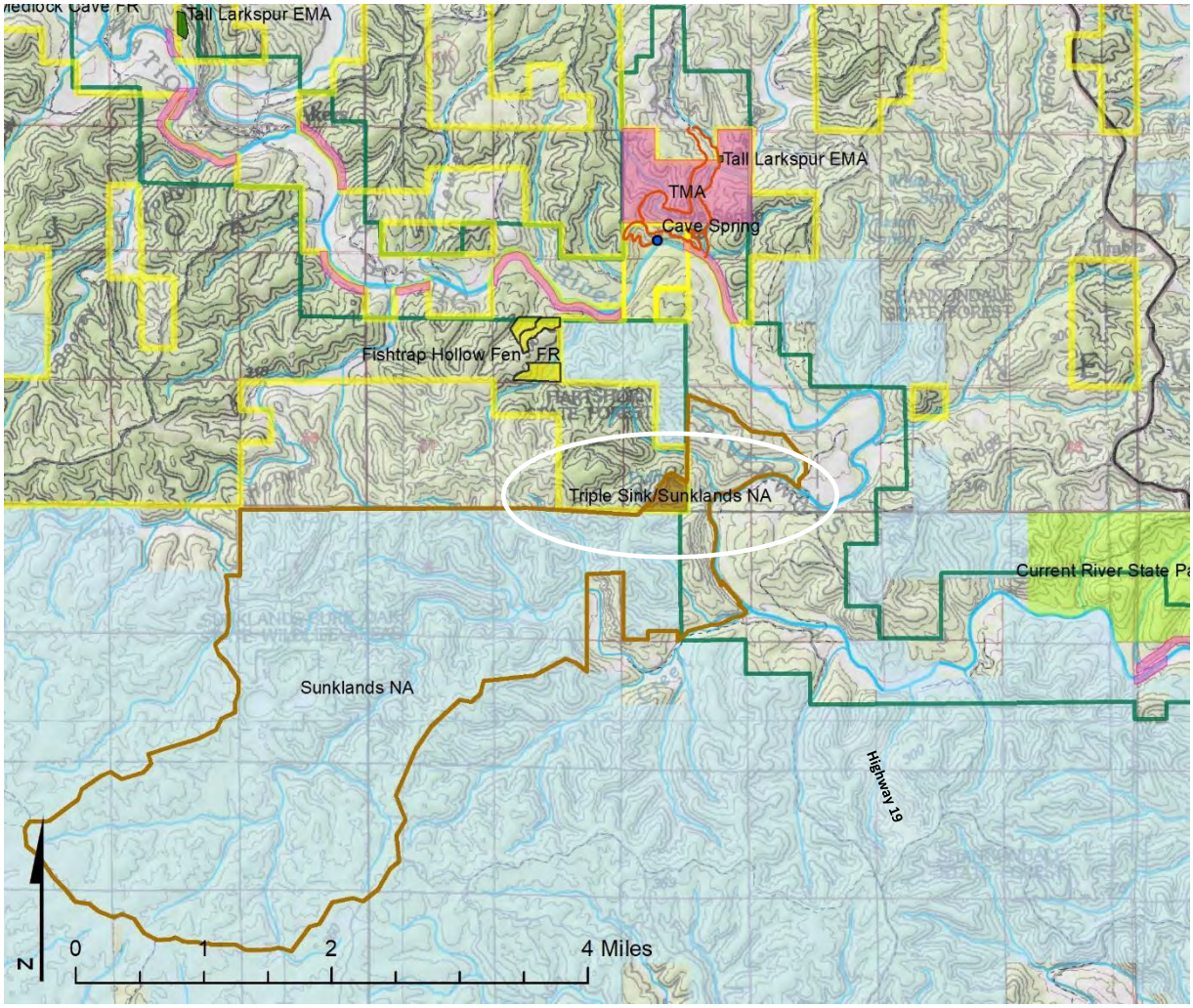
Triple Sink/Sunklands Natural Area, Shannon County, 42 acres, Section 33, T31N, R5W

Recognition**.** In 1980, three areas were designated as individual Missouri Natural Areas: Bur Oak Basin, Sunklands and Triple Sink. At that time Frank B. Powell Lumber Company owned Triple Sink Natural Area. The Powell lands were sold to Current River Pole (CRP) Company and in 2006 Pioneer agreed to trade some of its land in exchange for CRP lands that included Triple Sink Natural Area. As a much larger Sunklands Natural Area was being considered, Pioneer staff recommended enlarging Pioneer's Triple Sink area from 23 to 42 acres and it became part of the 6,295-acre Sunklands Area, which includes lands owned by Missouri Department of Conservation, Ozark National Scenic Riverways, Nature Conservancy, and L-A-D Foundation.

Description. Three forested sinkholes all within a steep-sided basin and natural communities characteristic of the Lower Ozarks section of the Ozark Natural Division. These sinkholes vary in size, depth, and vegetation. The steep hillsides range from 850 feet to 1060 feet in elevation. Within the largest sinkhole on the north-facing slope is alternate-leaved dogwood (*Cornus alternifolia*), golden seal (*Hydrastis canadensis*), and ginger (*Asarum canadense*). There is dry upland forest on the ridge above the sinkholes.

Management. Annual status reports are prepared by MDC staff and discussed. A recent concern has been the threat of feral hog damage, which requires attention.

Directions to the Site**.** Located directly west of Pulltite Spring. Access is easiest by crossing the river at the Pulltite Spring Campground. The site may be reached overland on woods trail from Lewis Hollow by truck or four-wheel drive and considerable walking. To do that you cross the river at Akers Ferry and travel south on Route K about 2.5 miles from Akers Ferry to Shannon County 359, which leads into Lewis Hollow. Near the mouth of the hollow, and about 1/2-mile from the Current River is a woods road leading up the hill to the ridge and following the ridge south and east towards the area.



Blair Creek Hanging Fen Forest Reserve, Shannon County

Description. This site in Shannon County is isolated and was initially visited by Pioneer staff along with botanists from Fish and Wildlife Service and National Park Service and reported to the Missouri Department of Conservation Natural Heritage Inventory. It was agreed that Pioneer would periodically monitor the site but not to publicize or map it. It will be monitored annually and has been naturally protected by its remote location.

Bluff School/Medlock Cave Forest Reserve, Shannon County, 56 acres

Description.

(Detailed location information deleted for website version)

Area Intentionally Left Blank
for Website Version

Gray bats use the cave. The Salem cave crayfish (Cambarus hubrichti), a species of conservation concern was reported from Medlock Cave (Hobbs and others 1977). Ozark cavefish (Typhlichthys eigenmanni), listed as endangered by the Missouri Department of Conservation and threatened by the U.S. Fish and Wildlife Service and are known from Flying W Cave, included within the reserve.

Bluff School is a one-room wooden frame building, representative of many Ozark rural schools constructed and in use between 1874 and 1940. Around 1940, Missouri ranked third in the nation for its number of one-room schools, and there were more than 75 in Shannon County alone. The date 1920 was written into the entrance step at the entrance to the building. According to a listing of teachers at Bluff School, teaching began here as early as 1928 and continued until 1952.

Management. Pioneer Forest began working on repair of the school building with assistance from retired Pioneer forester Russ Noah, later with neighbors the Howells, Backcountry Horsemen of Missouri, and three contactors to stabilize the structure and repair vandalism over the years. Ongoing maintenance and repair to the schoolhouse will be needed. The size of the bat population was significant enough to gate the entrance to Medlock Cave in 2004; the gate was repaired in 2015. The bat population is counted by MDC bat biologists every two years.

Cookstove/Squaredance Cave Forest Reserve, Shannon County, 12 acres

Description. Cookstove Cave is located within Pioneer's Roger Pryor Pioneer Backcountry. It has been part of Pioneer Forest since Leo Drey acquired the surrounding land in the 1950s. The cave was briefly noted in J. Harlan Bretz, Caves of Missouri (1956) and has had a long history of exploration. From cave files we have a variety of reports from John Cantwell 1959-1960, Earl Neller in 1968, Bill Bockstiegel in 1969, and Jan Ryan in 1975. The most detailed descriptions are those of Robert L. Taylor from 1974-1975, member of the Heart of the Ozarks Grotto of Missouri State University. It is the largest cave on Pioneer with a sinkhole entrance on the hillside above Holmes Hollow. There are 3400 feet of mapped passageway and the main gallery is impressive, extending 1100 feet and nearly 100 feet wide.

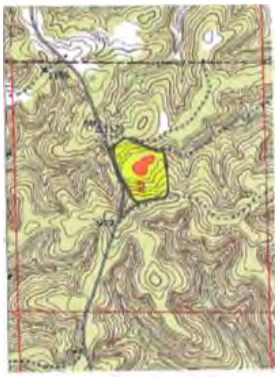
Area Intentionally Left Blank
for Website Version

Management. The cave is used by Indiana bats (*Myotis sodalis*), a species that is listed as endangered. The cave was gated in 2003 with funding from the US Fish and Wildlife Service. Since then the population has been re-counted every other year; it was stable for ten years and has increased since 2013. The last count in winter of 2017 was estimated at 6,084. The Cookstove Cave population of Indiana bats ranked tenth on a national ranking of Indiana bat hibernacula. Of Missouri's more than 7300 caves, Missouri Cave Biologist Bill Elliott noted that 53 serve as

hibernacula for Indiana bats. A total of 85% of the present-day Missouri population of Indiana bats hibernate in only eight locations, three of which are in Shannon, Washington, and Iron counties.

This section of the forest was cut during the period 1971-1973, and then more recently a salvage sale (2009) was conducted. A relatively small area of the forested hillside (approximately 12 acres) should be allowed to mature with no cutting on this portion of the hillside surrounding the entrance. This will reduce disturbance around the cave and should not reduce Pioneer's selective timber harvest in an appreciable way.

Cunningham Sink Forest Reserve, Shannon County, 27 acres in Section 2, T31N R2W

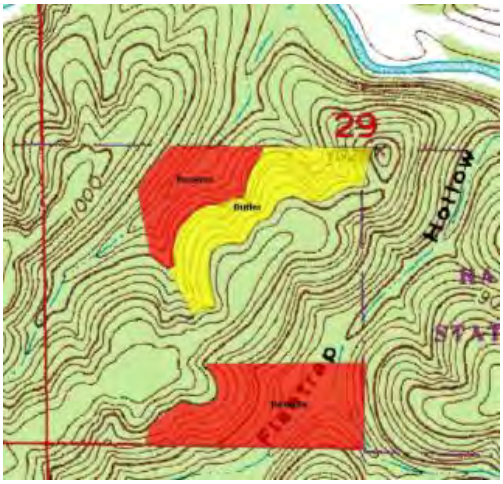


Description. This area is a large 3-acre sinkhole located near Akers Ferry in Shannon County. It holds water during the wet season and provides excellent breeding habitat for the wood frog and several salamander species. The dominant trees within this Ozark Highland sinkhole are overcup oak (*Quercus lyrata*), more typical from "wet bottomland forests, swamps, sloughs, banks of streams, and rarely sinkholes" (Yatskievych 2013). It is also known from Overcup Oak Sink Natural Area on the Mark Twain. Periodic natural inundation of the sinkhole plays an important role in its maintenance.

Management. There are two areas associated with the reserve. The core area (red-orange) is estimated at three acres and there is a forested buffer surrounding that estimated at 24 acres. Pioneer will not conduct timber management (no marking or harvesting of trees) within the orange colored portion of the reserve. No equipment is to enter or cross the sinkhole at any time.

Within the forested buffer noted in yellow, the north-facing hillside especially is of excellent site quality and has some very good trees. Timber harvest may occur within the buffer, but special care will be taken to further minimize equipment disturbance on hillsides and skid trails leading toward the basin. Pioneer's management here is always to be low impact and respectful of the model set by Forest Manager Terry Cunningham, who conducted a harvest in this area in 2007-2008, and for whom the area was named.

Fishtrap Hollow and Marshy Spring Hollow Fens Forest Reserve, Shannon County, 60 acres in Section 29, T31N R5W (insert new map from Denise)



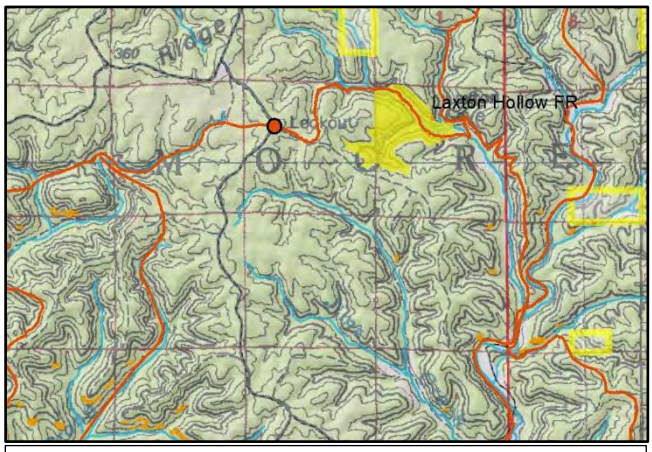
Description. The Fishtrap Hollow and Marshy Spring Hollow Fens were designated in 1995. These are boggy areas that are fed by a continuous seep of groundwater and are one of the rarest terrestrial communities in Missouri. Fens contain flora that is much more common in southeast Canada and the northeastern United States (Steyermark, 1964). Both Fishtrap Hollow Fen and Marshy Spring Hollow Fen were noted during the 1987 Missouri Natural Features Inventory and ranked as exceptional.

Fishtrap Hollow fen is a relict plant site with a beak rush (*Rhynchospora capillacea*) and a sedge (*Carex suberecta*) reported (Nigh 1987). *Carex suberecta* is also reported from Marshy Spring Hollow. Drier, glade-like areas around the fens include paintbrush (*Castilleja coccinea*), calamint (*Satureja arkansana*), and little bluestem (*Schizachyrium scoparium*).

Management. The two main areas, 1/10-acre Marshy Spring Hollow fen and the ½-acre Fishtrap Hollow fen are delineated as the core areas. Marshy Spring Hollow includes a limited forest management zone (yellow) where typical forest management may be modified where only trees that are dead or showing signs of dying may be harvested. Cull trees will be left standing. There will be no entries to thin healthy standing trees.

Laxton Hollow Forest Reserve, Shannon County, 167 acres in Sections 11 and 12 T30N R3W

Description. Laxton Hollow Reserve includes an old-age component of Pioneer Forest land, more typical of steep, isolated hollows on the forest during the 1930s and 1940s. The area includes mostly a northeast-facing slope of Laxton Hollow. There are older individual trees including scarlet oak, black oak, hickory, white oak, and northern red oak. Coarse woody debris is scattered across the forest floor. This forest reserve also includes the mouth of Laxton Hollow with Laxton Cave and Laxton Spring near Blair Creek. Much of the area lies next to the Ozark Trail along Blair Creek and includes the more recently developed Laxton Hollow Trail, which connects the old Himont Lookout Tower, now the Himont Trailhead (red dot), to the Ozark trail.

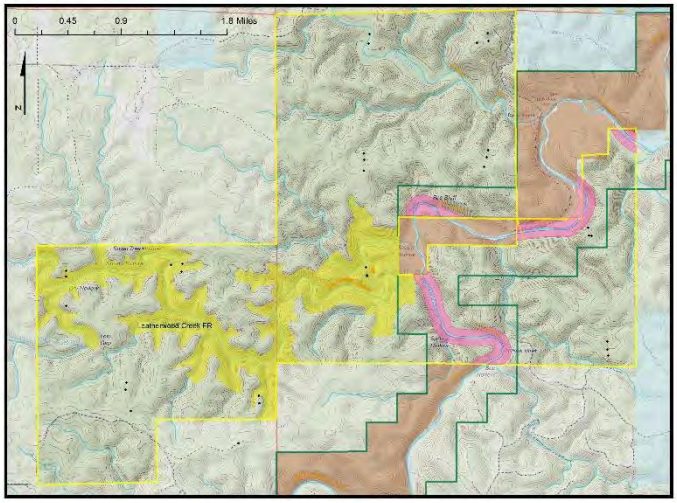


Laxton Hollow Forest Reserve is shaded yellow, private inholdings are outlined in yellow.

Management. There will be no timber harvest and management will improve the quality of its old-age character. Public use here is higher than for most forest reserves with hiking on the Laxton Hollow Trail and its use as access to the much longer Blair Creek Section of the Ozark Trail.

Leatherwood Creek Forest Reserve, Shannon County, 1003 acres in Sections 7 and 18 T28N R5W and Sections 13, 14, and 24 in T28N R6W

Description. The Leatherwood Creek Valley has been recognized as having unique geologic and biologic features (Bedan and Goetz 1976, Beveridge 1978, and White 1993). Pioneer Forest ownership includes nearly four miles of Leatherwood Creek and more than four miles of other tributary streams, all of which drain into the Jacks Fork River. Geologic features include a deeply dissected Ozark canyon, a natural Gasconade stone arch, at least 13 caves, two shelters, sinks, and glades. Several unique herbaceous plant species such as orange-throated ladies tresses orchid, golden ragwort, Loesel's twayblade orchid, and *Carex leptalea* are found on the Leatherwood Creek Reserve. The Loesel's twayblade orchid is listed on the Missouri Species and Communities of Conservation Concern Checklist. Big Cave is a gray bat cave; the most recent inventory of gray bats occurred in the winter of 2017 with the estimate at 200, a considerable decline from the 1990's.

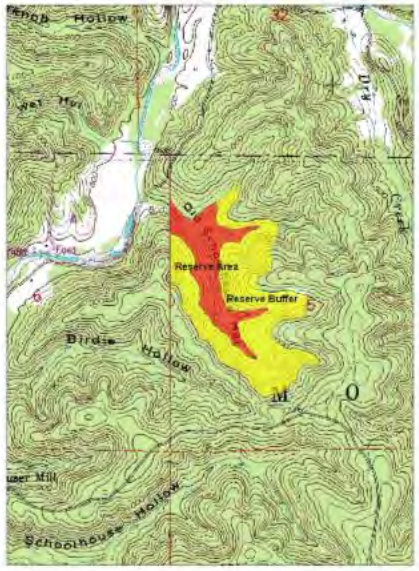


Leatherwood Forest Reserve 5/16/2019 DHV

Management. The entire area is excluded from regular forest management. Furthermore, there will be no salvage considered following catastrophic events.

Old Schoolhouse Hollow Fen Forest Reserve, Shannon County, 140 acres in Section 5, T30N, R3W

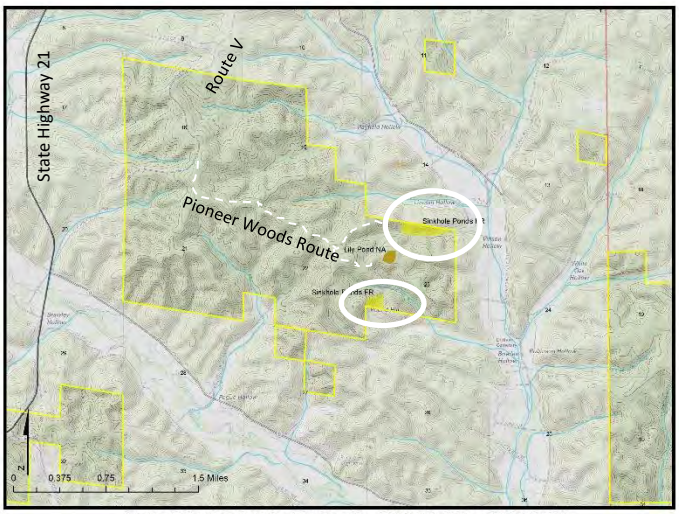
Description. Three small fens are located in Old Schoolhouse Hollow, a tributary to Big Creek. The fens are southwest-facing and the largest is located closest to the mouth of the hollow and approximately ¼-acre in size. The other two are approximately 0.15 acres each in size and are further up Old Schoolhouse Hollow. Several unique plant species are found here including a sedge (*Rhynchospora capillacea)*, other sedges (*Carex suberecta* and *Carex interior),* and Grass of Parnassus (*Parnassia grandiflora)*, all plants characteristic of these swampy open meadows. *Plantago cordata* is found in the streambed that is fed by the fen.



Management. Within the immediate reserve area, no harvest or salvage will be permitted (orange-red). Harvests within the buffer area (yellow) around the core reserve may only be trees that are dead, dying, or where mortality is expected prior to the next harvest entry. Salvage cuttings may occur in the buffer zone; however, no heavy equipment will be permitted to enter the core reserve area.

Sinkhole Ponds Complex Forest Reserve, Reynolds County, 34 acres in Section 23, T31N, R1E

Description. Sinkholes are natural depressions that are common in the highlands of the Ozark Plateau. Often, the sinkhole is attached to an underground cave complex. In many instances, however, the sinkhole becomes plugged and naturally holds water, creating a sinkhole pond. In many instances, sinkhole ponds are habitat for species that are found nowhere else in Missouri. The 1977 Missouri listing of rare and endangered species included seventeen species of plants that are found only in sinkhole ponds.

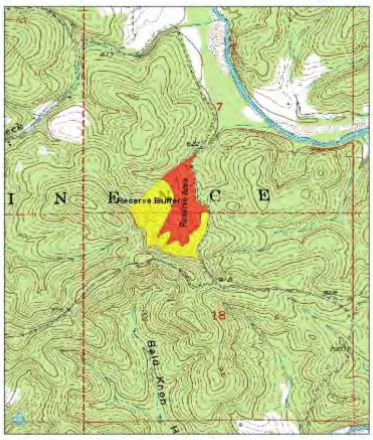


Lily Pond NA and Sinkhole Ponds FR Base Map: USGS 1:24,000 Topo, 6/13/2019 DHV

In 1953, Dr. Julian Steyermark (author of Flora of Missouri), visited the Sinkhole Ponds Complex, which includes Bowles Pond, Lily Pond, and Vinson Pond. He recommended that all three be preserved as unique habitats that are not duplicated in any other part of the state. Vinson Pond and Pioneer's portion of Bowles Pond were included in the original forest reserve, complementing Lily Pond Natural Area owned by the Nature Conservancy. The conservancy donated Lily Pond Natural Area to L-A-D Foundation in 2006.

Management. The protection of the sinkhole pond ecosystem, including the protection of the watershed draining into each pond, is the primary management objective. Within each area, there will be no harvest activity and no salvage within the protected zone.

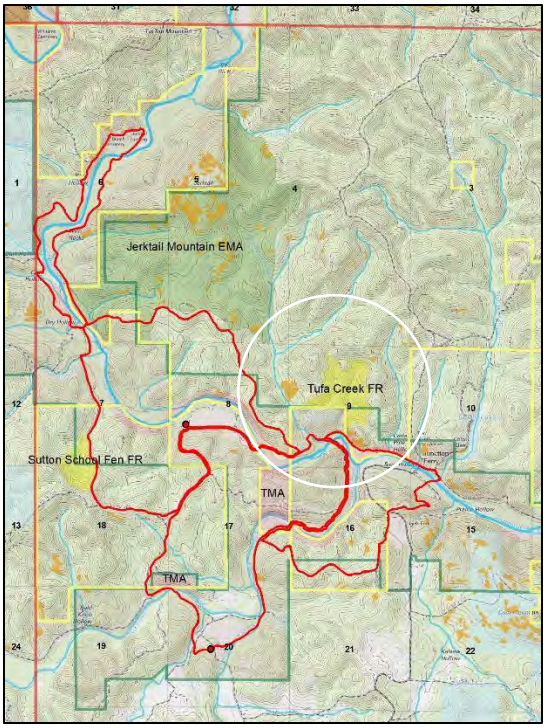
Sutton School Hollow Fen Forest Reserve, Shannon County, 60 acres in Sections 7 and 18, T29N R3W



Description. This high-quality fen is located within the Sutton School Hollow which flows into the Current River. This fen area is located on a dry-mesic forest with white oak and chinquapin oak. The forested area ends rather abruptly near the fen. Several rare and relict plant species found within the fen are Heartleaf plantain (*Plantago cordata*), sedges (*Carex interior, C. suberecta* and *Rhynchospora capillacea*), and the goldenrod (*Solidago riddellii).*

Management. No active timber management activities are to be conducted within the immediate fen reserve area (orange-red). Within the buffer zone (yellow), limited forest management may occur if trees are dead or dying, show immediate signs of decline, or where mortality is anticipated. Timber production is not a primary concern for the buffer area; however, salvage cuttings may be considered following major catastrophes.

Tufa Creek Forest Reserve, Shannon County, 116 acres in Section 9, T29N R3W



Description. The small creek here, originating at a year-round calcareous fen (0.6 acre) has deposited tufa from the chemical deposition of calcite (CaCO3) from water that is rich in dissolved calcium. It appears that the steep drop in elevation from the calcareous fen to the Current River causes the water to be turbulent, release carbon dioxide, and deposit calcium carbonate in the form of tufa. Few areas in Missouri exhibit this unique geologic feature.

On the southwest and east-facing slope of Thompson Creek is an igneous glade with large boulders and broken rubble. Found here are stunted winged elm and post oak, with little bluestem and prickly pear cactus interspersed. There is also a dolomite glade with sideoats grama, gammagrass, pale purple coneflower, and Missouri primrose. Forest species found here include shortleaf pine, black oak, and hickory on the igneous bedrock, with white oak and red oak dominant on dolomite.

Management. Active forest management will not be conducted within the drainage of the tufa creek area. Tufa deposits make this area an extremely unique and rare geologic feature and should continue to be protected from heavy equipment damage and the influence of timber harvests within the immediate area.

Shortleaf Pine-Oak Woodland Ecological Management Area, Shannon County,700 acres currently, Sections 28, 29, 32, 33 and 34, T30N, R04W, Lat/Long: 37.251/-91.399.
This includes the Virgin Pine Area, a portion of the Randolph tract, and 11 MDC acres.

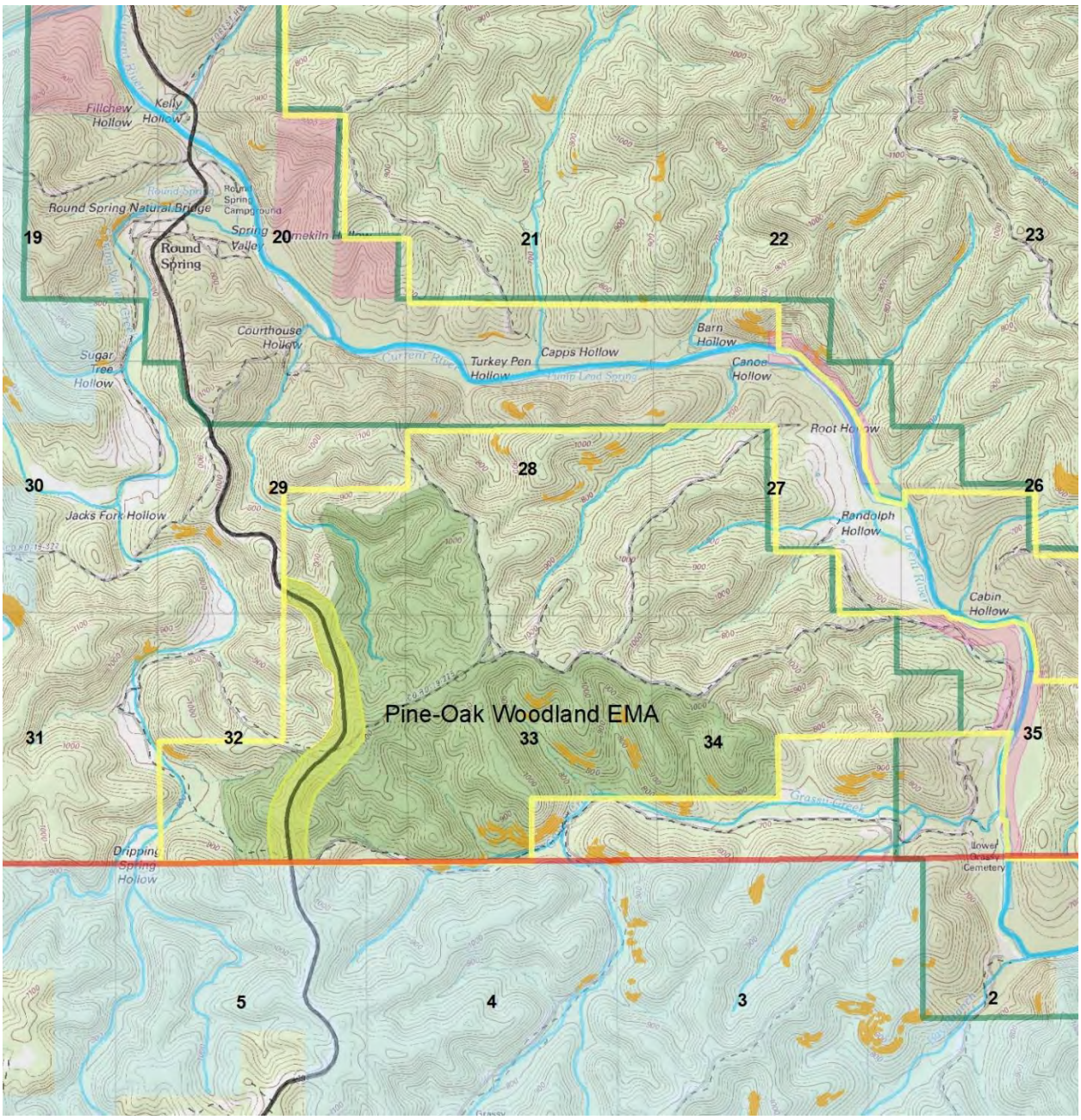
Description and target(s) for protection/management: The primary goal for this area is to restore the shortleaf pine and oak woodlands and associated dolomite glade natural communities. Old-growth pine (averaging about 230 years old) should be protected. This is the last known site for red-cockaded woodpeckers in Missouri. More than 500 plant species have been documented to date. Nine plots were established for monitoring of vegetation prior to prescribed burning, which started in 2009; they have been re-measured twice. Pine seedlings began to establish in 2014. A short hiking trail and interpretive drive are here (interpretation needs to be updated). Site is being used to educate managers and botanists. Priority bird species are returning, including prairie warbler and red-headed woodpecker.

Threats: Lack of appropriate fire, feral hogs, red cedar encroachment, vehicle trespass, dumping. Exotic invasive plants include: *Lespedeza cuneata, Centaura maculosa, Lonicera japonica, Sorghum halapense, Perilla frutescens, Carduus nutans, Albizia petiolata, Euonymus hederaceus, Elaeagnus umbellata, Melilotus* spp*., Bothriochloa bladhii*, and *Coronilla varia*. These have been treated with various methods such as herbicide and hand pulling. Feral hogs exist and threaten glades, woodlands, seeps, roads and wildlife. Feral horses have had a lesser impact.

Management Goals: Restoring diverse ground flora, establishing natural pine regeneration, and controlling excessive hardwood re-sprouts are all goals that require regular, dormant-season prescribed fire (two-to-four-year return interval). Commercial timber harvest goals are to manage existing pine and oak characteristic of woodlands to an appropriate basal area. Some canopy scarlet oaks are being retained until commercial maturity or salvaged as dead or damaged trees. Pre-commercial goals are to favor pine, white oak and post oak regeneration through TSI and brushcutting to reduce competition. Herbicides are used for stump/stem treatment and exotic invasives. Broadcast herbicide is prohibited.

Partners: MDC, NPS, AmeriCorps STL, MU-SAFE, TNC, DNR, Meramec Hills Master Naturalists, and numerous volunteers. Funding and assistance for our work here has been received from Wildlife Conservation Society, NRCS, MDC, USFS, and MoBCI.

Left, shortleaf pine seedlings emerging at Shortleaf Pine-Oak Woodland EMA; Right, first-year photo of a glade restored 2018-2019. **PHOTOS BY: Neal Humke**



Shortleaf Pine-Oak Ecological Management Area on Pioneer Forest

Tall Larkspur Ecological Management Areas, Shannon County, 85 acres in two tracts. In Section 21, T31N, R5W there are 48 acres of Pioneer Forest within a 438-acre project at Devil's Well, and in Sections 11 and 14, T31N, R6W there are 37 acres within a 197-acre project at Welch Lodge.

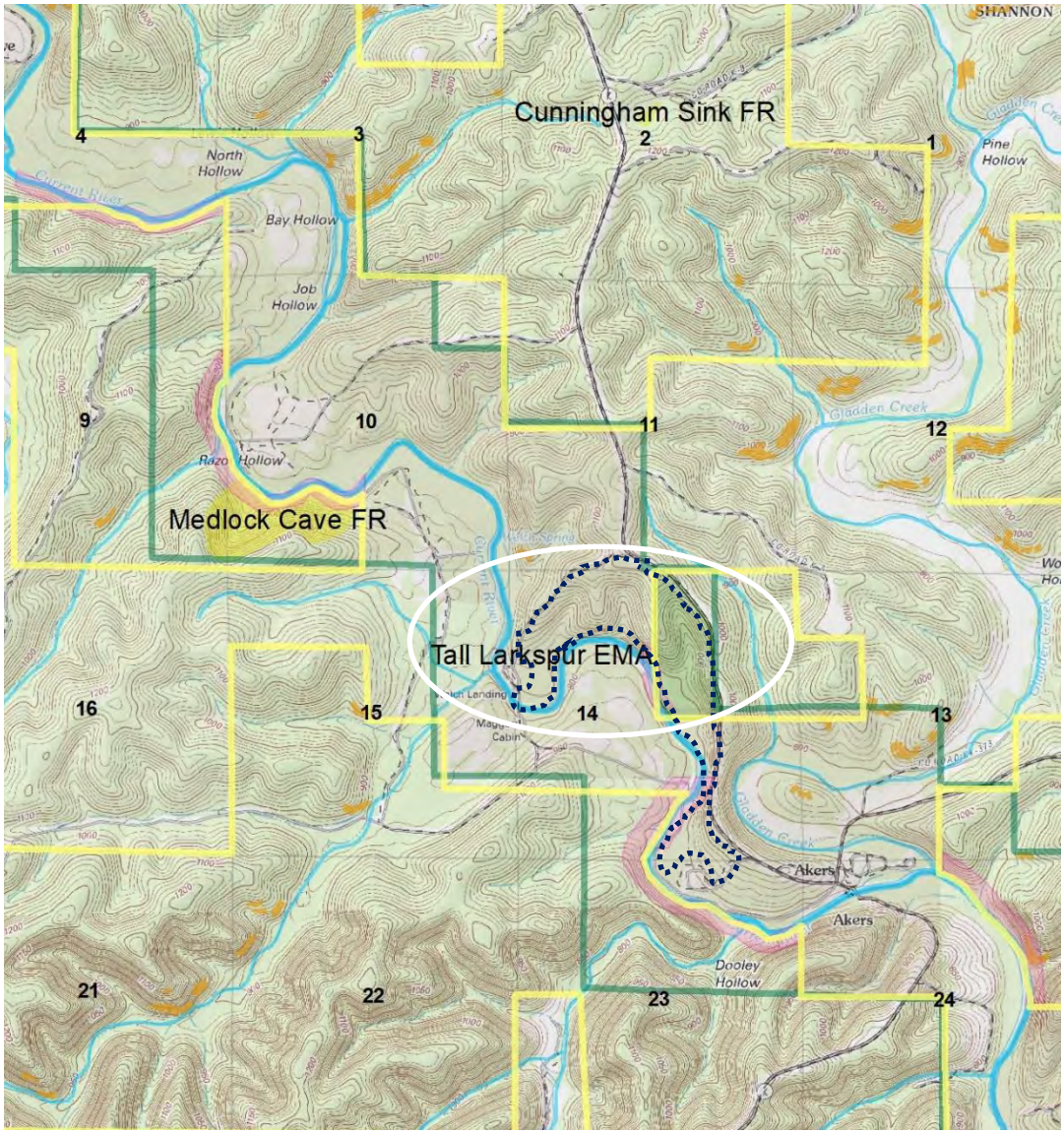
Description and targets for protection/management: Tall Larkspur (*Delphinium exaltatum)*, is a rare plant (S2) that grows in the woodland transition below dolomite glades in the Current River watershed. It requires open woodland habitat maintained by frequent (two-to-four-year return interval) dormant-season fire. Removing red cedar and fire intolerant hardwood is essential to restoring the appropriate glade/woodland structure and composition. No commercial harvests are planned. Dolomite glades/woodlands are generally very high in biodiversity. A blazing star (*Liatris scariosa* var. *nieulandii)* also ranked S2 and state tracked, is found at both sites and warrants prescribed fire. Devils Well was first burned in 2004, and Welch Lodge (PF property) in 2008. Cedar removal on Devils Well glade was initiated in 2015. Prairie warblers and other priority bird species have returned with management.

Threats: Lack of appropriate fire, feral hogs, red cedar and hardwood encroachment, exotic invasive plants, mechanical disturbance (ATVs, equestrian use, etc.).

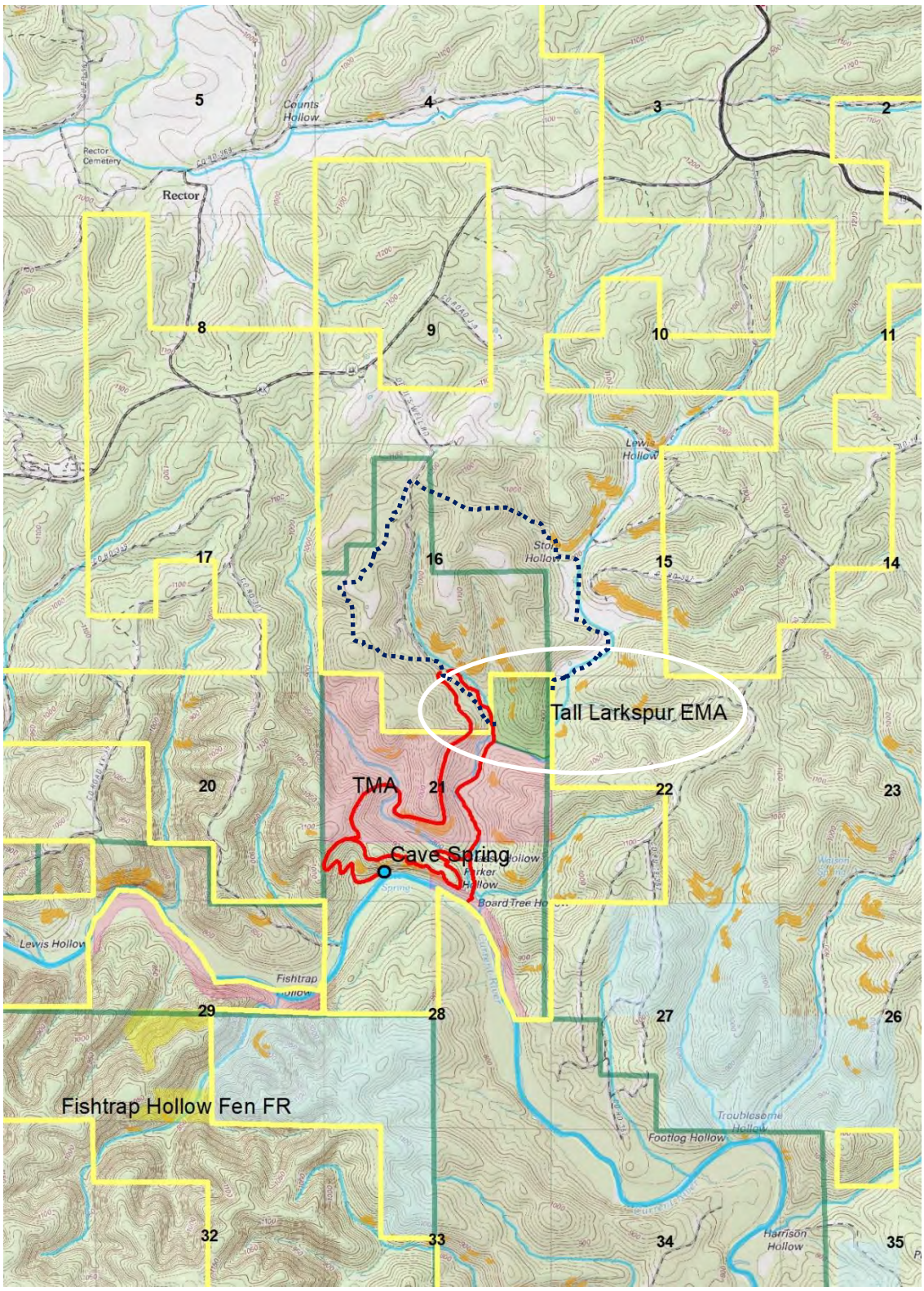
Recreation: Hiking loop trail system from Devil's Well to Cave Spring has moderate use and a portion of that trail serves as a prescribed fire line.

Partners: National Park Service in prescribed fire management, monitoring, and land ownership.

Above, photo of tall larkspur in bloom, above right is monitoring work to determine population size in response to prescribed fire, and below right is a more open dolomite glade established through a combination of stewardship practices.
PHOTOS BY: Neal Humke



Tall Larkspur Ecological Management Area near Welch Lodge; there are 37 acres of Pioneer Forest (highlighted in light green) within a larger 197-acre project area (outlined in dark-blue dotted line) under collaborative management by L-A-D Foundation/Pioneer Forest and Ozark National Scenic Riverways.



Tall Larkspur Ecological Management Area near Devils Well and Cave Spring, 48 acres of Pioneer Forest (shaded light green) within a 438-acre project (outlined by dark-blue dotted line), which includes lands of ONSR and another private landowner. The Cave Spring Trail is delineated by the red line.

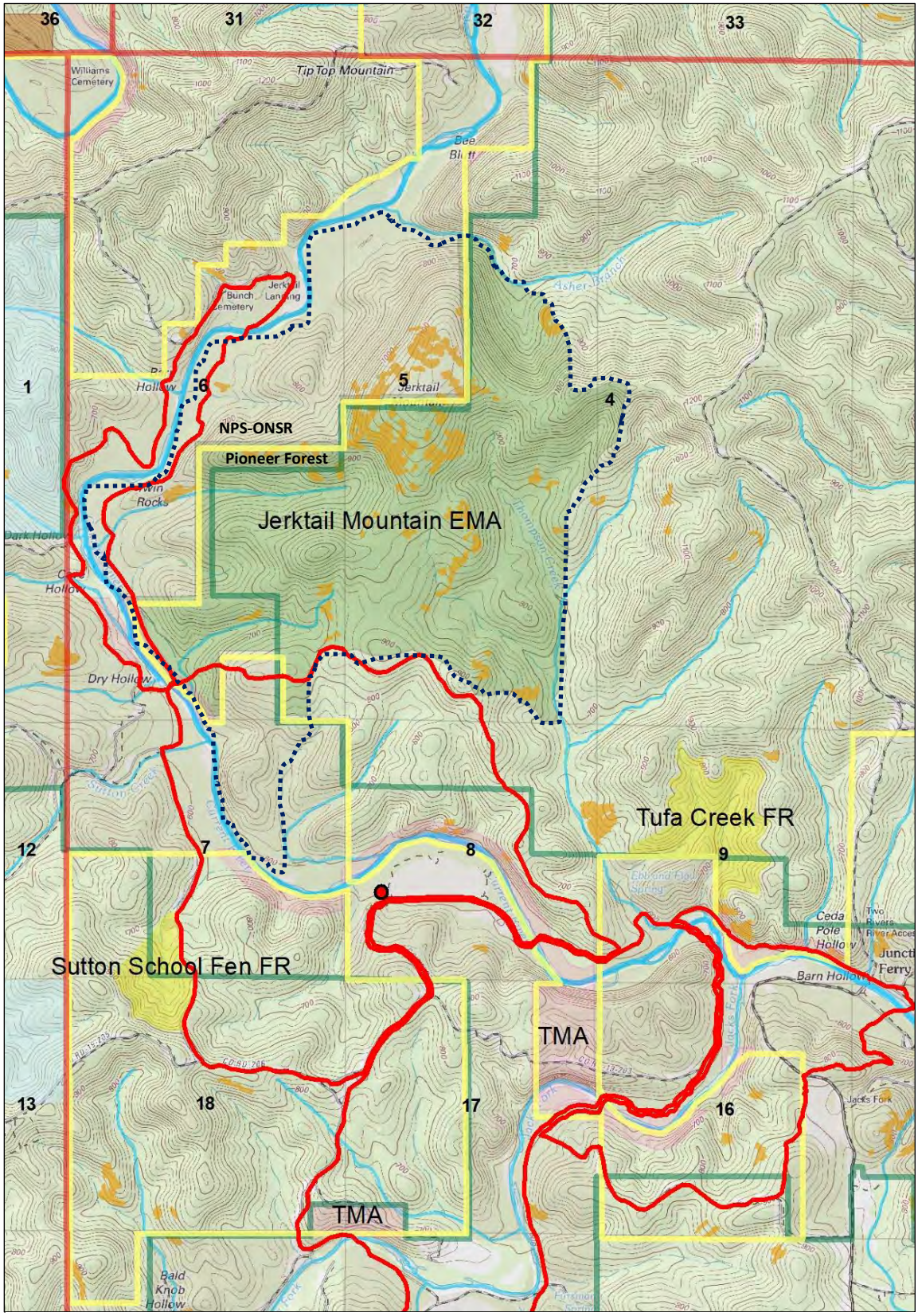
Jerktail Mountain Glades and Woodlands Ecological Management Area, Shannon County, Total Area of Pioneer Forest 1159 acres with an adjoining 678 acres owned by NPS-Ozark National Scenic Riverways) as part of a combined and jointly managed unit (1837 acres) located in Sections 4, 5, 6, and 7 T29N, R3W.

Description and target for management: Igneous (rhyolite) and dolomite glades and woodlands. Jerktail Mt. is one of several 1.6-billion-year-old rhyolite knobs found in the Current River area. Due to the varied geology of this site a rich array of natural communities exists. Fire management started in 2015. Numerous archeological sites, cemeteries, and copper and tiff mines are found here and were documented on both NPS and Pioneer land prior to management. There are county roads and designated NPS equestrian trails in the area. Threats include lack of appropriate fire, encroachment of red cedar and hardwood, damages from feral hogs, exotic invasive plants, and unauthorized vehicle and equestrian use. Black bear and mountain lion evidence has been confirmed from the area and a mountain lion was photographed at Two Rivers less than a mile away.

Timber Management Goals: Timber quality varies greatly within this unit. A marking plan was developed in 2015 related to aspect which targeted removal of fire-intolerant species. Future harvest could be used to help restore desired basal area.

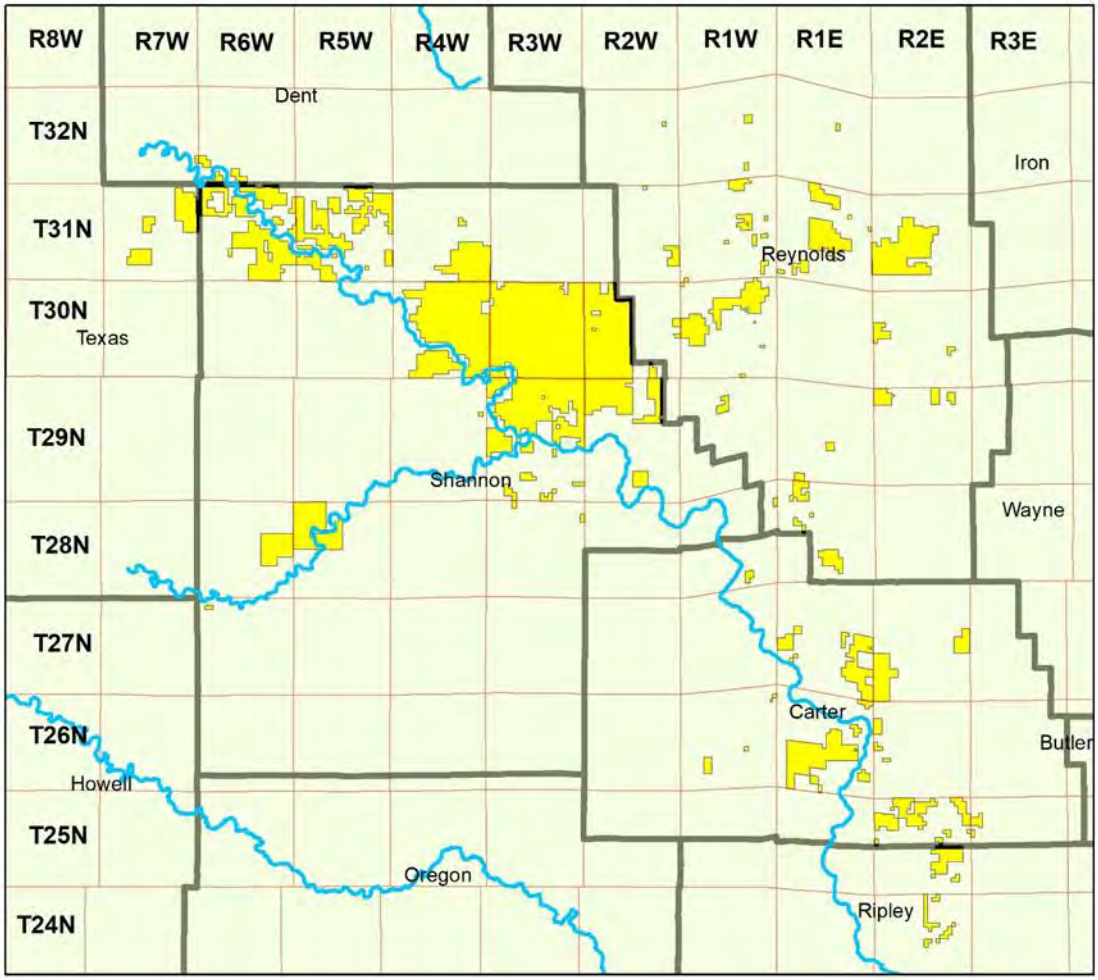
Partners: National Park Service in fire management, vegetation monitoring and land ownership. Funding and assistance has been received from the Wildlife Conservation Society and NRCS.

Monitoring: National Park Service is the lead with vegetation monitoring. L-A-D assists and has hired botanical contractors.



FOOTNOTE: 678 acres of NPS ownership joins Pioneer Forest (shaded above) to the southwest and west along the Current River, with Asher Branch as the northern boundary. The management unit is delineated by the dark-blue dotted line.

Township Maps, Pioneer Forest LLC

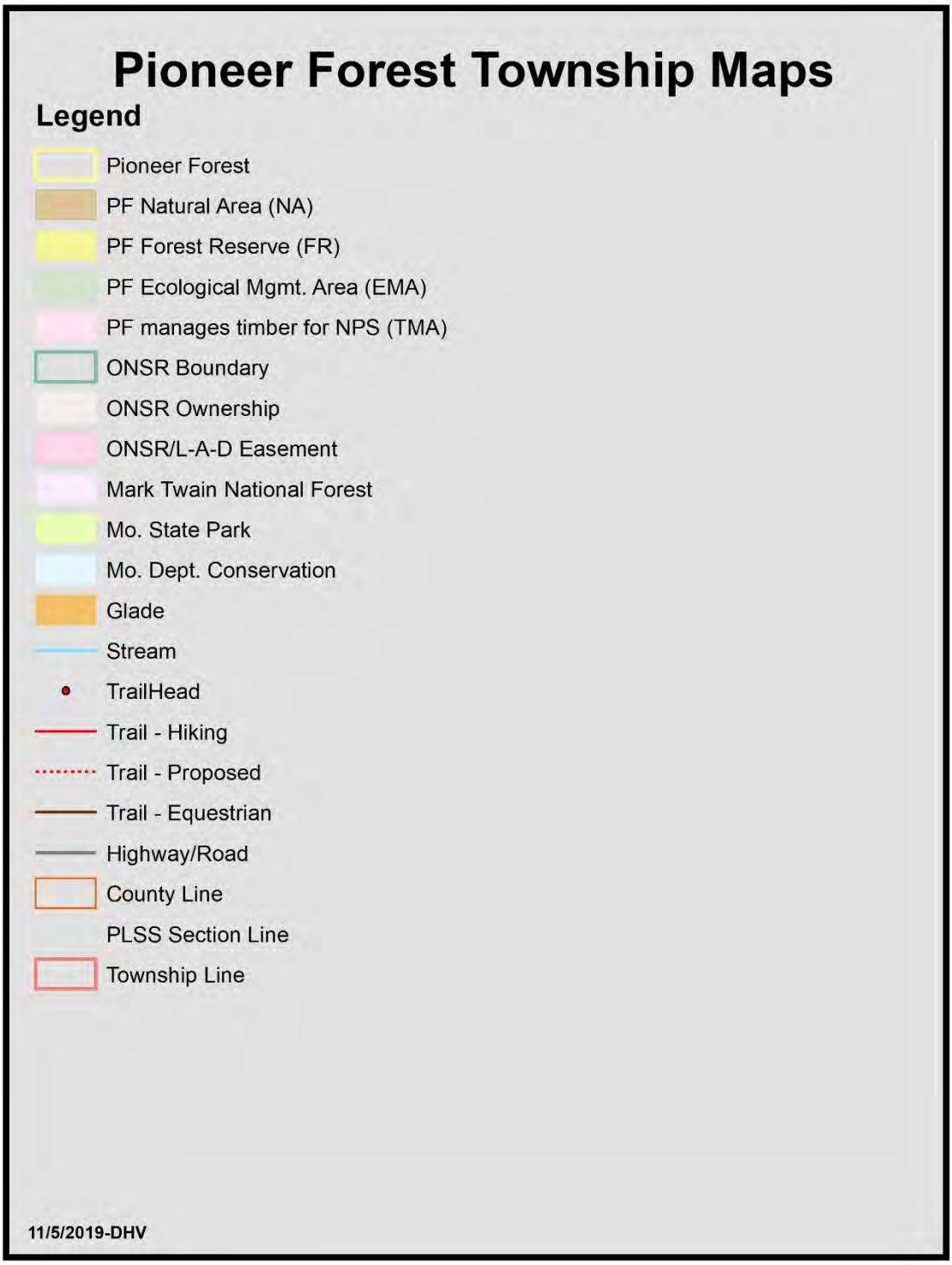


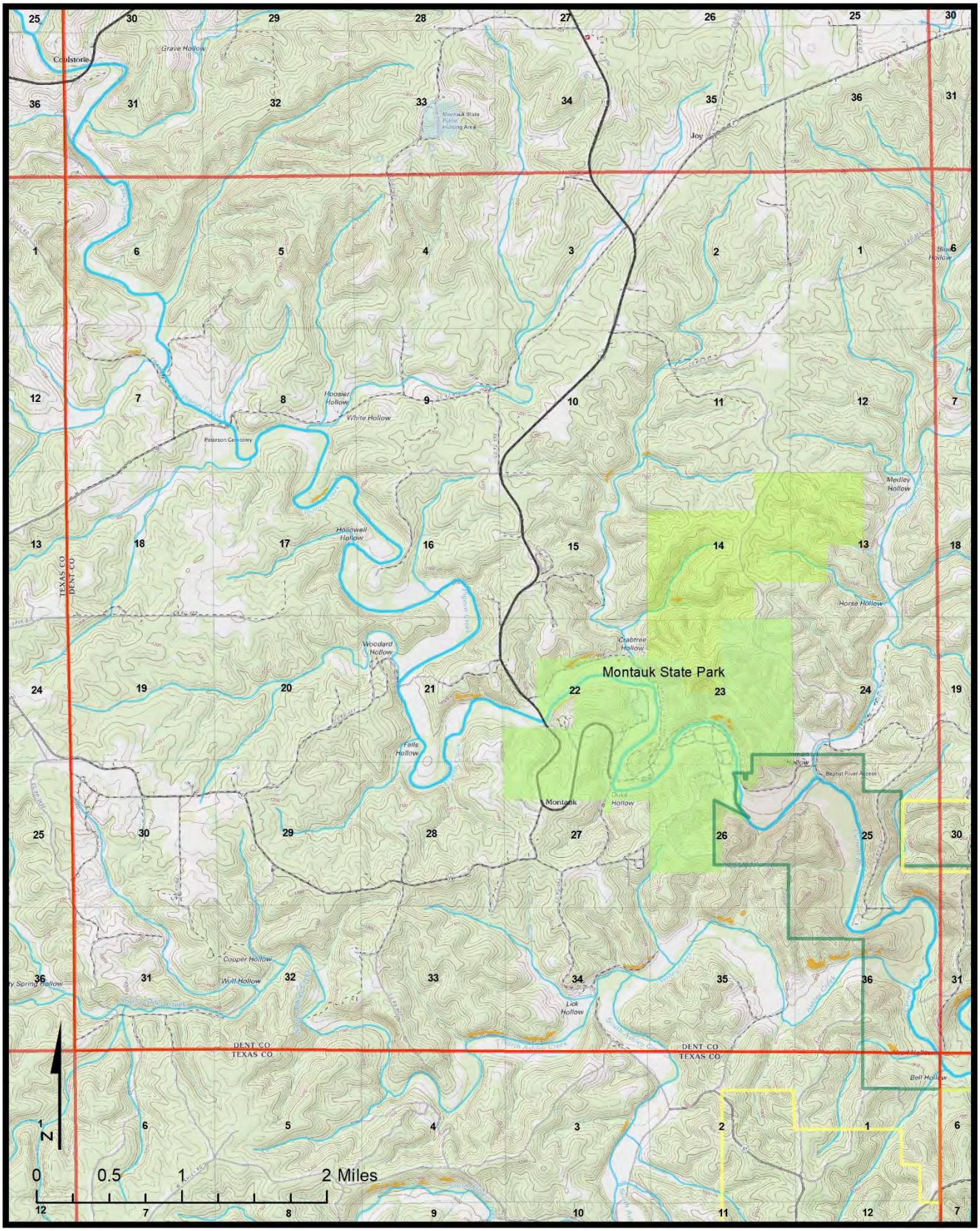
Township Locator Map

Legend

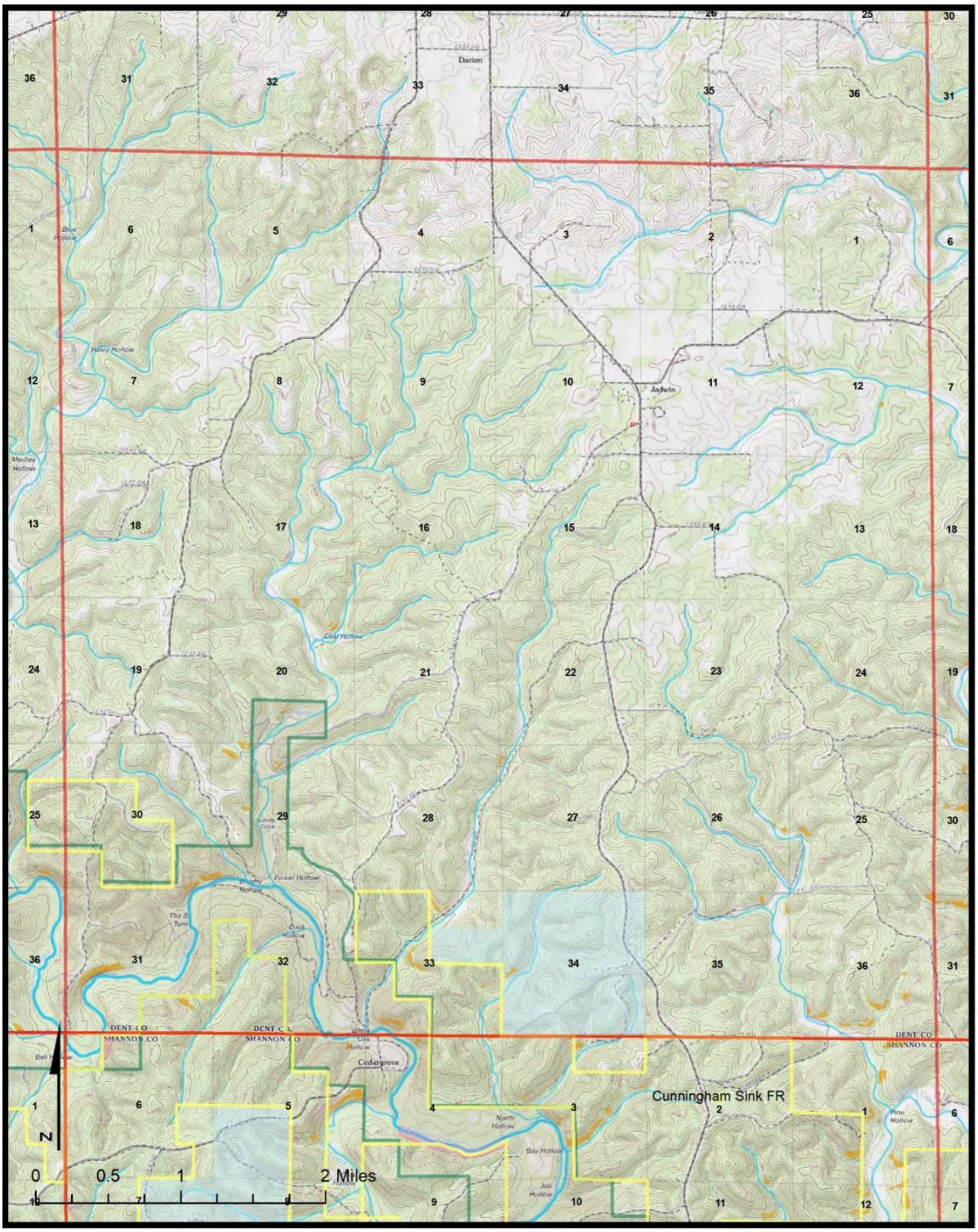
Pioneer Forest

Township

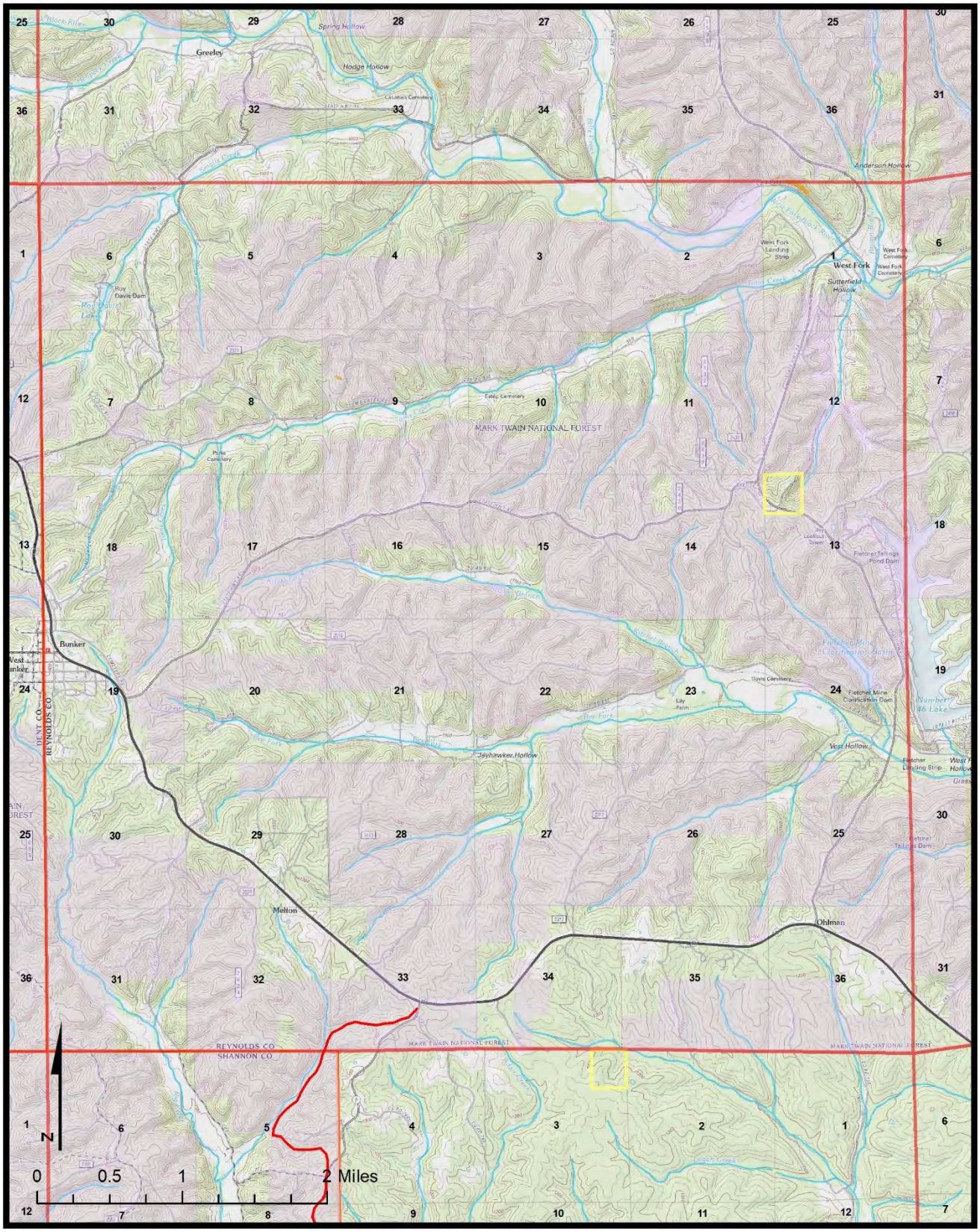

Pioneer Forest Township Maps
Legend
Pioneer Forest
PF Natural Area (NA)
PF Forest Reserve (FR)
PF Ecological Mgmt. Area (EMA)
PF manages timber for NPS (TMA)
ONSR Boundary
ONSR Ownership
ONSR/L-A-D Easement
Mark Twain National Forest
Mo. State Park
Mo. Dept. Conservation
Glade
Stream
TrailHead
Trail - Hiking
Trail - Proposed
Trail - Equestrian
Highway/Road
County Line
PLSS Section Line
Township Line
11/5/2019-DHV



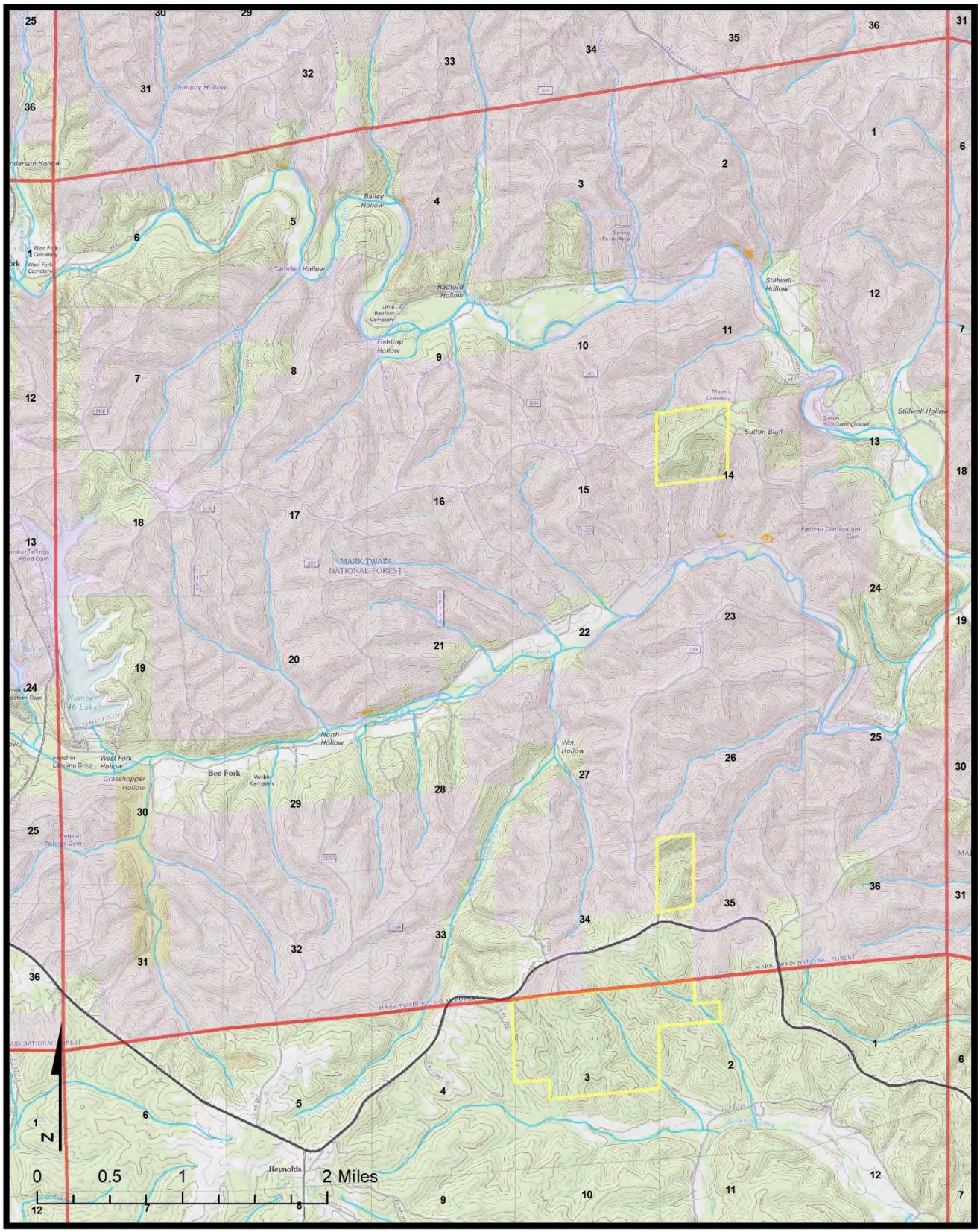
Pioneer Forest - T32N/R7W - 9/30/19 DHV



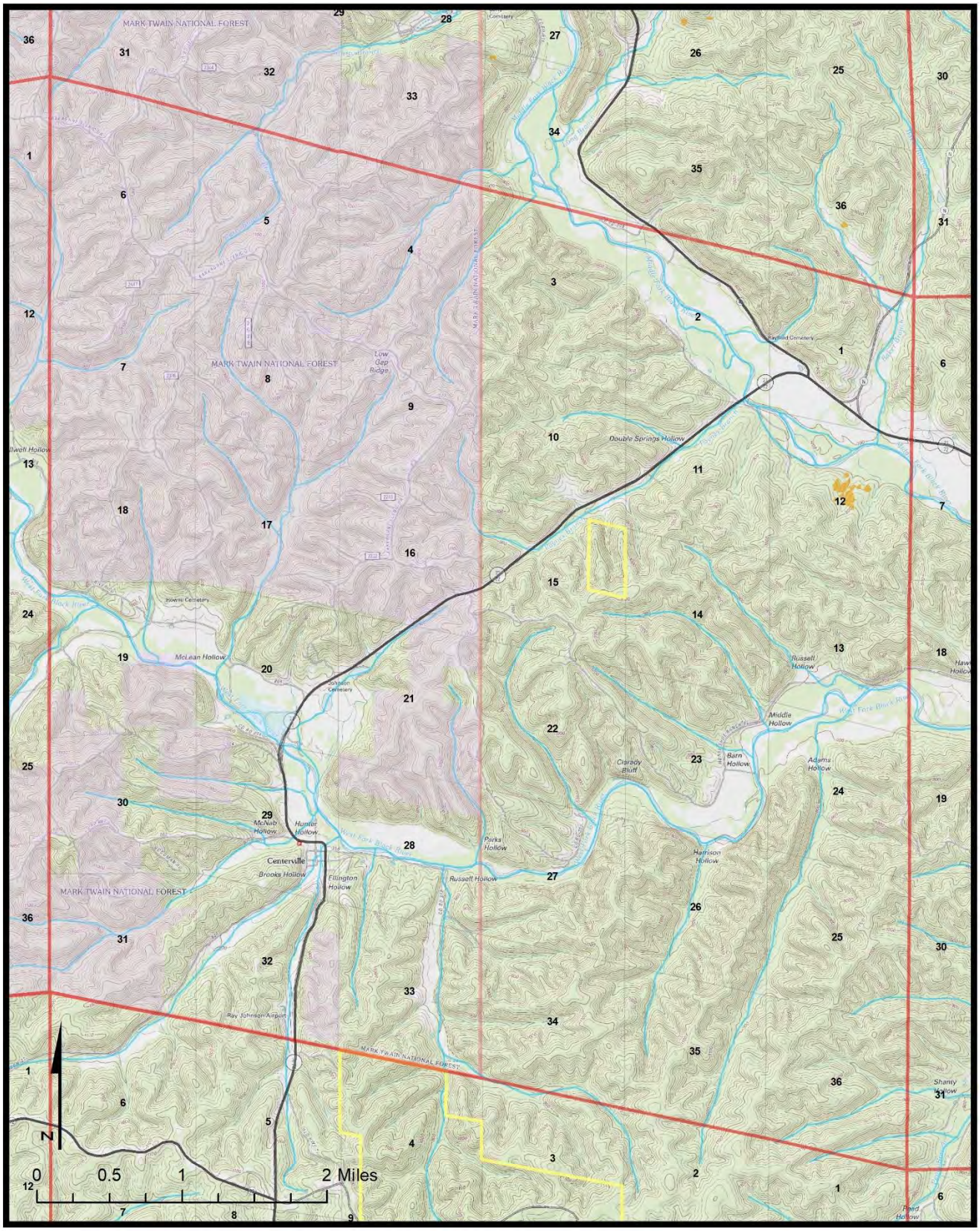
Pioneer Forest - T32N/R6W - 9/30/19 DHV



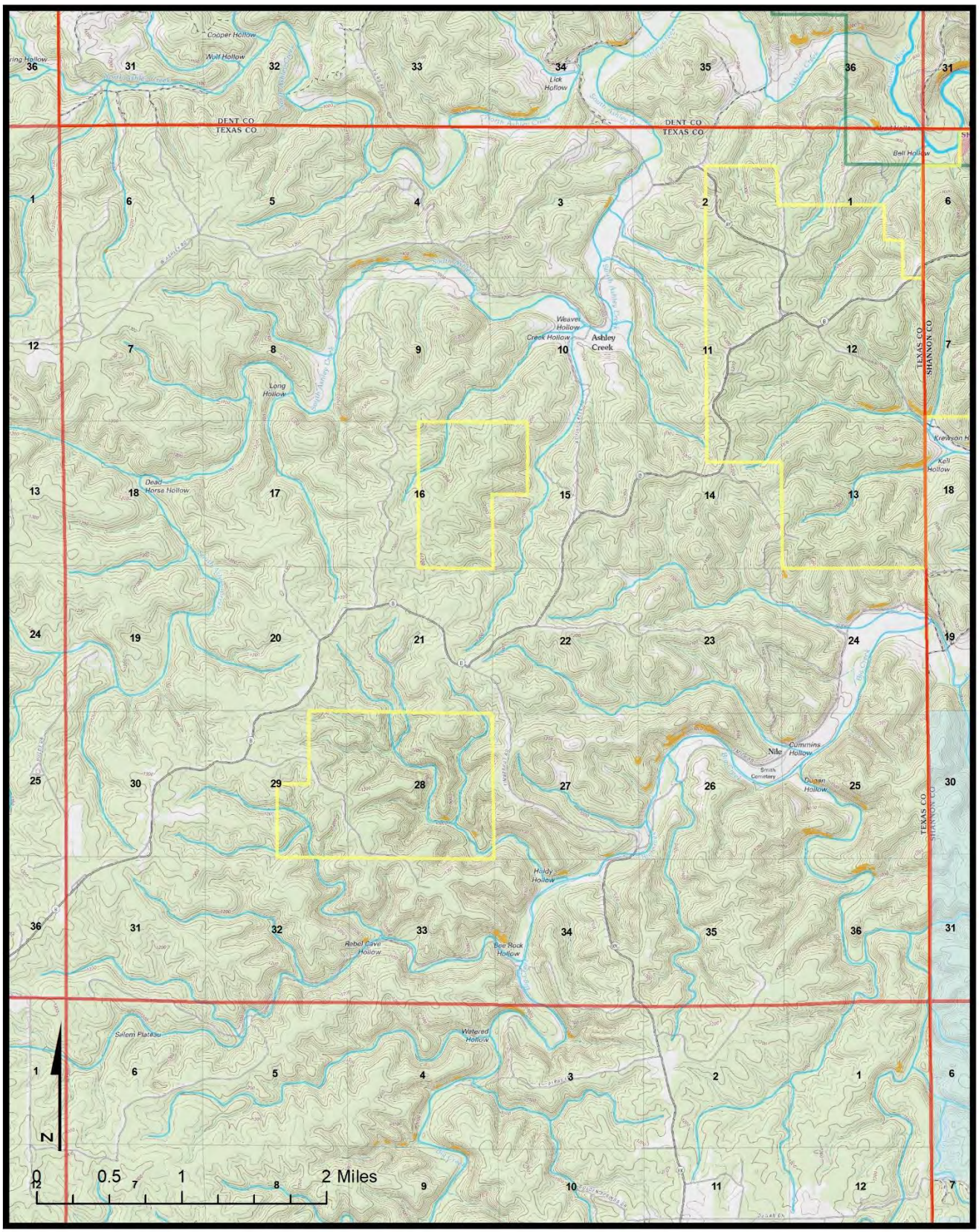
Pioneer Forest - T32N/R2W - 9/30/19 DHV



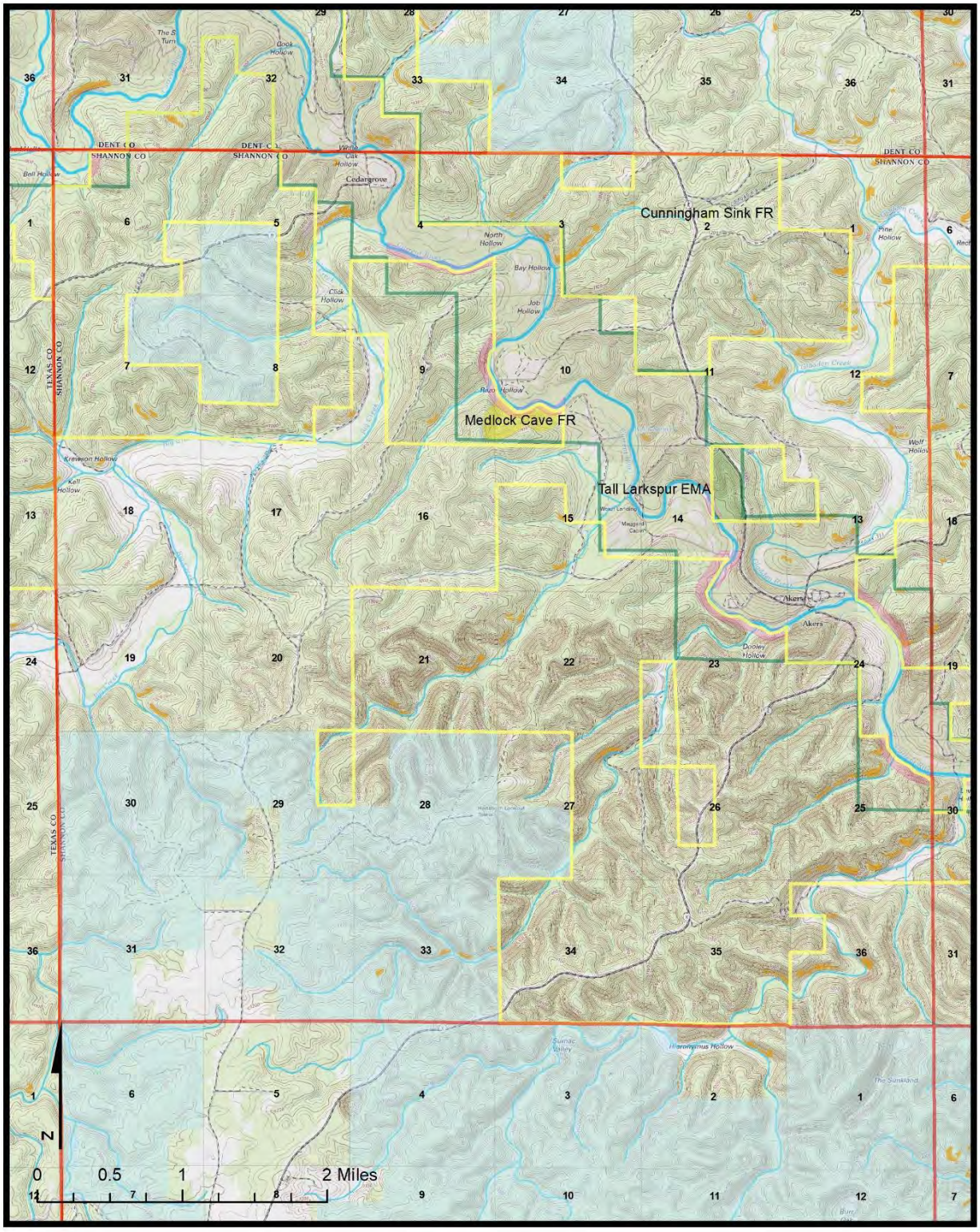
Pioneer Forest - T32N/R1W - 9/30/19 DHV



Pioneer Forest - T32N/R1E - 9/30/19 DHV

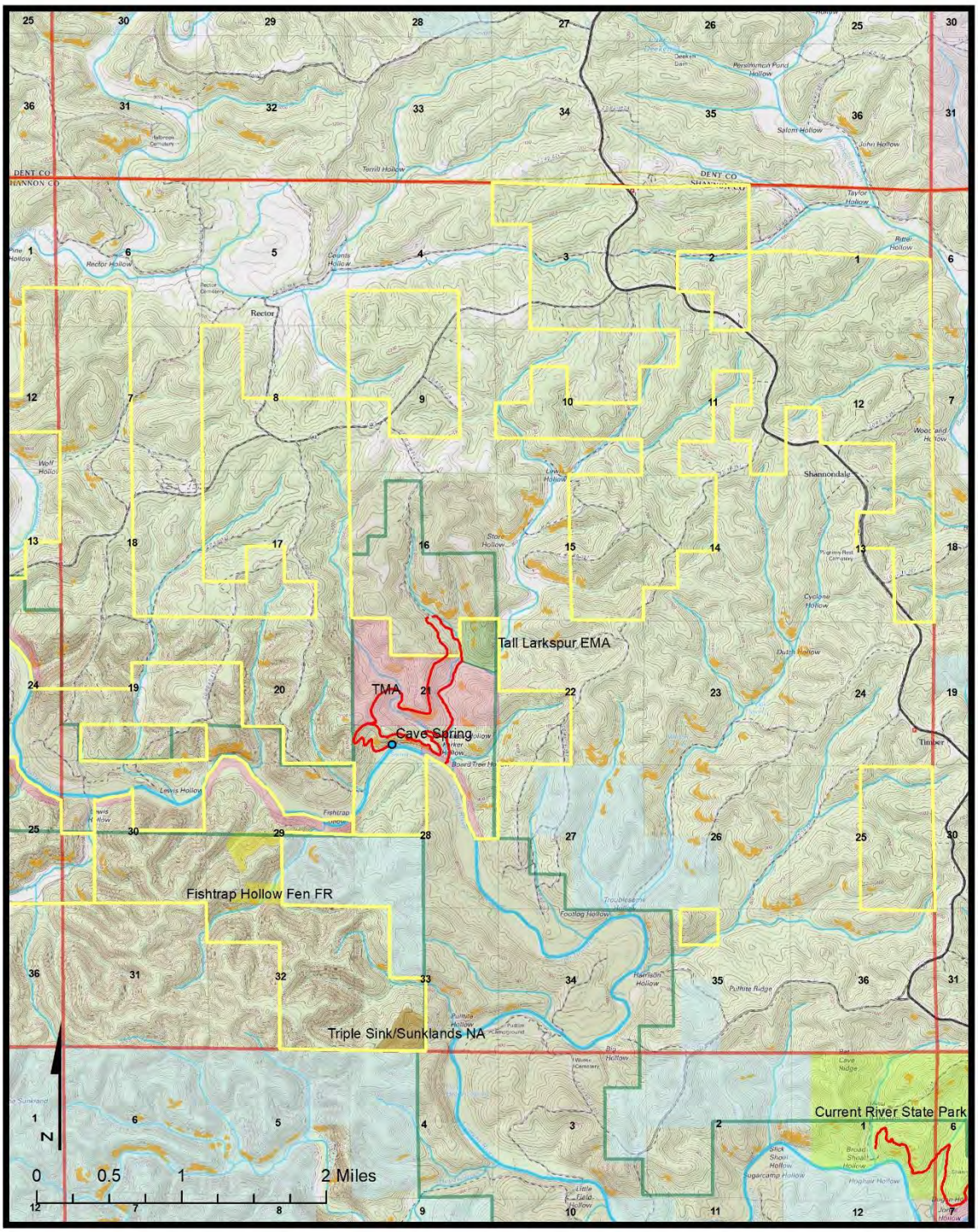


Pioneer Forest - T31N/R7W - 9/30/19 DHV



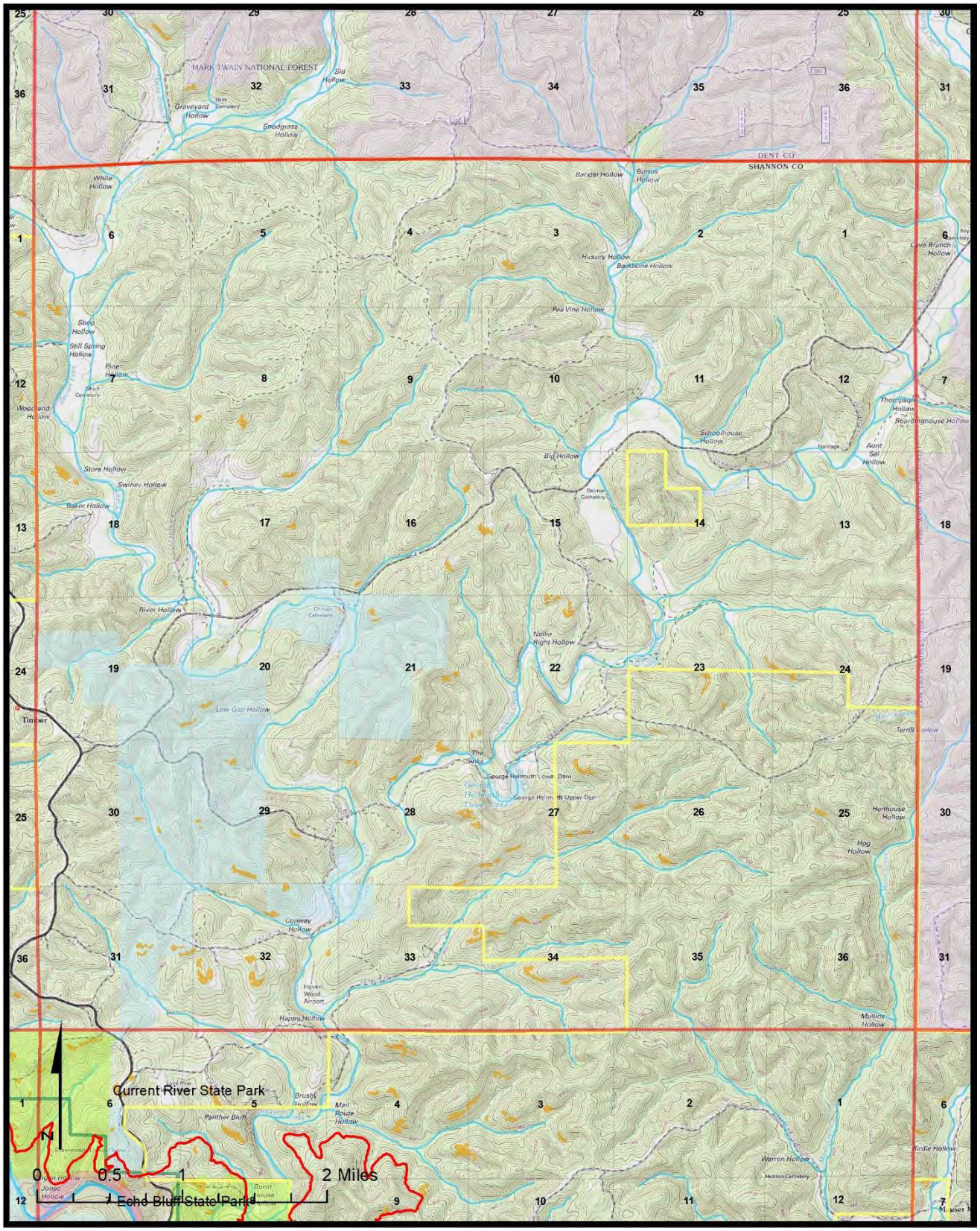
Pioneer Forest - T31N/R6W - 10/21/19 DHV

FOOTNOTE: In 1970 Leo and Kay Drey deeded to NPS-ONSR an easement to preserve scenic values on certain lands they owned in Carter and Shannon counties and within 300 feet of the ordinary low water mark of the Current and Jacks Fork Rivers. In 1974 the Dreys deeded these lands to the L-A-D Foundation. Shown here are river corridor lands in Shannon County in Sections 4 and 6 T31N R6W. Other easement lands are shown on the following township maps.

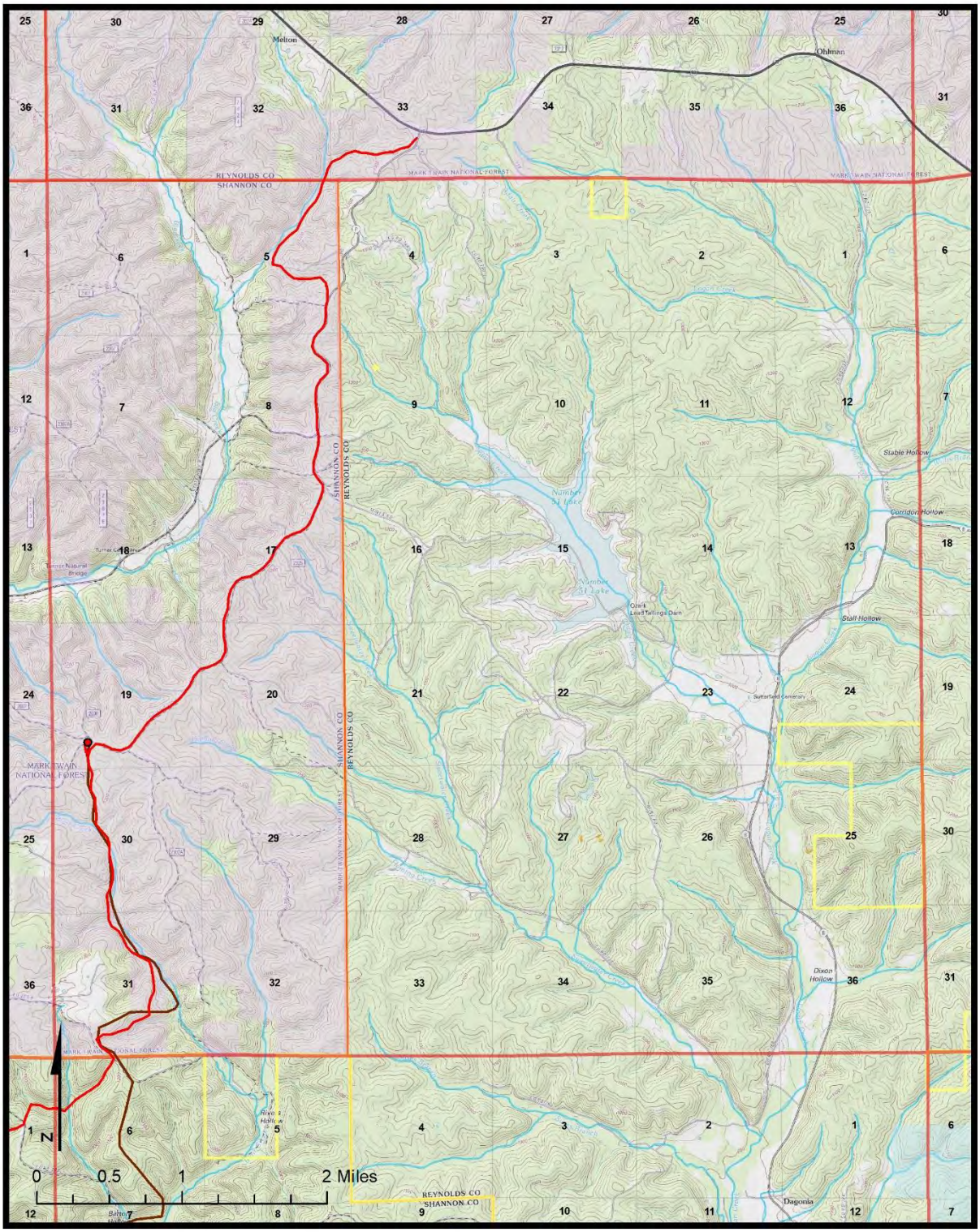


Pioneer Forest - T31N/R5W - 10/21/19 DHV

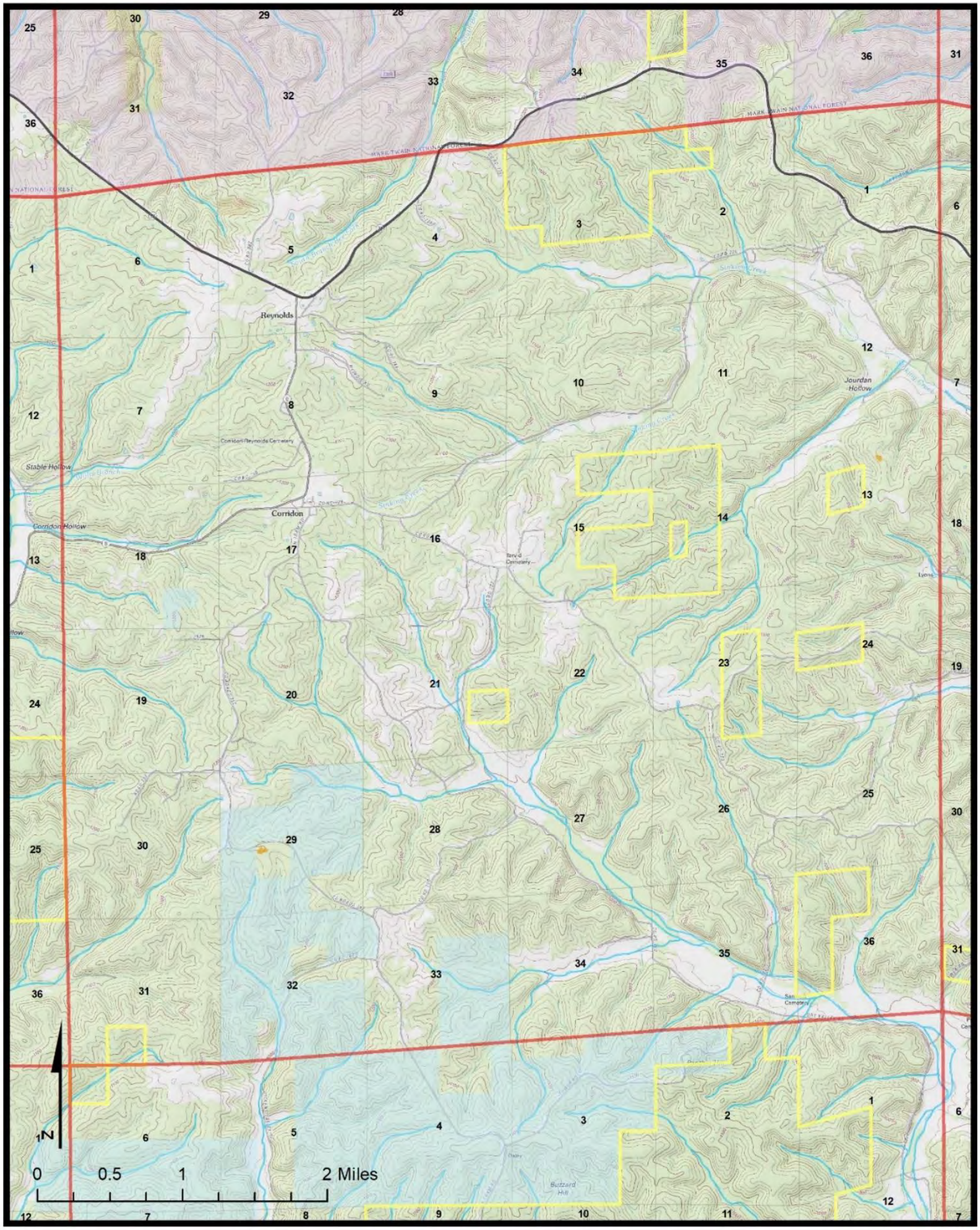
FOOTNOTES: A 1976 scenic easement deed granted to NPS-ONSR provided the right to certain restrictions regarding timber management on Pioneer Forest land within the national park (shaded here in pink; 369.70 acres in Section 21, T31N R5W). This agreement also includes a trail route in this same section reserved for future development. Subsequently, L-A-D and ONSR worked together to complete the Cave Spring Trail shown here in red line.



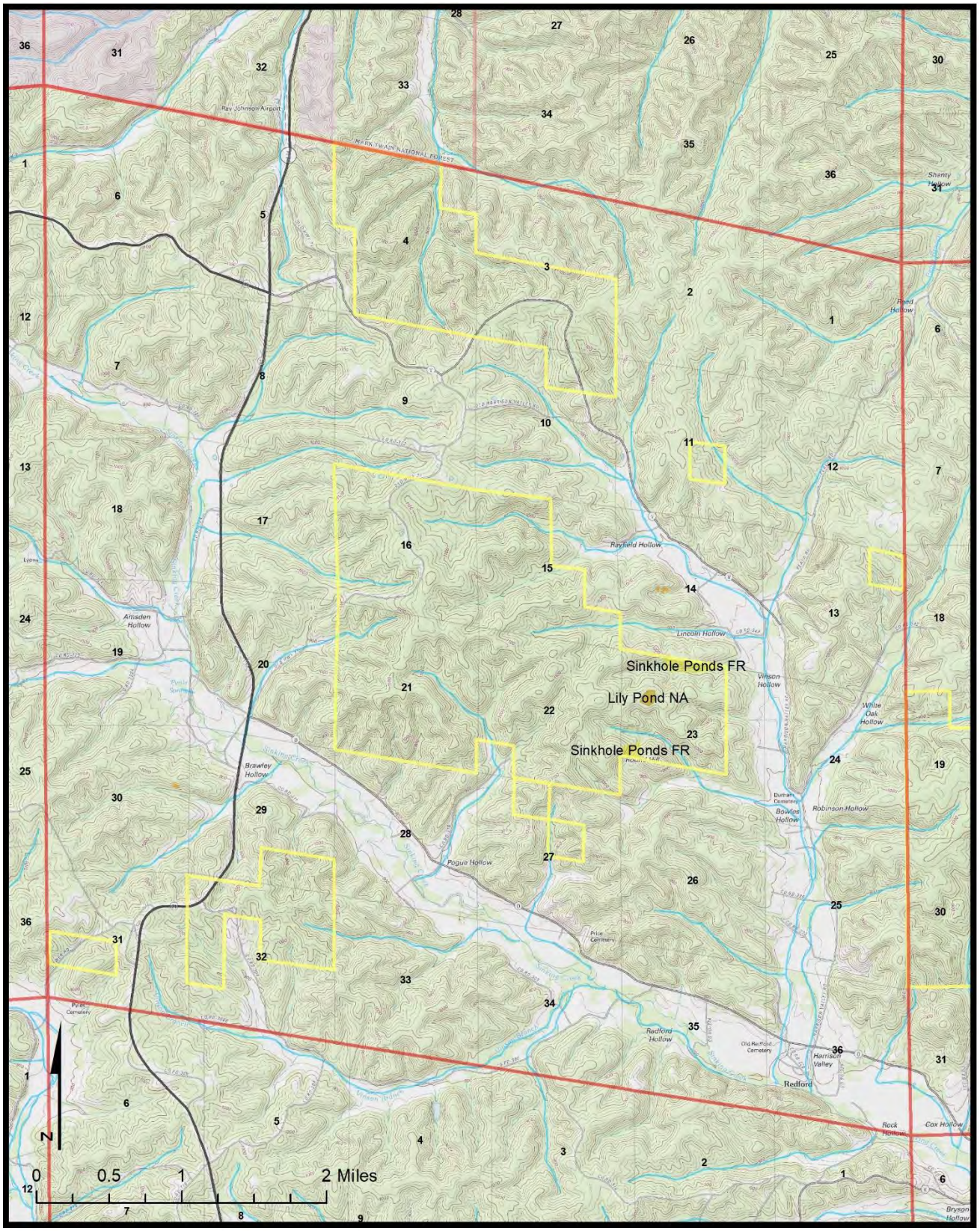
Pioneer Forest - T31N/R4W - 9/30/19 DHV



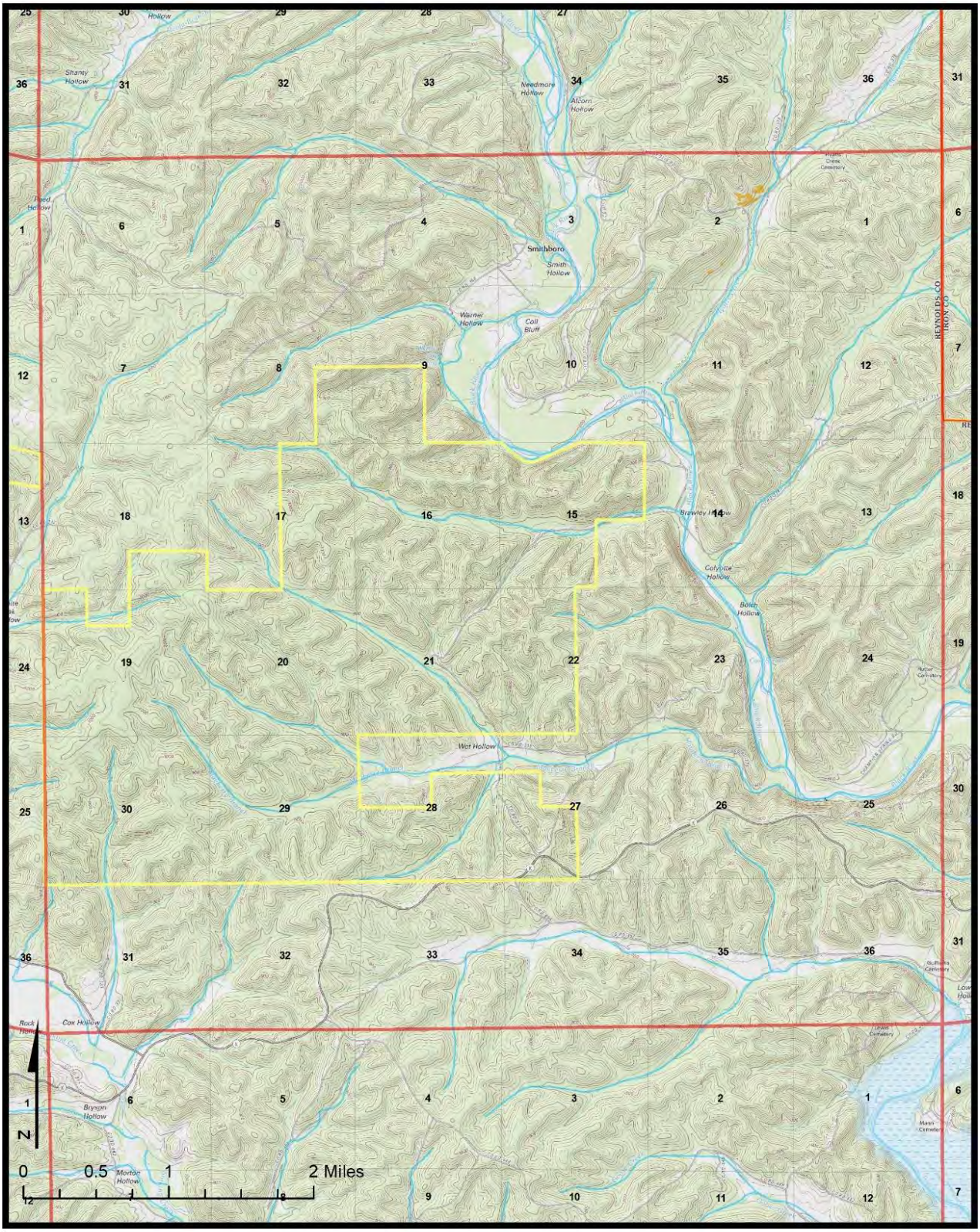
Pioneer Forest - T31N/R2W - 10/21/19 DHV



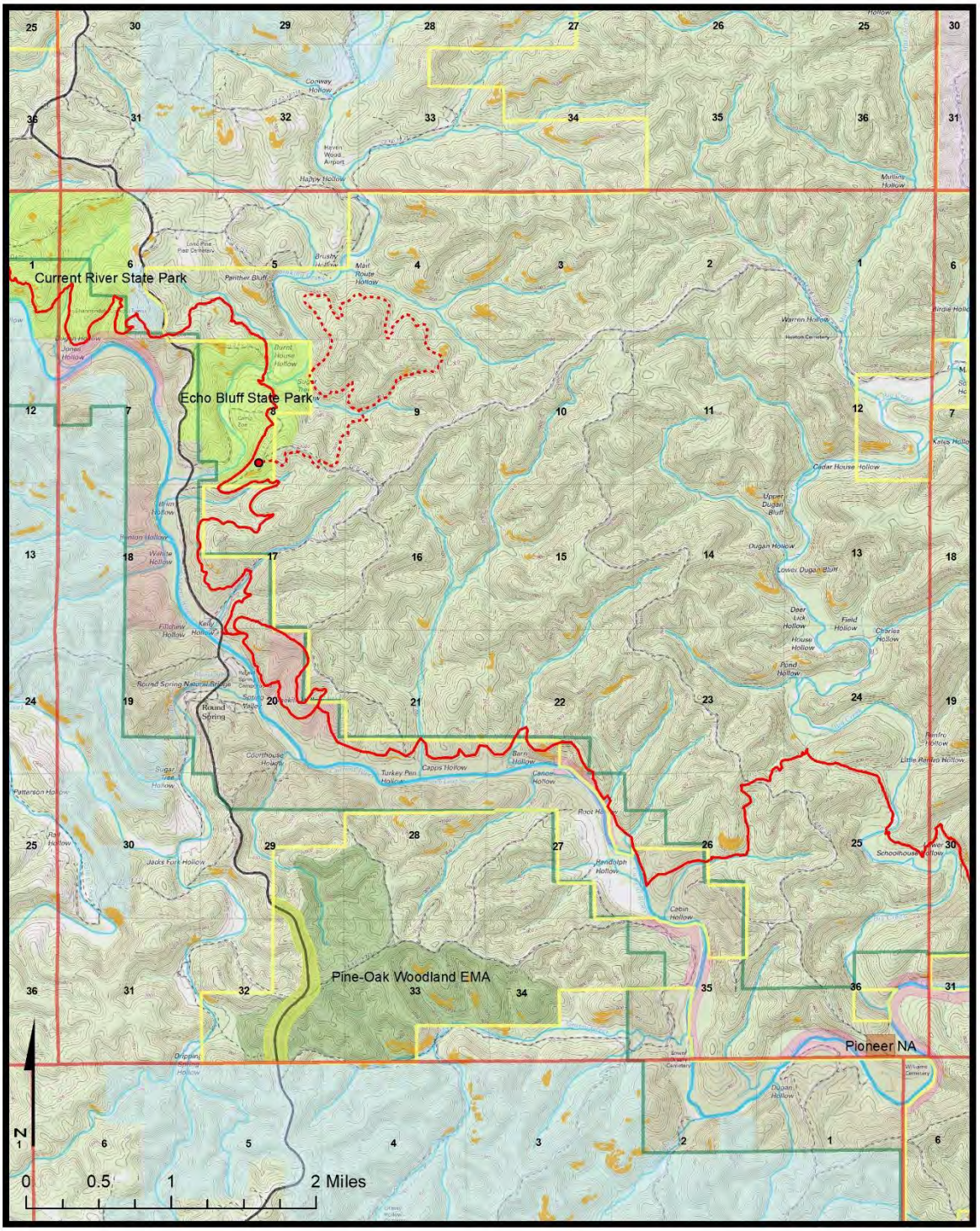
Pioneer Forest - T31N/R1W - 9/30/19 DHV



Pioneer Forest - T31N/R1E - 9/30/19 DHV

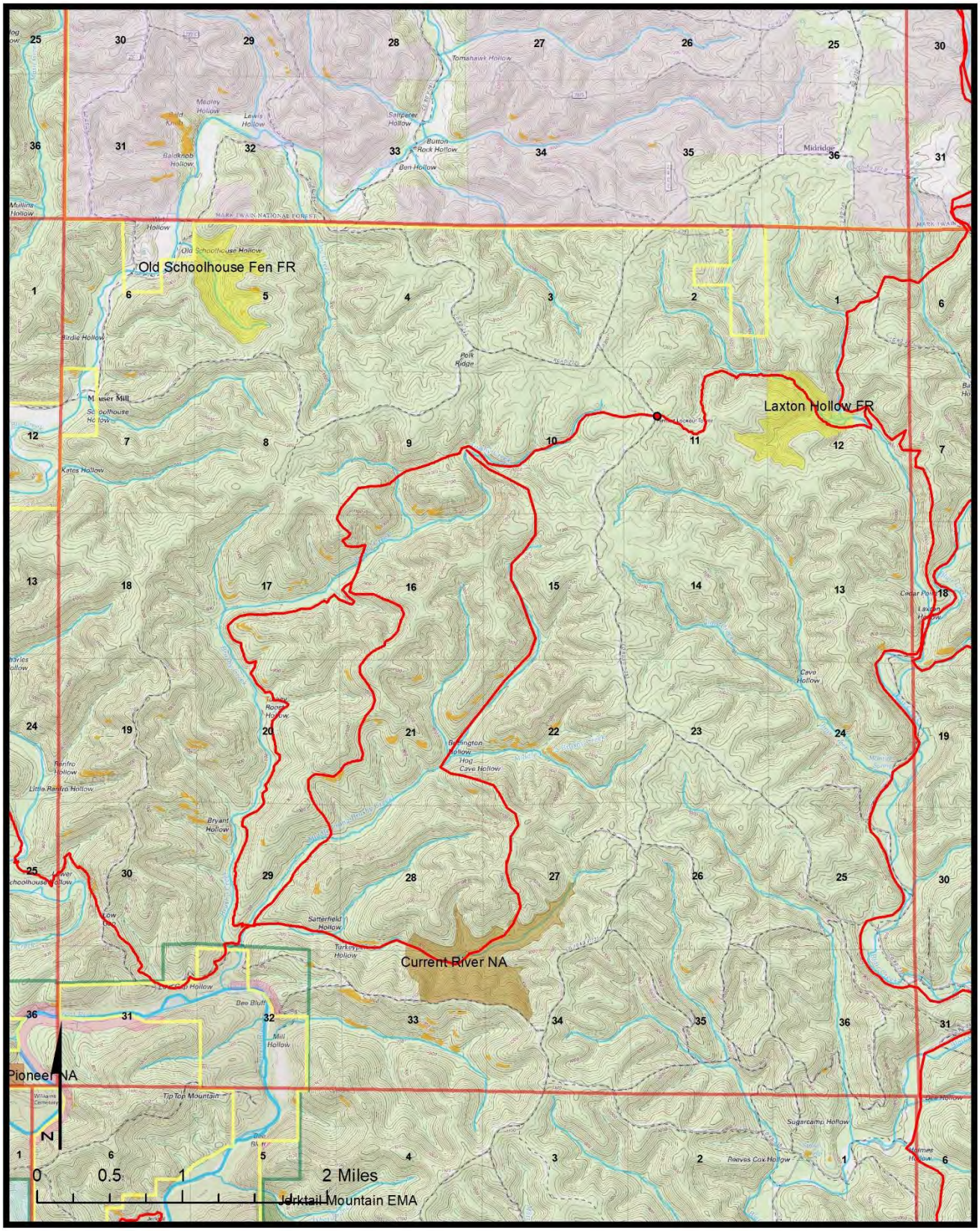


Pioneer Forest - T31N/R2E - 9/12/19 DHV

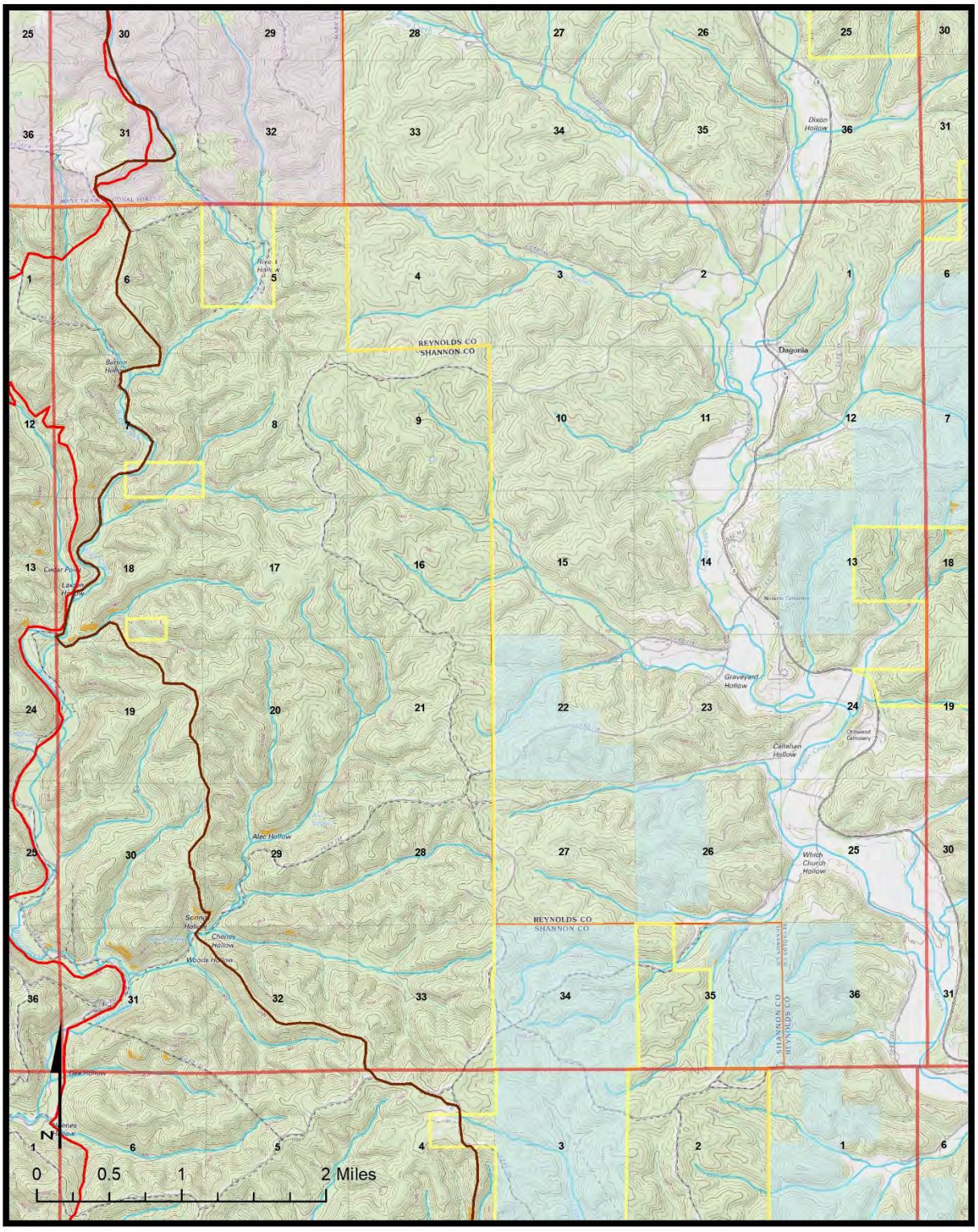


Pioneer Forest - T30N/R4W - 11/5/19 DHV

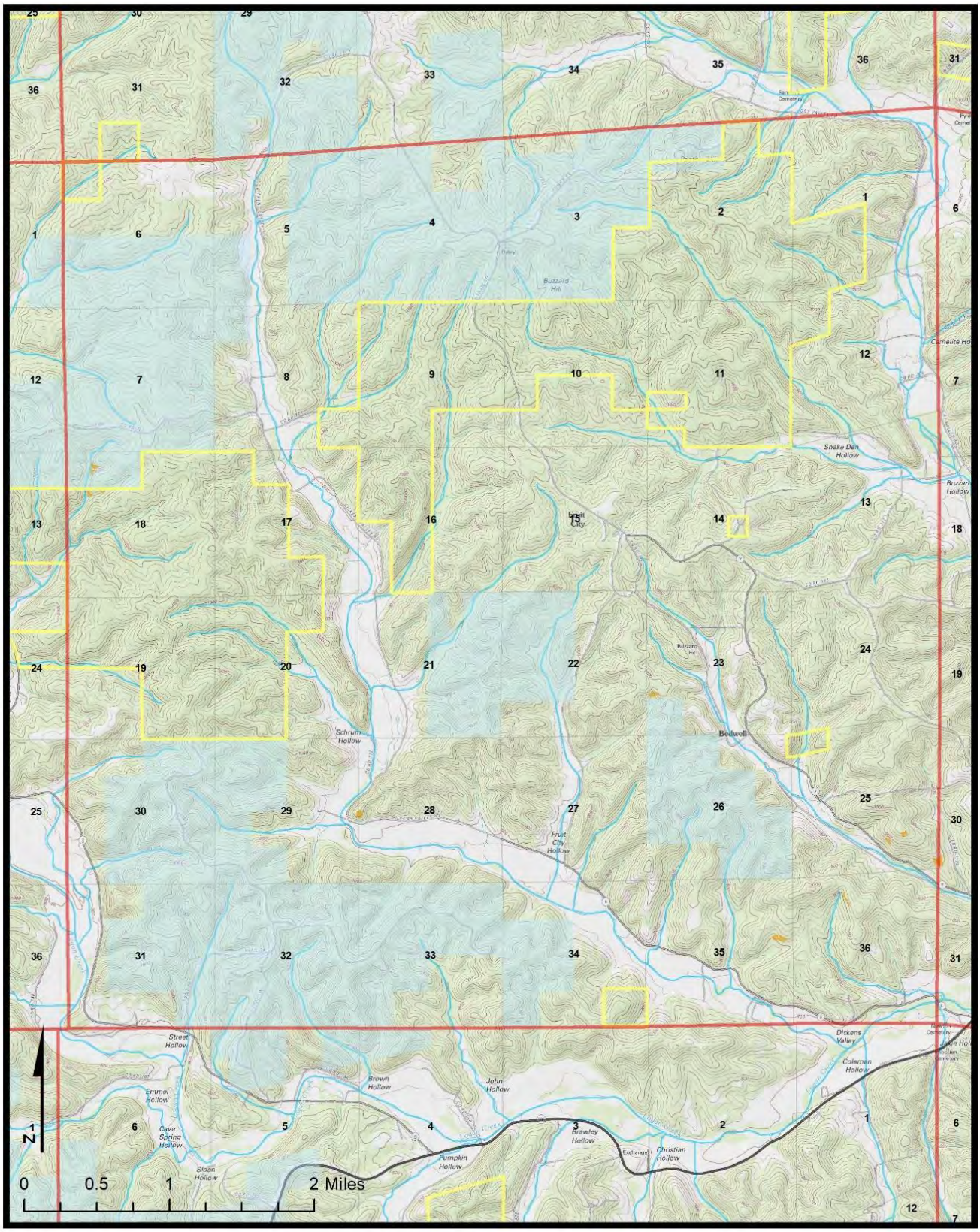
FOOTNOTE: A 1974 scenic easement timber management agreement (TMA) granted Leo Drey the right to harvest timber, under certain restrictions, on 267.09 acres of NPS-owned land in Sections 18 and 20 T30N R4W. That agreement ran for 30 years and was renewed between ONSR and Pioneer Forest LLC in 2004 to remain in effect unless either part notifies the other of its intention to cancel the Agreement.



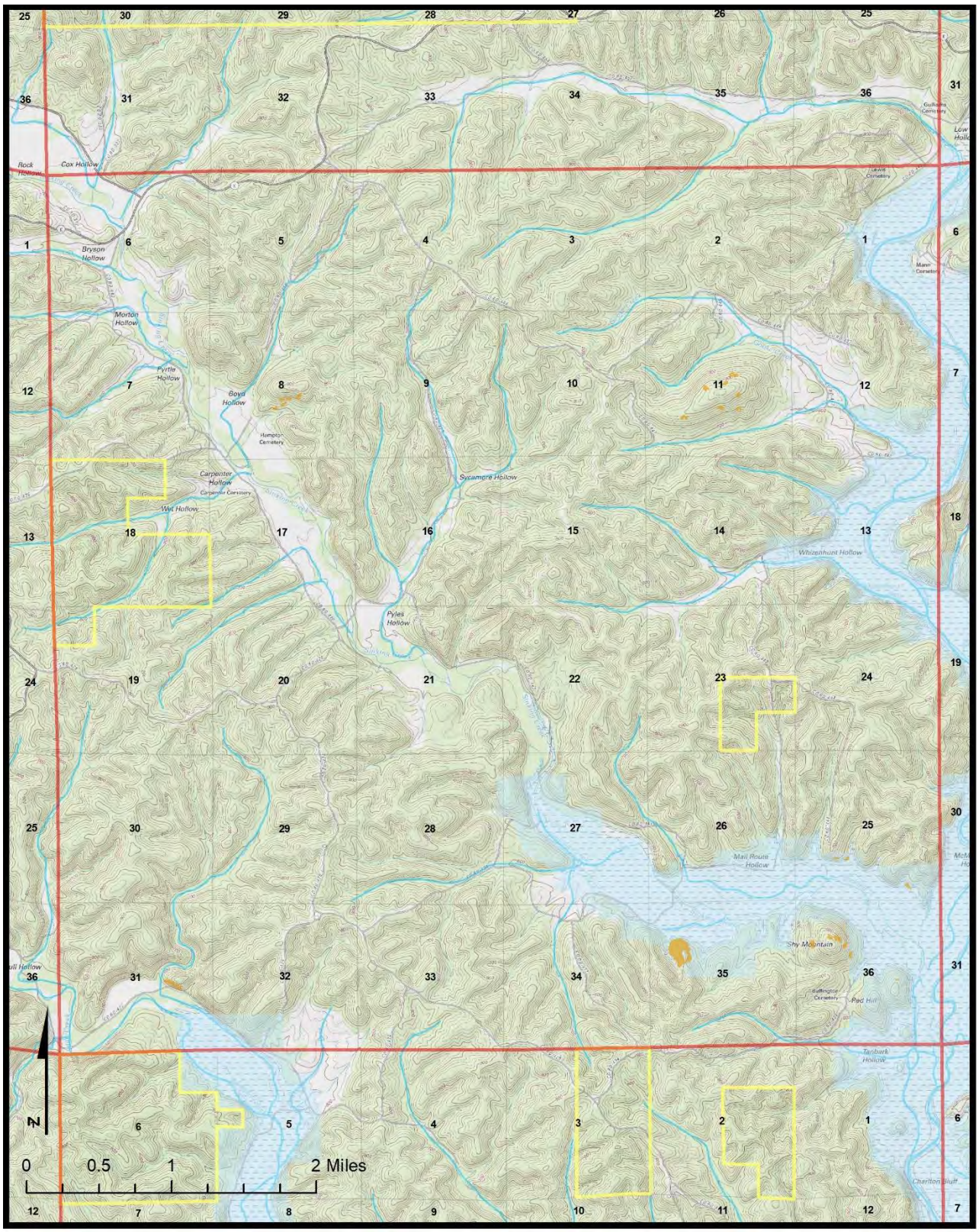
Pioneer Forest - T30N/R3W - 9/12/19 DHV



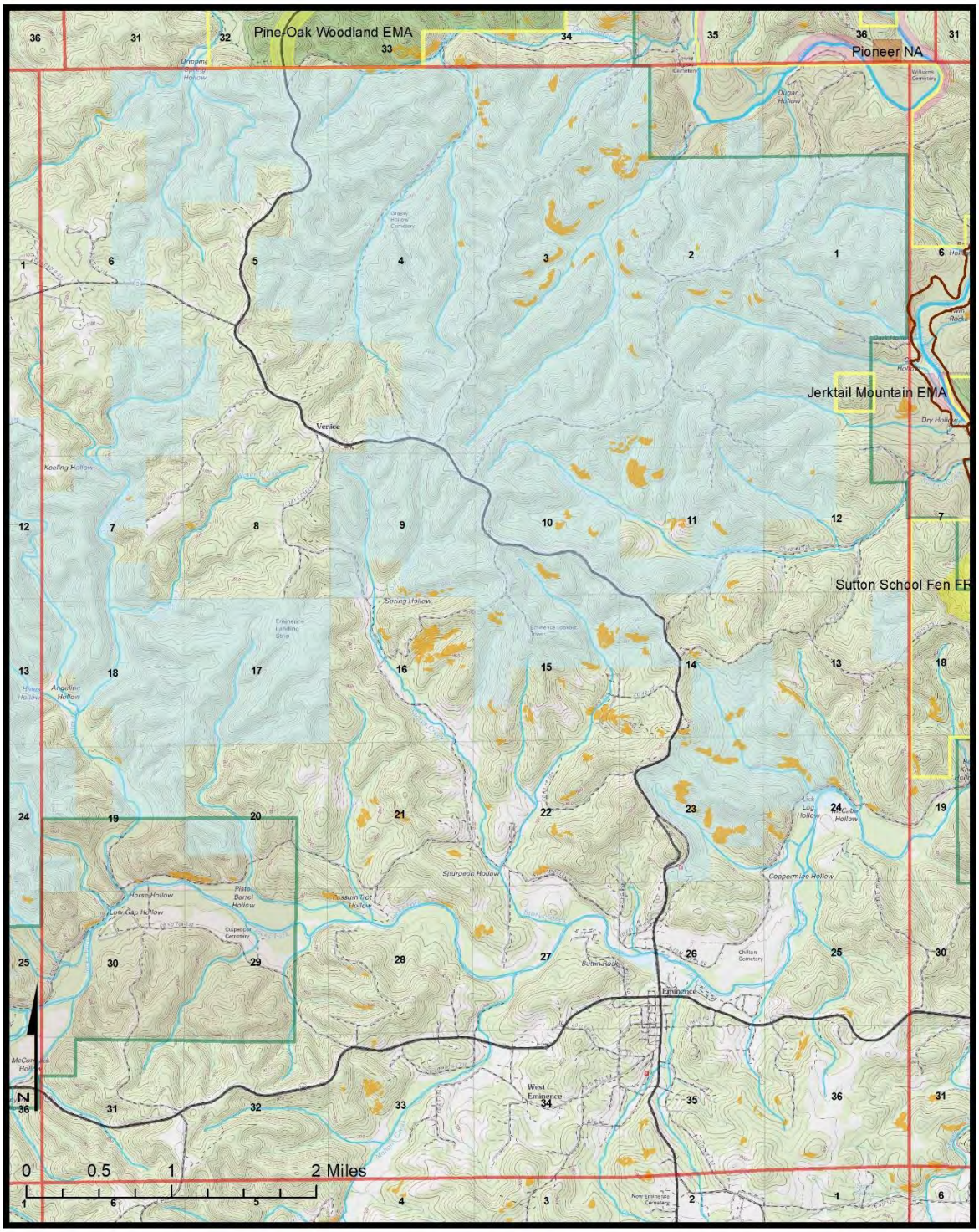
Pioneer Forest - T30N/R2W - 10/21/19 DHV



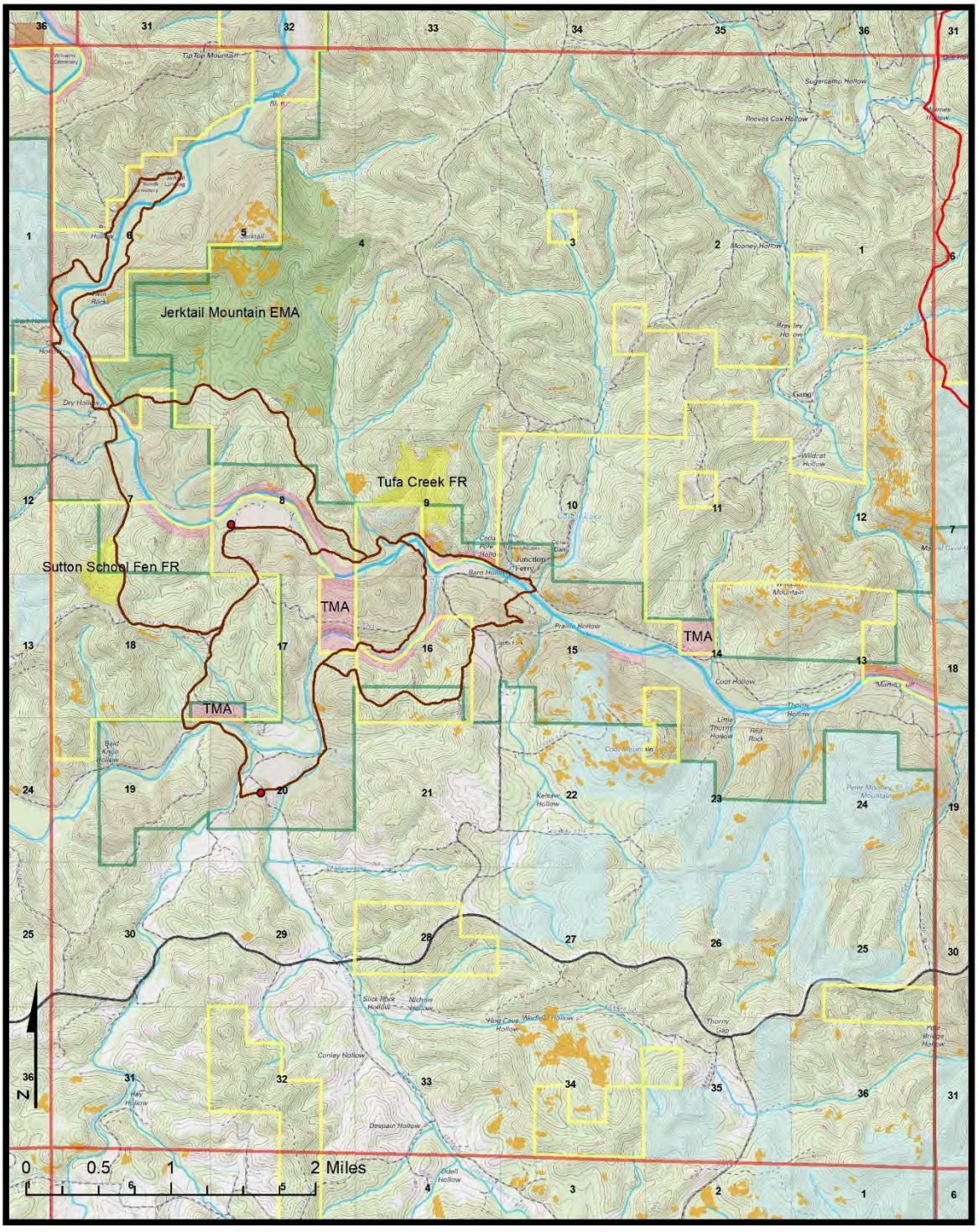
Pioneer Forest - T30N/R1W - 9/12/19 DHV



Pioneer Forest - T30N/R2E - 9/12/19 DHV

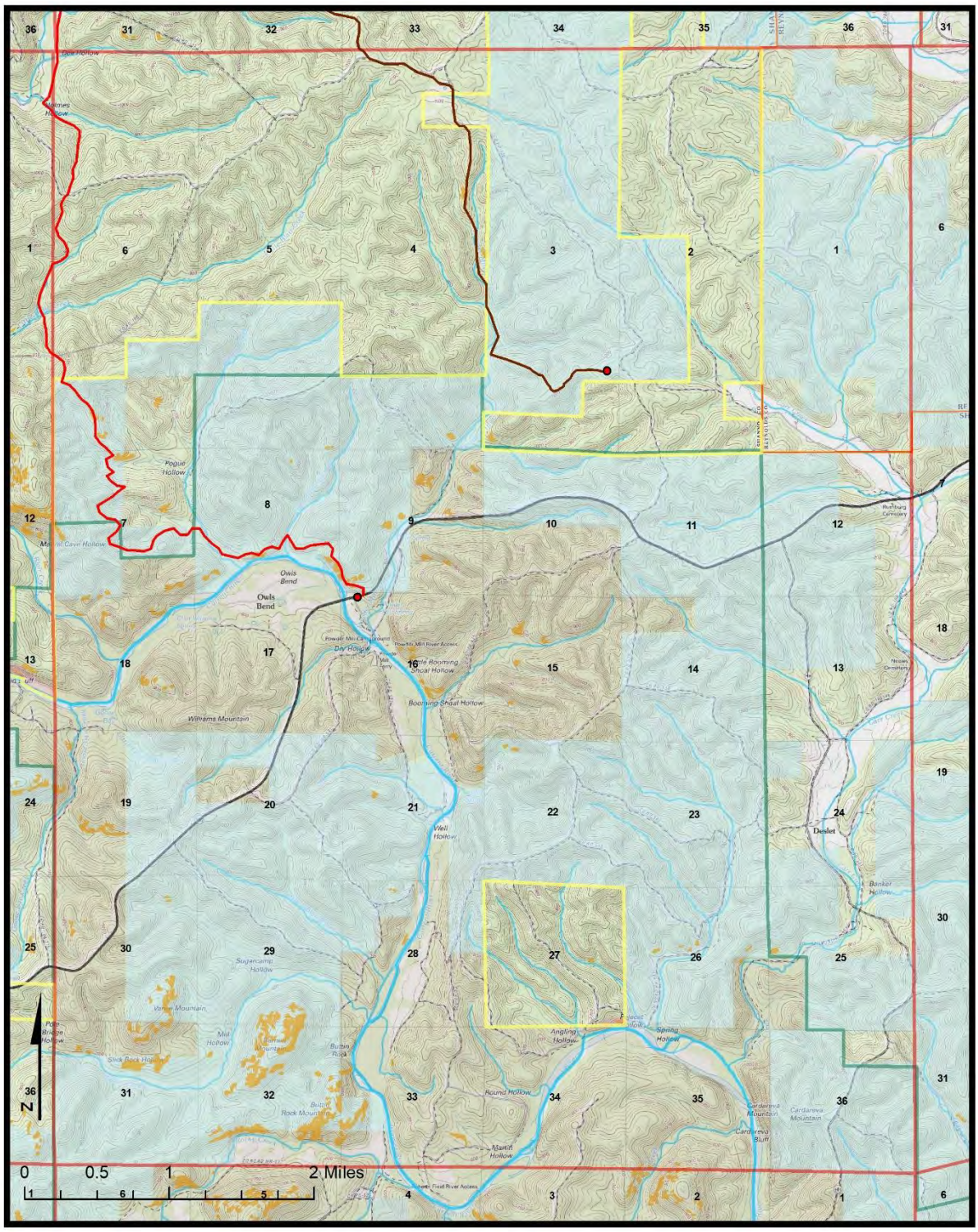


Pioneer Forest - T29N/R4W - 10/30/19 DHV

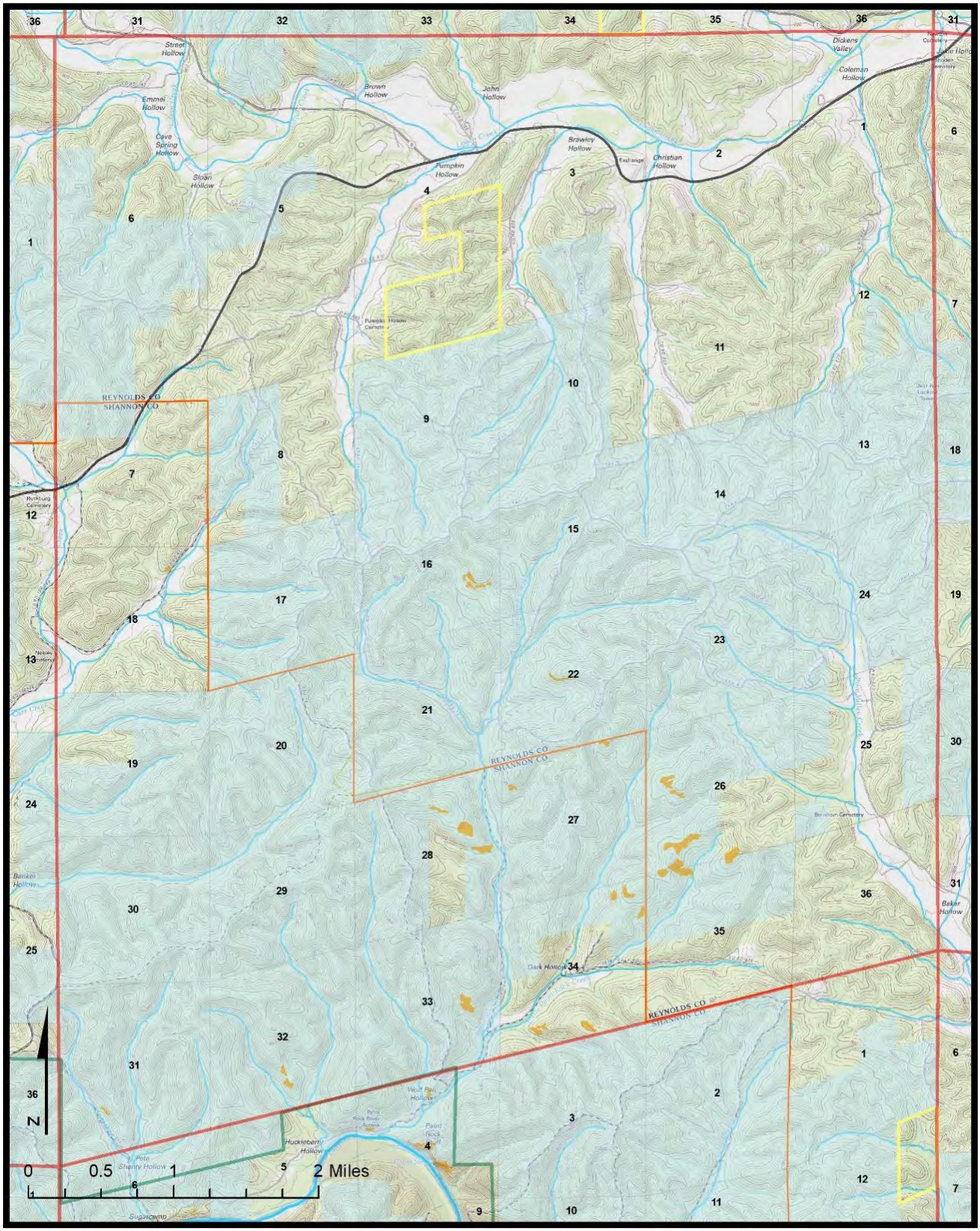


Pioneer Forest - T29N/R3W - 10/30/19 DHV

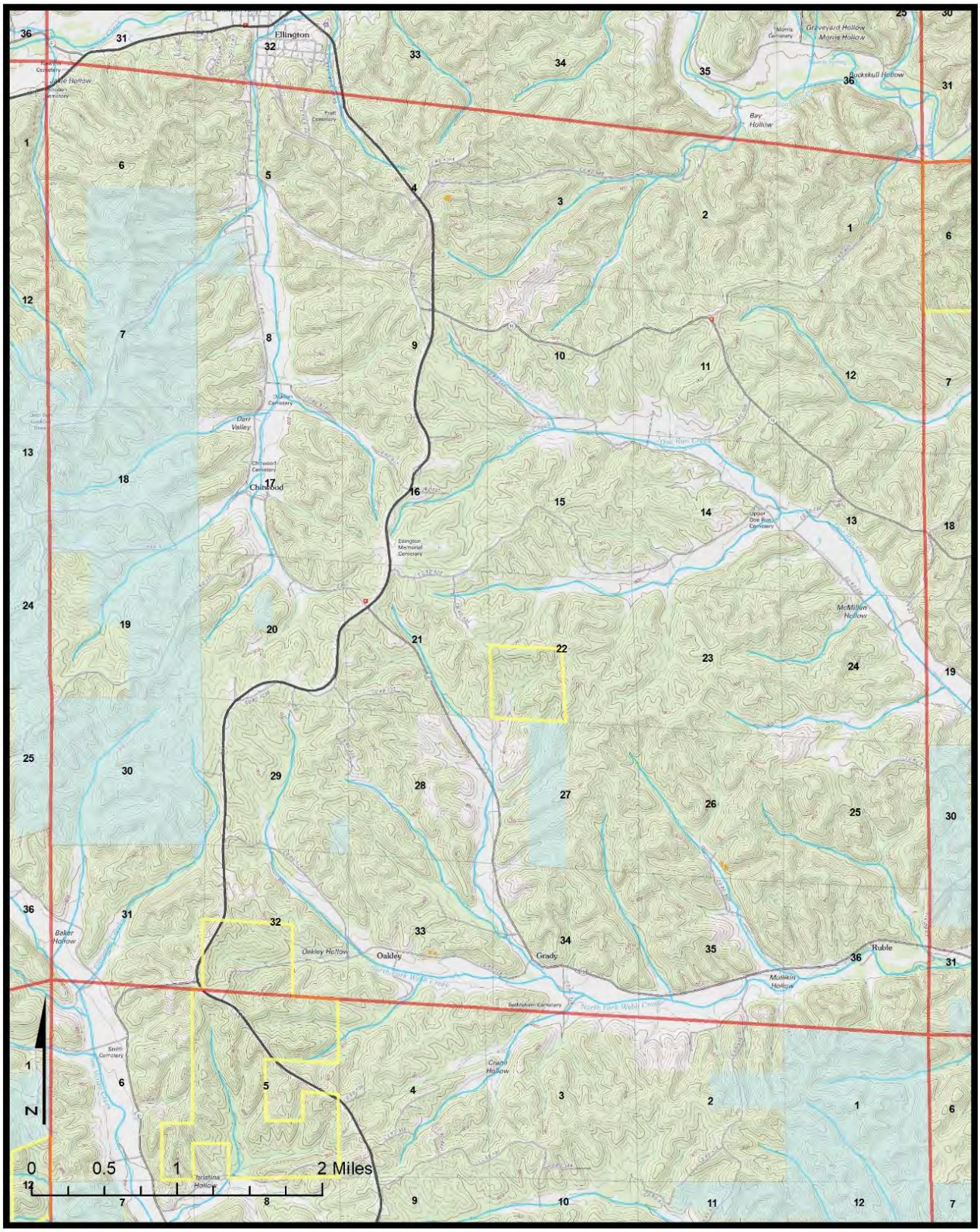
FOOTNOTE: A 1976 scenic easement deed granted to NPS-ONSR the right to certain restrictions regarding timber management (TMA) on certain Pioneer Forest land within the national park. There are three tracts of land, now owned by Pioneer Forest LLC and shaded here in pink: the tract shown to the right (35.14 acres) in Section 14; the tract shown above left (43.94 acres) in the E/2 NE Section 17; and the tract shown lower left (26.55 acres) in SW Section 17 and SE Section 18 T29N R3W.



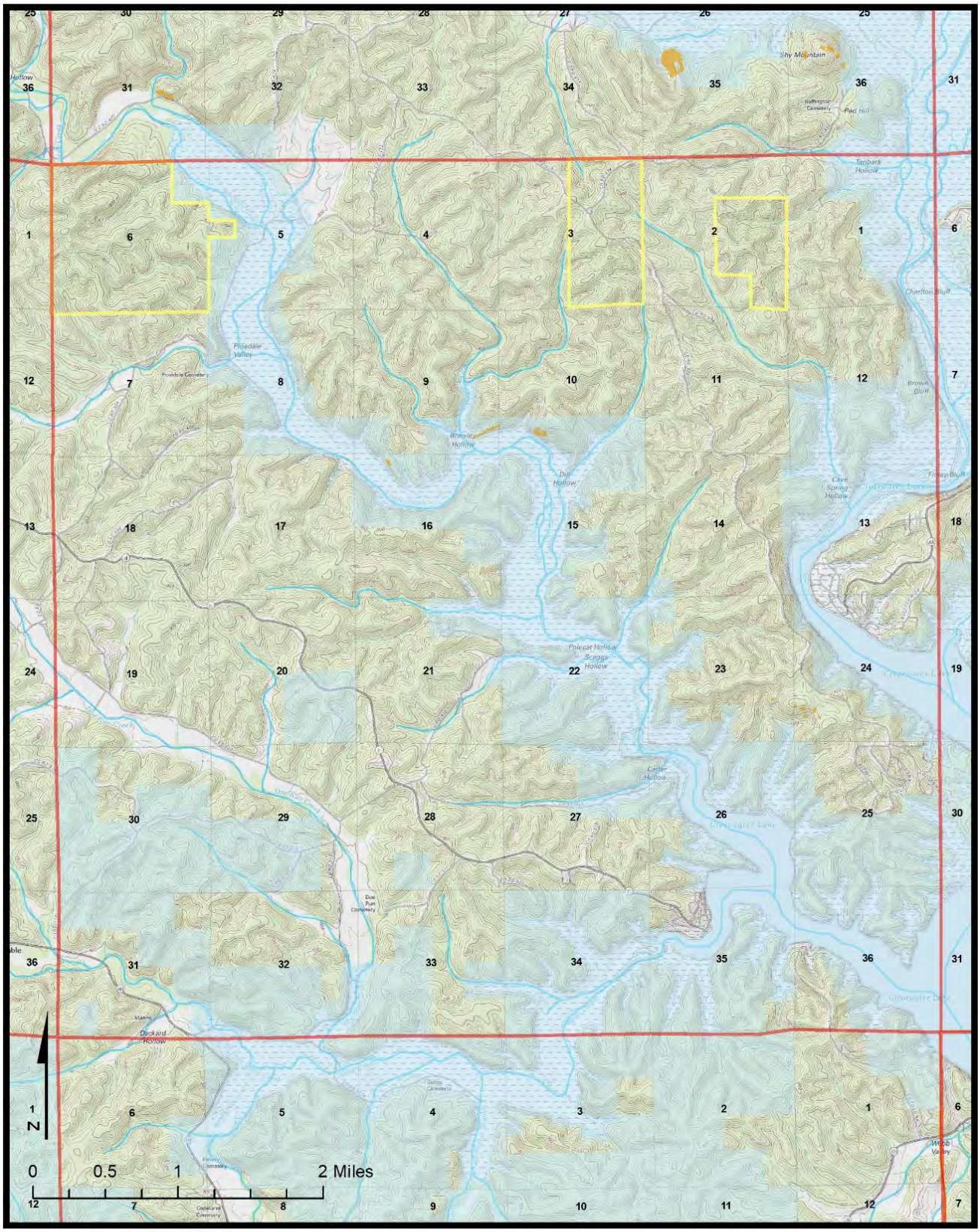
Pioneer Forest - T29N/R2W - 10/21/19 DHV



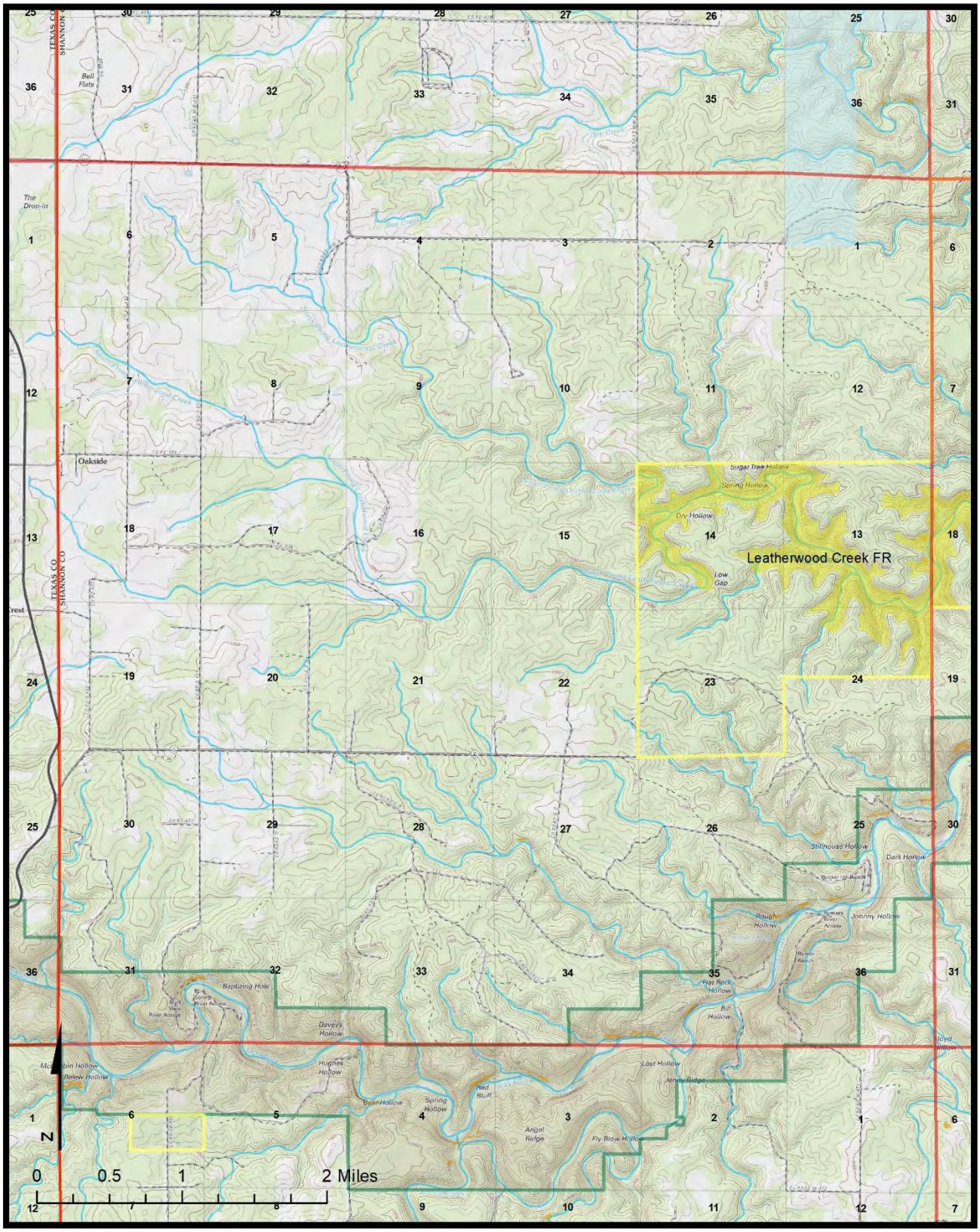
Pioneer Forest - T29N/R1W - 9/12/19 DHV



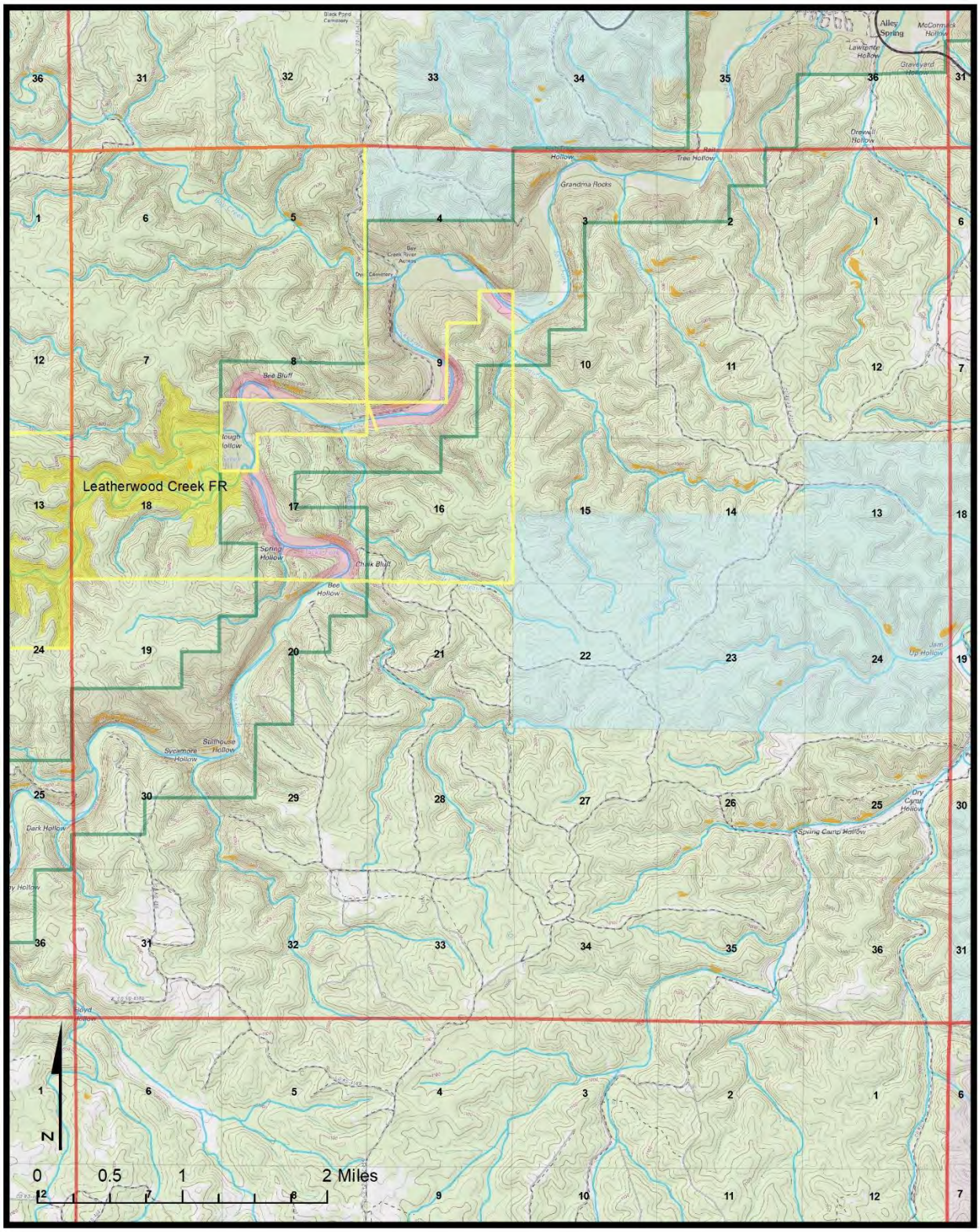
Pioneer Forest - T29N/R1E - 9/12/19 DHV



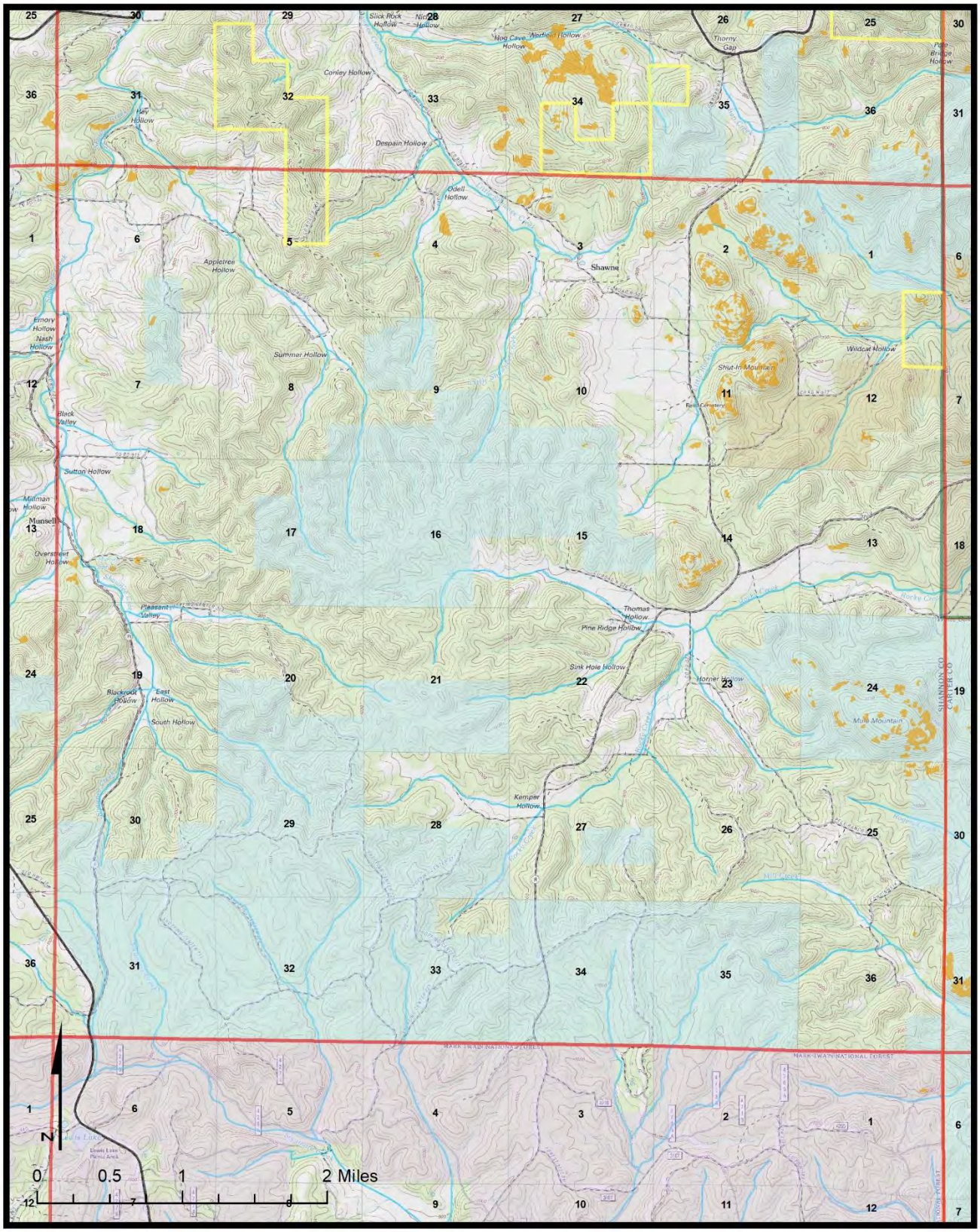
Pioneer Forest - T29N/R2E - 9/12/19 DHV



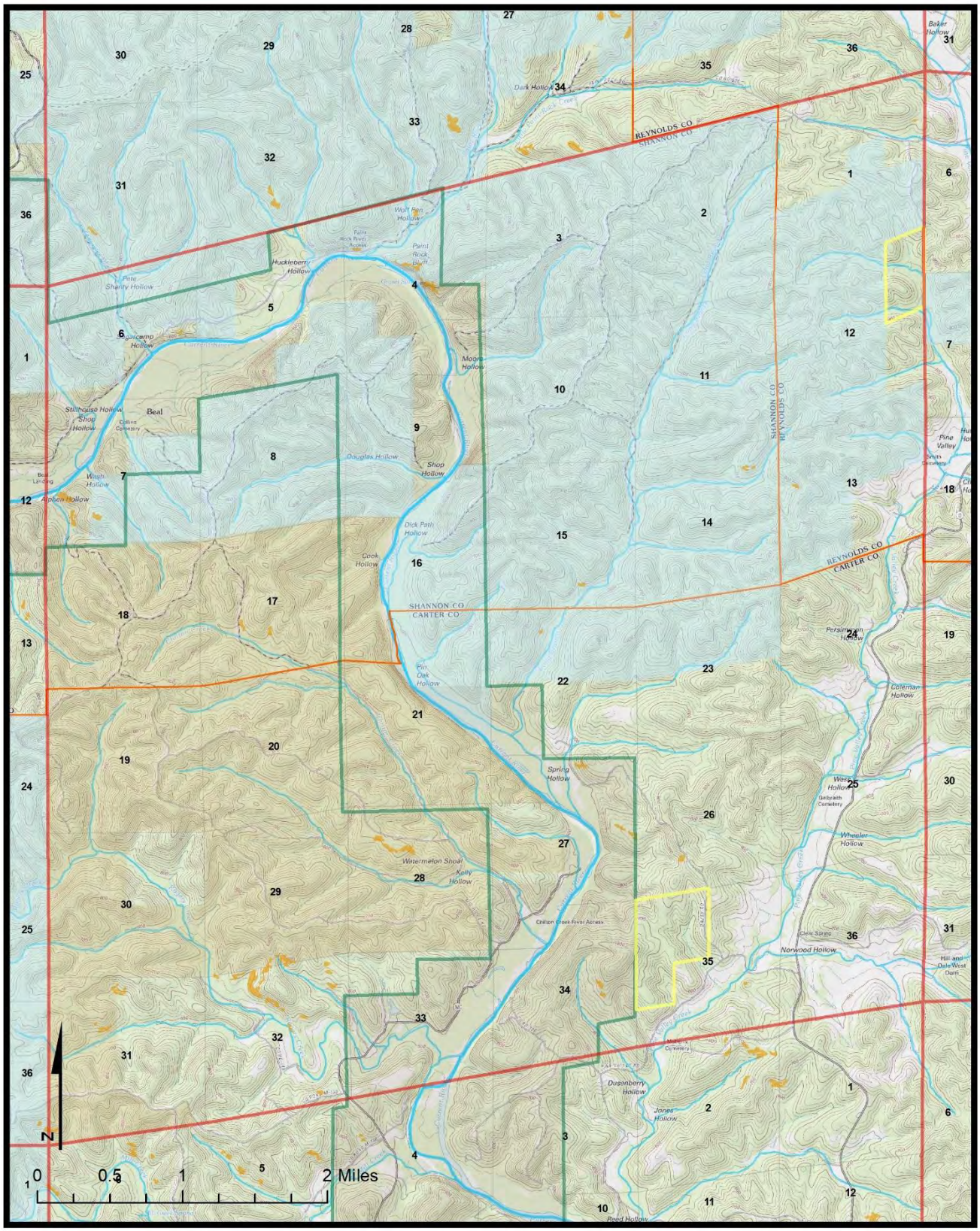
Pioneer Forest - T28N/R6W - 9/30/19 DHV



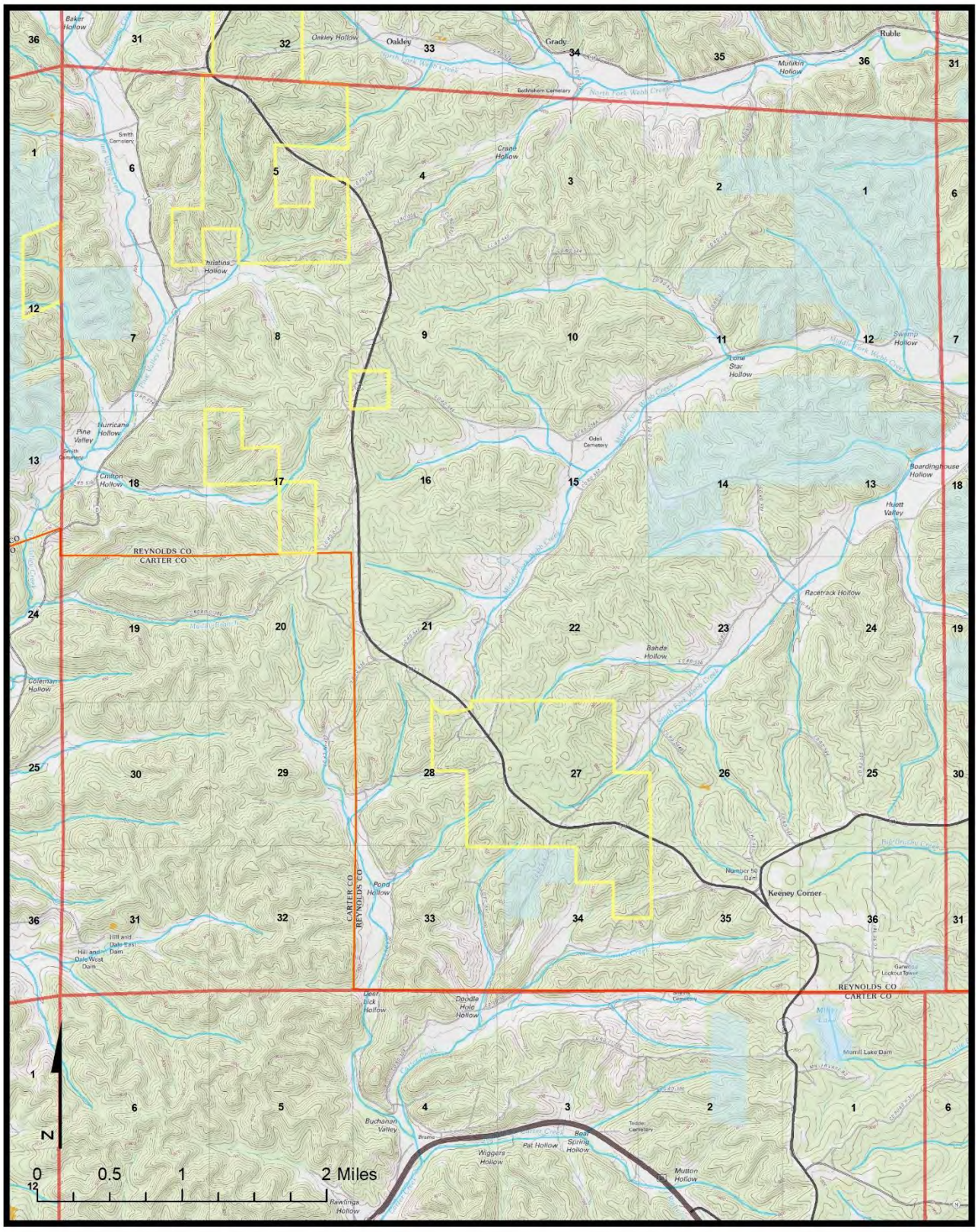
Pioneer Forest - T28N/R5W - 9/30/19 DHV



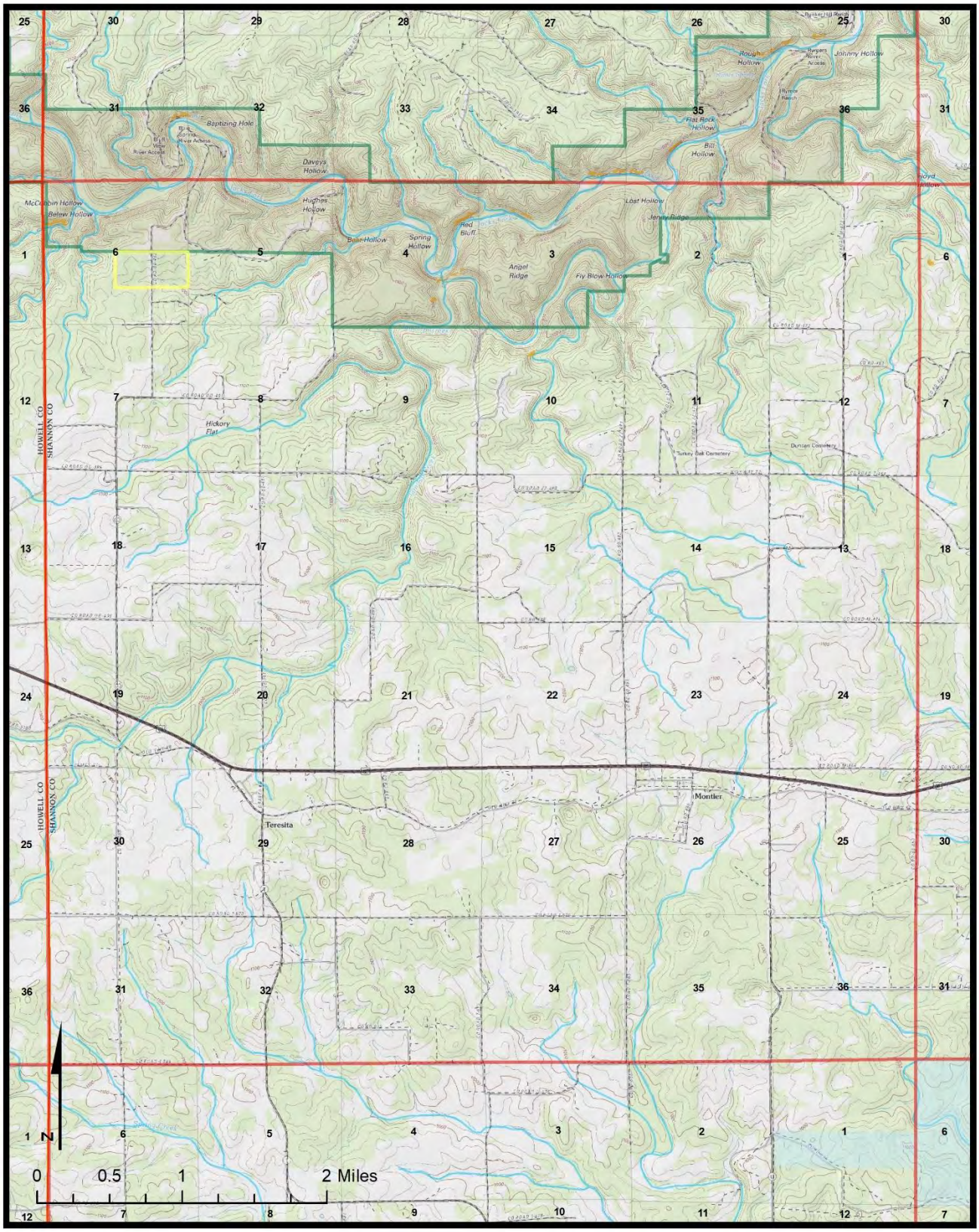
Pioneer Forest - T28N/R3W - 9/30/19 DHV



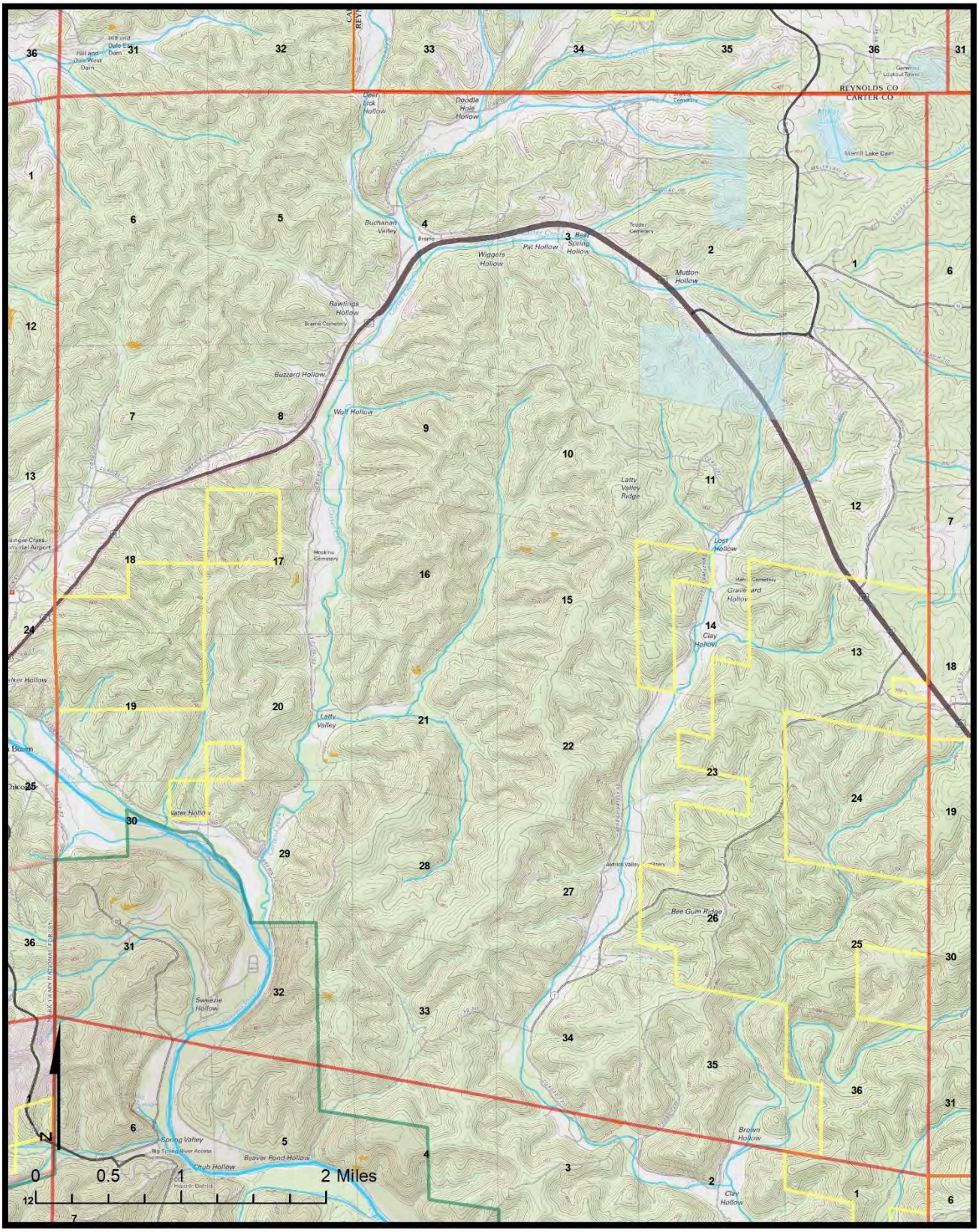
Pioneer Forest - T28N/R1W - 9/30/19 DHV



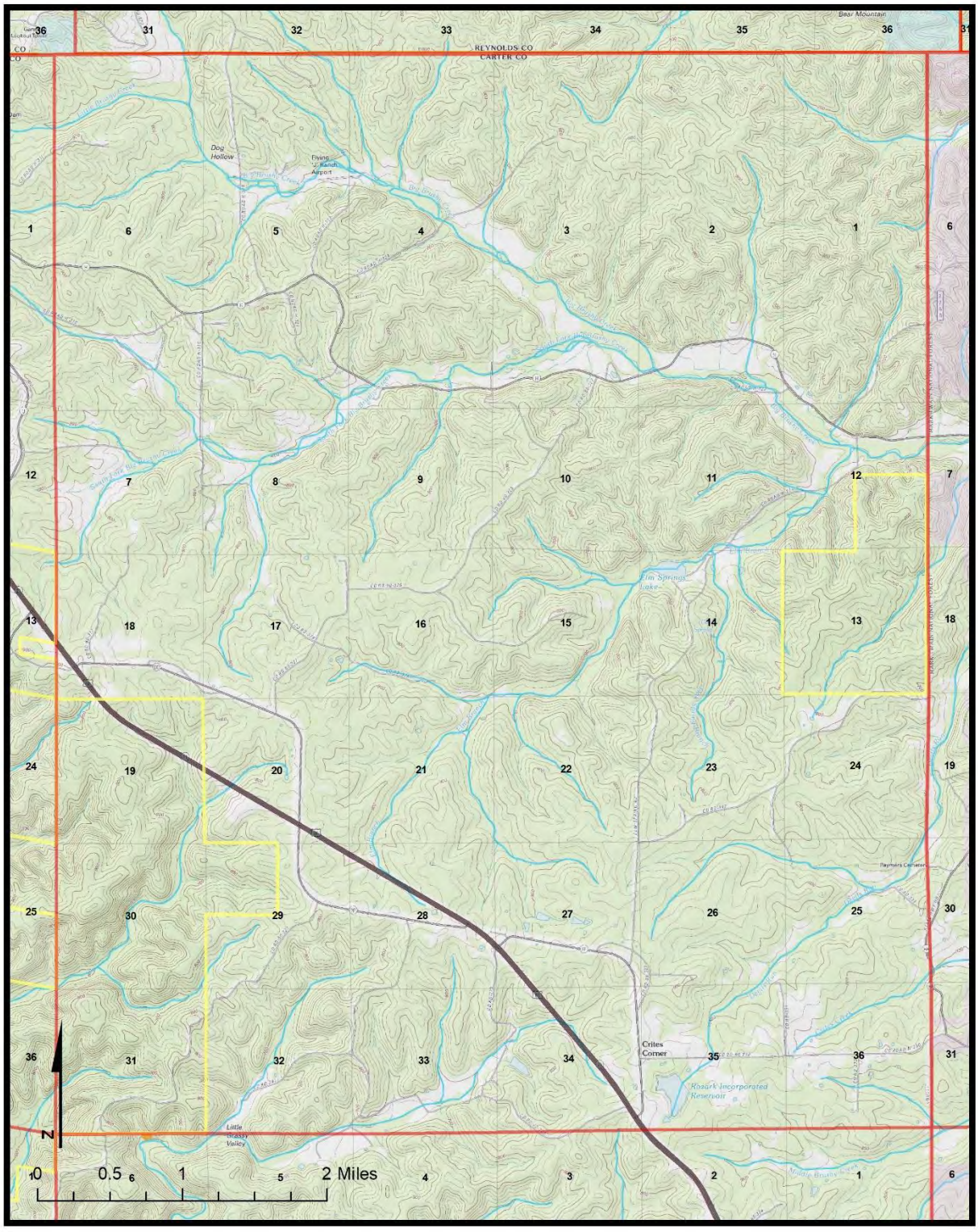
Pioneer Forest - T28N/R1E - 9/30/19 DHV



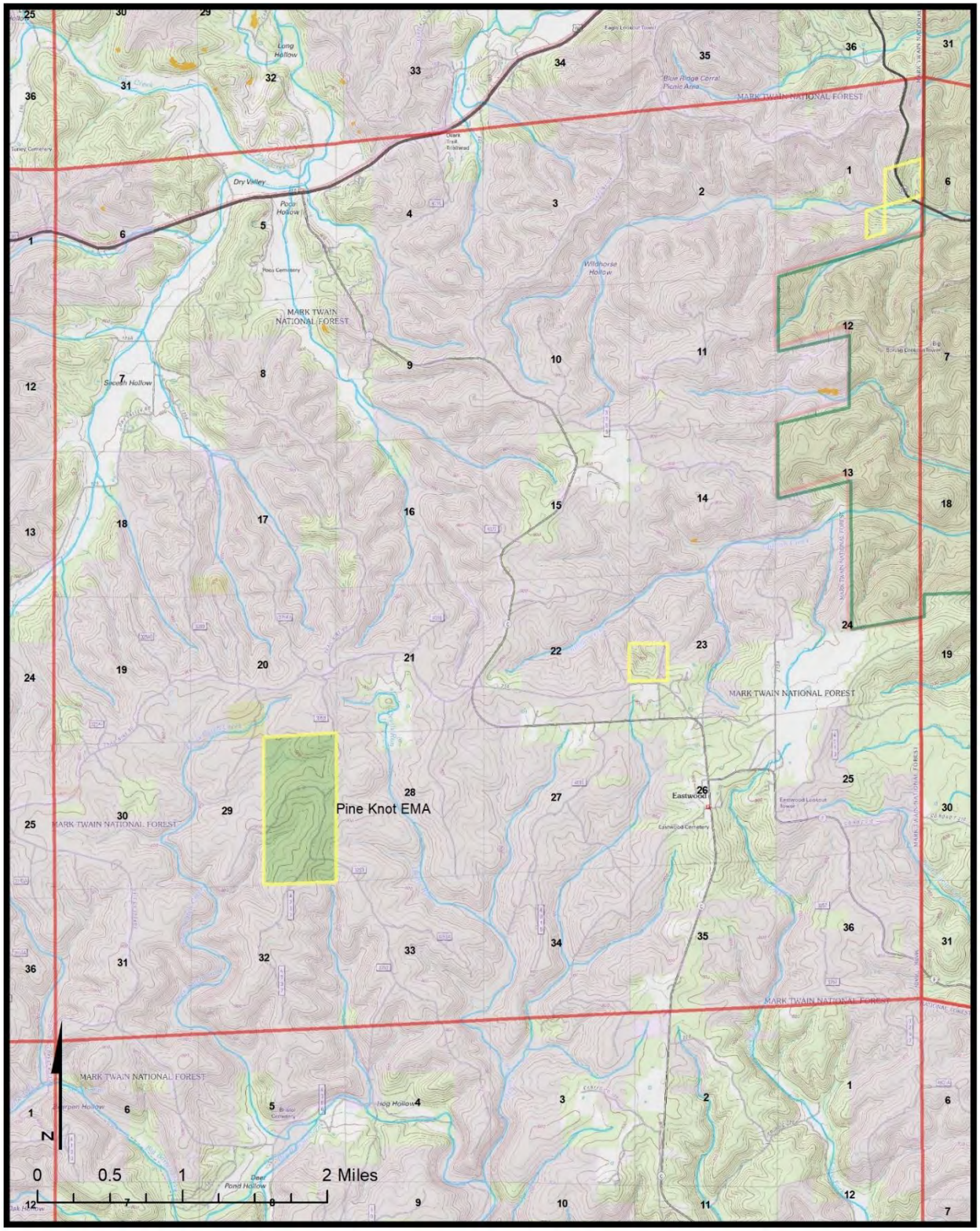
Pioneer Forest - T27N/R6W - 9/30/19 DHV



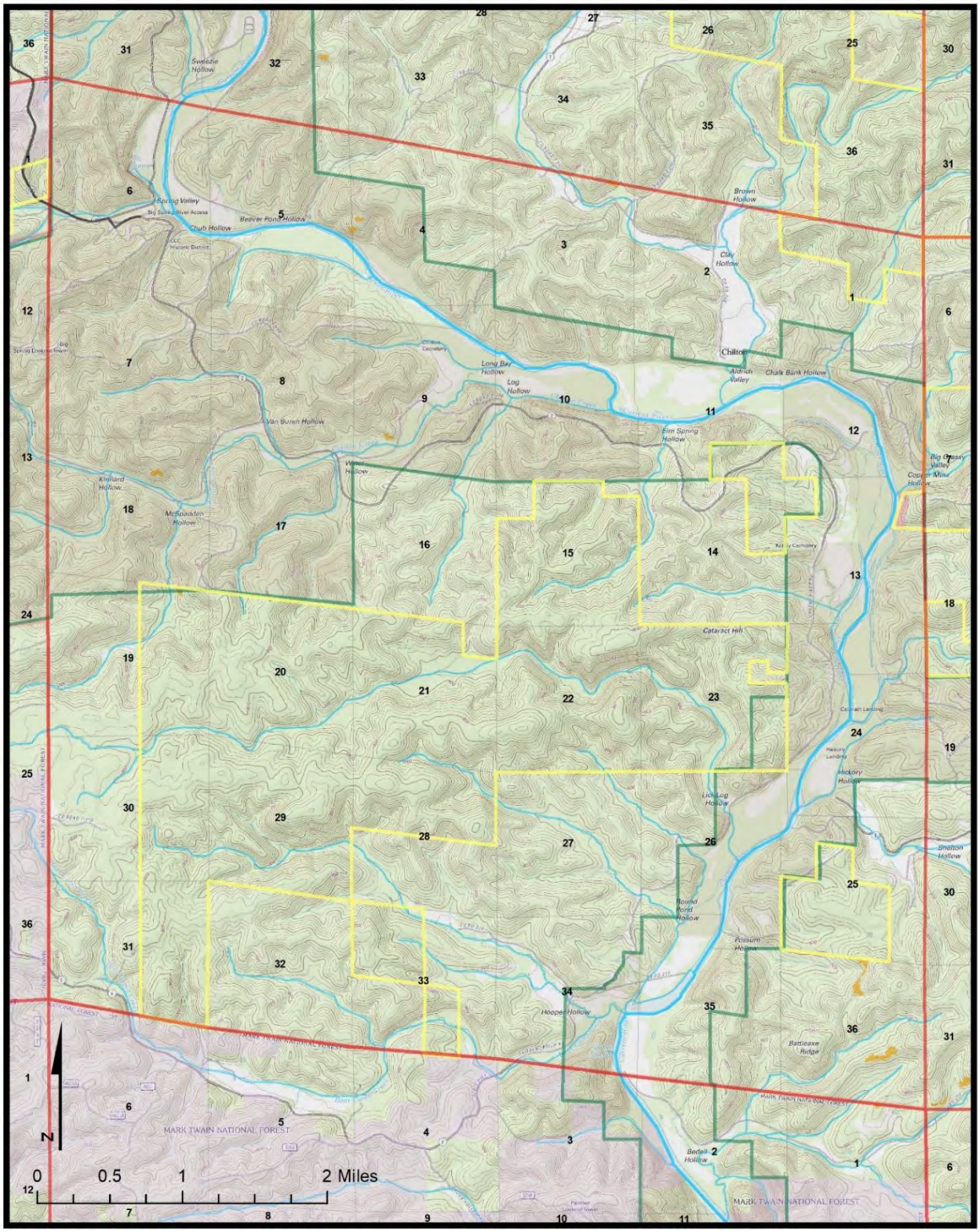
Pioneer Forest - T27N/R1E - 9/30/19 DHV



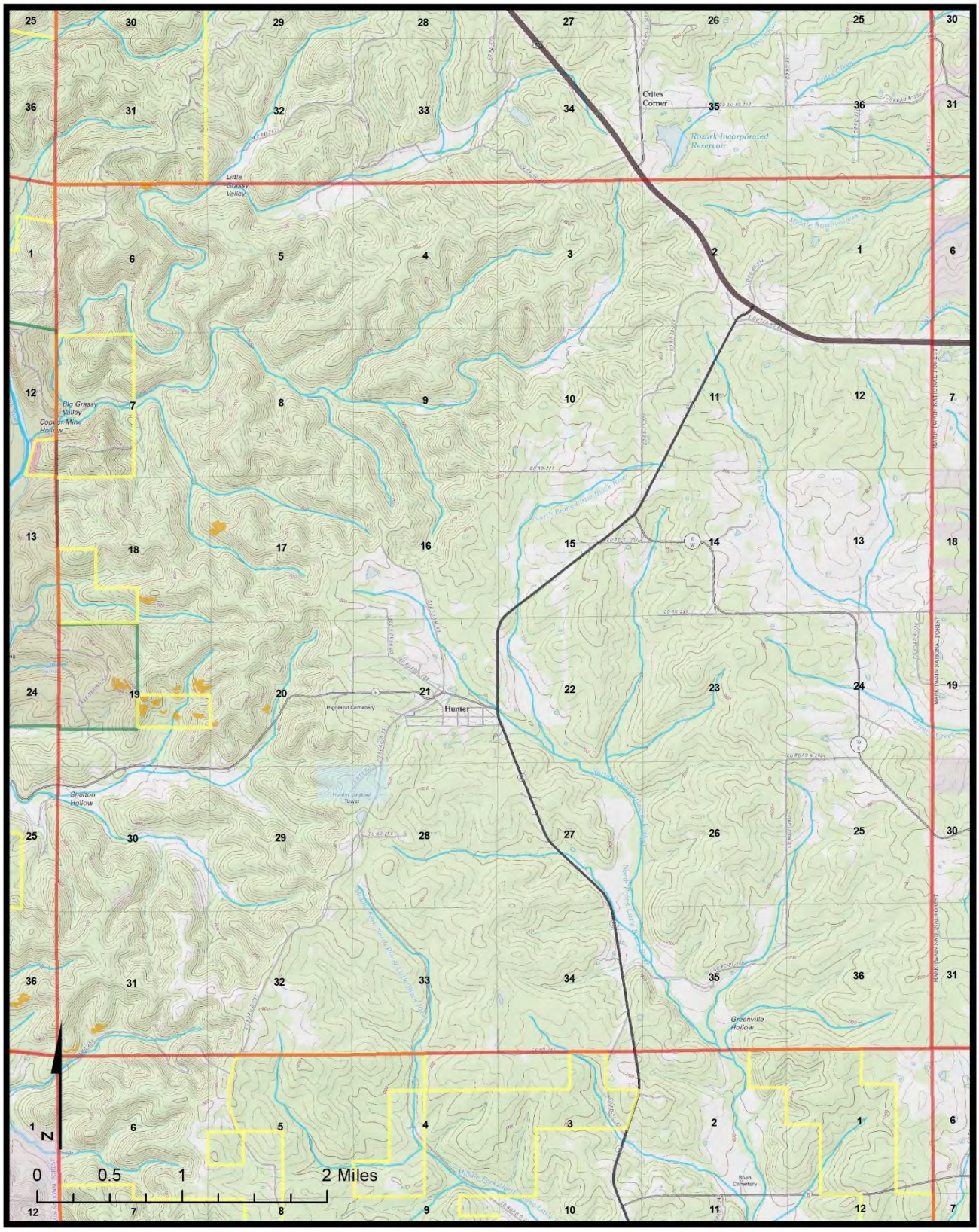
Pioneer Forest - T27N/R2E - 9/30/19 DHV



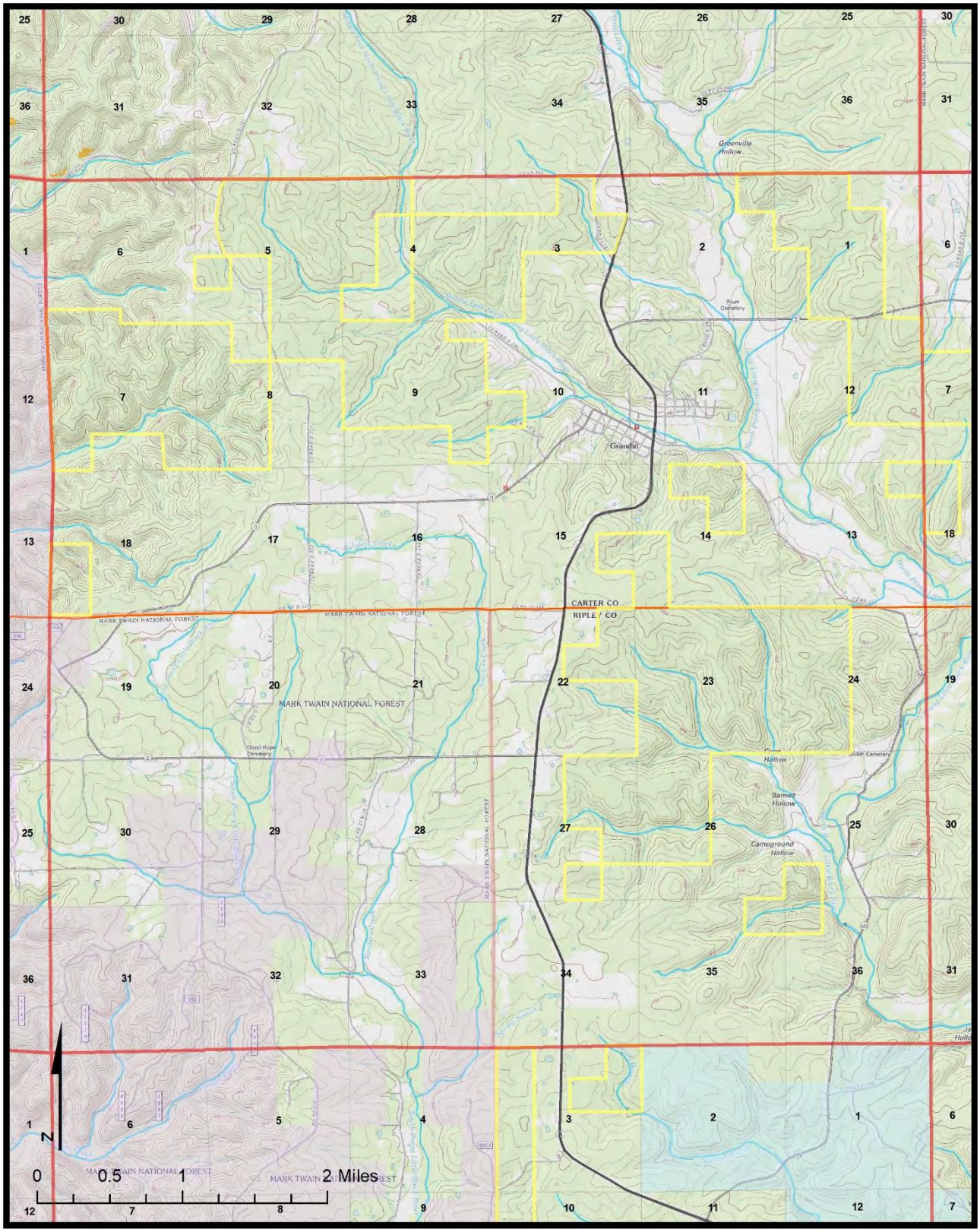
Pioneer Forest - T26N/R1W - 9/30/19 DHV



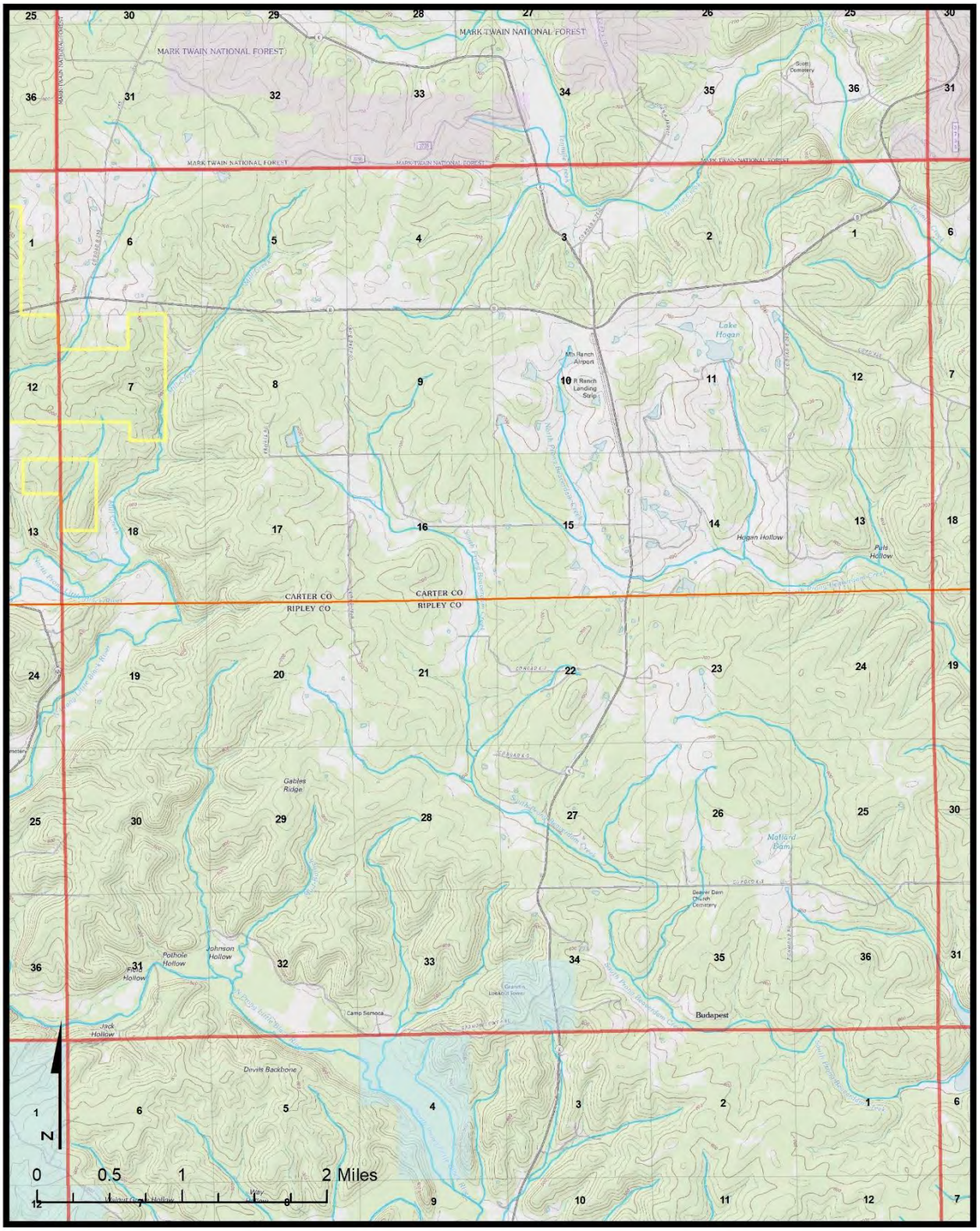
Pioneer Forest - T26N/R1E - 9/30/19 DHV



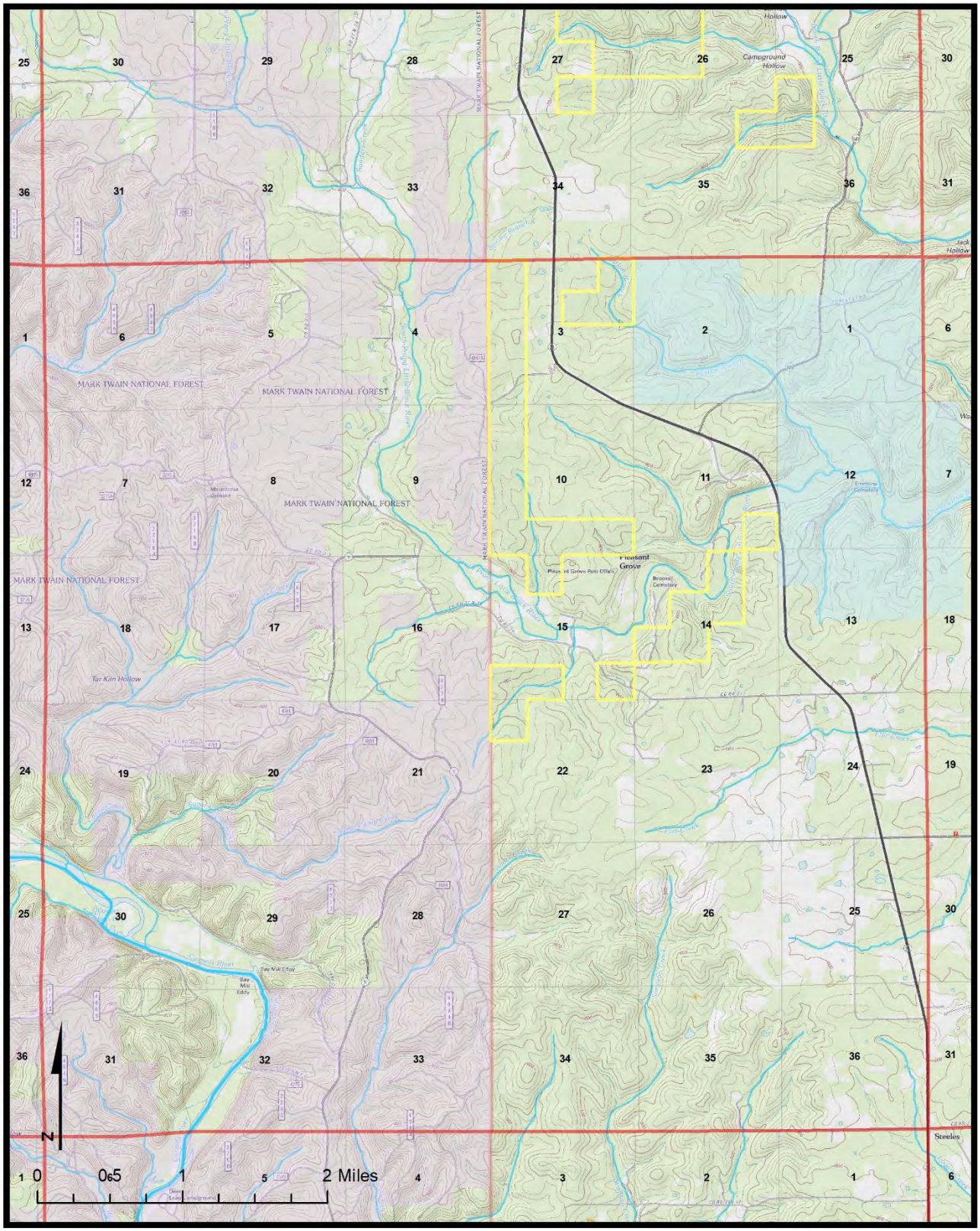
Pioneer Forest - T26N/R2E - 9/30/19 DHV



Pioneer Forest - T25N/R2E - 9/30/19 DHV



Pioneer Forest - T25N/R3E - 9/30/19 DHV



Pioneer Forest - T24N/R2E - 9/30/19 DHV

APPENDIX E

Pioneer Forest Contract for Timber Sale

(note: This is a sample contract for a timber sale by volume.)

Date: _____, 2019

I, _____"Purchaser" hereby agrees to purchase from Pioneer Forest LLC, "Seller", all marked living timber and dead timber designated by Seller's timber sale administrator.

Within _____ days of execution of this agreement, as security for the performance of Purchaser's obligations under this agreement and to insure strict compliance with the conditions of this contract, Purchaser shall deposit the sum of $10,000.00 with Pioneer Forest LLC in the form of either (1) cash; (2) a performance bond issued by a corporate surety, or (3) a letter of credit issued by a bank or lending institution in a form approved by Seller. Any money or other security held at the termination of this sale agreement may be applied on the final stumpage payment and after the close of the sale, the balance, if any, will be returned to Purchaser. The security deposit can be forfeited if Purchaser does not complete timber sale.

Purchaser agrees to make payment to Pioneer Forest LLC weekly or on demand for the following:

White oak staves : 60% of scaled price determined by stave buyer
Oak sawlogs: $220/mbf (down to a 10 inch top)
Oak/Pine blocking: $14/ ton (trees < 10 inches dbh, down to a 6 inch top)
Sawtimber pine: $100/mbf

All loads, including pulpwood and culls, with the exception of white oak staves, are to be sorted by product and weighed on a certified scale. Conversion rates shall be 12 lbs/board foot International ¼ Rule. Purchaser shall provide copies of weight tickets with weekly payments.

Purchaser agrees to all of the following terms and conditions and agrees to cut and remove said timber in strict accordance with the following conditions and requirements:

1. Stumps shall be cut so as to cause the least possible waste and not higher than 10 inches on the side adjacent to the highest ground.
2. All marked trees are to be cut and utilized to the smallest diameter in the tips as is practicable so as to cause the least waste.
3. Purchaser shall remove any marked sawlog that contains at least 50% merchantable material from the sale area.
4. Marked or designated sawlogs shall be weighed by a certified scale with a conversion rate of 12 pounds per board foot International ¼ Inch Rule.
5. Marked or designated blocking shall be weighed by a certified scale with a conversion rate of 12 pounds per board foot International ¼ Inch Rule.
6. Title to all timber sold under this agreement shall remain in Seller's possession until it has been weighed and paid in full.
7. Cutting and removal of the timber shall proceed in an orderly manner and shall be completed in one area before cutting is started on another area.
8. All telephone and power lines, fences, marked or designated trails, and roads within or immediately outside of the area shall be protected as far as possible in logging operations and if

damaged shall be repaired immediately by Purchaser. Roads and marked or designated trails shall at all times be kept free of logs, brush, and treetops.

9. Purchaser shall have the equipment and training necessary to respond to hazardous spills, including but not limited to spill kits, plans and knowledge of qualified personnel to call on in an event of a hazardous spill.
10. Purchaser shall do all in his power to prevent any unauthorized cutting of timber upon Seller's land and will immediately report to Seller any instances of such unauthorized cutting as may come to his attention. Unmarked or undesignated merchantable live trees cut or injured through carelessness of Purchaser or his employees or contractors shall be paid for at the rate of three times the current stumpage rate if the stump top diameter is less than 18 inches or $2.00 per board foot if the stump top diameter is 18 inches or larger.
11. Purchaser shall purchase general liability insurance from a company acceptable to Seller in the minimum amount of $1,000,000 and shall thereafter maintain such insurance as will protect Purchaser and Seller from claims which may arise from purchaser's operations under this agreement, whether such operations be by Purchaser, by employees of Purchaser, or by anyone for whose acts Purchaser may be liable, whether for bodily injury, death, or property damage and whether arising under the workers' compensation law, from the operation of a motor vehicle, or from any other operations of Purchaser. Seller shall be named as a certificate holder as additionally insured on the insurance policy. Purchaser shall provide proof of said insurance to Seller prior to conducting any operations or activity under this agreement.
12. Purchaser agrees to hold and save the Seller, its officers, agents or employees, harmless from any or all liability on account of any claim whatsoever, for wages, supplies, equipment, damage and injury to persons or property arising in connection with any activity conducted or undertaken by the Purchaser, his agents or employees under the terms of this contract.
13. Purchaser agrees to comply with all best management practices (BMPs) as described in the most current Missouri Department of Conservation publication "Missouri Watershed Protection Practices".
14. Purchaser agrees to clean up and remove any soil contaminated as a result of equipment maintenance or repair and to clean up the premises in a manner satisfactory to Seller within a period of 30 days following termination of this agreement.
15. Any equipment left on the premises after 30 days following the termination or full performance of this agreement shall be property of Seller, and, at the election of Seller, may be removed at Purchaser's cost or retained by Seller.
16. Purchaser and its employees shall do all in their power, both independently and upon request of Seller or an employee of the Missouri Department of Conservation, to prevent and suppress any forest fire upon or threatening Seller's land.
17. This agreement may not be assigned in whole or in part without the written permission of Seller.
18. Purchaser shall conduct all operations in accordance with safety standards under all applicable laws and regulations, including but not limited to the Occupational Safety and Health Act.
19. Purchaser shall have equipment and training necessary to respond to injuries, including but not limited to first aid kits, plans and knowledge of personnel to call on in the event of an injury.
20. All operations on the sale area, including the removal of marked timber, may be suspended by Seller at any time if the conditions and requirements contained in this agreement are disregarded. Failure to comply with any one of said conditions and requirements, if persisted, shall be sufficient cause for termination of this agreement. Purchaser shall forfeit the performance bond as liquidated damages.
21. This agreement may be canceled by seller at any time without prior notice and without cause at which time Purchaser shall have no claim to any marked or designated timber.

22. This agreement shall be binding upon the parties hereto, their executors, administrators and legal representatives, heirs, successors and assigns.

IN WITNESS WHEREOF, the parties have executed this agreement on the day and year designated by their signatures.

Pioneer Forest LLC, Seller

_____ Date:_____

By:_____,

Purchaser

_____ Date:_____

By:_____,

APPENDIX F

National, State, and Local Agreements

1. Timber Management Agreement on land owned in fee title by the National Park Service, Ozark National Scenic Riverways; March 4, 1974 and assigned to Pioneer Forest LLC, July 2004. the purpose is to manage said lands in accordance with timber management practices as set forth in the document to provide optimum watershed conditions and a sustained yield of forest products.
    - 267.09 acres, Shannon County, west ½ NE and Lot 4 (generally NE SE) of the fractional Section 20 and that portion of the E/2 of fractional Section 18, T30N R4W lying on the right bank (descending) excepting a portion 300 feet from and parallel with said riverbank. Exhibit A includes a detailed description of the land, Exhibit B includes management terms and practices.

2. Amended and Restated Lease, Trails of the Roger Pryor Pioneer Backcountry, Missouri Department of Natural Resources, July 15, 2014; First Amendment March 18, 2016.
    - Blair Creek Section, Ozark Trail, Blair Creek Equestrian Trail, Brushy Creek Trail, Current River Trail, Laxton Hollow Trail, Himont Trailhead.
    - Sugar Tree Hollow Trail and one-mile-long Current River Trail connector between Echo Bluff State Park and Current River State Park.

3. Lease, Timber Community Volunteer Fire Department, June 1, 1999, assigned to Pioneer Forest LLC, July 2004. The purpose is for the operation of a fire station and the storage of vehicles and equipment.
    - 3 acres, Shannon County, Section 3, T31N R5W

4. Lease, John Burroughs School in St. Louis, July 1, 1989; assigned to Pioneer Forest LLC, July 2004. The purpose is to be used and occupied only for recreation, education, and camping.

5. Scenic Easement Deed with Timber Management Agreement, Ozark National Scenic Riverways, August 2, 1976. The purpose is to acquire and maintain a scenic easement for the preservation of the scenic values of the river corridor and of the areas subject to Timber Management Agreement provisions for marking trees to be harvested by Pioneer Forest:
    - A 43.94 acre area near Two Rivers, Shannon County, part of E/2 NE Section 17, T29N R3W bounded by scenic easement lines parallel to and 300 feet perpendicular to the distance from the low water mark right bank descending of the Current River to the north, and the same measure from the low water mark left bank descending of the Jacks Fork River to the south.
    - 26.55 acres along the north side of Jacks Fork River in Shannon County, SW SW Section 17 and SE SE Section 18, T29N R3W, excepting certain lands along the river.
    - 35.14 acres approximately two miles downriver from Two Rivers, Shannon County, in SE NW Section 14, T29N R3W lying northeast of a line parallel to and 300 feet perpendicular distance from low water mark left bank descending of the Current River.
    - 369.70 acres lying between Devil's Well and Cave Spring, Shannon County, in NE NE, NW NW, S/2 N/2 and N/2 S/2 Section 21, T31N R5W, except 200-foot wide trail noted on tract 05-121 and to be "further defined when established." (Note: Subsequent work shared between Pioneer Forest and Ozark National Scenic Riverways has completed the Cave Spring Trail between NPS-owned Devils Well and L-A-D Foundation owned Cave Spring and crossing Pioneer Forest.)
    - Note: A 58.56-acre tract and a 33.68-acre tract in Shannon County, Section 7 T30N R4W referenced in the deed were traded away in 2000 to the State of Missouri, Department of Conservation.

6. Cave Gate, Medlock Cave. Cooperative Agreement with Missouri Department of Conservation that the constructed gate at Medlock Cave will remain in place for 30 years from the date of the agreement, November 2004.

7. Fire and Fire Management Across Boundaries. Memorandum of Understanding, L-A-D Foundation and USDI National Park Service, Ozark National Scenic Riverways, January 9, 2015. Covers sharing of personnel and equipment for management and planning, pre-burn preparation, burn implementation, monitoring, wildfire suppression, and training. Includes include Jerktail Mountain ad tall larkspur sites. The agreement is ongoing and to be reviewed every five years.

8. Echo Bluff Parks Easement, January 2017. Grants Pioneer Forest LL, a wholly-owned subsidiary of the L-A-D Foundation, Inc. for ingress, egress and access for periodic passing and repassing of loaded and unloaded logging trucks, related to silviculture, conservation, and research to State Highway 19 250B (formerly known as State Highway 19B and also known as "Echo Bluff Drive."

9. Participating Agreement, Fuels or Noxious Weed Treatment. Agreement between L-A-D Foundation and USFS Mark Twain National Forest, January 2018, includes 320 acres of Pioneer Forest in Burn Unit 1 of the Fremont/Pineknot East Prescribed Burn Project. Expires five years from signing.

10. Memorandum of Understanding, sharing of Missouri Natural Heritage Program data, September 27, 2019, for a period of five years.

APPENDIX G

Commonly Used Tract Names and General Locations

Many sites around the forest are referred to by the name of the previous owner who sold us the land or by some other designation that has become commonly used by the forest staff. The use of these tract names today commonly refers to a general area of the forest rather than to a specific tract, previous owner, or feature. The following is a list of some of the more commonly used place names often used in staff discussions and reports to the forest owner or foundation board.

Becker Tracts – There were two separate purchases. A 120-acre tract in Sections 23 and 26 partially filled in one of Pioneer's largest ownerships located south of Akers Ferry and extending across Howell, Barn, and Lewis Hollows. A second 160-acre tract was acquired as part of a 440-acre transaction with Missouri Department of Conservation (MDC). Pioneer's acquisition connected its large tract mentioned above with other lands at Fishtrap Hollow and those acquired from Current River Pole Company, all of that now connected for six miles along Current River. MDC added a critical piece of land at the northern edge of its Sunklands area.

Berger Tract – This tract is located in Section 20, T31N, R7W, and is where the largest pine planting of about 65 acres of old ridgetop fields can be found. The plantation was thinned three times for posts as of 2003 and is now large enough to begin producing small sawlogs averaging about 12 inches at d.b.h. The shortleaf pine was planted in 1957. The tract was purchased in 1963.

Cotton Tract – This tract is on the hill to the east of Van Buren and generally centers around the land in Sections 18 and 19, T27N, R1E.

Dalton Tract – This land along Blair Creek was acquired in 2007. The 520-acre tract joined four pieces of Pioneer land. At the time it was acknowledged that it was an ambitious undertaking, and resulted in a more strategic consolidation approach along Blair Creek and within the backcountry.

Egyptian Tract – This tract of over 5,000 acres was purchased from the Egyptian Real Estate Trust and Egyptian Tie and Timber Company. It lies along Mayberry Branch, Wet Hollow, and Brawley Hollow west of the Black River. It is generally all of our land in T31N, R2E in Reynolds County.

Geiger Place – This name generally refers to the land centered around the junction of two roads in the SESE of Section 21, T30N, R2W and between Graveyard Hollow and Alec Hollow.

Kell Field Plantation – An old field planted to pine in 1961. This was an experimental planting. The plantings were in alternate rows of Arkansas loblolly, Georgia loblolly, and Missouri shortleaf pine. Most of the loblolly pine died, so a planting of North Carolina white pine was completed the following year. Most of the white pine then also died. The plantation has been thinned four times. The last thinning in 2003 yielded a high volume of sawtimber, and the plantation has an excellent stand remaining in good condition.

Kellogg Tract – A 790-acre addition to the Lily Pond Tract acquired in 2015.

Krewson Field – Office records show that the Old Breedon Field in the SWSW of Section 12, T31N, R6W was planted to shortleaf pine in April of 1961. A young staff, being unaware of the Breedon designation, began calling this the "Krewson Field" around 1970 because of the proximity of Krewson Hollow.

Lily Pond Tract – This tract is located in Section 23, T31N, R1E, and includes Lily, Vinson, and a portion of Bowles Sinkhole Ponds. These ponds support unique plants and plant communities, Lily Pond is a Missouri Natural Area and Bowles and Vinson ponds are forest reserves. Lily Pond was donated to the L-A-D Foundation in 2006.

Lizzy Heaton Ridge – This ridge runs south from the Camp Zoe Road (Shannon County-250C) through T30N, R4W to the Current River.

Moore Tract – The area in T31N R4W (generally in Sections 26 and 35). Named after Moore who served as a Shannon County official. South of the County Sinks road there are good stands of larger, purer shortleaf pine on the southern and western slopes that have been protected under our management and might be further managed to demonstrate Ozark pineries.

Powell Tract – A 280-acre tract near Cedar Grove. This tract joined the north end of Pioneer's ownership between Pioneer and the ONSR and provided the opportunity to control access. This large area surrounds MDC state forest land above ONSR at Cedar Grove. These lands, owned by MDC and L-A-D, provide a nearly five-mile long, undeveloped entrance to the Current River.

Rabbit Ranch - So named by Charlie Kirk and Nick Nichols, who sold the land to Pioneer Forest, because when they first bought it they speculated that it would only be good for growing rabbits. The tract is located between Logan Creek and Dickens Valley in T31N, R1W. Today it supports an excellent stand of native shortleaf pine due, in large part, to many days of labor by Kirk and Nichols.

Randolph Tract – The Virgin Pine strip is located along Highway 19 and all of Pioneer's contiguous land south of the Current River below Round Spring is considered the Randolph Tract.
Spencer Jones Tract – This tract is in Dent County and was once owned by Spencer Jones. It was acquired as excess land from the US Park Service, Ozark National Scenic Riverways project. Old fields on this tract were seeded to shortleaf pine in 1971. There is extensive natural pine throughout this tract. Several portions of this tract support poor hardwood but there are also a few sites where excellent oak is growing.
Tick-A-Chig Ridge – The ridge above Satterfield Hollow to the south and running west from the Himont Road through Sections 32, 33 and 34, T30N, R3W. The Tick-A-Chig Ridge Road leads down to Current River at Bee Bluff.
Woods Hole -- a spot on the Current River at the end of the road that runs from Highway 19 east through the Randolph Tract.

APPENDIX H

Glossary of Terms

Acre – A unit of land area measurement equal to 43,560 square feet.
Advanced regeneration – Seedlings or saplings that develop or are present in the understory.
Age class – An aggregation of trees that are essentially the same age. Age-class is often used synonymously with "size-class." Age intervals of ten years are commonly considered to be the same age-class.
Aquatic invertebrate taxa – includes a range of organisms such as snails, crustaceans, insect larvae, leeches, and aquatic worms.
Aspect – The cardinal direction that a slope faces (north, south, east, west)
Avifauna – Avian wildlife, birds.
A-level stocking – A measure of stocking for forest management introduced by Samuel Gingrich in 1967 to compare the area occupied by trees relative to an optimum level of density. The A-level stocking is considered nearly overstocked, B-level stocking is described as the onset of full site occupancy and defined generally as 60 percent of full stocking, and C-level is a measure of minimum basal area required to carry existing stands.
Basal area – The area (in square feet) of the cross section of a tree stem, including the bark, generally at breast height (4.5 feet above the ground). In the aggregate, it is the total cross-sectional area per acre of all trees at breast height.
Biological diversity – The existence of a variety plants, animals, and other living beings in particular regions or ecosystems.
Blocking – Structural wood products used to pack and ship manufactured goods.
Board foot – A unit for measuring wood volume and commonly used to express the amount of wood in a tree, sawlog, or piece of lumber. A piece of wood one foot wide by one foot long by one inch thick.
Bolt – A short log or a squared timber cut from a log, usually less than 8 feet in length.
Buffer strip – A strip of vegetation that is left unmanaged or is managed to reduce the impact a treatment or action on one area would have on an adjacent area. For example, a streamside buffer.
Canopy – The continuous cover of branches and foliage formed collectively by the tops, or crowns, of adjacent trees.
Canopy closure – The progressive reduction of space between tree crowns as they spread laterally.
CFI – Continuous Forest Inventory. An inventory repeated with regular frequency, over a long time period, to locate and estimate quantities by species, product, size, quality, and other characteristics.
CFM – Conservation Federation of Missouri
Chrono-sequence – Forest stands covering a range of ages and management-related disturbances.
Clearcut – A harvest method used in the even-aged silvicultural system. The removal of all merchantable and non-merchantable trees greater than 1.0 inch in diameter in one harvest cut. Pioneer Forest management does not include the use of clear-cutting.
Community – An assemblage of plants, animals, bacteria, and fungi that live in an environment and interact with one another, forming a distinctive living system with its own composition, structure, environmental relations, development and function.
Conservative species – Plants or animals associated with an intact natural community, generally defined as species that have evolved over millennia to thrive in a very specific set of ecological conditions. In the absence of these conditions, populations of conservative species may decline rapidly, particularly in reaction to abrupt changes in the environment. For example, a non-conservative plant species may be found abundantly along roadsides and old fields, whereas more conservative plants may only be found in undisturbed natural areas.
Cord – A unit of gross volume measurement for stacked roundwood based on external dimensions, generally a 4 by 4 by 8-foot stack (128 cubic feet of stacked wood.)
CRF – Cave Research Foundation
Cross-tie – A transverse timber forming a foundation or support.
Cull – Tree or log of merchantable size that, because of defect, has no merchantable value. A cull may be highly valuable as a den tree.
Customary rights – Rights that result from long habitual or customary actions that have, by such repetition and by uninterrupted acquiescence, acquired the force of law within a geographical or sociological unit.
Cutting cycle – The planned interval between partial harvests in an uneven-aged stand.
Dendrochronology – The study of tree rings and tree ring patterns influenced by environmental factors such as climate and fire. Analyzing annual growth increments helps us to understand the age of a tree or a forest canopy, and to compare responses to change between species and within a forest or a region.

Den tree – A living tree with a cavity large enough to shelter wildlife. Also called a cavity tree.
Diameter breast height (d.b.h.) – Diameter of a tree measured on the uphill side of the tree at 4.5 feet (breast height) above ground line.
Disturbance regimes – Any of a variety of events, such as wind, floods, and/or fires, that cause a significant change in the local or regional environment and the associated plants or animals.
Dolomite – A carbonate sedimentary rock consisting of double carbonates of calcium and magnesium and in Missouri associated with karst.
Down woody debris – Woody portions of trees that have fallen to and are lying on the ground. Down woody debris includes twigs, branches, logs, stumps, and whole trees that have fallen. Also referred to as either fine or course woody debris.
Duff – Partly decayed organic matter on the forest floor.
Ecological Management Area (EMA) – Internal L-A-D/Pioneer Forest designation where ecological management is the primary goal. Prescribed fire and timber management are often necessary to meet and maintain our ecological goals. Examples include Jerktail Mountain EMA and Tall Larkspur EMA.
Ecosystem – A conceptual unit comprised of organisms interacting with each other and their environment, having the major attributes of structure, function, complexity, interaction and interdependency, temporal change with no inherent definition of spatial dimension.
Endangered species – Any species in danger of extinction throughout all or a significant part of its range. Endangered species may be either state or federally listed.
Erosion – The displacement of soil from one place to another by any means, including wind, water, gravity, logging, and road building.
Even-aged management – A system of forest management in which stands are maintained or cut with relatively minor differences in age, usually less than 10 percent of the rotation.
Even-aged silvicultural system – The application of a combination of actions that results in the creation of stands of trees of essentially the same age that are growing together. Managed even-aged forests are characterized by a distribution of blocks of single-age stands (and therefore, tree size) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a stand is obtained during a short period at or near the time that a stand has reached the desired age or size and is harvested. Clear-cut, shelterwood, or seed tree cutting methods produce even-aged stands.
Exotic species – Species that would not occur naturally in the location where they are found.
Federally listed – Animals or plants formally added to the federal lists of endangered or threatened wildlife or plants by the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service. In legal terms, also includes species formally proposed for addition to these lists.
Fen – A wetland characterized by mineral-rich groundwater of pH neutral or alkaline chemistry and dominated by grasses and sedges.
Feral – Having escaped or been released from domestication and become wild, for example feral hogs.
Fluctuating asymmetry (FA) – A measure of developmental stability based on genetic complexity.
Forest – An area dominated by trees with greater than 60% canopy cover and interspersed with multi-layered shade-tolerant sub-canopy trees, shrubs, vines, ferns, and ground flora that is rich in spring ephemerals. Trees attain heights 60 to over 100 feet.
Forest reserve – Pioneer recognizes high-quality, characteristic Ozark features and some typical forest features on its lands. These could be of state-wide significance but recognized mainly for their regional importance or for their importance to the forest.
Forest structure – Layers of vegetation within a forest, in general: seedlings, advanced reproduction, saplings, poles, and overstory. Except for seedlings, each layer can include multiple age classes.
Fragipan – Loamy, brittle subsurface soil layer low in porosity and organic matter, and is low or moderate in clay, but high in silt and fine sand. A fragipan appears to be cemented and restricts roots.
GIS/GPS — Geographic Information System that tells us where a particular oak is within the forest, compared to GPS (Geographic Positioning System) which tells us the point where we are within the forest.
Glade – Open, exposed bedrock areas dominated by drought-adapted herbs and grasses in an otherwise woodland or forest matrix.
Harvest cycle -- The time period between harvest entries when using an ueven-aged management system.
Harvest rotation – The time period between harvests when using an even-aged management system.
HCVF – High Conservation Value Forests – Those forests that possess one or more of the following attributes: (1) globally, regionally, or nationally significant concentrations of biodiversity (e.g., endangered species) and/or large landscape-level within the management unit, where viable populations of mostly naturally occurring species

exist in natural patterns of distribution and abundance; (2) forest areas that are in or contain rare, threatened, or endangered species; (3) forest areas that provide basic services of nature in critical situations (e.g., protection of water catchments and control of soil erosion).
Hibernaculum – A refuge, such as a cave, where animals, such as bats, will hibernate over winter.
High-grading – Harvesting to extract only the most valuable trees from a forest. No consideration is given to regeneration requirements of tree species or future development and health of the trees or forest.
High-quality hardwoods – Hardwood trees or stands that will yield high-value timber products, such as face veneer, knot-free lumber, furniture, or specialty product stock and flooring.
Ingrowth – Trees that during a specified period have grown past an arbitrary lower limit, primarily of diameter or height. Ingrowth is usually expressed as basal area or volume per unit area.
Indicator species – A species whose presence in a certain location or situation at a given population level indicates an environmental condition. Population changes are believed to indicate effects of management activities on a number of other species or on water quality.
Karst (topography) – Terrain with distinctive characteristics of relief and drainage arising primarily from a higher degree of rock solubility than is found elsewhere. Some examples are springs, losing streams, underground drainage and water reservoirs, caves, natural bridges, and sinkholes.
Kerf (also Kirf) – The width of a cut a saw makes in cutting through wood; in usage, a thinner kirf on a saw blade dramatically increases the yield on a given log.
Landscape – A physiographic unit capable of sustaining several populations of a species; a mosaic of landforms and plant communities irrespective of ownership or other artificial boundaries.
Legacy tree (or forest) – Preserves certain qualities (such as old-growth trees or forests, wildlife habitat, species, community, etc.) that may be lacking on a landscape scale.
Log landing – A place where logs are taken (skidded) to be loaded on trucks for transport to the mill.
Losing stream – A flowing stream that gradually gets smaller or disappears due to the loss of some or all of the flowage into below-ground channels or caverns.
MBF – Thousand board feet
MDC – Missouri Department of Conservation
MFPA – Missouri Forest Products Association
Merchantable Tree Height – The height of a tree measured from a one foot stump height to a diameter at which the trunk is too small to be marketable. On Pioneer, hardwood sawlogs are measured to a 10 inch small-end diameter, and cedar and pine sawlogs are measured to a 6 inch small-end diameter.
MMBF – Million board feet.
Mature tree – A tree in which growth has reached the culmination of mean annual increment (economic maturity) and/or one in which growth equals loss of biomass, beyond which decline and mortality will eventually occur (biological maturity).
Mesic – (Of an environment or habitat) containing a moderate amount of moisture.
Native species – Flora or fauna naturally occurring in a particular area, and not introduced by humans.
NA – Natural Area, representative of certain biologic or geologic characteristics with high natural qualities.
Native species – Flora or fauna naturally occurring in a particular area, and not introduced by humans.
Natural forest – A forested area with many of the principal characteristics of the native ecosystem.
Natural regeneration – An age class created by natural seeding, sprouting, suckering, or layering.
Neotropical migrants – Bird species that breed in the United States during summer and spend winter in Mexico, Central America, South America, and the Caribbean Basin.
Non-timber forest products – All forest products except timber; other materials obtained from trees, such as resin, bark, and leaves, as well as other non-tree plant or animal products found in a forest.
NRCS – Natural Resources Conservation Service, part of the U.S. Department of Agriculture.
NSS – National Speleological Society.
Old-growth forest – Ecosystems distinguished by old trees and related structural attributes. Old-growth encompasses the latter stages of stand development, which typically differ from earlier successional stages in ways that may include tree size; accumulations of large, dead woody materials, especially on the forest floor; number of canopy layers; species composition; and ecosystem functions.
Old-growth stand – A stand of mature trees that is unroaded or lightly-roaded, with little evidence of previous logging, usually ranging in size from 15 to 500 or more acres, and of sufficient size and configuration to maintain specific ecological functions.
Overstory – The uppermost layer of foliage that forms a forest canopy.
Plantation – A forested area that lacks most of the principal characteristics of native ecosystems because of human activities, such as planting, sowing, and intensive crop-like management and harvests.

Prescribed fire – (Prescriptive fire management) The knowledgeable and controlled application of fire to a specific land area to accomplish preplanned resource objectives.
Progeny – Offspring from a parent, in this case the offspring of tree species within the timber stand.
Regeneration – Seedlings and saplings existing in a stand. This is the process by which a forest is renewed, either artificially by direct seeding or planting, or naturally by self-sown seeds and sprouts.
Riparian area or zone - An area along the bank of a river, stream, lake, or pond identified by the presence of vegetation that requires free or unbound water or is moister than normally found in the area. The zone may be a narrow strip of vegetation that borders a creek, river, or other body of water. Riparian zones may occupy only a small percentage of a watershed but are extremely important components of the general landscape.
Root-sprung – A condition of storm-damaged trees in which high winds bend a tree to the point where roots are partially pulled from the ground, but the tree is not blown down.
Savanna – Grasslands interspersed with open-grown scattered trees or groupings of trees. They are strongly associated with prairies and are dominated by prairie grasses and forbs. Canopy cover is usually less than 30 percent, but greater than 10 percent.
Sawlog – A log of suitable size for sawing into lumber. Sometimes used as shorthand for referring to a "sawlog tree," or a tree of suitable size for processing into lumber.
Scale – A measure of volume in a tree, based on the diameter and height of the tree.
Silviculture – The art and science of tending a forest by manipulating its establishment, composition, and growth to best fulfill the objectives of the owner, which may include the production of timber.
Single-tree selection – A harvest method expressed by the selection of individual trees to be removed from a stand of trees.
Skid trail – A road or trail over which equipment or horses drag logs from the stump to a road or log landing.
Snag – A standing dead tree from which leaves and most of the branches have fallen. A snag may be newly dead and appear to be a leafless tree or may be little more than a tall stump from which all the limbs and bark have fallen. Snags are used by a variety of wildlife species.
Stave – Narrow length of wood with a slightly beveled edge forming the sides of barrels, tanks, and pipelines.
Stream – A channel with a defined bed and a bank that carries enough water flow at some time during the year to flush out leaves. (1) Ephemeral streams flow less than 10 percent of the time in direct response to rainfall, with a channel that may be scoured or unscoured and is always above the water table. (2) Intermittent streams flow seasonally (10 percent to 90 percent of the time) in response to a fluctuating water table, with a scoured channel that is at least three feet wide. (3) Perennial streams flow year-round (more than 90 percent of the time) with a scoured channel that is always below the water line.
Stumpage – The value of standing timber or uncut merchantable timber.
Suckering – The generation of sprouts that grow along the trunk of a tree, usually after a drastic change in growing conditions, such as a heavy harvest that allows a sudden increase of light to reach the trunk.
Sustainable forest management – The practice of meeting forest resource needs and values of the present without compromising the forest's value for future generations.
Talus – A slope formed especially by an accumulation of rock debris.
Threatened species – Any listed likely to become endangered within the foreseeable future.
Timber stand improvement (TSI) – A thinning made in timber stands to improve the quality, composition, structure, condition, health, and growth of the remaining trees.
Topographic relief – The three-dimensional quality of the surface of the land depicting differences between the lowest and highest elevations within an area. (A topographic map showing contour intervals.)
Topographic roughness – A measurement of the variability of the land surface in a particular area that takes into account slope, shape, and aspect within the landscape.
Tree taper – The degree to which a tree's stem or bole decreases in diameter as a function of height above ground.
Tufa - A natural, calcareous deposit associated with springs, lakes, and groundwater.
Understory – The area of the forest at the lowest height level below the forest canopy. Plants in the understory are a mix of saplings of canopy trees together with understory trees and shrubs. In the Ozarks, dogwood, redbud, and bladdernut are rarely tall and are generally understory trees.
Uneven-aged silvicultural system – The application of a combination of actions that results in the creation of stands in which trees are in at least three age classes. Managed uneven-aged forests are characterized by a distribution of age classes and tree sizes ranging from regeneration to mature trees on each acre throughout the forested area. Regeneration in a particular stand is obtained throughout the harvest cycle and following a harvest and, in oak/hickory stands, is retained until a short time after complete canopy closure. Single-tree selection or small-group selection tree harvest methods produce uneven-aged stands.
Vascular plant – Plants with specialized tissue for circulating resources (water, mineral, and photosynthetic

products), including ferns, club mosses, conifers, and flowering plants, which include deciduous trees.
Vegetative architecture – Stratified vegetation levels within the forest consisting of various canopy layers, understory layers, and groundcover.
Veneer – A thin slice of wood removed from a log. The thin slice is laminated onto a lower quality or more stable base, and is often, but not necessarily, of the same species.
Veneer tree – A tree more than 18 inches in diameter, knot-free and high-quality with veneer logs.
Volume – The amount of wood in a tree, stand of trees, or log expressed in some unit of measure, such as board feet, cubic feet, etc.
Water bars – Used to prevent erosion on sloping trails or roads by reducing the velocity of the water and the length of its flow; generally constructed at a diagonal across the path.
Watershed – An area of land with a single drainage network. A watershed may be very large, such as the Mississippi River watershed, or smaller, such as the Blair Creek watershed. A watershed may or may not include a perennial stream. Holmes Hollow in Shannon County is an example of a watershed without a perennial stream.
Wetlands – Those areas that are inundated by surface or ground water often enough to support plants and other aquatic life that require saturated or seasonally saturated soils for growth and reproduction. Wetlands generally include swamps, marshes, bogs and similar areas such as sloughs, potholes, wet meadows, fens, river overflows, mud flats, and natural ponds.
Woody debris – All woody material, from whatever source, that is dead and lying on the forest floor.
Woodland – A natural community with a canopy of trees ranging from 30-100 percent canopy closure, with a sparse understory and a dense groundcover of shrubs, forbs, grasses, and sedges. Canopy height may range from 20-90 feet depending on site conditions.
Working forest – That portion of a forest dedicated to the production of forest products.