Western Pennsylvania Conservancy

ALLEGHENY COUNTY PARKS ECOLOGICAL ASSESSMENT AND ACTION PLAN

WHITE OAK PARK

Prepared for the Allegheny County Parks Foundation
December, 2021

FOREWARD

With nine parks encompassing over 12,000 acres, Allegheny County boasts one of the largest regional park systems in the country. While recreational activities make each park a unique destination, nature is the common thread that connects our parks and is our most treasured – and jeopardized – asset. The abundant resources found in our parks' forests, meadows and streams provide vital habitat for flora and fauna that clean our air and water, pollinate our plants and connect the web of life. We are stewards of these natural sanctuaries and are working to protect them for future generations.

To advance our stewardship efforts, in 2020 the Claude Worthington Benedum Foundation made a grant to the Allegheny County Parks Foundation. The Parks Foundation, together with the Allegheny County Parks, partnered with the Western Pennsylvania Conservancy (WPC) to conduct an Ecological Assessment and Action Plan in White Oak Park. This study evaluates the park's natural resources and ecological assets and recommends an implementation plan for protecting, preserving and improving the environmental health of the park.

The earliest aerial photographs of White Oak Park from 1939 show that about 60% of the ridges and hilltops were once cleared for agriculture. Later photographs also show strip mining in the southern end of the park. Today about 85% of the park is in natural condition (not developed or actively managed) and 40% of this area was never tilled or mined and has been continuously forested since 1939. These areas have mature forest communities and should be a special focus for management to maintain their integrity. Geological influences such as high concentrations of calcium in the bedrock contribute to rich soils which support a diverse plant community, especially within the more mature forest areas on the steep slopes.

Areas of the park have been mapped as best, good, or poor based on their ecological integrity. White Oak Park contains several populations of plant species that are rare in Pennsylvania and Allegheny County, and conservation should be a management goal, including natives such as Red Mulberry and ramps. Areas of invasive species populations such as Mile-a-minute and Japanese Knotweed have been mapped for removal. The challenge ahead is to help maintain the ecological integrity of the “best” areas and improve the “poor” areas using the recommendations provided.

Erosion is of concern in White Oak Park. WPC identified several problem areas that would benefit from green infrastructure to manage stormwater. Some paved areas could be converted to pervious to increase infiltration of rain water, riparian buffers improved, and detention facilities to slow down runoff could be added. The report suggests installing deer fencing to protect areas from extensive deer over browsing and creating a comprehensive trail development and management plan to protect tender native plants. The report also brings to attention the threat of the Spotted Lanternfly and Cytospora canker caused by a fungus that affects trees within the park.

We are deeply grateful to the Claude Worthington Benedum Foundation for providing the funding to make this report possible. We also thank the outstanding staff at the Western Pennsylvania Conservancy and Allegheny County Parks Department for their expertise and insightful contributions to this effort. We look forward to collaborating with the County Parks staff and other partners to prioritize, fund and implement these recommendations and to continue this type of important ecological work in all of the Allegheny County Parks.

Caren Glotfelty
Executive Director
December 2021

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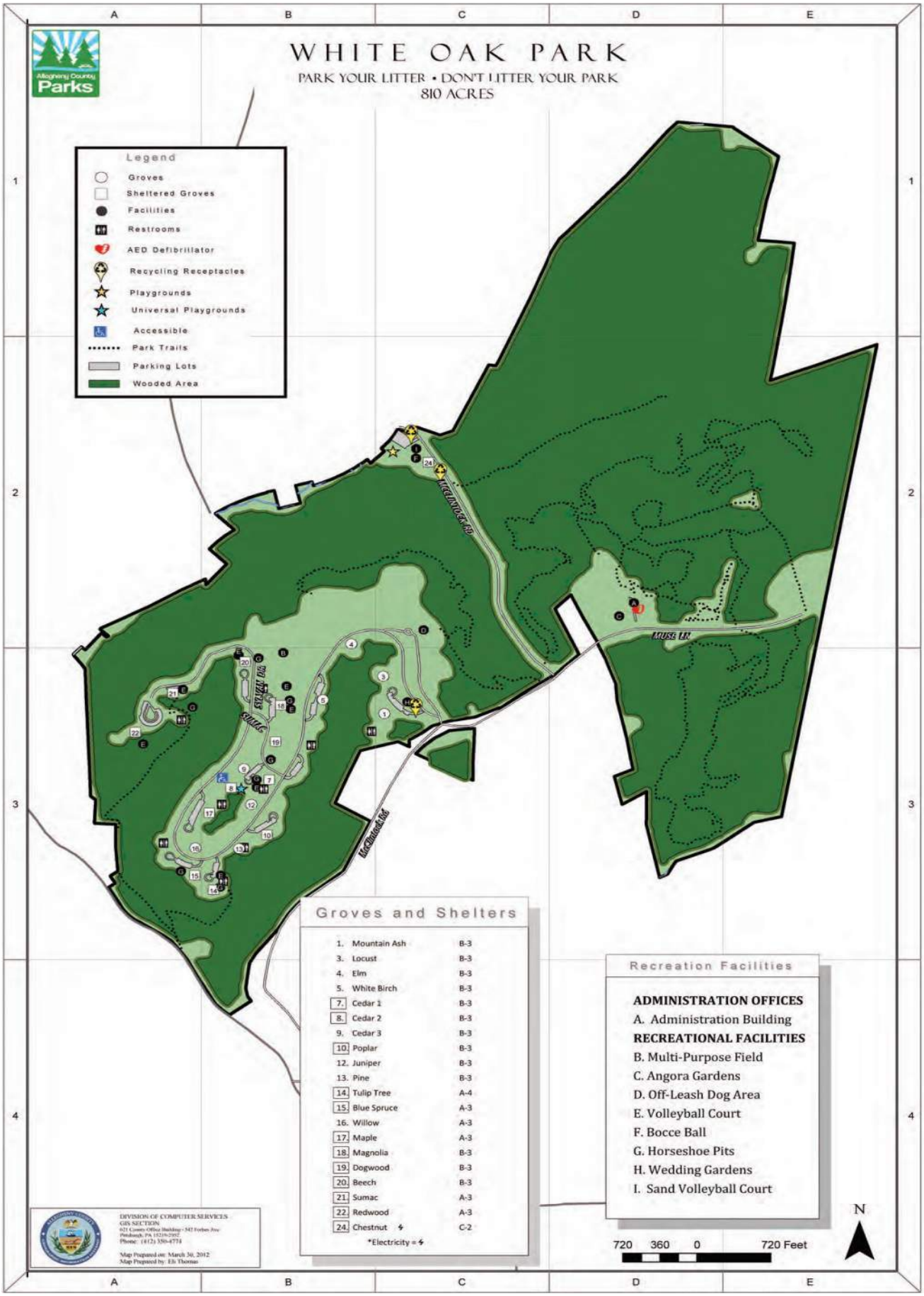
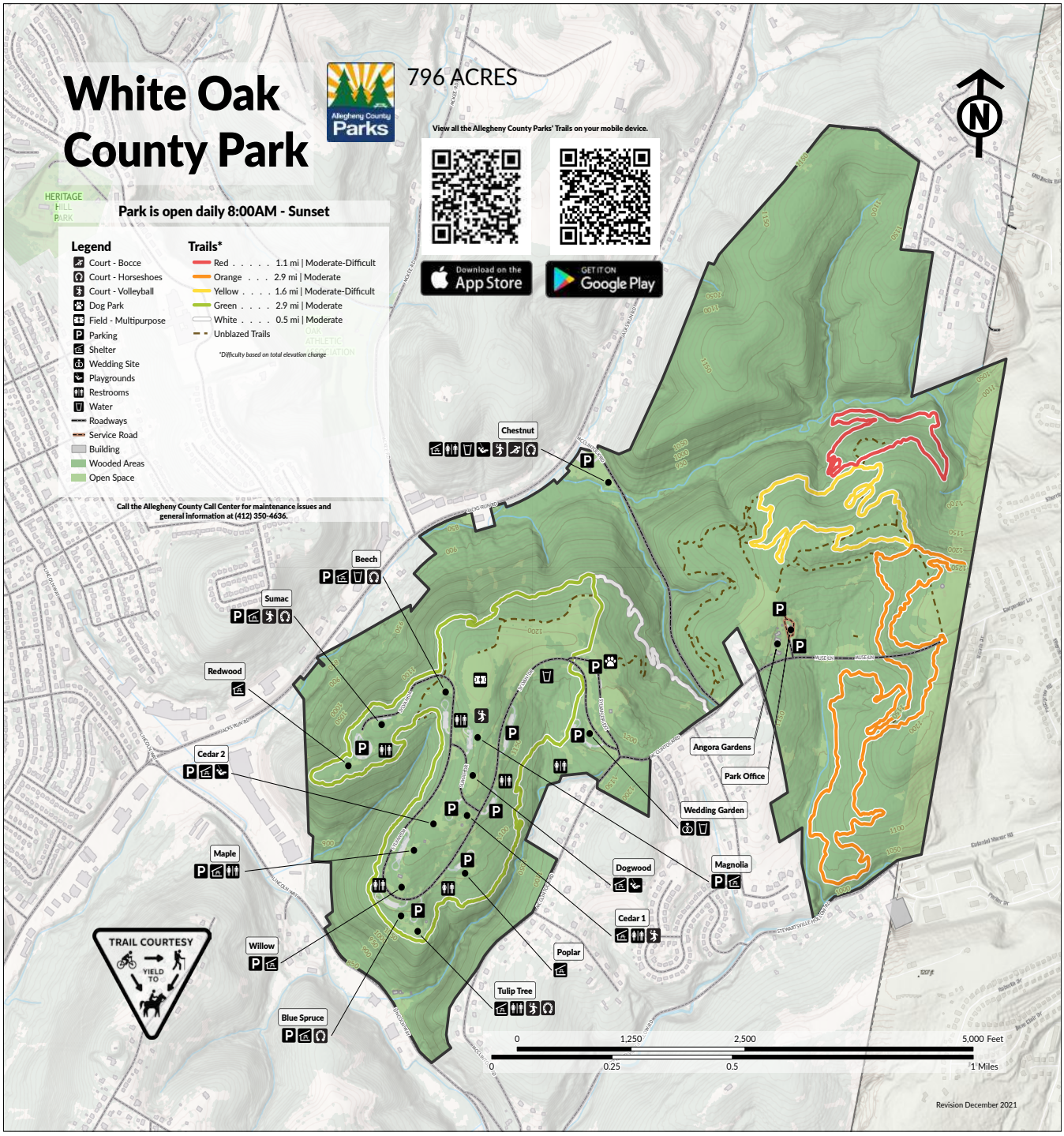

WHITE OAK PARK
PARK YOUR LITTER • DON'T LITTER YOUR PARK
810 ACRES
Allegheny County Parks
Legend
Groves
Sheltered Groves
Facilities
Restrooms
AED Defibrillator
Recycling Receptacles
Playgrounds
Universal Playgrounds
Accessible
Park Trails
Parking Lots
Wooded Area
McCANDLESS RD
MUSE LN
McClintock Rd
Groves and Shelters
1. Mountain Ash B-3
3. Locust B-3
4. Elm B-3
5. White Birch B-3
7. Cedar 1 B-3
8. Cedar 2 B-3
9. Cedar 3 B-3
10. Poplar B-3
12. Juniper B-3
13. Pine B-3
14. Tulip Tree A-4
15. Blue Spruce A-3
16. Willow A-3
17. Maple A-3
18. Magnolia B-3
19. Dogwood B-3
20. Beech B-3
21. Sumac A-3
22. Redwood A-3
24. Chestnut C-2
*Electricity = ϟ
Recreation Facilities
ADMINISTRATION OFFICES
A. Administration Building
RECREATIONAL FACILITIES
B. Multi-Purpose Field
C. Angora Gardens
D. Off-Leash Dog Area
E. Volleyball Court
F. Bocce Ball
G. Horseshoe Pits
H. Wedding Gardens
I. Sand Volleyball Court
DIVISION OF COMPUTER SERVICES
GIS SECTION
Map Prepared on: March 30, 2012
Map Prepared by: Eli Thomas
720 360 0 720 Feet
N


White Oak County Park
796 ACRES
Park is open daily 8:00AM - Sunset
View all the Allegheny County Parks' Trails on your mobile device.
Download on the App Store
GET IT ON Google Play
Legend
Court - Bocce
Court - Horseshoes
Court - Volleyball
Dog Park
Field - Multipurpose
Parking
Shelter
Wedding Site
Playgrounds
Restrooms
Water
Roadways
Service Road
Building
Wooded Areas
Open Space
Trails*
Red . . . . . 1.1 mi | Moderate-Difficult
Orange . . . 2.9 mi | Moderate
Yellow . . . . 1.6 mi | Moderate-Difficult
Green . . . . 2.9 mi | Moderate
White . . . . 0.5 mi | Moderate
Unblazed Trails
*Difficulty based on total elevation change
Call the Allegheny County Call Center for maintenance issues and general information at (412) 350-4636.
Chestnut
Beech
Sumac
Redwood
Cedar 2
Maple
Willow
Blue Spruce
Tulip Tree
Poplar
Cedar 1
Dogwood
Magnolia
Wedding Garden
Angora Gardens
Park Office
TRAIL COURTESY
YIELD TO
0 1,250 2,500 5,000 Feet
0 0.25 0.5 1 Miles
Revision December 2021

SECTION I - ECOLOGICAL OVERVIEW:

1.1 ECOLOGICAL OVERVIEW

This section provides an overview of the ecology of White Oak Park. The state of ecosystems today in the park is due to the interaction of the basic environmental conditions in the park; the plants, animals and other living organisms that inhabit our region; and the land management activities of people. Allegheny County's Ecological Heritage provides a background for understanding White Oak Park natural communities in a regional context, while Land Use and Ecological History of White Oak Park describes the ways in which human activities have affected the development of natural communities in the park. The state of the natural communities is the result of historic land-use, most notably surface mining and agriculture. Soils and geology are the foundations of the web of life, providing nutrients and shaping growing conditions for plants, which are the base of the food chain. The Geology and Soils sections below describe these features of the park in more detail.

At White Oak Park, about 85% of the park area is in natural condition (not developed or actively managed), while 15% is managed and maintained for more intensive recreational uses like picnic groves, playgrounds, and sports fields. The character of the area in natural condition is primarily determined by past land use. About 40% of the area in natural condition was never tilled or mined, and has been continuously forested since the earliest available aerial photographs, dated 1939. These areas today have mature forest communities, and should be a special focus for management to maintain and enhance their diversity and integrity. This area corresponds to the forest rated "best" ecological integrity within the park.

About 60% (404 acres) of the area currently in natural cover was previously cleared, mostly for agriculture, although 60 acres were strip mined. These areas today contain forests that are characterized as "modified successional" or "early successional" depending on their maturity. When land uses entail soil turnover and complete removal of living forest plant material and seed banks, the forest communities that regenerate post-disturbance are typically much lower in diversity than undisturbed natural communities, and include few "conservative" forest species. If the regeneration occurred in the last 3-4 decades, rather than earlier, it is likely that invasive non-native species have high cover, due to the general ubiquity of invasive species seed in that timeframe. In White Oak Park, the post-clearance land in natural cover has a range of ecological condition today; 10% is rated "good" ecological integrity, 43% is rated "Ok," and 47% is rated "poor". The areas that were previously mined also have some visible topographical disturbances remaining from the mining.

1.2 ALLEGHENY COUNTY'S ECOLOGICAL HERITAGE

This region's natural ecosystems have developed over tens of thousands of years. Further south, the Southern Appalachian Mountains are one of the world's biodiversity hot spots, in part because of a hospitable climate and in part because ecological development was never reset by glaciation. Southwestern Pennsylvania is at the northern edge of this bioregion; the character and diversity of its plant and animal life show both an Appalachian and Midwestern influence, and it is markedly different than previously glaciated ecosystems just a short distance to the north. Southern influences extend into Allegheny County in particular because of the moderate climates along the major river corridors: the Ohio, Allegheny, Monongahela, and Youghiogheny. White Oak Park's natural communities show a moderate influence of mesic southern flora.

There are no detailed descriptions of the region's ecosystems preserved before about 1900. Historical ecological assessment techniques such as pollen analysis conducted in other areas of the northeast show that significant ecosystem changes were set in motion in the 1600 and 1700s by the arrival of Europeans

Mature Successional Forest within White Oak Park

and the decimation of Native American societies, who had influenced and managed natural landscapes for several thousand years previous to the arrival of European colonists. Furthermore, by the early 1900s, clearcutting for agricultural development and timber sale was already well advanced in the region, and early documentarians could only assess the remaining forest areas. However, despite these limitations, their work remains the best reference we have available for the original character of our region's forest ecosystems.

In the early 1900s, E. Lucy Braun catalogued the natural forest ecosystems of eastern North America, in a definitive work that can never be replicated because these systems have been so extensively altered in the years since. She placed southwestern Pennsylvania within the Cumberland and Allegheny Plateaus section of the original Mixed Mesophytic forest region (Braun, 1950). This region extends from northern Alabama to glaciated northeastern Pennsylvania; Allegheny County is at the far northern end. The Mixed Mesophytic Forest is characterized by an exceptionally diverse tree canopy, and by a rich Appalachian-influenced herbaceous layer. Dominant species of the climax forest in this region are the American beech (*Fagus grandifolia*), tulip tree (*Liriodendron tulipifera*), basswood (*Tilia sp.*), sugar maple (*Acer saccharum*), American chestnut (*Castanea dentata*), sweet buckeye (*Aesculus octandra*), red oak (*Quercus rubra*), white oak (*Q. alba*), and hemlock (*Tsuga canadensis*). According to Braun's work, Allegheny County lies within a subdivision of this region called the Low Hills Belt, characterized by a larger proportion of oak than is typical for Mixed Mesophytic Forest. White Oak Park includes one small area classified as mesophytic forest, but it is in very poor condition and does not show the expected diversity for this community.

Otto Jennings of the Carnegie Museum of Natural History also wrote pioneering baseline ecological descriptions for the region in the early 1900s. He described two forest types for the region, a "White Oak Association" and a "Sugar maple – Beech Association". The White Oak Association is found on rolling uplands and rounded hills, and it is dominated by white oak, shagbark hickory, red maple, and other oak species. The Sugar maple – Beech Association is found on richer, moister soils such as floodplains, valleys, and lower slopes, and the canopy dominants are sugar maple, American beech, hickories (*Carya spp.*), red oak, white oak, white ash (*Fraxinus americana*), and American basswood. This characterization describes the pattern of community types seen at White Oak Park well, with the Sugar maple – Beech Association corresponding to the modern "Tuliptree – beech – maple forest" community type, and the White Oak Association corresponding to several oak-dominated community types (see Community Types section for more information).

In the last few centuries, since European colonization, this ecological baseline has undergone unprecedented changes; today's landscape reflects both the rich ecological heritage of the region, and the impact of many modern

challenges such as forest pests, fragmentation, invasive species, and post-agricultural forest recovery. Tree species that were once a ubiquitous part of our region's forests, such as the American chestnut, American elm, white ash, and green ash, have been eliminated or greatly reduced in our forests by the introduction of exotic forest pests and diseases. More species may still be lost; oak species, hemlock, and American beech are threatened by the gypsy moth, hemlock wooly adelgid, and beech bark disease complex, respectively. Invasive plant species have been introduced that are displacing native species on a large scale. Excessive deer browse is also a modern problem that threatens forest regeneration and diversity, as deer were previously held in check by keystone predators such as wolves. At White Oak Park, long term excessive browse appears to have greatly diminished the diversity and cover of native species. Our challenge in landscapes such as the Allegheny County Parks is to safeguard and improve the health of our remaining natural diversity, and to restore ecological health where it has been impaired.

Mature Successional Forest within White Oak Park

1.3 LAND USE & ECOLOGICAL HISTORY OF WHITE OAK PARK

We examined historic aerial photos (Penn Pilot 2021) of White Oak Park. Historic aerial photos from 1939, 1956, and 1967 were georeferenced in ArcPro. Modern aerial photos (ESRI basemap imagery 2020) were used to make inferences about current land use practices and natural community composition.

By 1939, about 60% of the park area had been cleared for agriculture, mostly on the hilltop and ridge areas, which tend to be flatter than the slopes and valleys (Figure 1)**.** Most steep slopes and tributary valleys remained at least partially forested (either mature forest or successional forest).

By 1956, some areas that were clear in 1939 had regenerated forest cover (Figure 2); most of these areas today are classified as "Ok" ecological integrity, in slightly better condition than the forests that regenerated later. Signs of strip mining are visible in the aerial photo as well; the southern end of the park has bright, clear areas while the northern end has narrow cleared areas, either mined earlier and now partially restored, or only partially developed at this time.

By 1967, regenerating forest can be seen in more of the previously cleared areas (Figure 3). However, many of the cleared areas are still open, showing that regrowth did not begin until after this time, possibly when the park was created (within a few years of the 1967 photo). These most recently regenerated forest areas have relatively poor ecological integrity; they probably regenerated slowly as tree propagules spread across the landscape after the end of maintenance activities. They have a higher proportion of invasive species, which may be because they were in a more open, early-successional state when seed source of these species began to be introduced to the area.

FIGURE 1

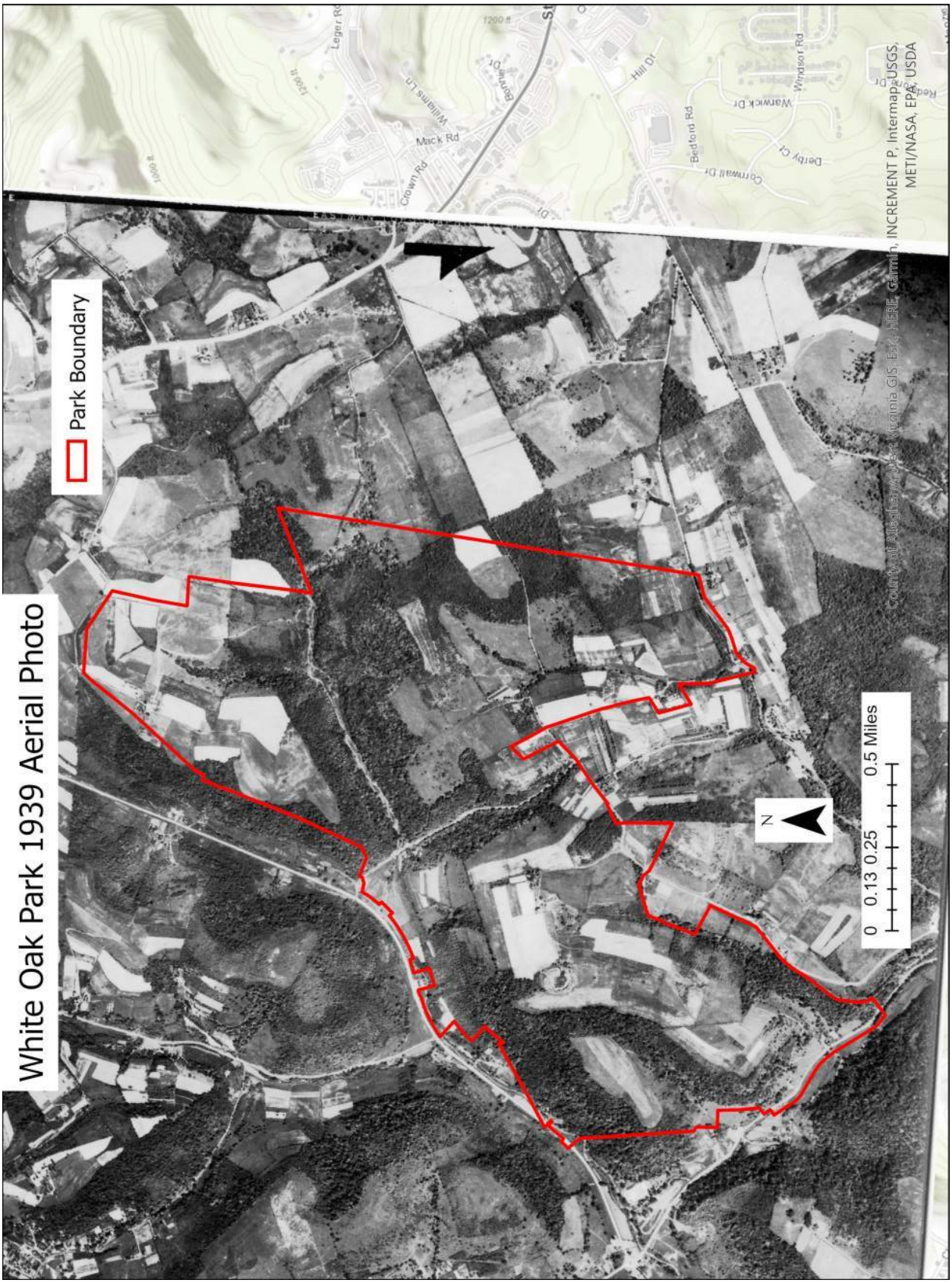

White Oak Park 1939 Aerial Photo
Park Boundary
N
0 0.13 0.25 0.5 Miles
Mack Rd
Crown Rd
Hill Dr
Bedford Rd
Warwick Dr
Windsor Rd
Derby Ct
Cornwall Dr
Bertrand Dr
Williams Ln
Leger Rd
1200 ft
1000 ft
County of Allegheny, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

FIGURE 2

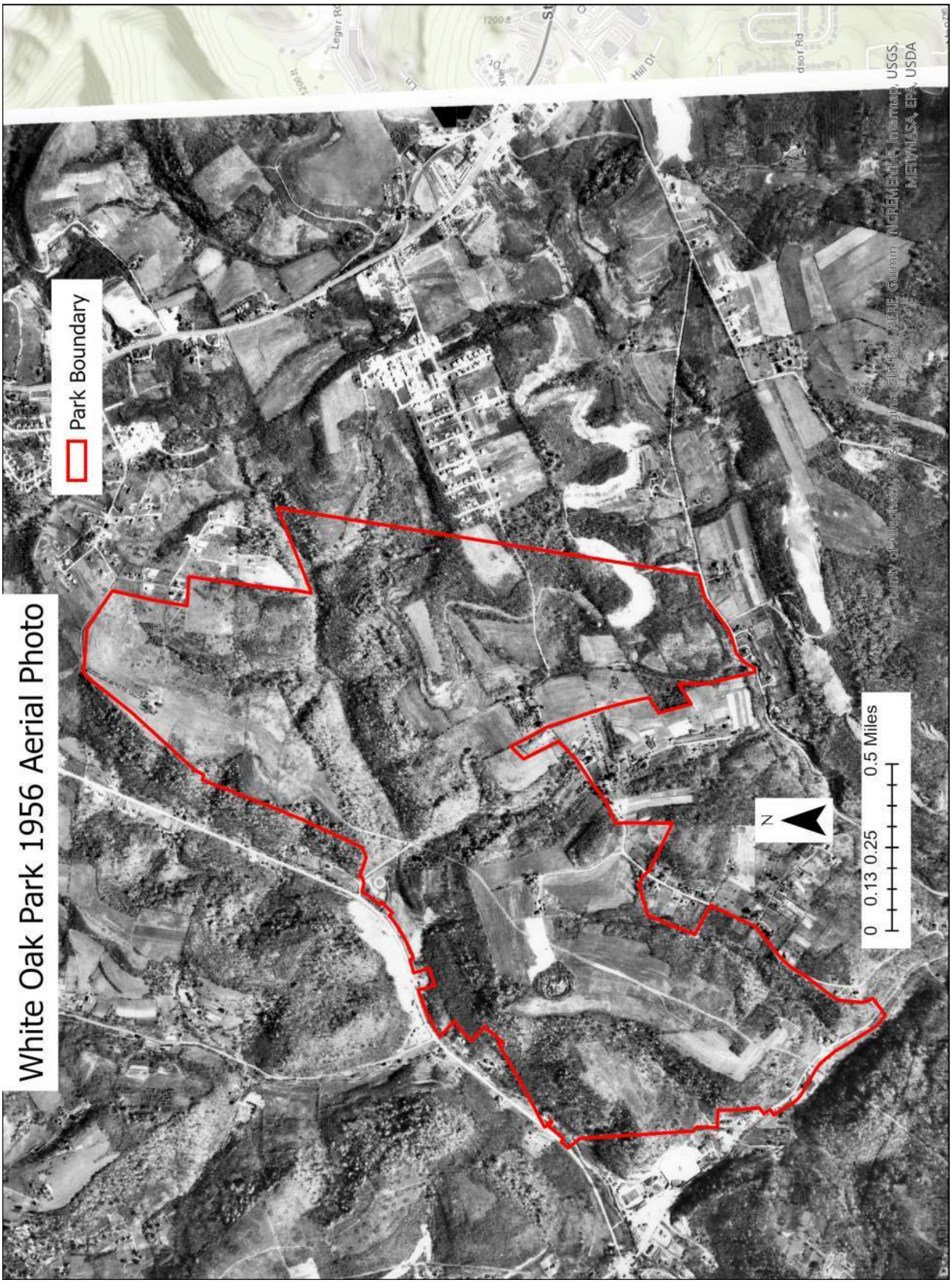
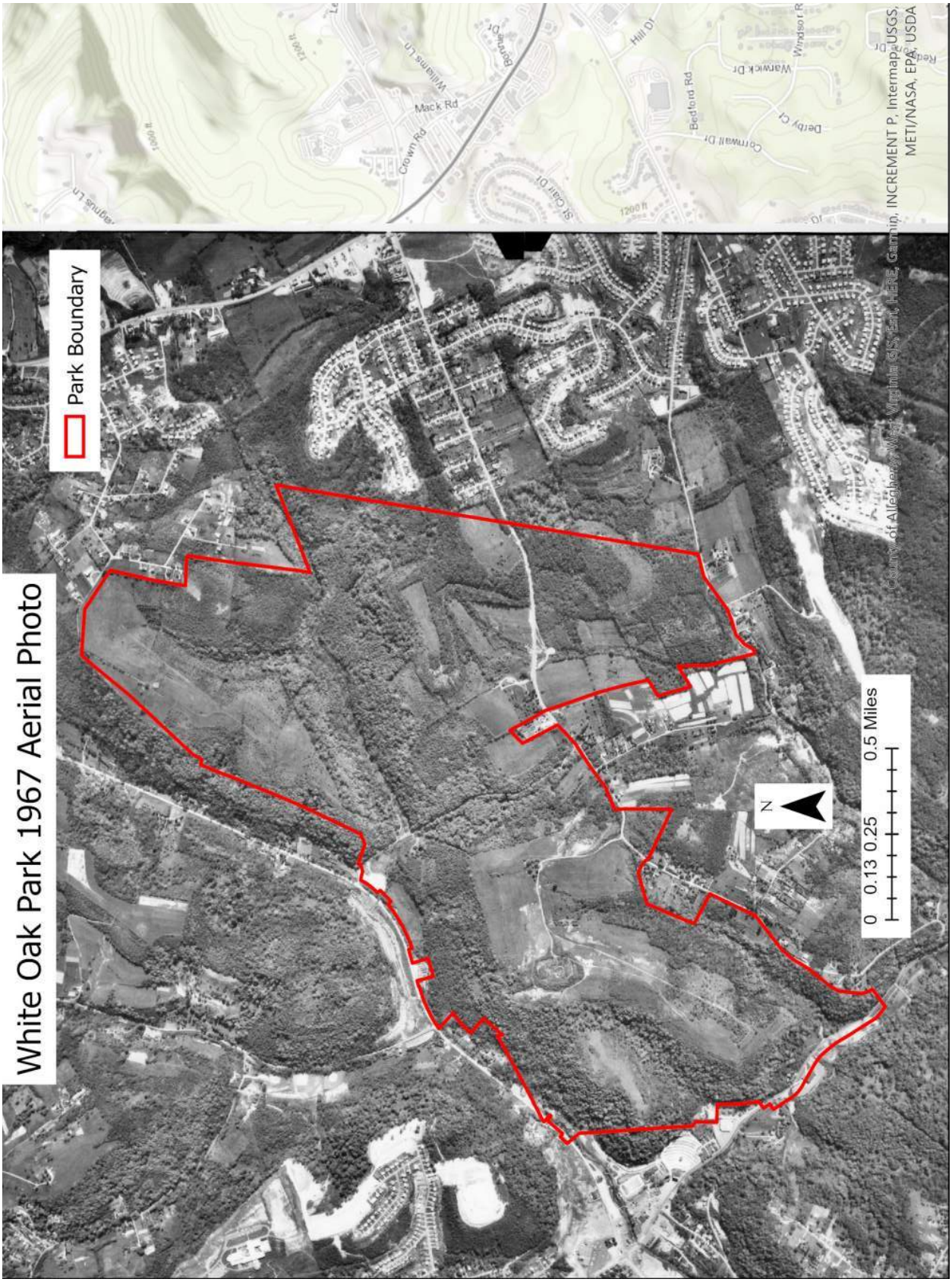

White Oak Park 1956 Aerial Photo
Park Boundary
N
0 0.13 0.25 0.5 Miles
Hill Dr
dson Rd
1200 ft
Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

FIGURE 3


White Oak Park 1967 Aerial Photo
Park Boundary
N
0 0.13 0.25 0.5 Miles
County of Allegheny, West Virginia GIS, esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA
Mack Rd
Crown Rd
Bedford Rd
Warwick Dr
Derby Ct
Hill Dr

1.4 GEOLOGY

Surface geology refers to the bedrock layers closest to the surface of the earth. Bedrock is the foundation material for soil, and also greatly influences the chemistry of water bodies such as streams, rivers, and lakes. Surface geology can be a determining factor in the diversity of plant life on land, and animal life in streams and lakes.

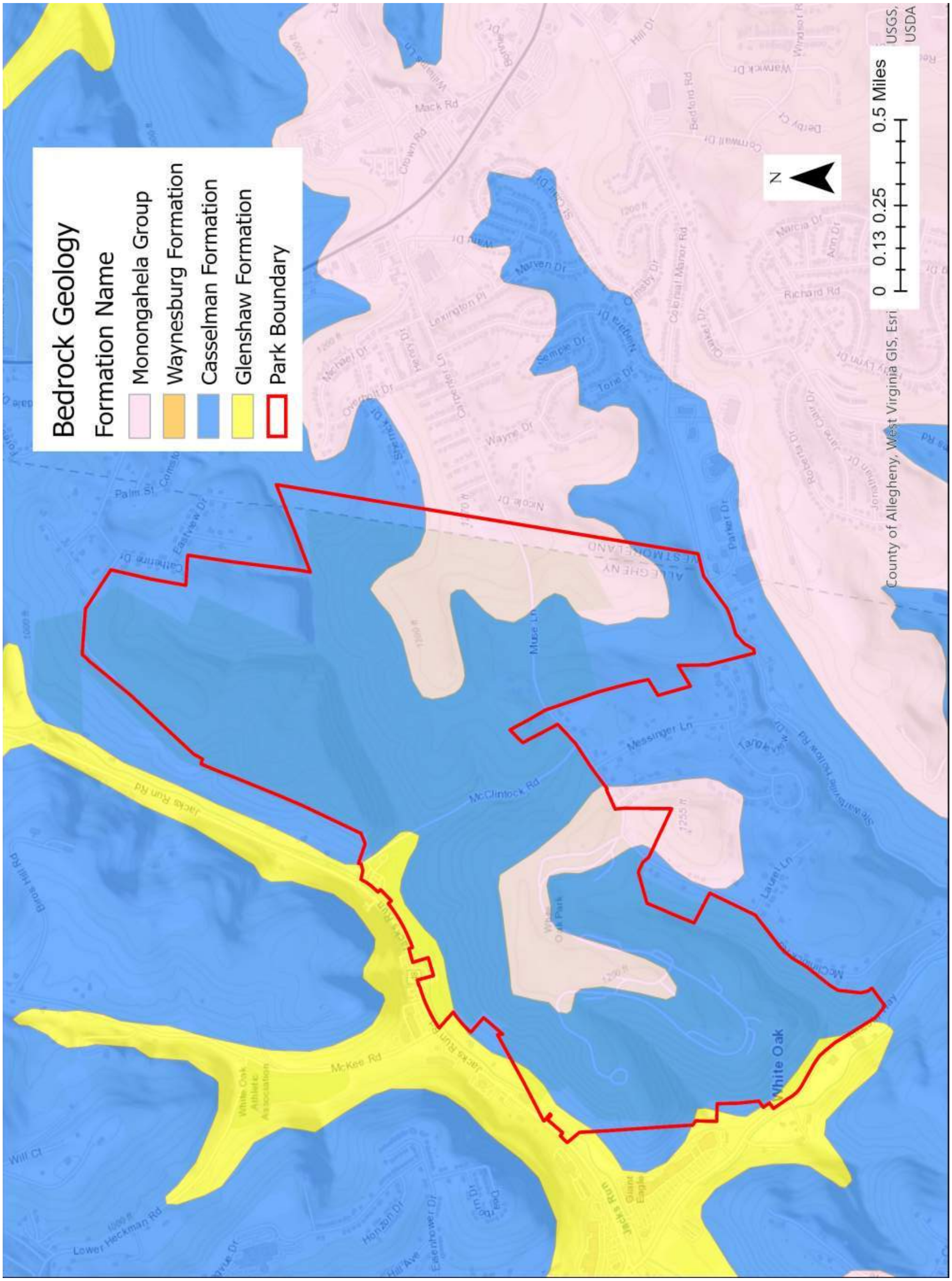
Pennsylvania is divided into physiographic regions based on landforms and geological history. White Oak Park is located in the Pittsburgh Low Plateau section of the Appalachian Plateau province, characterized by low rolling hills that formed by the gradual erosion of stream valleys, rather than the tectonic upheavals that formed the Allegheny and Appalachian ranges. In this region, the surface geology layers were formed through sedimentary processes, and they have not been extensively folded by subsequent tectonic activity; today they lie horizontally or gently undulate over large distances. The Pittsburgh Low Plateau is within the unglaciated portion of the Appalachian Plateau province.

Geologists classify rock layers into groups and formations based on the time period in which they formed. Formations are also described according to their mineral composition, which greatly influences soil materials and plant life. The surface geology of White Oak Park is mostly the Casselman Formation, with some areas of Monongahela formation, and Glenshaw formation just along the perimeter of the park along Jack's Run Road and Lincoln Way (Figure 4)**.** The Casselman formation consists of layers of primarily shale, with lesser areas of siltstone, sandstone, limestone, and coal. These materials are for the most part neither excessively calcareous or acidic, and the formation does not create a distinctive influence on plant communities.

The Glenshaw Formation is primarily shale layers, with lesser areas of sandstone, limestone, and coal. However, there is a fairly thick band of calcareous materials called the Ames limestone that occurs at the boundary between the Glenshaw and Casselman formations. This corresponds with a forested slope in the very western edge of the park that had highly calcareous soils present, and better diversity and regeneration of conservative wildflower species than most other forested areas. It may be that the high mineral content of the soil offers additional support to these species, allowing them to better withstand deer browse.

The Monongahela Group consists of many layers of limestone, shale, sandstone, and coal. It has a fairly high proportion of calcareous materials, because some of the limestone layers are relatively thick, and some of the sandstone and shale layers are also calcareous. These calcareous materials in turn influence the calcium content and pH of the soil. In some areas, the Monongahela

FIGURE 4


Bedrock Geology
Formation Name
Monongahela Group
Waynesburg Formation
Casselman Formation
Glenshaw Formation
Park Boundary
N
0 0.13 0.25 0.5 Miles
County of Allegheny, West Virginia GIS, Esri, USGS, USDA

formation contributes a strong influence on the plant communities present and facilitates the presence of high-pH specialists, but this is not evident in White Oak Park. Because calcium dissolves readily in water, and leaches out of soils quickly, the influence of calcareous bedrock materials is strongest on slopes, where erosion removes surface materials and exposes new bedrock relatively quickly (Ciolkosz et al. 1995; Bennie et al. 2006). In White Oak Park, the Monongahela formation underlies relatively flat hilltop areas, some of which are currently in non-forest use. Furthermore, some of the area underlain by Monongahela geology was disturbed by strip mining, which appears to have followed the fairly large and economically important coal seam within this formation, the Pittsburgh Coal. Sometimes mining of the Monogahela exposes some calcareous elements, and calcareous flora is observed on the periphery; this may be the case with the glade fern population in White Oak Park.

1.5 SOILS

Soil types vary according to topographic position (USGS 1981). The lowest topographic positions, along the floodplains of major stream channels, have Newark silt loam soils. Gilpin, Weikert, and Culleoka channery silt loam (a map unit including several undifferentiated types) is found on lower slopes, often adjacent to the Newark silt loams of the floodplains. Dormont Silt Loams are another major soil type in the park, found on lower to mid-slope positions, adjacent to and upslope of the Gilpin-Weikert-Culleoka type. Culleoka channery silt loams and Culleoka-Weikert channery silt loams are found on upper slopes and ridgetops.

Drainage in these soils ranges from moderately well drained to well drained. Because soil types correspond to topography, they also correspond to categories of natural communities documented at Settlers Cabin. Mature forests, found mostly in mid to low slopes surrounding streams, and are associated with Gilpin, Weikert, and Culleoka complex. Some mature slope forests are also found on Dormont soils. Successional communities are extensive in the park across a variety of topographic settings, and found on all of the park's major soil types. Interpreting the association between soils and natural communities, with the exception of successional communities in strip mined areas, should be approached with caution. In this setting, natural communities are more likely associated with disturbance history, aspect, and slope, rather than soil types.

1.6 OLD GROWTH TREES AND FOREST AT WHITE OAK PARK

White Oak Park has a large area of mature forest, and in some areas this includes some spectacular trees of exceptional size and girth. They may or may not be classified as "Old-Growth", depending on the definition used. Some define old growth in comparison to a tree species' average lifespan (which these trees might qualify under), while other definitions require a tree to have been alive before European settlement (Davis 1996), which is less likely for these trees.

The ages of the exceptionally large trees cannot be determined conclusively without coring them. Depending on site conditions, trees of the same size can be vastly different in age. At a poor site where soil and climate inhibit growth, a 6" wide tree of a slow-growing species might be 150 years old, whereas a fast-growing species at a site with high light with abundant nutrients and water might be 2 1/2' wide at just 75 years old. Most of the places we observed large trees in White Oak appear to be rich sites, with abundant moisture and nutrients in the soil, that would facilitate trees reaching larger sizes at a younger age. However, the size of these trees is certainly larger than what one usually finds in similar sites.

Large Birch Tree in the Mature Forest at White Oak Park

Some additional evidence suggests inferences about the trees' history. Many of the very large trees at White Oak show signs of having been open-grown (grown up without neighbors, having a broader crown with lower branching than usual), which would indicate they are second-growth after an early cut, rather than original forest. The exceptionally large trees were also mostly not "climax" forest species, ie ones that reproduce despite a closed canopy. Many are tuliptree and various oaks, which often re-grow quickly after a cut or fire. Seeing large oaks in a canopy and smaller sugar maples in a sub-canopy layer beneath it (as we do in some areas of White Oak) suggests the area was cut, and the

1.7 CONSERVATIVE PLANT SPECIES OF WHITE OAK PARK

The following table lists plant species found in White Oak Park that require intact natural habitats with little disturbance. The “Coefficient of Conservatism” is a rating developed to estimate how strongly a plant requires such a habitat; a species rated “10” will almost never be found outside of a very intact natural habitat, while a species rated “1” can easily colonize disturbed areas. The presence of species rated “5” or above can serve as a guide to indicate good quality natural habitats (Swink and Wilhelm 1994). They are also important conservation targets because many of the species rated “6” or above generally re-establish extremely slowly once lost (this is especially true for herbaceous species, less so for woody species).Some natural habitats depend on natural disturbances, such as floodplains or fire. Although species that inhabit these ecosystems generally have low coefficients of conservatism, this does not diminish their ecological importance.

Despite the evidence of long-term overbrowsing by white-tailed deer, which has left many local areas with sparse native herb layers, when all species found in the park are combined, White Oak Park has considerable richness of conservative plant species compared to other parks. This is due to the range of geological conditions in the park, which includes some calcareous areas, and the range of habitat types, from floodplains and seeps to dry, rocky upper slopes. However, many conservative species have small populations in the park, and may be present at only one or a few scattered locations. If steps are not taken to curb overbrowsing, actively protect and even restore some of the smallest populations, and to manage invasive species, some of these species may be lost within a decade.

Scientific Name	**Common Name**	**C - Value**	**Growth Form**
Cardamine rotundifolia	Mountain watercress	8	herb
Carex albursina	Sedge	8	herb
Carex platyphylla	Broad-leaf sedge	8	herb
Carex prasina	Sedge	8	herb
Diplazium pycnocarpon	Narrow-leaved glade fern	8	herb
Gaultheria procumbens	Teaberry	8	herb
Panax quinquefolius	Ginseng	8	herb
Phlox divaricata	Woodland phlox	8	herb
Rubus pubescens	Dwarf blackberry	8	herb
Trillium grandiflorum	Large-flowered trillium	8	herb
Tsuga canadensis	Canada hemlock	8	tree
Acer nigrum	Black maple	7	tree
Adiantum pedatum	Northern maidenhair	7	herb
Allium tricoccum	Ramp	7	herb
Arabis laevigata	Smooth rockcress	7	herb
Asarum canadense	Wild ginger	7	herb
Cardamine diphylla	Two-leaved toothwort	7	herb
Carex leptonervia	Sedge	7	herb
Caulophyllum thalictroides	Blue cohosh	7	herb
Claytonia caroliniana	Carolina spring-beauty	7	herb
Deparia acrostichoides	Silvery glade fern	7	herb
Juglans cinerea	Butternut	7	tree
Medeola virginiana	Indian cucumber-root	7	herb
Ostrya virginiana	Hop-hornbeam	7	tree
Phegopteris hexagonoptera	Broad beech fern	7	herb
Polygonatum biflorum	Solomon's seal	7	herb
Quercus coccinea	Scarlet oak	7	tree
Quercus montana	Chestnut oak	7	tree
Quercus shumardii	Shumard oak	7	tree
Solidago flexicaulis	Zigzag goldenrod	7	herb
Tilia americana	American basswood	7	tree
Trillium erectum	Purple trillium	7	herb
Viola pubescens	Hairy yellow forest violet	7	herb

Scientific Name	**Common Name**	**C - Value**	**Growth Form**
Acer saccharum	Sugar maple	6	tree
Actaea racemosa	Black snakeroot	6	herb
Amelanchier arborea	Shadbush	6	tree
Carex digitalis	Sedge	6	herb
Carpinus caroliniana	Hornbeam	6	tree
Carya glabra	Pignut hickory	6	tree
Carya ovalis	Red hickory	6	tree
Carya ovata	Shagbark hickory	6	tree
Dichanthelium acuminatum	Panic grass	6	herb
Dichanthelium boscii	Panic grass	6	herb
Dryopteris marginalis	Marginal wood fern	6	herb
Fagus grandifolia	American beech	6	tree
Festuca obtusa	Nodding fescue	6	herb
Galium circaezans	Wild licorice	6	her
Hydrangea arborescens	Sevenbark	6	shrub
Hydrophyllum canadense	Canadian waterleaf	6	herb
Hydrophyllum virginianum	Virginia waterleaf	6	herb
Morus rubra	Red mulberry	6	tree
Nyssa sylvatica	Sourgum	6	tree
Oxalis violacea	Violet wood-sorrel	6	herb
Packera obovata	Ragwort	6	herb
Paronychia canadensis	Forked chickweed	6	herb
Pinus strobus	Eastern white pine	6	tree
Polygonatum pubescens	Downy Solomon's seal	6	herb
Quercus alba	White oak	6	tree
Quercus rubra	Northern red oak	6	tree
Quercus velutina	Black oak	6	tree
Rosa carolina	Pasture rose	6	shrub
Sedum ternatum	Wild stonecrop	6	herb
Silene stellata	Starry campion	6	herb
Solidago caesia	Bluestem goldenrod	6	herb
Vaccinium pallidum	Lowbush blueberry	6	shrub

Scientific Name	Common Name	C - Value	Growth Form
Viburnum acerifolium	Maple-leaved viburnum	6	shrub
Acer saccharinum	Silver maple	5	tree
Arisaema triphyllum	Jack-in-the-pulpit	5	herb
Asclepias incarnata	Swamp milkweed	5	herb
Asimina triloba	Pawpaw	5	tree
Athyrium filix-femina	Lady fern	5	herb
Athyrium filix-femina var. asplenioides	Southern lady fern	5	herb
Betula lenta	Black birch	5	tree
Cardamine concatenata	Toothwort	5	herb
Carex pensylvanica	Sedge	5	herb
Carya cordiformis	Bitternut hickory	5	tree
Castanea dentata	American chestnut	5	tree
Claytonia virginica	Spring-beauty	5	herb
Cystopteris protrusa	Protruding bladder fern	5	herb
Dioscorea villosa	Wild yam	5	herb
Dryopteris intermedia	Evergreen wood-fern	5	herb
Eurybia divaricata	White wood aster	5	herb
Floerkea proserpinacoides	False-mermaid	5	herb
Fraxinus americana	White ash	5	tree
Geranium maculatum	Wood geranium	5	herb
Geum laciniatum	Herb-bennet	5	herb
Glyceria striata	Fowl mannagrass	5	herb
Hamamelis virginiana	Witch-hazel	5	shrub
Heracleum lanatum	Cow-parsnip	5	herb
Laportea canadensis	Wood-nettle	5	herb
Lindera benzoin	Spicebush	5	herb
Liriodendron tulipifera	Tuliptree	5	tree
Maianthemum racemosum	False solomon's-seal	5	herb
Osmorhiza claytonii	Sweet-cicely	5	herb
Osmorhiza longistylis	Anise root	5	herb
Platanus occidentalis	Sycamore	5	tree
Podophyllum peltatum	Mayapple	5	herb

Scientific Name	**Common Name**	**C - Value**	**Growth Form**
Polystichum acrostichoides	Christmas fern	5	herb
Quercus palustris	Pin oak	5	tree
Sanguinaria canadensis	Bloodroot	5	herb
Smilax hispida	Bristly greenbrier	5	vine
Symplocarpus foetidus	Skunk cabbage	5	herb
Thelypteris noveboracensis	New York fern	5	herb
Ulmus americana	American elm	5	tree
Viburnum prunifolium	Black-haw	5	shrub

Virginia Waterleaf
(Hydrophyllum virginianum)

Woodland Phlox (*Phlox divaricata*)

oaks regrew first, and the maples later (after the oak canopy was established). Beech and sugar maple would be examples of "climax" species and there are some large individuals of these species as well, though.

The prevalence of these very large trees in the park may indicate that cutting and forest recovery occurred earlier here than in many places, thus giving the trees more time to regrow and gain size. It may also indicate that the site is a very rich site, facilitating rapid tree growth.

In addition to referring to old and often magnificent-looking trees, old-growth forests have particular ecological traits arising from the lack of disturbance. These include the presence of conservative species, including many mosses and lichens; and the presence of structural characteristics such as tree hollows and downed wood. The forest ecosystems of the park where the large trees are present are not truly examples of these very intact systems; however, the presence of the large, aged trees does confer some of these characteristics, especially the structural ones, and that is very valuable for the wildlife that need them, such as bird species that nest in tree hollows. These trees are indeed a beautiful and unique ecological asset to the park, even if the answer to whether they are old growth depends on the definition used.

1.8 RARE SPECIES CONSERVATION AT WHITE OAK PARK

The park contains several populations of plant species and one species of animal that are rare in the state or region, or considered to be significant for their value as indicators of high-quality habitat. Conservation of these species should be a management priority. All of these species are found only in calcareous soils.

Red mulberry *(Morus rubra)*:

The red mulberry is a native species, distinct from the more common white mulberry (*Morus alba*) that was introduced from China and now often grows as a weed in city and suburban settings. The red mulberry is the only legally listed species known in the park, with a status of Pennsylvania Threatened.

Fruit color is not useful in distinguishing the native and non-native mulberry species, as both can have purple fruits; the "white"

Red Mulberry foliage within White Oak Park

mulberry commonly has purple fruit or white / pinkish-purple fruit, while the "red" mulberry exclusively has purple fruits. Red mulberry is a native subcanopy tree that was once more common along floodplains and rich hillsides, although never tremendously abundant. It appears to have declined dramatically in recent decades, potentially due to unknown disease agents (Ontario Ministry of Natural Resources 2013), and to hybridization with the white mulberry (Burgess et al. 2005).

In White Oak Park, one mature individual was observed in the Jack's Run East Tributary best ecological integrity area, and a seedling was observed in the Jack's Run Slopes best ecological integrity area.

Management Recommendations:

- Monitor trees for signs of decline due to disease.
- Provide a browse protection structure for the seedling, which showed signs of repeated browsing.

Paw paw *(Asimina triloba)*:

The paw paw is a forest understory tree that produces a tasty fruit. It has long been part of Native American diets and highly esteemed in rural Appalachia. It reaches the northern extent of its geographic range in Pennsylvania, becoming very scarce in the northern half of the state. It also indicates fairly rich, often calcareous soils. In the southern half of Pennsylvania, it is somewhat limited by relative scarcity of such habitats in good condition, but not so uncommon as to be legally listed. It also may be increasing due to an uptick in interest in the species resulting in some human-assisted propagation. Paw paw forms clonal stands which may all be a single genetic individual; however, they are not self-pollinating. Multiple genetic individuals must be present for fruit to set, and conversion of flowers to fruit can be naturally low even under those conditions. Male flowers sometimes occur on separate trees from female flowers, although plants can switch from producing one type of flower to the other, or produce both; in that case they are still not self-pollinating, though.

Management Recommendations:

- Observe trees to determine if they are setting fruit. If they are not, introduction of another genetic individual may facilitate fruit set.
- Paw paw are deer resistant due to the presence of bitter compounds in leaves and bark, and do not need special protection from browse.

Glade fern *(Diplazium pycnocarpon)*:

Glade fern is listed on the PNHP Watch List because it is fairly uncommon, and it is an indicator species for mesic calcareous forest habitat. It requires high-pH soil with a strong calcareous influence. There is one small population on the southern slope of the Jack's Run Eastern Tributary "best" ecological integrity area. The soil pH was very high at this location, pH 7.5.

Management Recommendations:

- Maintain overall forest cover and health around the population to reduce susceptibility to invasive species.
- Steward the local area to remove invasive species that might outcompete the glade fern. Glade fern is a fairly tall species and likely emerges early enough that it could remain competitive with Japanese stiltgrass, but it would not be competitive with Japanese knotweed or invasive shrubs like bush honeysuckles (*Lonicera spp*).
    - Monitor the Japanese stiltgrass periodically and assess whether the glade fern would benefit from reduction in stiltgrass cover.
    - Remove other species as they first establish, while small.

Glade Fern, located in the Mature Forest in White Oak Park

Ramps *(Allium tricoccum, Allium burdickii)*:

Ramps are a conservative species of rich mesic forest habitats; they are also an edible plant with great cultural significance in Appalachia. In recent years, culinary use of ramps has become more widespread, and harvesting for sale at farmers' markets and to restaurants has increased. However, the plant grows fairly slowly, taking 7 years to reach flowering maturity from seed. Although this species can sometime be found growing very abundantly in large patches, research (Rock et al 2004) has shown that only very modest harvesting is sustainable: 10% of the population every ten years (ie, with 9 years in between for recovery). This species is listed on the PNHP Watch List because of its cultural value and concern about overharvesting.

Although our Pennsylvania ramps have generally been viewed as a single species in the past (Allium tricoccum), research on populations further south has shown that there may actually be several distinct species. Local researchers are currently undertaking genetic and ecological studies of Pennsylvania ramps to determine what species we have and where they are distributed within the state. We observed two populations of ramps in White Oak Park, one of which fits the classic form of Allium tricoccum, and a second population that has different features and has been tentatively identified by ramps researchers as the less-common species narrow-leaved wild leek (Allium burdickii). The narrow-leaved wild leek has a more localized global range, centered in the Midwest; in Pennsylvania, is has only been found in the southwestern region of the state to date. It also appears to require more specific habitat conditions, which may be why it is much less common than ramps. It appears to require strongly calcareous soils and slightly drier conditions than ramps.

Management Recommendations:

- The population within the Jack's Run South Tributary ecological integrity area is downslope from a heavily used trail. While most visitors would likely be deterred by the steep slope, it may face harvest pressure, and it should be monitored for signs that plants are being dug up. The population in the Jack's Run Slope Ecological Integrity Area is remote and far from any trail, and likely does not face harvest pressure. At this time, it is also significantly more abundant in this area.
- Post generic signs in the park to encourage users to take only photographs and leave only footprints and to convey the message that harvesting any plant materials is not sustainable in a park with a large number of public users.
- The main other threat to this species is the expansion of invasive plant species in the stream ravine where it grows; see recommendations for stewardship of the Jack's Run South Tributary and Jack's Run Slope Ecological Integrity Areas.

Butternut *(Juglans cinerea)*:

The butternut, or white walnut, is a tree species related to the black walnut. It has declined greatly over the last several decades because of an butternut canker, a disease caused by an introduced fungus, and is now fairly rare. While the butternut was never extremely common, it had a regular presence in forests across a broad range of North America. "For over two centuries, North American butternut (*Juglans cinerea L.*) was cherished for its exceptional wood properties and was sought after for the manufacture of fine furniture, musical instruments, and boats (Woeste & Pijut, 2009). The species was also valued for its sweet, oily nuts that were desired by both Native Americans and European settlers and are also a source of large mast utilized by various wildlife species"(Morin et al. 2017). Research into butternut conservation is

ongoing, and suggests that there may be some degree of natural resistance to the fungal disease. Furthermore, butternut reproduction is inhibited in some settings because it requires open conditions with little competition to establish.

Management Recommendations:

- Surviving trees should not be cut down, even if they have signs of disease. The disease may infect resistant trees without killing them; death occurs when the disease causes girdling, and if the tree can contain the infection to prevent this from occurring it will survive even with damage. Exposure is likely already ubiquitous as the pathogen produces abundant spores distributed by wind (Parks et al. 2013).
- Investigate the potential to use resistant butternut (cuttings or seeds from surviving trees) in canopy gap restoration. Habitat requirements are fairly similar to white ash, which has recently died en masse and left canopy gaps that need active attention to prevent further forest decline.
- Some research indicates that comparatively higher, drier sites may enhance survival of butternut (Morin et al. 2017); while surviving trees are most often observed in floodplains in our areas, mesic upland sites should be considered for potential restoration attempts.

Butternut *(Juglans cinerea)*

Blue Crayfish *(Cambarus monongalensis)*:

This species has been found living in seeps in the Jack's Run East area. It is a burrowing crayfish, living most of its life in burrows that it creates rather than in streams. It is regionally endemic species that is so far only known from western Pennsylvania and West Virginia. It appears to require forested seepage wetlands for adequate habitat. Crayfish burrows can provide critical habitat for other species, as they are moist environments with somewhat stable temperatures that provide refuge from extreme heat and cold.

Management Recommendations:

- Maintain forest quality around seeps that occur in mature forest.

- Maintain water quality, including consideration of potential groundwater inputs to the seeps where the crayfish lives.

Round - leaf ragwort *(Packera obovata)*:

This species is included on the PNHP Watch List because it is an indicator of calcareous forest habitat, and because it is a larval host plant for a rare butterfly species. The caterpillar of the metalmark butterfly feeds exclusively on the round-leaf ragwort. It was found in one location within the park, on the eastern slope above Muse Lane near the entrance of the park.
The metalmark butterfly is much less common than the round-leaf ragwort, so most plant populations will not have associated metalmark butterfly populations. However, documenting locations of decent sized populations of the host plant may help butterfly researchers to locate additional butterfly populations and to understand the distribution of potential habitat in the state. The plant is also a nice indicator of quality forest conditions, and is presence is correlated with higher species diversity.

Management Recommendations:

- The main threat to this species is the spread of invasive species in the areas where it lives. Refer to invasive management recommendations for the Jack's Run East Best Ecological Integrity Area, where this species is found.

Round Leaf Ragwort *(Packera obovata)*

1.9 PLANT COMMUNITY TYPES AT WHITE OAK PARK

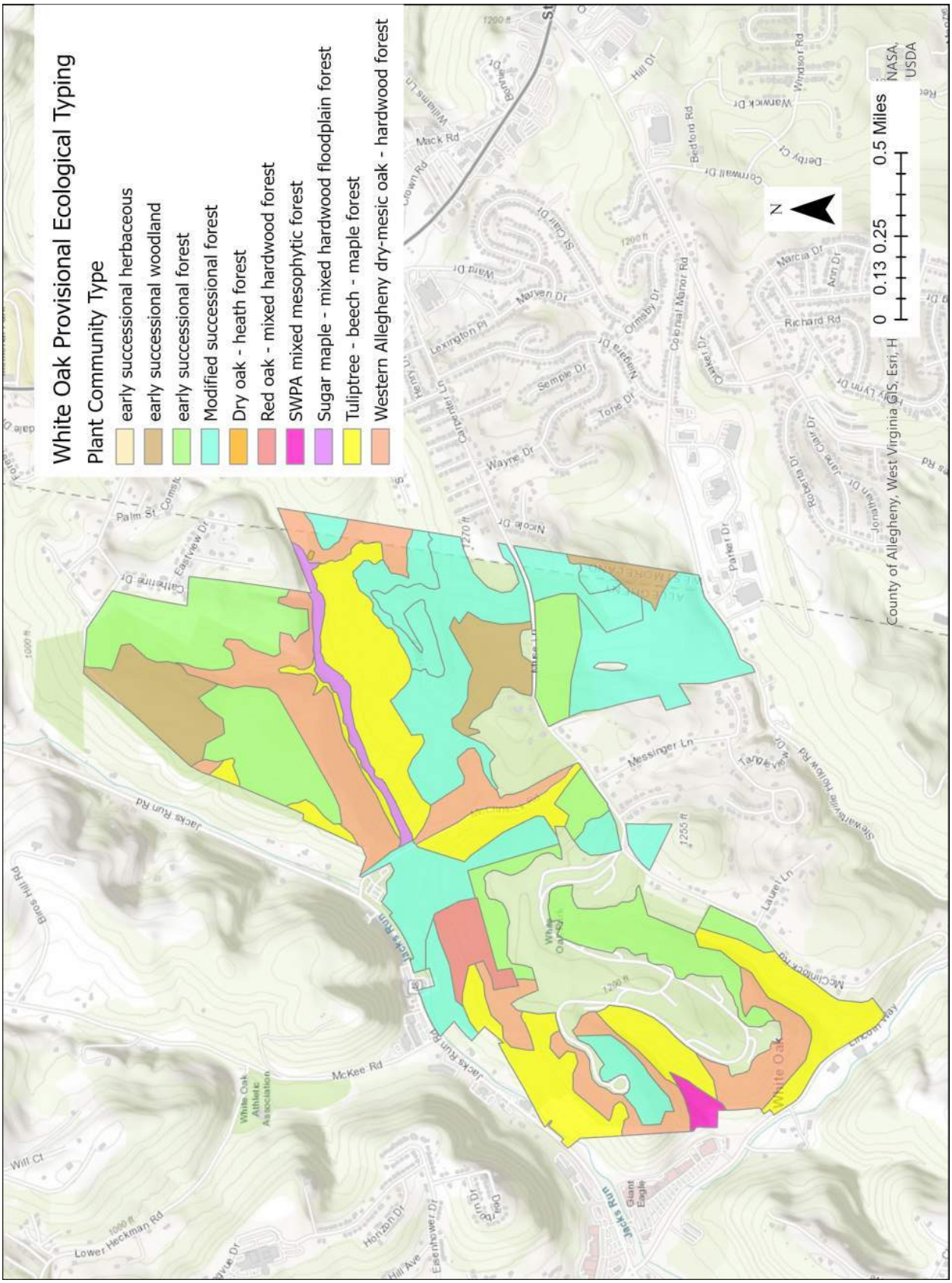
Community types are assigned using the Pennsylvania Natural Heritage Program's plant community classification system and the U.S. National Vegetation Classification When possible, community types were assigned using the Pennsylvania Natural Heritage Program's plant community classification system (PNHP 2018). In certain situations, we utilized the National Vegetation Classification (USNVC 2018) if a similar, but more accurate community type was available for natural or successional communities at Settlers Cabin park. There were many successional types that were not easily classified by the Pennsylvania or Natureserve classifications, and are closely associated with disturbance history; we have done our best to summarize the conditions and composition of these successional communities in their own section below. There were also park-specific types (both natural communities and successional communities), not part of the Pennsylvania classification and with no clear Natureserve analog. These park-specific types may be part of a mosaic of natural or successional communities, or may represent a variant of a natural community that results from disturbance history or regional botanical composition.

1.9.1: TERRESTRIAL COMMUNITIES - Western Allegheny Dry-Mesic Oak - Hardwood Forest:

This community was found on south and west facing dry-mesic slopes in White Oak Park. The canopy typically includes black oak (*Quercus velutina*), red oak (*Quercus rubra*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), black birch (*Betula lenta*), sassafras (*Sassafras albidum*), and scarlet oak (*Quercus coccinea*); subcanopy trees may include American hop-hornbeam (*Ostrya virginiana*), serviceberry (*Amelanchier arborea*), and flowering dogwood (*Cornus florida*).

Black oak (*Quercus velutina*) in Whte Oak Park

FIGURE 5


White Oak Provisional Ecological Typing
Plant Community Type
early successional herbaceous
early successional woodland
early successional forest
Modified successional forest
Dry oak - heath forest
Red oak - mixed hardwood forest
SWPA mixed mesophytic forest
Sugar maple - mixed hardwood floodplain forest
Tuliptree - beech - maple forest
Western Allegheny dry-mesic oak - hardwood forest
0 0.13 0.25 0.5 Miles
N
NASA, USDA
County of Allegheny, West Virginia GIS, Esri, H
Jacks Run Rd
McKee Rd
Messinger Ln
Parker Dr
Wayne Dr
Richard Rd
Colonial Manor Rd
Mack Rd
Lower Heckman Rd
Laurel Ln
White Oak
Giant Eagle

Red Oak - Mixed Hardwood Forest:

We documented this community type in midslope positions in White Oak Park. This community type is typically in intermediate positions between low-slope mesic communities (sugar maple floodplain forest or tuliptree – beech – maple forest types) and upper-slope dry oak – mixed hardwood communities. Red oak is a canopy dominant; the community is further characterized by the presence of a sometimes quite diverse canopy that includes both mesic and dry-mesic species, such as: black oak (*Quercus velutina*), white oak, shagbark hickory (*C. ovata*), red maple, black maple (*A. nigrum*), slippery elm (*Ulmus rubra*), black birch (*Betula lenta*), white oak (*Quercus alba*), black cherry, tuliptree (*Liriodendron tulipifera*), Sassafras (*Sassifras albidum*), and beech (*Fagus americana*). The shrub layer includes spicebush (*Lindera benzoin*), witch hazel (*Hamamelis virginiana*), and alternative-leaved dogwood (*Cornus alternifolia*). Typical herbaceous species include mayapple (*Podophyllum peltatum*), Christmas fern (*Polystichum acrostichoides*), intermediate wood fern (*Dryopteris intermedia*), marginal wood fern (*Dryopteris marginalis*), and sweet-scented bedstraw (*Galium triflorum*). The herbaceous layer can contain rich indicators, but at White Oak tended to be lower-diversity in the instances of this community type at White Oak Park, most likely due to long-term overgrazing.

Sugar Maple - Basswood Forest:

This type was documented in mid-slope positions and in stream ravines within the park, most often on north- and east-facing slopes. It is one of several mesic forest community types found in the park. The canopy typically is dominated by sugar maple, with basswood also present. While there may be a variety of other species present, it is distinguished from the Mixed Mesophytic Forest community by a lower overall canopy diversity. Some of the mid-slope forests in the park are mainly dominated by sugar and/or black maple, with little basswood component, but are classified with this type due to lack of a better fit elsewhere. Typically, this community has a fairly rich herbaceous layer, although this is diminished in many examples by disturbance or deer browse. The examples in White Oak Park are moderately diverse, including species such as lady fern (*Athyrium felix-femina*), striped violet (*Viola striata*), mayapple, shining fescue (*Festuca obtusa*), zigzag goldenrod (*Solidago flexicaulis*), a sedge (*Carex gracillema*), and bloodroot (*Sanguinaria canadensis*). See the descriptions of the “Douglass Run Slopes” and “Northern Park Slopes” areas for more detail on the examples of this type in the park.

Tuliptree - Beech - Maple Forest:

This is a mesic forest type found in one of the fairly intact ravines of the park. It is characterized by a canopy including sugar maple, American beech, and tuliptree all in significant proportions. Typically the herbecous layer is fairly rich. The park example is found in the "Southern Mesic Ravine" area; see description for more detail.

Tuliptree Sapling at White Oak Park

Southwestern Pennsylvania Mixed Mesophytic Forest:

This is a mesic forest type found in the two stream ravines that also contain large tufa formations (the "Middle Tufa Ravine" and the "Northern Tufa ravine" areas). It is an Appalachian forest type that reaches its northern-most extent in Pennsylvania. Although our examples do not have the extreme diversity of this type further south, it is still one of the most diverse forest types found in Pennsylvania. It is characterized by a great diversity of species in the canopy, which many include sugar maple, basswood, American elm and/or slippery elm, red oak, black walnut, butternut (*Juglans cinerea*), hackberry, bitternut hickory and/or shagbark hickory, and red mulberry (*Morus rubra*). The herbaceous layers are typically very rich, with many conservative species, as well. In Pennsylvania this forest type is usually found on soils of fairly high pH, as is true in White Oak Park. Within the park, these communities contain exceptional herbaceous diversity, including some species not found elsewhere in the park.

1.9.2: PALUSTRINE COMMUNITIES:

Sugar Maple - Mixed Hardwood Floodplain Forest

This type typically occurs on small to medium size tributaries of the Ohio River Basin. At White Oak Park, Sugar maple – mixed hardwood floodplain forests were documented in floodplain along Douglass Run and at the base of a small tributary hollow that feeds into it. The examples of this type in the park are not in pristine condition, influenced by past and present disturbance and fairly small in extent, but the community is recognizable. It is similar to the sugar maple – basswood forest, but also includes riparian and wetland species such as American sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), and black walnut (*Juglans nigra*) skunk cabbage (*Symplocarpus foetidus*), and wood nettle (*Laportea canadensis*).

Seepage Wetlands

There are several small seepage wetlands on floodplain terraces, floodplain / slope interfaces, and mid-slope areas in White Oak Park. As with other communities in the park, these generally do not have the expected level of herbaceous density and diversity, probably due to deer browse. Some of these on floodplains match the skunk cabbage – golden saxifrage seep community description; others would not, but seep community types are not yet fully developed, so we are generically referring to them as "seepage wetlands." Typical species of floodplain seeps include wingstem (*Verbesina alternifolia*), skunk cabbage (*Symplocarpus foetidus*), many-leaved bulrush (*Scirpus polyphyllus*), fowl mannagrass (*Glyceria striata*), New York fern (*Thelyteris noveboracensis*), jewelweed (*Impatiens sp.*) and sensitive fern (*Onoclea sensibilis*). These areas are valuable for amphibians and other wetland-dependent animals, including the blue crayfish (*Cambarus monongalensis*), an uncommon species that lives in mud burrows in seeps and floodplains and has been documented in the Jack's Run East area**.**

1.9.3: SUCCESSIONAL COMMUNITIES:

Modified Successional Forest:

These are mature forest communities where the composition does not match any described natural forest community types, due to the influence of past disturbance on the site. They may have been tilled or experienced other near-complete vegetation removal in the past, removing most or all conservative species. They are characterized by a prevalence of early-successional species. The canopy may include black cherry, red maple, sassafras, American elm, black birch, in addition to more scattered additions of typical mature forest species such as sugar maple, red oak, and hickories. In our examples, spicebush is the predominant native shrub, sometimes forming dense stands. Non-native invasive shrubs are also common, such as multiflora rose, bush honeysuckles, Japanese barberry, and the vine oriental bittersweet. Native herbs often include jumpseed, wingstem, mayapple, and golden ragwort. Non-native invasive species such as garlic mustard and Japanese stiltgrass are often common.

Early Successional Herbaceous:

This broad successional type includes grass and forb dominated communities, including managed rights-of-way, and formerly disturbed sites. Some are highly invaded by non-native species. Common native species include goldenrods, blackberries and raspberries, milkweeds, and spicebush; common invasive species include oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), and Japanese stiltgrass (*Microstegium vimineum*).

1.10 ECOLOGICAL INTEGRITY MAPPING

In White Oak Park, the most ecologically intact communities are found in the stream valleys and adjacent steep slopes, as these areas were difficult to log or farm in the past and retained natural plant communities. Slope, aspect, and elevation drive transitions in community type, with more mesic forest types on north- and east- facing slopes, low slopes, and floodplains; and drier forest types on south- and west- facing slopes and upper portions of slopes.

A large part of the park is forested, which is true of many county parks, but at White Oak, a comparatively large proportion of the forested area has high-quality canopy. However, within these quality-canopy forests, most areas have lost herbaceous diversity to long-term overbrowsing by white tailed deer, and only a few areas remain with remnants of the expected native herbaceous communities that should correspond to the quality native forest canopy that is present. We have highlighted the areas with the greatest ecological integrity and diversity by mapping areas as “best” “good” and “poor” quality natural communities.

- **“Best quality”** – these areas have mature plant communities with species diversity as good as or better than is typical for an intact example of the community type in our region, including more “conservative” species that require intact forest habitat and do not re-establish quickly after disturbance. These species have special conservation value, because they are difficult to re-establish once lost. They can also provide seed and propagule stock for restoration efforts elsewhere in the park, if they are managed to develop healthy populations and sustainably harvested. These areas also currently have low presence of invasive species, and should be monitored and managed to prevent the establishment and spread of invasives.
- “**Good quality”** – these are areas that have medium-aged to mature plant communities, with species diversity that is somewhat lower than expected for a reference example of the community type. “Conservative” species are less common or absent in these areas. Exotic species may be present but native species are dominant. Restoration of greater species diversity should be considered through movement of seed propagules from “best quality” examples of similar community types in the park. Invasive species management may also be needed in these areas.
- **“Poor quality”** – these are areas that have early successional plant communities with low diversity of native plants; species tend to be non-conservative, ie those that can colonize disturbed habitats easily, and exotic invasive plants are common. These areas will require intensive management to restore ecological quality and allow them to proceed on a natural successional path to develop a mature native plant community. The primary difficulty is the need to manage invasive species so that natives can establish and mature.

1.10.1: BEST QUALITY AREAS

Jack's Run Eastern Tributary:

This area includes the mature forested slopes on either side of Muse Lane. The eastern slope is west-south-west facing, and has Western Allegheny dry-mesic oak-hardwood forest. The western slope includes a tributary to Jack's Run at the bottom of the valley, and mature mesic forest of along the slopes above. It is mainly of the tuliptree-beech-maple type. Some of the more intact native wildflower communities in the park are found along the western slope ravine.

Jack's Run Eastern Tributary

Canopy dominants are sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), basswood (*Tilia americana*), northern red oak (*Quercus rubra*); the shrub layer is mainly spicebush (*Lindera benzoin*) with scattered witch-hazel (*Hamamelis virginiana*).

The herbaceous layer includes the following conservative wildflower species: black snakeroot (*Actaea racemosa*), bloodroot (*Sanguinaria canadensis*), wakerobin (*Trillium erectum*), large-flowered trillium (*Trillium grandiflorum*), mayapple (*Podophyllum peltatum*), New York fern (*Thelypteris noveboracensis*), blue cohosh (*Caulophyllum thalictroides*), bluestem goldenrod (*Solidago caesia*), broad beech fern (*Phegopteris hexagonoptera*), broad-leaf sedge (*Carex platyphylla*), Canadian waterleaf (*Hydrophyllum canadense*), Christmas fern (*Polystichum acrostichoides*), cleavers (*Galium aparine*), cutleaf toothwort (*Cardamine concatenata*), ramp (*Allium tricoccum*), sedge (*Carex leptonervia*), sedge (*Carex digitalis*), Solomon's-seal (*Polygonatum pubescens*), , sweet-cicely (*Osmorhiza claytonii*), two-leaved toothwort (*Cardamine diphylla*), white wood aster (*Eurybia divaricata*), wild stonecrop (*Sedum ternatum*), wild-ginger (*Asarum canadense*), yellow violet (*Viola enemion*),false Solomon's-seal (*Maianthemum racemosum*), garlic-mustard (*Alliaria petiolata*), ginseng (*Panax quinquefolius*), hay-scented fern (*Dennstaedtia punctilobula*), hooked crowfoot (*Ranunculus recurvatus*), Indian cucumber-root (*Medeola virginiana*), intermediate wood fern (*Dryopteris intermedia*), Jack-in-the-pulpit (*Arisaema triphyllum*). Floodplain terraces and channel edges also have the following wetland species: jewelweed (*Impatiens*), silvery glade fern (*Deparia*

acrostichoides), skunk-cabbage (*Symplocarpus foetidus*), wingstem (*Verbesina alternifolia*), wood nettle (*Laportea canadensis*), and sedge (*Carex prasina*). Invasive species are not densely established in this area; species include Japanese barberry (*Berberis thunbergii*), Japanese knotweed (*Fallopia japonica*), Japanese stiltgrass (*Microstegium vimineum*), oriental bittersweet (*Celastrus orbiculatus*), and daffodil (*Narcissus*).

Management Recommendations:

- Restore canopy gaps in and adjacent to this area.
- Monitor ramps for poaching.
- Fence between the trail and road as per Figure 9; this would protect the wildflower populations from deer browse damage and allow them to recover in numbers.
- Monitor for the establishment of invasive species, and remove while populations are small.

Jack's Run Slopes:

This area consists of mature forest along the slopes above Jack's Run. While the slopes near the entrance to the park contain successional forest, further west the forest is mature, a mixture of tuliptree – beech – maple community and the dry oak – mixed hardwood forest on exposed convex upper slopes and the west-facing slope at the far western end of the park.

The western end of the tuliptree – beech – maple forest is somewhat unique in the park in that it is a fairly large area with strongly calcareous soil. The wildflower community contains a few unique species due to this influence. It is clearly browse-impacted, with some species occurring mainly as juveniles (trillium, bloodroot), but some of the expected conservative wildflowers are still present.

The canopy is dominated by sugar maple (*Acer saccharum*), with the following species also interspersed: American beech (*Fagus grandifolia*), blackgum (*Nyssa sylvatica*), sycamore (*Platanus occidentalis*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), basswood (*Tilia americana*), American elm (*Ulmus americana*).

A single browsed seedling of the Pennsylvania-threatened tree species red mulberry (*Morus rubra*) was observed on this slope.

The slope also contains a large population of the watch list species Allium burdickii, a recently subdivided species of ramps that occurs only in southwestern Pennsylvania, on drier, more calcareous soils than the common species of ramps (*Allium tricoccum*) which is found elsewhere in the park. Other wildflower species found in the mesic forested areas include: white-

snakeroot (*Ageratina altissima*), Jack-in-the-pulpit (*Arisaema triphyllum*), black birch (*Betula lenta*), cutleaf toothwort (*Cardamine concatenata*), Virginia spring-beauty (*Claytonia virginica*), wild yam (*Dioscorea villosa*), field horsetail (*Equisetum arvense*), white wood aster (*Eurybia divaricata*), sensitive fern (*Onoclea sensibilis*), mayapple (*Podophyllum peltatum*), Solomon's-seal (*Polygonatum biflorum*), Solomon's-seal (*Polygonatum pubescens*), bloodroot (*Sanguinaria canadensis*), wild stonecrop (*Sedum ternatum*), trillium (*Trillium*), grape (*Vitis*), and a wild mustard (*Cardamine*).

The floodplain at the base of the slopes has some substantial patches of Japanese knotweed, and these are expanding up onto the slopes where there are seepages.

The dry oak – mixed hardwood forest areas have canopy dominated by oak species, with some richer wildflower indicators still present. Canopy species include northern red oak (*Quercus rubra*), black birch (*Betula lenta*), chestnut oak (*Quercus montana*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), while herbaceous species include mayapple (*Podophyllum peltatum*), wild stonecrop (*Sedum ternatum*), small-flowered crowfoot (*Ranunculus abortivus*), Solomon's-seal (*Polygonatum biflorum*), cutleaf toothwort (*Cardamine concatenata*), and Virginia spring-beauty (*Claytonia virginica*). Witch-hazel (*Hamamelis virginiana*) predominates in the shrub layer.

Management Recommendations:

- Monitor ramps population for poaching.
- Deer browse protection to enhance the wildflower population.
- Monitor for pioneer invasive species; reduce/remove Japanese knotweed in floodplain and hillside seeps, if possible.

Middle Ravine:

This is a steep ravine around a headwaters tributary to Jack's Run with several kinds of mature forest communities.

The mouth of the ravine has a rather degraded version of southwestern Pennsylvania mixed mesophytic forest. This community type is typically found in mesic cove settings and has a high diversity of canopy, shrub, and herbaceous species. However, in this example, the canopy species composition and setting indicate the community type, but the shrub and herbaceous diversity are greatly reduced from long-term overbrowsing. Black maple (*Acer nigrum*) is dominant, with black walnut (*Juglans nigra*) and bitternut hickory (*Carya cordiformis*) also present. Herbaceous species include wingstem (*Verbesina alternifolia*), Christmas fern (*Polystichum acrostichoides*), and the non-native invasive species Japanese stiltgrass (Microstegium vimineum),

Japanese barberry (*Berberis thunbergii*), and Japanese knotweed (*Fallopia japonica*).

The lower slopes of the ravine and the north-facing southern slope have mesic tuliptree-beech-maple forest, with the typical canopy dominants of sugar maple or black maple (*Acer saccharum, A. nigrum*), tuliptree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). The upper slope of the northern slope (south-east facing) has a slightly drier red oak – mixed hardwood type forest, where red and white oaks are more prominent in the canopy.

The south-west facing slope connecting Middle Ravine and Southern Ravine also has mature forest, of the dry oak – mixed hardwood type. The canopy includes white oak (*Quercus alba*), black oak (*Quercus velutina*), chestnut oak (*Quercus montana*), American beech (*Fagus grandifolia*), sassafras (*Sassafras albidum*), pawpaw (*Asimina triloba*), northern red oak (*Quercus rubra*), shagbark hickory (*Carya ovata*), and shadbush (*Amelanchier arborea*), bitternut hickory (*Carya cordiformis*), while witch-hazel (*Hamamelis virginiana*) is a common shrub.

Management Recommendations:

- Removing pioneer clusters of Japanese knotweed from the ravine is a priority, due to the ability of this species to totally displace native floodplain vegetation, and the extreme difficulty in eradicating it once it has established.

Southern Ravine:

This is a steep-sided ravine around a headwaters tributary to Jack's Run with mature tuliptree-beech-maple forest. Canopy dominants include northern red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), tuliptree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). Less common species include bitternut hickory (*Carya cordiformis*), sycamore (*Platanus occidentalis*), white oak (*Quercus alba*), and black oak (*Quercus velutina*). Spicebush (*Lindera benzoin*) is the main shrub species present. The subcanopy species pawpaw (*Asimina triloba*). The herbaceous layer is very sparse and less diverse than would be expected, with Christmas fern (*Polystichum acrostichoides*), New York fern (*Thelypteris noveboracensis*), and scattered patches of wild ginger (*Asarum canadense*) in the stream ravine.

The non-native invasive species Japanese stiltgrass is present although not yet dominant in most areas, and tree-of-heaven (*Ailanthus altissima*) is also scattered.

1.10.2: GOOD QUALITY AREAS

Jack's Run Slopes:

The northern end of Jack's Run Slopes area, adjacent to Muse Lane, is much more disturbed and invaded than the southern end that was designated "best" ecological integrity. In between the disturbed area and the best quality area, there is a transitional zone rated "good" ecological integrity. This area has a middle aged forest community of the miscellaneous successional forest type, a mixture of mature and successional species. Native diversity is moderate. Invasive species are present but not dominant; canopy gaps are somewhat frequent, which tend to have higher presence of invasives.

Middle Ravine:

The northern slope of the Middle Ravine area is younger and more successional in character than the area designated "best" ecological integrity. Invasive species are present at a higher level, but not dominant.

General Management Recommendations for Areas of "Best" and "Good" Ecological Integrity:

- Manage deer populations in the park to reduce browsing pressure. Immediate deer fencing around especially sensitive areas may be a good way to stop further loss of plant diversity, as long-term deer management plans are developed.
- Trail development should be limited in the mature forest areas. If mountain biking cannot be contained to trails, trails should be restricted to foot traffic.
- Interpretive signage regarding the biodiversity value of the mature forest areas, including requests not to pick flowers or other native vegetation, and to refrain from damaging recreational activities, may help with public cooperation in conservation-oriented management of these areas.
- Mature forest areas should be a special focus for invasive species management, to preserve these ecosystems while they are still in reasonably good condition. These areas should be monitored for pioneer invasive species, and these removed when detected.

1.11 OVERALL RECOMMENDATIONS

1.11.1: TRAIL MANAGEMENT:

Mountain Biking Trails within White Oak Park

Mountain biking is a major use at White Oak Park, and an active community of bikers has helped to develop and maintain many trails for this use. We did not observe extensive problems with erosion or vegetation damage at this time, although trail density was somewhat high in some areas.

Trail Recommendations:

- Follow best management practices to minimize trail impact on surrounding vegetation, topography, and erosion.
- Professional assessment of the trail system can identify problem areas and recommend alternative solutions.
- Avoid routing trails near sensitive ecological features that would be vulnerable to poaching or damage from recreational exploration; this might include attractive rare flower species, delicate geological formations such as waterfalls, caves, or cliffs, etc.. If trail routing cannot avoid such features, signage and physical barriers can help prevent damage to these features.
- From the perspective of ecological impact, the areas rated “OK” and “poor” ecological integrity are ideal for trail placement, and for more active uses.
- Minimize trail density in “good” and “best” ecological integrity areas; while some trail development is not incompatible with these areas and can create the benefit of developing public appreciation, dense networks of trails can erode the area available to native plants and wildlife.

- Limit use to foot traffic in particularly sensitive areas, ie those with steep slopes, abundant and diverse native vegetation, or wetland terrain.
- In less-sensitive high ecological integrity areas, active use should be contingent on the user community's ability to stay on existing trails and avoid unsanctioned trail proliferation.
- Because horses can transport invasive species, horse use should be avoided in high ecological integrity areas.

1.11.2: STREAMBANK EROSION & RUNOFF MANAGEMENT:

We observed serious erosion of streambanks on some stream tributaries within the park. These areas should be assessed further to determine the cause of this erosion, and whether it is possible to mitigate them. It is most ideal to redress the root causes through improved stormwater runoff management rather than treating only the end result through physical reinforcement where the erosion is occurring. Where streambank erosion occurs within "Best" or "Good" Ecological Integrity areas, physical restructuring should be approached with particular care for the potential of such projects to damage native vegetation, introduce non-native species, create canopy breaks that facilitate invasive species over natives, and alter habitat for amphibians and crayfish.

Streambank Erosion within White Oak Park

Extreme rainfall events have become more common and may continue to do so into the future due to anthropogenic climate change; this exacerbates problems associated with runoff, such as flood damage to floodplain and lower slope forest communities, and streambank erosion. Under these conditions it becomes all the more critical that best management practices are employed to manage and mitigate runoff and flooding.

1.11.3: Proactive Conservation Measures Towards Ecologically Intact and Regionally Imperiled Features in the Park.

There is a great a range of ecological stewardship needs within the park landscapes; however, we suggest two priorities. Those areas that remain in good condition ecologically should be stewarded to remain in good condition; and populations of species that are regionally rare should be protected. Both of these categories are prioritized because they are difficult to restore once lost, and because they are particularly significant to maintaining native biological diversity in our region.

The "Ecological Integrity Mapping" section below identifies areas within the park that are in good condition and are good repositories of native diversity; specific recommendations are provided for each area. In general, the following kinds of stewardship are useful:

- Invasive species control (see recommendations below).
- Canopy gap remediation. Where canopy gaps exist within high quality forest, there is a risk that they will degrade the surrounding forest, as vines spread to pull down adjacent trees, and invasive species establish populations in the favorable gap conditions that can then spread into adjacent high quality areas. In most cases, even when canopy gaps occur from natural events such as treefall, native forest will not be able to re-establish without protection from deer browse and management of invasive species. Figure 6 shows canopy gaps noted during this study; however, it should not be considered a comprehensive inventory.

1.11.4: INVASIVE SPECIES MANAGEMENT

Because invasive species have established so extensively at this point that it is impossible to control or eradicate them in all areas, efforts must be strategically directed towards the areas where they will have the most impact. The highest priorities are outlined below:

Remove Pioneer Populations of Invasive Species:

It is far easier and less labor intensive if new invasive species that have not previously established in an area are detected and removed before they become well-established, rather than attempting to eradicate them over a large area once they have become established. Figure 7 shows a map of pioneer invasive species populations observed during the ecological study.

Steward "Best" and "Good" Ecological Integrity Areas:

Most "best" and "good" ecological integrity areas have fairly low levels of invasive species infestation at present. The most effective strategy in

FIGURE 6

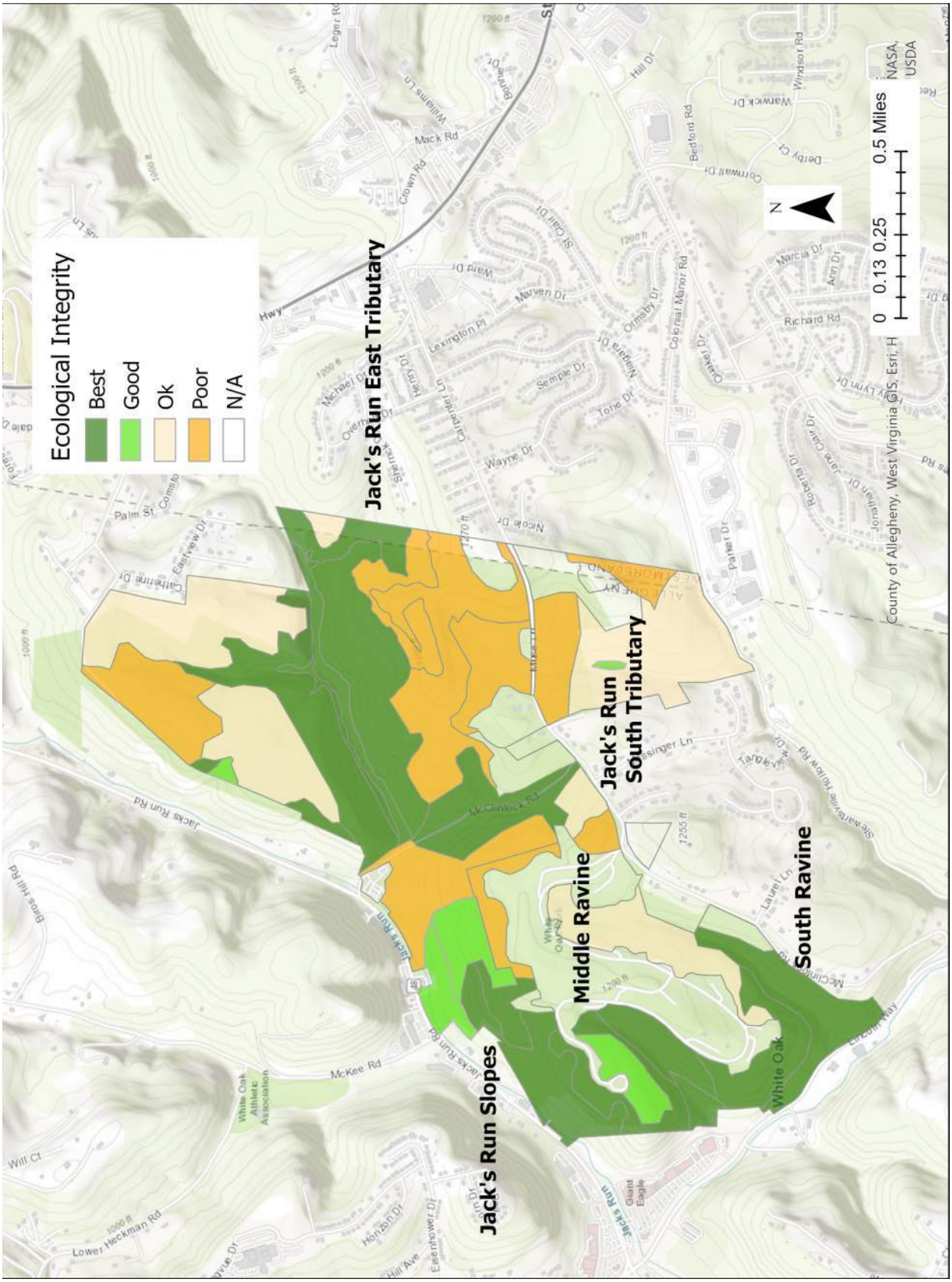
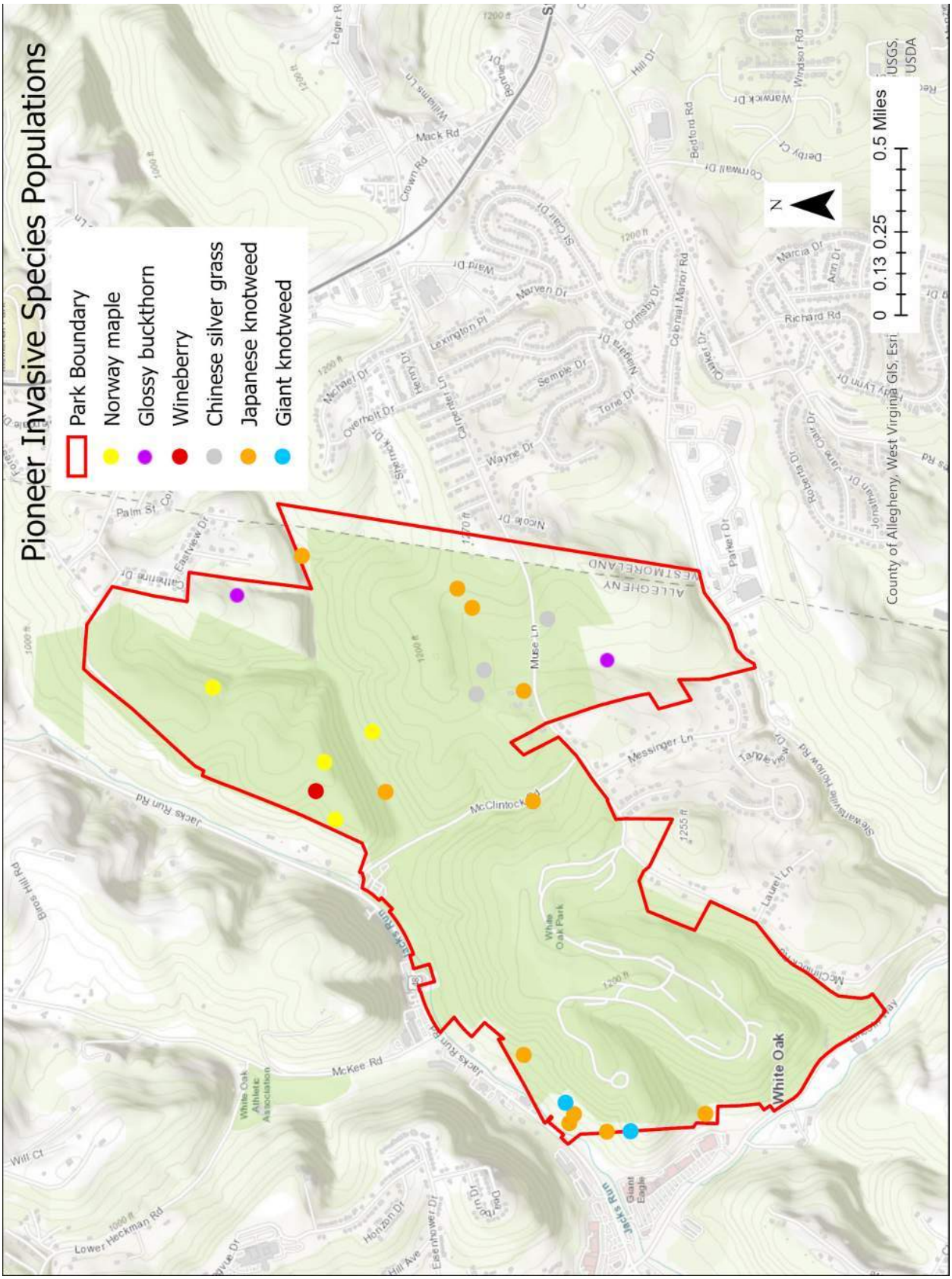

Ecological Integrity
Best
Good
Ok
Poor
N/A
Jack's Run East Tributary
Jack's Run South Tributary
Middle Ravine
South Ravine
Jack's Run Slopes
0 0.13 0.25 0.5 Miles
N
NASA, USDA
County of Allegheny, West Virginia GIS, Esri, H

FIGURE 7


Pioneer Invasive Species Populations
Park Boundary
Norway maple
Glossy buckthorn
Wineberry
Chinese silver grass
Japanese knotweed
Giant knotweed
0 0.13 0.25 0.5 Miles
N
County of Allegheny, West Virginia GIS, Esri
USGS, USDA
White Oak
Muse Ln
Messinger Ln
McClintock Ln
McKee Rd
Jacks Run Rd
Jacks Run
White Oak Park
White Oak Athletic Association
Giant Eagle
Lower Heckman Rd
Mack Rd
Crown Rd
Wayne Dr
Richard Rd
Colonial Manor Rd
Laurel Ln
Hill Ave
Horizon Dr
Eisenhower Dr
Will Ct
Glass Hill Rd
ALLEGHENY
WESTMORELAND

maintaining the quality of these areas is to develop a program for volunteer or staff personnel to periodically monitor these areas for new invasive species and remove them while the plants are few in number. At White Oak, this is particularly challenging because the areas rated “best” or “good” are fairly extensive, and many also have somewhat reduced native vegetation due to long-term overbrowsing, leaving them more vulnerable to non-native species.

Where infestations exist that cannot be controlled through casual hand-picking efforts, a more detailed area-specific assessment and treatment plan will be needed. The places where Japanese knotweed has established along the stream floodplains within “best” ecological integrity areas require this higher level of attention.

Canopy gaps are prime areas for establishment of invasive species, due to high light levels, disturbance, and lack of established native vegetation. Remediating canopy gaps can help to maintain ecological integrity over the long term.

Manage Invasives in Areas Recently Removed from Mowing or other Maintenance

Reduction of mowing in large park systems can have many benefits, including reduced fuel and labor costs, and increased ecological function of lands once native species re-establish. However, these areas are also vulnerable to the establishment of invasive species, especially where they occur adjacent to forests, woodlands, or shrublands where invasive species are already common.

Manage Invasives where they have Particular Impact on Recreational or Other Park Uses:

In the case of White Oak Park, one species that may fall into this category is mile-a-minute.

Mile-a-Minute Management

Mile-a-minute (*Persicaria perfoliata*) is a non-native invasive species that forms dense, vining mats in high light areas, climbing over and smothering native vegetation. Although it is an annual, it grows extremely fast and seeds can persist for 6 years. The stems, while fairly weak, are covered in small thorns. The mat-like growth habitat and thorniness create a particular problem in recreational use settings. Once well established in an open area, it is very difficult to eradicate. However, it does not grow nearly as vigorously under shaded conditions, so if canopy cover can be restored in an area, its presence will likely diminish greatly. This species has currently not spread throughout the park, but has established small-to-moderate populations in canopy gaps and open successional forest in several areas (Figure 8). Seeds can be moved

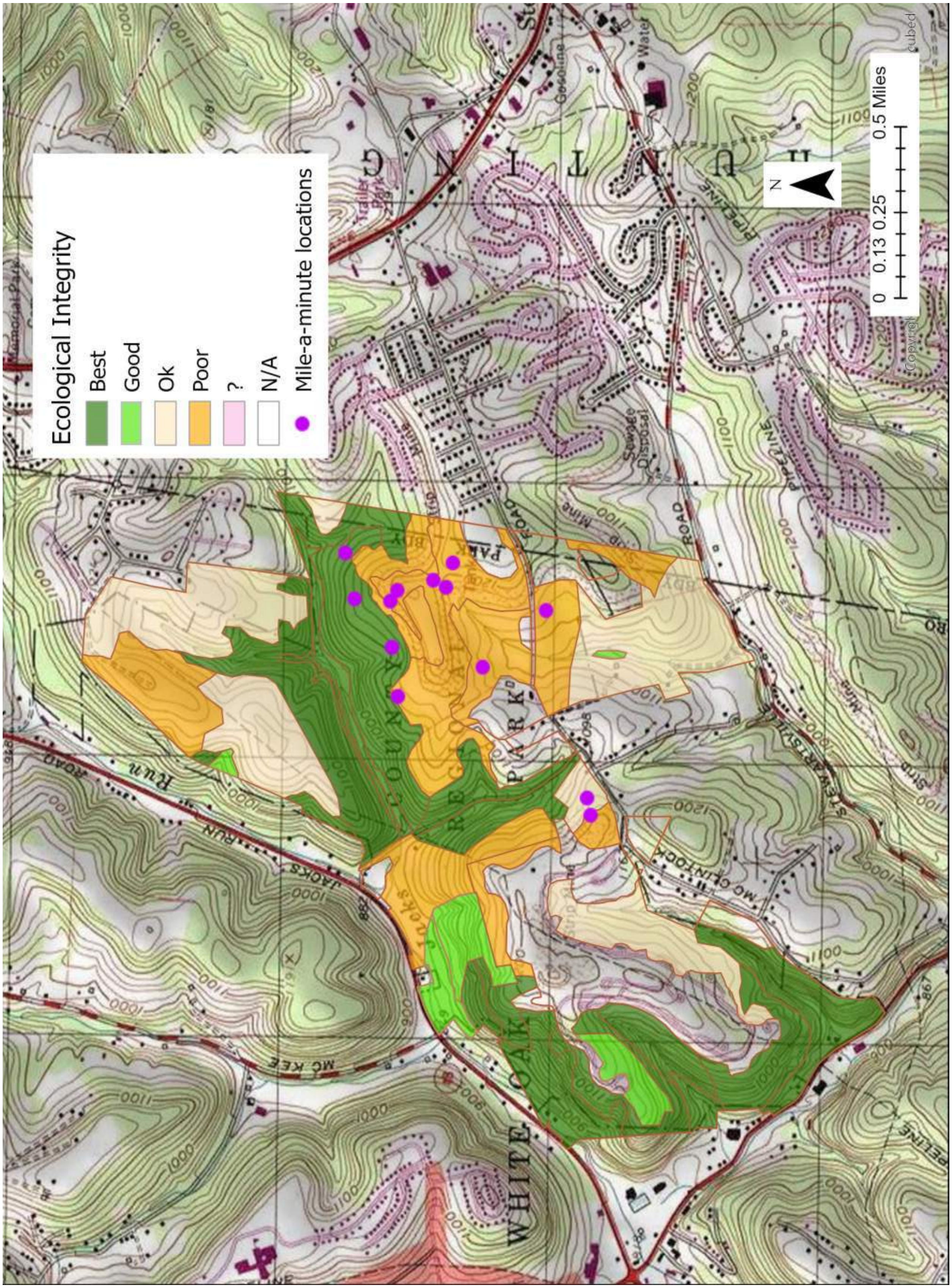
around by birds, other animals, and by flowing water (Templeton et al 2020).

- Prioritize removal & reduction of small populations, as this will limit their ability to spread more extensively. Hand-pulling with gloves on is effective and not difficult for a small number of plants. If seeds have not formed, plants can be left to dry; if seeds have already formed, plants must be bagged, removed, and destroyed.
- Prioritize removing or reducing the species where it has established in canopy gaps within "best" ecological integrity areas. In these cases, the best long-term solution is to restore forest in the gap, eliminating the edge and open conditions where mile-a-minute thrives. However, if canopy gap restoration projects are undertaken where mile-a-minute has already established, ongoing control of this species while woody species mature to provide shade must be built into the restoration plan.

Mile - a - Minute climbing a tree at White Oak Park

- For larger areas of successional forest where mile-a-minute has already established extensively, consider introduction of the biological control weevil *Rhinoncomimus latipes*, approved by the USDA for distribution for this use.
- Do not move plant materials, soil, or leaf litter from areas where mile-a-minute is established to areas where it has not yet established, as the seeds remain viable for 6 years and could be transported even if no living plants are visible.

FIGURE 8

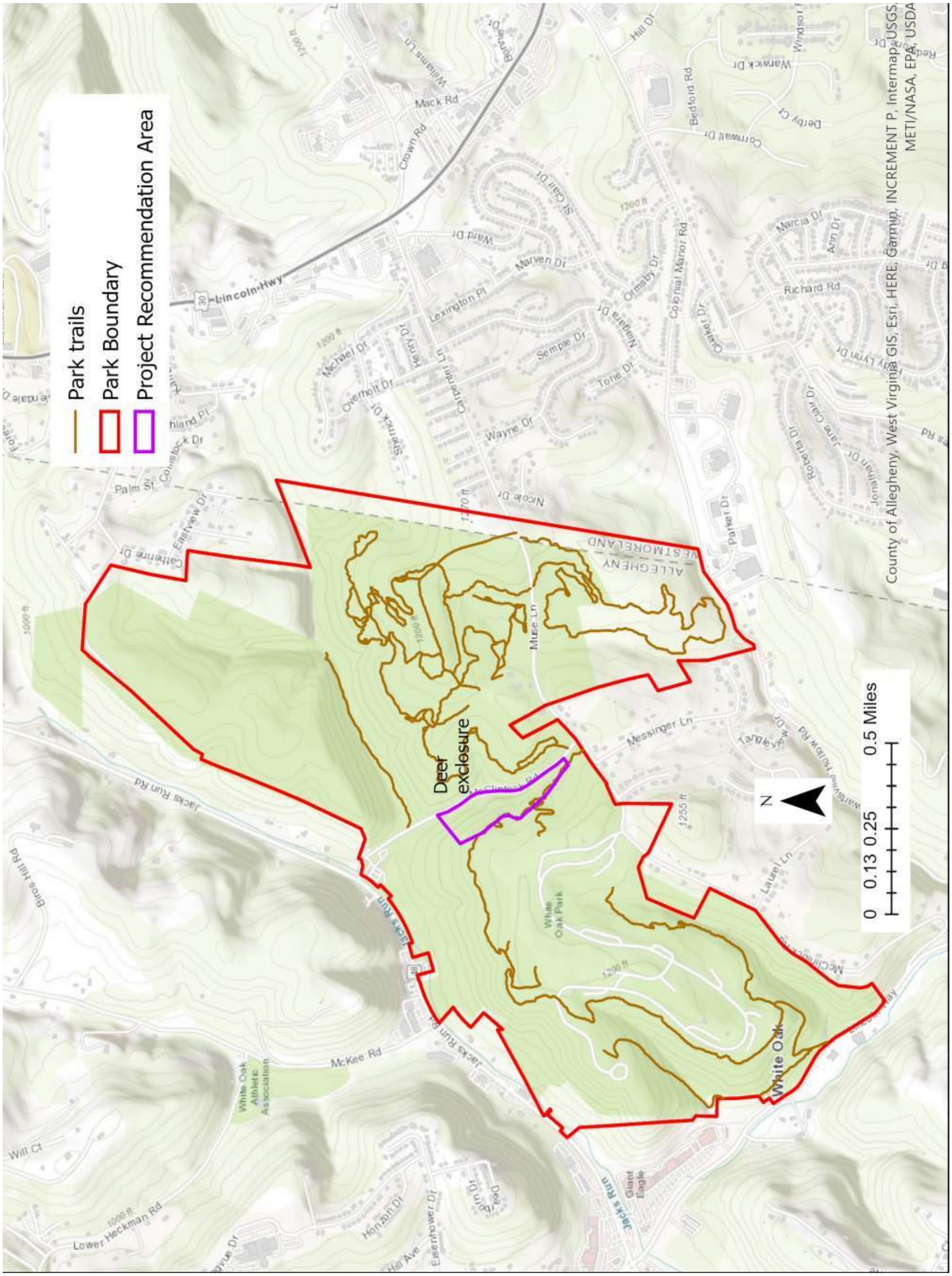

Ecological Integrity
Best
Good
Ok
Poor
?
N/A
Mile-a-minute locations
N
0 0.13 0.25 0.5 Miles

Holistic Planning for Invasive Control:

- Whenever control efforts are undertaken, plans should be included for subsequent revegetation, either through protection of natural seed source germination or through introduction of native plant materials consistent with the site and the surrounding natural communities.
- Restoration efforts will be most successful if time and resources are allocated for thorough invasive control before introduction of new plant materials. All restoration plans should also include long-term maintenance efforts to monitor and control invasive species while native vegetation is establishing.
- Many species commonly used in landscaping are highly invasive in natural settings, such as burning bush, privet, Japanese barberry, and Japanese silver-grass (*Miscanthus sinensis*). All species introduced for horticultural purposes should be reviewed for invasiveness, and excluded if they exhibit invasive tendencies.
- Take precautions to prevent accidental introduction of invasive species from equipment and the movement of materials. Earth moving equipment should always be cleaned between sites to prevent movement of seeds in dirt on tires or blades. Fill, compost, and soil moved from other areas can also be sources of invasive plant material; know the source, and vet it before use.
- Reduction of seed and propagule from surrounding areas is also helpful in preventing new populations from establishing in new areas. At White Oak Park, species planted at Angora Gardens should be reviewed to ensure no invasive species are included. It also appears that neighboring properties are using Japanese silver grass as an ornamental landscape plant, and this is spreading into the park.
- Deer browse pressure makes natural areas more susceptible to the establishment of invasive species by creating bare soil areas and reducing competition from native species. Reducing deer browse pressure can strengthen the natural resilience of forest communities.

Deer Browse within White Oak Park

FIGURE 9


Park trails
Park Boundary
Project Recommendation Area
Deer exclosure
White Oak Park
White Oak
0 0.13 0.25 0.5 Miles
N
County of Allegheny, West Virginia GIS, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA
ALLEGHENY
WESTMORELAND
Jacks Run Rd
McKee Rd
Lincoln Hwy
Muse Ln
Messinger Ln
White Oak Athletic Association
Giant Eagle

1.11.5: DEER BROWSE MANAGEMENT:

When deer population densities are too high, native plants and natural communities can be severely impacted. These species are their primary food. While plants can typically recover from some browse impact, when high levels of browse continue for many years, the recovery capacity is diminished, and populations begin to decline. Many native wildflowers do not disperse or re-establish quickly or easily, and if they are eradicated from an area due to overbrowsing, they may not replenish even if browsing is reduced (Goetsch et al. 2011; Pendergast IV et al. 2016). Studies have shown that long-term overbrowsing causing a permanent reduction in native species diversity, that can only be remediated through active re-introduction of lost species. This effect is clearly visible in many of Allegheny County's forests, where the tree canopy composition and site conditions suggest a diverse array of native herbs should be present, but instead there is only bare soil with scattered herbs, or deer-resistant fern species. Deer overbrowsing also reduces other ecological functions: excessive bare soil reduces rain absorption capacity and increases soil erosion and flood vulnerability; long term overbrowse increases susceptibility to establishment and spread of invasive species (Knight et al. 2009); and overbrowsing also prevents forest regeneration.

In White Oak Park, it appears that long-term overbrowsing has greatly reduced the native herbaceous cover and diversity in large areas of the park, including most of the mature forested areas. Without fully knowing the land use history we cannot definitively assign deer browse as the cause of the current low cover and lack of diversity observed in the park, but there are few other explanations compatible with the persistence of mature forest canopy cover. Other explanations would be a past land use such as intensive livestock grazing within the forest. Steep slopes and outcrops are naturally inaccessible to deer, and when these show a clear difference in species composition from flat areas, as we observed at White Oak Park, it is evidence that deer browse has altered the community.

- Continue efforts to encourage and facilitate deer hunting within the parks and support regional efforts to increase hunting and reduce deer populations.
- Put up deer fencing around any particularly valuable ecological areas that are showing browse impact, and around any restoration projects where new materials are vulnerable to deer browse.
    - At White Oak Park, fencing may be a particularly viable strategy due to the limited areas that still contain good herbaceous diversity, and the location of these areas. See Figure 9.
    - The large areas that currently have low native herbaceous diversity may not recover unless active restoration of native plant material is undertaken, concurrently with protection from browsing.

Appendix 1

Invasive Species of White Oak Park, Pioneer species listed first with management detail.

= low effort = medium effort = high effort

Scientific name	Common name	Growth form	Distribution in park	Regional distribution	Habitat	Cultivated?	Management notes
Acer platanoides	Norway maple	tree	pioneer	moderately widespread	forest	yes	There were very few individuals found, in only a few locations, and this species is fairly easy to kill. A prime "pioneer" target.
Cardamine impatiens	Bittercress	herb	pioneer	uncommon	forest, wetland		This was currently rare in the park and in low numbers, but it spreads incredibly rapidly, and I am seeing more and more of it everywhere I go. If there's a chance to contain it, that is now, but the chances of success are probably not great.
Frangula alnus	Glossy buckthorn	shrub	pioneer	widespread	forest, open areas		This becomes a major forest invasive, and can also be dense in wetlands, meadows and open areas. One area of the two areas it was seen was a wetland. Treatment is much the same as other shrubs, so not tremendously difficult. Good to attempt removal while numbers are still low, although continued vigilance against re-establishment will be needed, since the seeds are dispersed by birds.
Miscanthus sinensis	Silver-grass	herb	pioneer	uncommon	forest	yes	This species is commonly used in landscaping and in the last few years we are seeing an increase in naturalized populations establishing in forest settings. We observed some stands in forested areas of the park, but they were not yet large.
Persicaria perfoliata	Mile-a-minute weed	vine	pioneer	moderately widespread	open areas		This species can greatly degrade early successional areas for recreational use, due to its prickly stems and matted, blanket-like growth form.

Scientific name	Common name	Growth form	Distribution in park	Regional distribution	Habitat	Cultivated?	Management notes
Rubus phoenicolasius	Wineberry	shrub	pioneer	uncommon	forest, open areas		This species can become a dense invader of forested settings, and is currently very limited in the park, an ideal time to remove it.
Arundo donax	Giant cane	herb	pioneer	rare		yes	This species had established in a waste area opposite Andorra Gardens. It is quite invasive further south, but I do not know if it will persist through winter here.
Forsythia	Forsythia	shrub	rare	moderately widespread	forest, open areas	yes	
Hesperis matronalis	Dame's-rocket	herb	rare	widespread	forest		
Ailanthus altissima	Tree-of-heaven	tree	uncommon	widespread	forest, openings, waste ground		
Artemisia vulgaris	Common mugwort	herb	uncommon	moderately widespread	open areas, fields, edges		
Fallopia japonica	Japanese knotweed	herb	uncommon	widespread	floodplain		Although both species of Japanese knotweed have greater numbers in the park than the other "pioneer" species, we recommend trying to address this species now because it is still possible to prevent it from completely dominating and displacing all other floodplain vegetation.
Fallopia sachalinensis	Giant knotweed	herb	uncommon	widespread	floodplain		Although both species of Japanese knotweed have greater numbers in the park than the other "pioneer" species, we recommend trying to address this species now because it is still possible to prevent it from completely dominating and displacing all other floodplain vegetation.

Scientific name	Common name	Growth form	Distribution in park	Regional distribution	Habitat	Cultivated?	Management notes
Glechoma hederacea	Gill-over-the-ground	herb	uncommon	widespread	forest, especially floodplains		
Lonicera japonica	Japanese honeysuckle	vine	uncommon	widespread	forest, open areas	yes	
Stellaria media	Common chickweed	herb	uncommon	widespread	forest, open areas		
Berberis thunbergii	Japanese barberry	shrub	uncommon; presence moderately widespread, but not very dense where present.	widespread	forest	yes	
Celastrus orbiculatus	Oriental bittersweet	vine	moderately widespread		forest, open areas		
Microstegium vimineum	Stiltgrass	herb	moderately widespread	widespread	forest, open areas, wetlands		
Persicaria longiseta	Low smartweed	herb	moderately widespread	moderately widespread	forest, open areas, wetlands		
Rosa multiflora	Multiflora rose	shrub	moderately widespread	widespread	forest, open areas		
Alliaria petiolata	Garlic-mustard	herb	widespread	widespread	forest		

SECTION II - TREE PLANTING RECOMMENDATIONS:

Diseased Black Cherry Trees within White Oak Park

2.1 WHITE OAK PARK: BLACK CHERRY REMOVALS

Several large dead or dying black cherry trees are present within the mowed area adjacent to the Willow shelter. The primary park service road that transverses the western portion of the park forms a long horseshoe bend in this location. In total, nine black cherry trees were observed to be in a potentially hazardous condition.

The trees are succumbing, in part, to a disease called cytospora canker. The causal agent for this disease is an airborne fungal pathogen that infects trees after coming in contact with exposed wounds. Mechanical damage from lawn mowers and weed trimmers is a primary reason for the spread of cytospora canker in landscaped trees. When mower blades are set too low, they scrape against a tree's root system and create open wounds. Weed trimmers that come too close to a tree's lower trunk will weaken and remove the bark. Many tree diseases and pests will capitalize on these fresh wounds.

The disease then spreads throughout the tree's vascular system. The tree will respond by plugging up its tissue in an effort to restrict further spread of the disease. In doing so, however, the affected area also becomes cut off from the flow of water and nutrients. This often causes the area to decline. In the case of a canker disease, the progressive growth of the infected area can eventually girdle a branch or stem, further restricting capacity of the tree's vascular system.

Diseased Black Cherry Trees adjacent to the Willow Shelter

White Oak Park: Black Cherry Tree Removals and Replacement Tree Planting

2.2 TREE MAINTENANCE RECOMMENDATIONS

The best defense against cytospora disease is through respectful landscaping practices and timely tree maintenance. The WPC Forester recommends the following to keep landscaped trees healthy in mowed areas:

- Mulch all trees, regardless of size, to limit grass and weed growth near tree trunks and major roots.
    - Mulch rings should be maintained annually.
    - Mulch should be only two to four inches deep.
    - Mulch should not make contact with any part of the trunk.
    - Only use undyed, hardwood mulch.
- Raise mower decks and maintain grass at a taller height, at least immediately around a tree.
- Mow less frequently.
- Convert mowed lawns into natural meadows.
- Train park staff to mow/weed trim cautiously around trees.
- Only prune trees in winter.
- Sanitize pruning tools with alcohol after use on each tree.
- Plant trees species in mowed areas that are more tolerant of wounding or root damage (similar to construction sites)

Tree Damage Caused by Mower Deck.

2.3 RECOMMENDED SPECIES FOR REPLACEMENT TREE PLANTING

All of the following tree species can be more resistant of cytospora canker, if managed properly, and are more tolerant of wounding or root damage:

Common Name	***Scientific Name***
Hickory	*Carya. spp.*
Hackberry	*Celtis occidentalis*
Hawthorne	*Crataegus spp*
Kentucky Coffeetree	*Gymnocladus dioicus*
American Sweetgum	*Liquidambar styraciflua*
Osage - Orange	*Maclura pomifera*
Blackgum	*Nyssa sylvatica*
American Sycamore	*Platanus occidentalis*
London Planetree	*Platanus x acerifolia*
Swamp White Oak	*Quercus bicolor*
Chinkapin Oak	*Quercus muehlenbergii*
Bur Oak	*Quercus macrocarpa*

2.4 TREE SPECIES TO AVOID PLANTING

All of the following tree species are highly susceptible to cytospora canker and intolerant of wounding or root damage:

Common Name	***Scientific Name***
Aspen/Poplar/Cottonwood	*Populus spp.*
Apple	*Malus spp.*
Cherry/Plum/Peach	*Prunus spp.*
Birch	*Betula spp.*
Willow	*Salix spp.*
Spruce	*Picea spp.*
Silver Maple	*Acer saccharinum*
Honeylocust	*Gleditsia triacanthos*

All of the following tree species are not recommended for planting due to other serious pest or disease issues:

Common Name	***Scientific Name***	**Disease**
Beech	*Fagus spp.*	Beech Leaf Disease
Spruce	*Picea spp.*	Needlecast / Canker
Ash	*Fraxinus spp.*	Emerald Ash Borer
Hemlock	*Tsuga spp.*	Hemlock Woolly Adelgid
Walnut	*Juglans spp.*	Thousand Canker Disease
Flowering Dogwood	*Cornus florida*	Anthracnose
Northern Red Oak	*Quercus rubra*	Oak Wilt Disease
Pin Oak	*Quercus palustris*	Oak Wilt Disease
Shingle Oak	Quercus imbricaria	Oak Wilt Disease

SECTION III - GREEN INFRASTRUCTURE RECOMMENDATIONS:

3.1 GREEN INFRASTRUCTURE APPROACHES TO STORMWATER MANAGMENT:

WPC has identified specific locations within White Oak Park where green infrastructure facilities can help address stormwater management problems. Park managers met with WPC, ACPF, and County Parks staff members to assess these locations where stormwater runoff is creating serious water quality issues including non-point source pollution, erosion, and sedimentation. The issues present within the parks is consistent with stormwater management problems throughout the region, wherein wet weather runoff damages water quality, stream morphology, and habitat due to excessive runoff from large areas of impermeable surfaces such as parking lots, roads, buildings, and sidewalks. Within the parks, this runoff is typically discharged to open greenspaces such as fields and woods where the flush of hot, dirty water creates the damage. In collaboration with the Allegheny County Parks Department landscape architecture staff, WPC is outlining some straightforward approaches for green infrastructure for both parks below.

3.1.1 CHESTNUT GROVE PARKING LOT OFF OF MCCLINTOCK ROAD

This highly visible and well-used parking lot is slated for improvements in 2022 , including repaving and the installation of solar facilities. The partners discussed the possibility of changing the grade of the lot during this reconstruction to divert “hot and dirty” stormwater runoff from directly entering the adjacent Jacks Run stream (see catch basin photo right). The runoff currently creates erosion, sedimentation, and flooding issues, affecting habitat and water quality.

Parking Lot Catch Basin

The improvements to the lot do not currently include regrading it to drain to the adjacent green swale that exists to the northeast of the lot. Regrading could be prohibitively expensive but there is the possibility of positioning the new solar panels (covering about half of parking lot) to help redirect at least some of the runoff from the panels to the swale next to the parking lot. Currently, the parking lot runoff travels to the southwest corner of the parking lot where it enters a catch basin and then a pipe that discharges the runoff about 10 feet above the grade of the stream.

Another possible intervention would be removing some of the existing asphalt in the southwest portion of the lot and installing a bioswale where plants and rocks can capture, polish, and slow the runoff before it enters the catch basin and is discharged into the stream.

Trenches installed within the parking lot to redirect the water to the northeast swale are not advisable due to a high level of maintenance.

Chestnut Grove Parking Lot, slated for 2022 upgrades.

Greenspace adjacent to the Chestnut Grove Parking Lot

Chestnut Grove Parking Lot Approaches:

Solar Panel Retrofit Approach:

The parking lot upgrades are being managed by the Allegheny County Parks and Facilities Management Departments. Department staff could investigate options for directing runoff from the solar panels into the adjacent greenspace. This would be a process undertaken directly with the solar contractor prior to reconstruction beginning in March 2022.

Bioswale Approach:

The installation of a bioswale would entail the following:

- Hydrologic analysis to determine runoff volume.
- Infiltration Testing
- Land Survey
- Design of the bioswale (contracted or in-house) to meet desired stormwater runoff capture goals. Controlling 100% of the first inch of runoff is a fairly standard approach in this region.
- Asphalt demolition
- Construction—excavation, grading, connection to existing sewer/catch basin, stone and plants installations.
- Maintenance.

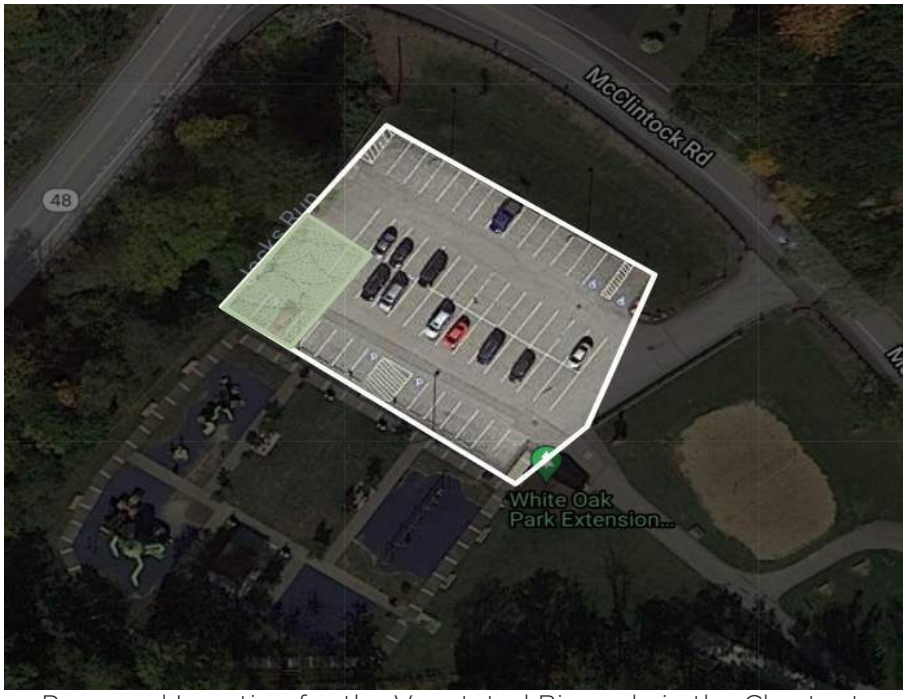
Watershed Modeling Data:

For project planning purposes, WPC has utilized the online "Model My Watershed" tool to estimate the efficacy of green infrastructure modifications to the project recommendations in this report. As stated on the Wikiwatershed website, "Model My Watershed" is part of Stroud Water Research Center's WikiWatershed initiative. WikiWatershed is a web toolkit designed to support citizens, conservation practitioners, municipal decision-makers, researchers, educators, and students to collaboratively advance knowledge and stewardship of fresh water.

This data is intended only for planning purposes. Hydrologic analyses and runoff models should be undertaken by qualified professionals prior to construction of any green infrastructure facility. Modelling data generated by the Wikiwatershed "Model My Watershed" web toolkit is required for several Pennsylvania state agency grant programs that fund watershed protection analysis and implementation projects.

Specifications for Chestnut Grove Parking Lot Bioswale:

- The area of the parking lot was used as the basis for calculating runoff. Since the lot is surrounded by greenspace, it is assumed that the lot and its catch basin do not receive other runoff inputs from other impermeable areas. The lot is 20,540 square feet in area.
- The addition of a 2,335 square foot vegetated bioswale in the southwest corner of the lot would intercept and infiltrate 100% of a 1" 24-hour wet weather event.
- The capture volume per 1" wet weather event would be 1,621 cubic feet of runoff.
- Infiltration would increase from 48% to 95% (the other 5% is evapotranspiration).
- The bioswale would completely eliminate suspended solids, Nitrogen, and Phosphorous from entering Jacks Run during a 1" wet weather event.
- The proposed bioswale would result in the loss of four parking spaces.
- Modeling data specific to the Chestnut Grove Parking Lot bioswale can be accessed online at https://modelmywatershed.org/project/37239/.



Proposed Location for the Vegetated Bioswale in the Chestnut Grove Parking Lot.

Chestnut Grove Budget Estimates:

Trees, Supplies & Planting Site Prep.				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Two Inch Caliper Trees	Balled and Burlapped Landscape Trees for GI Facilities	$220.00	5	$1,100.00
Shrubs	For Bioswales	$35.00	50	$1,750.00
Perennials & Grasses	Native Grasses & Perennial Flowers for Bioswales	$25.00	150	$3,750.00
Planting Supplies	Mulch, Soil, Stakes, Tubes, Fencing, Tie	$500.00	1	$500.00
Subtotal				**$7,100.00**

Project Management				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Project Director	Manage RFP Process & Contracts, Convene Partners, Financial Management, Staff and Contractor Oversight, Grant Management	$100.00	30	$3,000.00
Coordinator	Coordinate Partners & Volunteers for Planting	$50.00	50	$2,500.00
Subtotal				**$5,500.00**

Contracted Professional Services				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Landscape Architect	Design Services, Plant Selection and Sourcing Drawings, Planting Oversight	$150.00	75	$11,250.00
Civil Engineering	Hydrologic Analysis, Construction Drawings	$150.00	40	$6,000.00
Construction of GI	Demolition, Heavy Construction, Piping for GI facilities, Stone Installation, Excavation, Grading	$40,000.00	1	$40,000.00
Monitoring GI	Monitoring Protocol Developed for at least 1 Year. Monitoring Stream Channel Morphology	$3,000.00	1	$3,000.00
Survey	Land Survey for Construction	$3,000.00	1	$3,000.00
Subtotal				**$63,250.00**
Chestnut Lot Total				**$75,850.00**

Greenspace adjacent to the Chestnut Grove Parking Lot. Stormwater does not currently enter this greenspace..

3.1.2 CULVERT IMPROVEMENTS

Allegheny County Parks Department and Allegheny County Parks Foundation staff suggested that simple catch basin and culvert improvements throughout the park could substantially reduce sedimentation entering unnamed tributaries and Jacks Run. Develop a replicable model for the culverts, including plantings and design features such as stone, that will capture the first 1.5" of runoff from roads and parking lots and promote slow release to nearby wooded areas.

Areas visited included the "Wedding Gardens and Mountain Ash Shelter" and "Beech" shelter parking areas and associated runoff issues.

At the Wedding Gardens site, runoff from White Oak Park Ext. (road) and the parking area is captured in a series of catch basins that lead to a stone culvert and then ultimately discharge to a large lawn area. Erosion is evident in this area, as it is in other similar situations throughout the park.

Wedding / Gardens Mountain Ash Area

Erosion from Runoff off the Parking Area

Stone Culvert

Culvert Improvements & Riparian Buffer Approach for Wedding Garden Site:

- Undertake structural improvements of the culvert for aesthetic and functional purposes.
- 20 foot wide riparian buffer plantings along the discharge route of the runoff, including all native trees, shrubs, perennials, and grasses.
- Informational signage regarding the project approach to controlling stormwater within the park and the importance of riparian buffers.

In this case, runoff calculations using the Wikiwatershed web toolkit do not show any impact from upstream bioswale installation, mostly given the existing vegetation cover. The approach here is to address the flush of runoff in the adjacent open greenspace with riparian buffer plantings and features such as stone weirs that will slow the runoff and promote infiltration before erosion and sedimentation can negatively impact the nearby forest and stream. Implementation of this project will also help reduce maintenance issues such as mowing wet, eroded areas.

Proposed Culvert Improvement and Riparian Buffer

Wedding Garden Culvert & Riparian Buffer Project Budget Estimates:

Trees, Supplies & Planting Site Prep.				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Restoration Trees	2-5 Gallon Native Trees	$60.00	60	$3,600.00
Shrubs	Native Shrubs for Riparian Buffer	$35.00	300	$10,500.00
Perennials & Grasses	Native Grasses & Perennial Flowers	$25.00	1000	$25,000.00
Planting Supplies	Mulch, Soil, Stakes, Tubes, Fencing, Tie	$3,500.00	1	$3,500.00
Subtotal				**$42,600,00**

Administration & Facilitation				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Project Director	Manage RFP Process & Contracts, Convene Partners, Financial Management, Staff and Contractor Oversight, Grant Management	$100.00	50	$5,000.00
Coordinator	Coordinate Partners & Volunteers for Planting	$50.00	75	$3,750.00
Subtotal				**$8,750.00**

Contracted Professional Services				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Landscape Architect	Design Services, Plant Selection and Sourcing Drawings, Planting Oversight	$150.00	75	$11,250.00
Civil Engineering	Hydrologic Analysis, Construction Drawings	$150.00	20	$3,000.00
Construction /Masonry	Grading, Stone Weirs, Culvert Masonry, Structural Improvements	$25,000.00	1	$25,000.00
Monitoring GI	Monitoring Protocol Developed for at least 1 Year. Monitoring Stream Channel Morphology	$3,000.00	1	$3,000.00
Informational Signage	Durable Outdoor Educational Signage	$2,500.00	1	$2,500.00
Survey	Land Survey for Construction	$3,000.00	1	$3,000.00
Subtotal				**$47,750.00**
Wedding Garden Total:				**$99,100.00**

3.1.3 CEDAR ONE SHELTER PARKING LOT

Cedar One Shelter Parking Lot

The catch basins within and around the “Cedar One” shelter parking lot capture a significant amount of stormwater runoff from other nearby parking areas and White Oak Park Exd Road, causing severe runoff, erosion, and sedimentation in the adjacent woods and unnamed stream. This may be a location where subsurface retention facilities would be effective. Otherwise, retention would be required further up the sewershed to slow runoff and reduce non-point source pollution and sedimentation in the stream.

White Oak Park Exd

Existing Conditions:

Catch Basin next to the Cedar Grove Lot.

Catch Basin in the Center of Cedar Grove Lot, just above the Outfall Pipe

Severe Eriosin Affecting Stream Morphology & Habitat.

Severe Eriosin from the Outfall Pipe from the Cedar Grove Lot

Subsurface Retention and Riparian Buffer Approach:

- Hydrologic analysis to determine runoff volume and size of retention tanks.
- Infiltration Testing
- Land Survey
- Riparian buffer design and planting plan.
- Demolition of existing asphalt parking lot.
- Construction—excavation, tank installation, sewer/catch basin connections, stone weir installations.
- Volunteer planting and maintenance events.
- Monitoring and maintenance.
- Informational signage.

Proposed Retention Tanks & Riparian Buffer Plantings for Cedar Grove Lot

Cedar Grove Lot Subsurface Retention & Riparian Buffer Budget Estimates:

Trees, Supplies & Planting Site Prep.				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Restoration Trees	2-5 Gallon Native Trees	$60.00	60	$3,600.00
Shrubs	Native Shrubs for Riparian Buffer	$35.00	300	$10,500.00
Perennials & Grasses	Native Grasses & Perennial Flowers	$25.00	1000	$25,000.00
Planting Supplies	Mulch, Soil, Stakes, Tubes, Fencing, Tie	$3,500.00	1	$3,500.00
Subtotal				**$42,600,00**

Administration & Facilitation				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Project Director	Manage RFP Process & Contracts, Convene Partners, Financial Management, Staff and Contractor Oversight, Grant Management	$100.00	50	$5,000.00
Coordinator	Coordinate Partners & Volunteers for Planting of the Riparian Buffer	$50.00	75	$3,750.00
Subtotal				**$8,750.00**

Contracted Professional Services				
Category	**Description**	**Unit Cost**	**Units**	**Total**
Landscape Architect	Design Services, Plant Selection and Sourcing Drawings, Planting Oversight, Tank Installation Specifications	$150.00	125	$18,750.00
Civil Engineering	Hydrologic Analysis, Construction Drawings	$150.00	75	$11,250.00
Riparian Buffer, Construction & Masonry	Grading, Soil, Stone Weirs, Culvert Masonry, Structural Improvements	$35,000.00	1	$25,000.00
Retention Tank & Permeable Surface Installation	Demolition, Tank Installation, Connections to Sewer System, Permeable Paving	$175,000.00	1	$175,000.00
Monitoring GI	Monitoring Protocol Developed for at least 1 Year. Monitoring Stream Channel Morphology	$3,000.00	1	$3,000.00
Informational Signage	Durable Outdoor Educational Signage	$2,500.00	1	$2,500.00
Survey	Land Survey for Construction	$3,000.00	1	$3,000.00
Subtotal				**$248,500.00**
Chestnut Lot Total				**$299,850.00**

SECTION IV - PROJET & MANAGEMENT RECOMMENDATIONS:

Adult spotted lanternfly. Credit: Jon-Marc Burdick, Cameron County Conservation District (Pennsylvania iMapInvasives Database - Presence record #1071021

4.1 Forest Canopy Gap Restoration

Canopy gap restoration is a tool to maintain the long-term ecological integrity of the park's highest quality forests and natural communities. Figure 10 shows where canopy gaps have been documented in "best" ecological integrity areas in the park; these are priority restoration areas.

The goal of the canopy gap restoration tree plantings is to reforest relatively small areas where gaps have formed in native forest communities, to create a trajectory for re-establishment of native forest and improved forest integrity. If left unmanaged, canopy gaps can become establishment sites for non-native invasive species and robust vine growth, that then expands outwards into adjacent forests, causing further canopy loss and ecosystem destabilization. The strategy is to first eradicate any existing invasive plant populations, then plant a suite of native trees, shrubs, and herbs that match the existing natural forest community, and will over time out-compete invasive plant species that could seed in, to restore a contiguous forest community.

Figure 11 shows the canopy gaps overlaid on plant community type mapping. Almost all the canopy gaps are in Tuliptree – beech – maple forest type, while one point in the northern part of Jack's Run East area is situated in Red oak – mixed hardwood forest. Several points are situated in or adjacent to "Modified successional forest", but in these cases, the goal should not be to match this disturbed community type, but to extend the mature "Tuliptree – beech – maple" type that is adjacent. See Section 1.9 for descriptions of the natural community types found in White Oak Park, including species composition, for guidance in selecting species for use in restoration plantings. Gap restoration plans should be developed with the long-term goal of matching the species composition of the surrounding mature forest community. An important caveat, however, is to avoid the use of species with widespread and severe forest pest or disease problems. It is also important to test soil pH and assess moisture levels at the site, and select for planting only species that are compatible with these site conditions.

A forest restoration plan is a multi-year project that should include several phases:

- **Site preparation**: Remove invasive species, if present. Year 1-2
- **Phase I planting**: Establishing density and shade are most important; species that grow fast in gaps but do not persist long-term in shade may be used in this phase, possibly interspersed with slower-growing species. Tree and shrub species are the primary shade-providers; herb species for temporary cover (to prevent invasives on undesireable species establishing in bare ground) may be used, as well as natives that tolerate both sun and shade. Year 2-3 (if invasive removal is needed; year 1 if not).

FIGURE 10

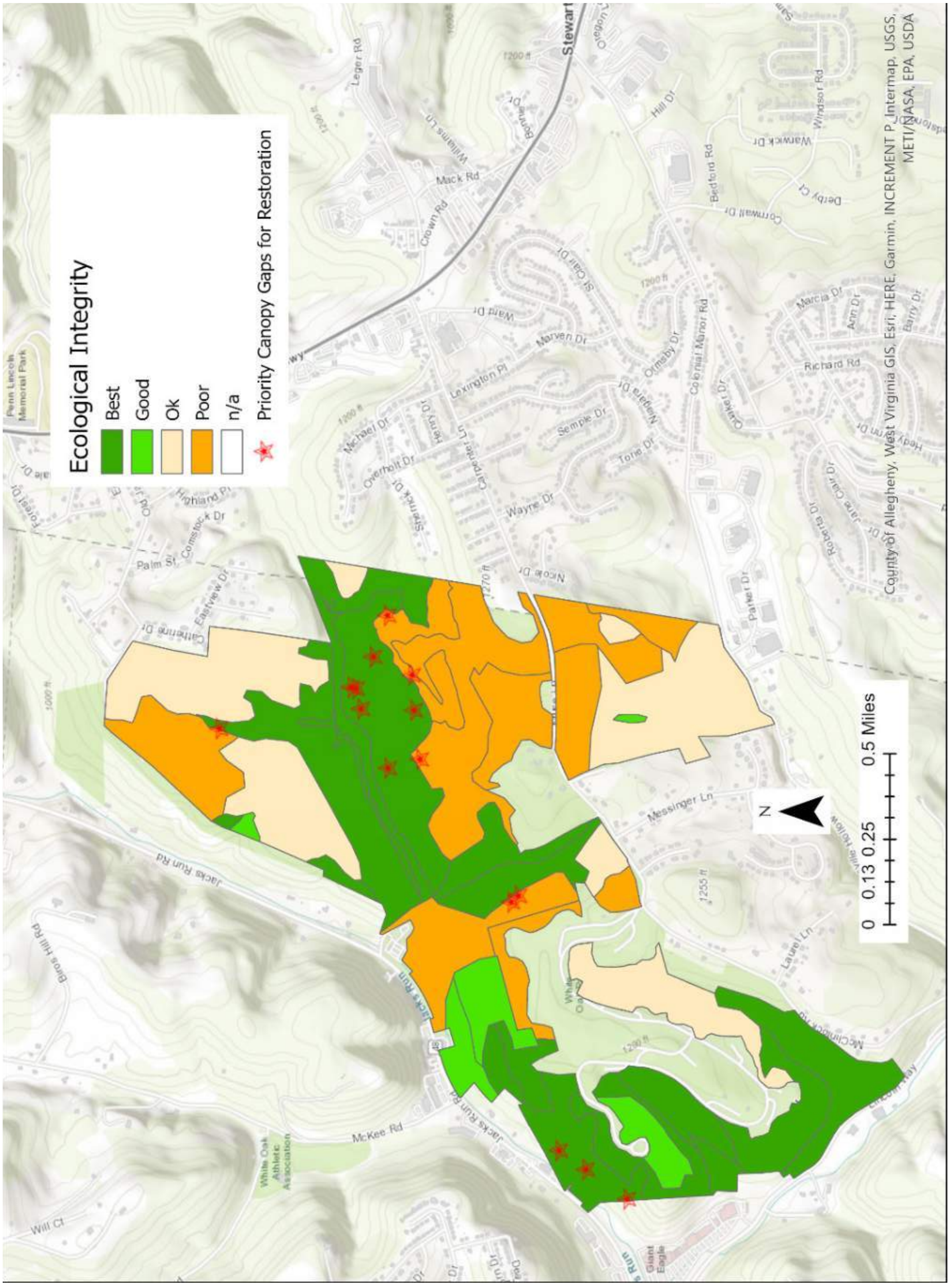
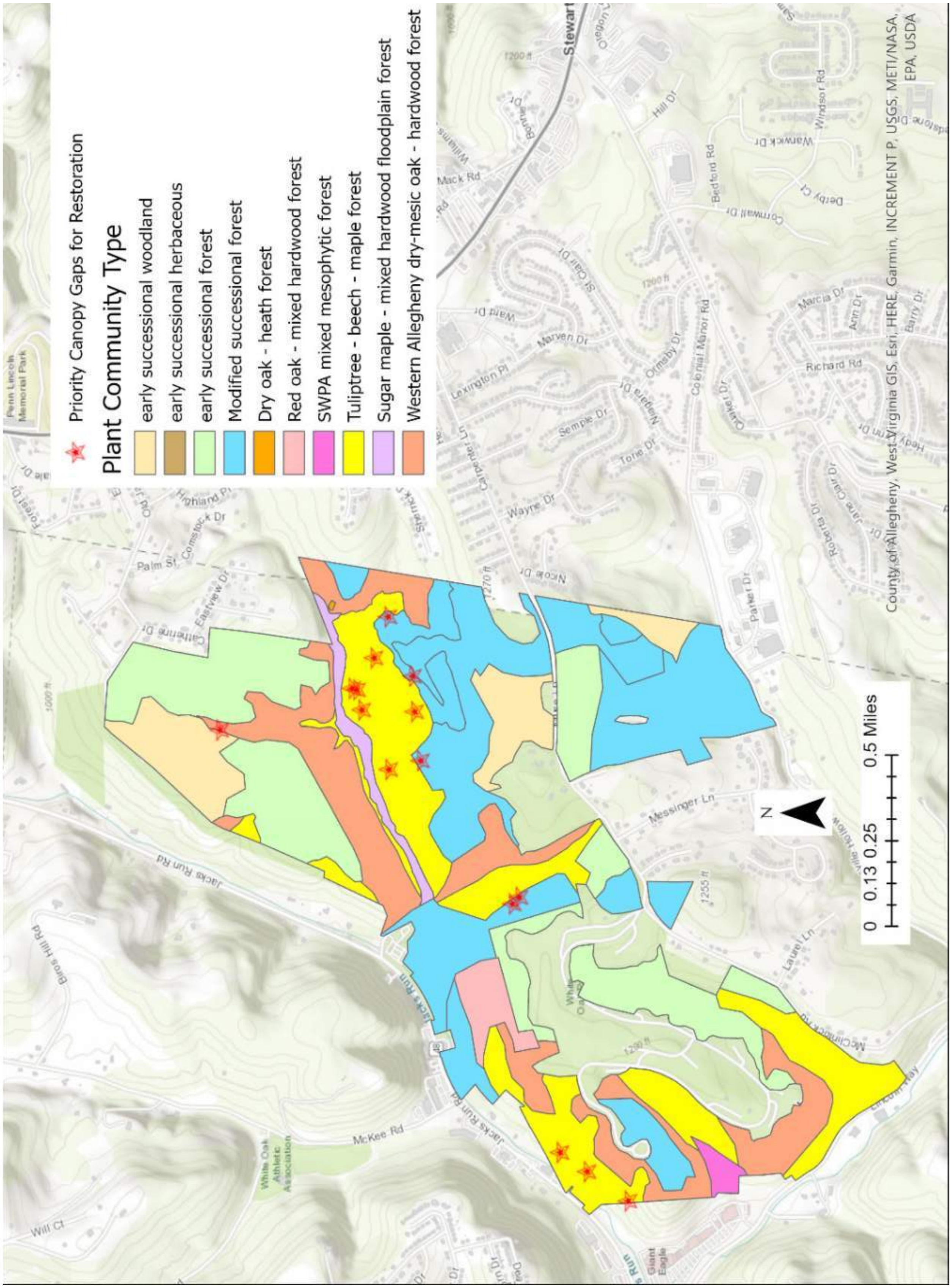

Ecological Integrity
Best
Good
Ok
Poor
n/a
Priority Canopy Gaps for Restoration
N
0 0.13 0.25 0.5 Miles
County of Allegheny, West Virginia GIS, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

FIGURE 11


Priority Canopy Gaps for Restoration
Plant Community Type
early successional woodland
early successional herbaceous
early successional forest
Modified successional forest
Dry oak - heath forest
Red oak - mixed hardwood forest
SWPA mixed mesophytic forest
Tuliptree - beech - maple forest
Sugar maple - mixed hardwood floodplain forest
Western Allegheny dry-mesic oak - hardwood forest
0 0.13 0.25 0.5 Miles
N
County of Allegheny, West Virginia GIS, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA

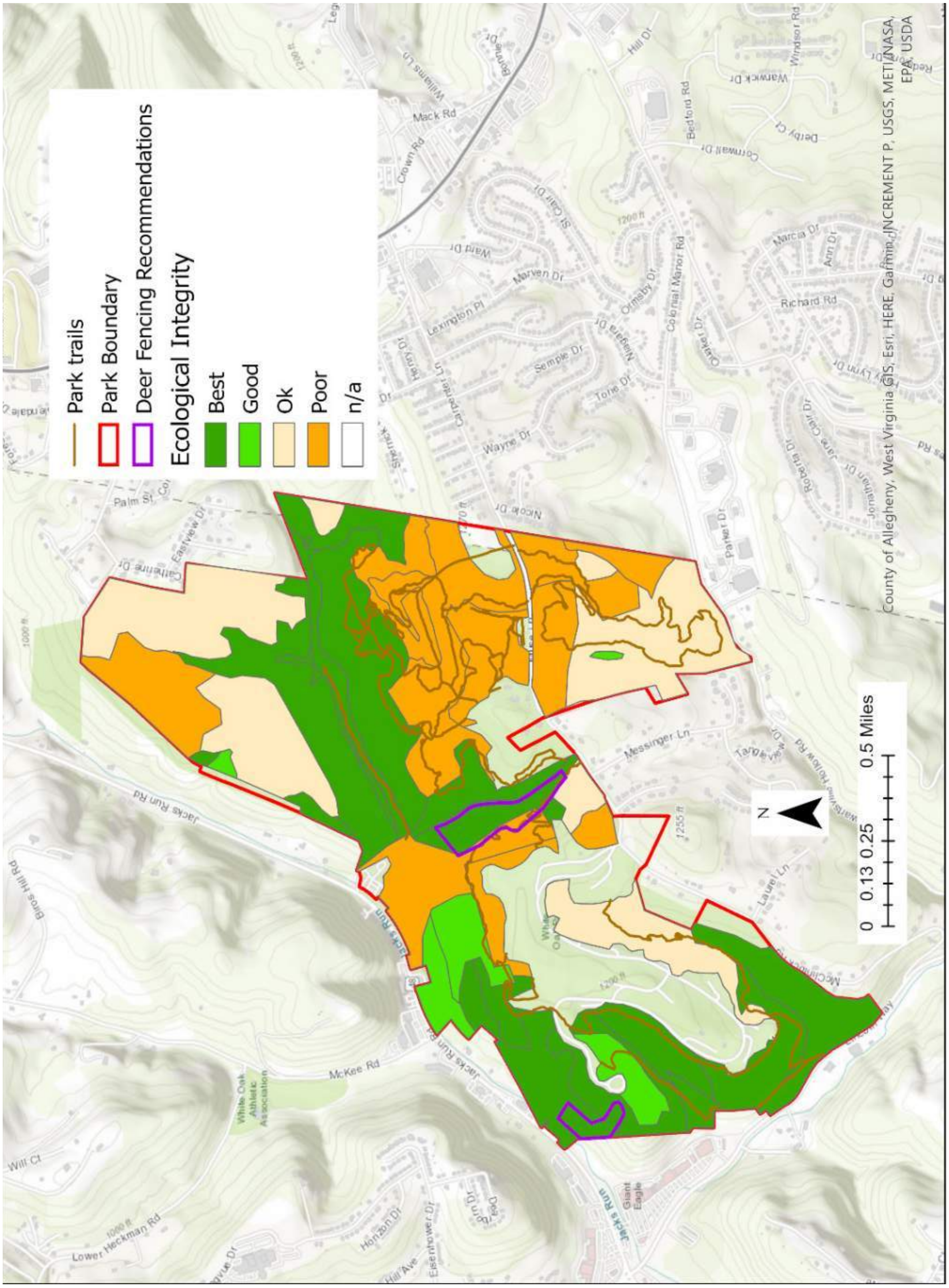
- **Ongoing Management:** Water new plantings (year 1), protect from deer and small mammal herbivory (install during planting years, maintain during other years), spot-treat invasive species (every year).
- **Phase II Planting:** Once shade has established, introduce native forest shrub and herb species that are shade-tolerant, slower growing, and typical of the target forest community but unlikely to re-establish on their own. Years 7-10, depending on phase I growth.

1/4 Acre Canopy Gap Budget			
Material	**Unit Cost**	**Units**	**Total**
Trees (2 gal)	$25.00	150	$3,750.00
Tubes / Stakes	$7.50	150	$1,125.00
Deer Fencing	$6.00	370	$2,220.00
Deer Fence Gate	$500.00	1	$500.00
Perennial Plugs	$3.00	500	$1,500.00
Shrubs (1 gal)	$15.00	100	$1,500.00
Signage	$500.00	1	$500.00
Subtotal			**$11,095.00**
Invasive Plant Control: Foliar Spray		1	$550.00
Invasive Vine Control		1	$1,000.00
Invasive Tree/Brush Control		1	$1,750.00
Herbaceous Plant Control		1	$1,350,00
Subtotal			**$11,645 - $12,845**
Annual Spot Maintenance of Invasive Regrowth (7 Years)		7	$2,625.00
Total			**$14,270 - $15,470**

4.2 Deer Fencing

Deer herbivory of native plants is a major problem that has eroded biological diversity and impaired forest regeneration over years at White Oak Park. Creating deer exclosures around important mature forest areas that still harbor good biodiversity can safeguard these plants, as well as encourage regeneration of damaged individuals and from the seedbank. Most of the mature forest in the park would likely benefit from deer exclusion, but it is probably impractical to fence at this scale. Furthermore, many areas of the park have extremely sparse herbaceous layers where herbivory has already reduced species diversity and tree regeneration, and the effects of fencing in these areas is less certain. Seeds and underground plant structures may or may

FIGURE 12


Park trails
Park Boundary
Deer Fencing Recommendations
Ecological Integrity
Best
Good
Ok
Poor
n/a
0 0.13 0.25 0.5 Miles
N
County of Allegheny, West Virginia GIS, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA

not still be present to provide natural regeneration. If natural regeneration does not occur, restoration planting would be needed to restore the full diversity expected of these natural communities. Pilot fencing projects in areas where wildflower populations are reduced but still present could give an indication of how the forests will respond. The map below shows two areas that currently still have good wildflower populations, each including some species of special interest.

The area highlighted within the "Jack's Run South" best ecological integrity area (see Figure 12) is the top priority for fencing; this area hosts mature forest with good wildflower diversity, including many conservative species. It is also relatively accessible, as it is bounded on one side by a road and the opposite side by a trail. The trail is heavily used, which provides opportunity for public education around the effort, and potentially for public enjoyment of the aesthetic benefits of improved wildflower abundance and diversity. The "Trillium Trail" natural area in Fox Chapel provides an example of a large fenced area with trail entrance and exit structures that allow foot traffic but do not allow deer passage.

The recommended deer exclosure area at the western edge of the park on the slope above Jack's Run is a portion of a slope that has mature native forest with juvenile and browsed wildflowers, and calcareous soils. A red mulberry seedling was also observed. If deer were excluded, wildflower numbers and diversity might significantly improve. The PA-threatened species red mulberry might also be able to regenerate into a population of mature trees. This area is not as accessible as Jack's Run South, and also does not suggest natural boundaries to the fenced area; the entire slope and adjacent ravines might benefit from fencing. Therefore we selected a portion of the slope centered around a known area of wildflower diversity where the effects of fencing could be observed without extravagant expense. The southern end of the proposed fencing area is a ravine that currently has very low herbaceous cover and diversity, but very nice mature sugar maple canopy; the effects of regeneration in these conditions could be observed through this project. The ravine and slope areas could also be approached separately if it were more feasible from a cost or implementation perspective.

If these pilot projects go well, and if there are additional funds available for fencing, similar exclosures could be designed for the Jack's Run East, Middle Ravine, and South Ravine best ecological integrity areas. Precise locations should be determined from on-the-ground survey of current wildflower populations in advance of project implementation. Costs would be similar to the first two projects identified, modified by the size of the fenced area.

Deer Fencing Per Acre			
Description	**Quantity**	**Unit Cost**	**Total Cost**
Deer Fencing, 8ft Woven Fence, 12ft Galvenized Steel Posts	740 ft	$6.00	$4,440.00
Deer Fence Gate	1	$500.00	500.00
			$4,940.00
Deer Fencing Per 1/4 Acre			
Deer Fencing, 8ft Woven Fence, 12ft Galvenized Steel Posts	370 ft	$6.00	$2,220.00
Deer Fence Gate	1	$500.00	500.00
			$2,720.00

4.3 Priority Invasive Species Control – Pioneer Populations

Pioneer populations of 7 species were identified at White Oak park. Below we have separated these into those can be effectively addressed by staff and volunteers (4 species), vs. those requiring larger and more concerted efforts, potentially involving herbicides (3 species).

Staff & Volunteer Projects
Each of these species could be approached as a small to medium-sized project for park rangers or other staff to address, potentially with volunteer assistance.

Wineberry *(Rubus phoenicolasius)*
Small project. This is a non-native species of red raspberry that can form dense thickets, especially in more open areas. Only a few shrubs were observed; they can be removed manually with a spading fork when soils are moist. This species can be identified any time of the year due to its distinctive branches covered in red bristles.

Giant reed *(Arundo donax)*
Small project. This species has established on the edge of the parking area opposite Angora Gardens. It is invasive further south; it is unknown whether it would survive winter in our region. If it's still present in spring of 2022, it should definitely be removed.

Chinese silver grass *(Miscanthus sinensis)*
Moderate project; potential for goat control. Chinese silver grass has spread from ornamental plantings in residential settings into natural areas of the park. It can continue to spread from seed and through vegetative spread in clones outwards from the initial clumps. However, it is not extensively established at this point. This species can be controlled by repeated cutting or grazing during the growing season (not in early spring, which stimulates growth), or by herbicide application. It may be a good candidate for control by goats. Digging is not very successful because new plants can regenerate from root fragments; fire stimulates growth**.**

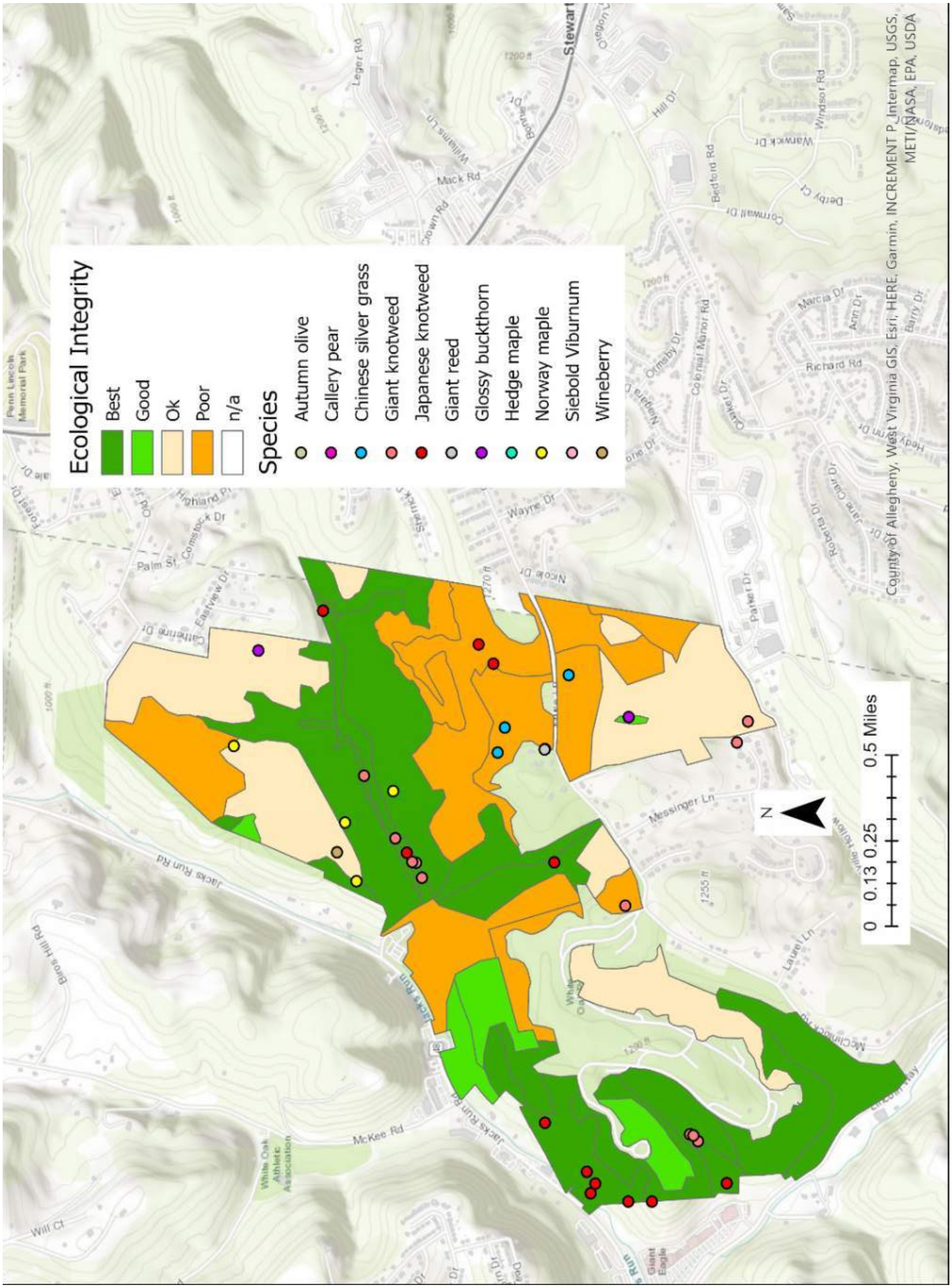
Norway maple *(Acer platanoides)*
Small project. Norway maple can form thickets and eventually dense canopy that shades out almost all other species. Only a few individuals were observed in the park, however, and control is easily implemented by volunteers with mechanical techniques. Saplings and small trees can be cut to ground level. Larger trees can be girdled by making a cut all the way through the bark in a complete circle around the trunk, several inches wide.

Larger Projects

The following species are considered "pioneers" because they have not spread to the point where they are pervasive; however, the infestations are larger than those described above, and the control techniques more difficult or more dependent on herbicide application. These are best planned as larger projects for staff (if they have appropriate training, resources, and time), or as tasks to be contracted out with dedicated funding.

Glossy buckthorn *(Frangula alnus)*
Glossy buckthorn has established in some wetlands in the park south of Carpenter Lane, and was also observed in one early successional forest setting (although seeds are bird-dispersed, and is likely more pioneer individuals will continue to be found in these settings). This species resprouts when cut or mowed. Seedlings can be pulled if roots are removed with the plant, and larger individuals can be girdled, although sometimes girdled individuals resprout if herbicides are not used in the cut. However, many populations consist of many medium-sized shrubs which may not be easily removed by pulling or girdling; this may require herbicide use. Furthermore, the wetland setting requires extra care in selecting and applying chemicals to minimize impact to sensitive native flora and fauna. This shrub seeds prolifically and seeds grow from the seed bank for a couple years; however,r most will germinate in the first year. Treatment will likely require monitoring for several years with repeated rounds of control on individuals that resprout or grow from seed.

FIGURE 13


Ecological Integrity
Best
Good
Ok
Poor
n/a
Species
Autumn olive
Callery pear
Chinese silver grass
Giant knotweed
Japanese knotweed
Giant reed
Glossy buckthorn
Hedge maple
Norway maple
Siebold Viburnum
Wineberry
0 0.13 0.25 0.5 Miles
N
County of Allegheny, West Virginia GIS, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

Japanese knotweed *(Fallopia japonica)* and Giant knotweed *(Fallopia sachalinense)*

There are two invasive species of large knotweeds; Japanese and Giant knotweed. The giant knotweed has larger leaves and canes, and can more readily spread outside of wetlands. Both species were observed in White Oak Park, in small to moderate sized stands along many of the floodplains of streams in parks. However, at this point they only cover a small fraction of the total floodplain area. If not controlled, these species will continue to spread and form dense thickets that entirely dominate floodplains, and exclude almost all other vegetation. This not only reduces plant biodiversity, but greatly degrades the habitat for native animals. Control of these species, however, is extremely difficult, requiring a several-year plan and continued monitoring with follow-up efforts as needed. The plants are extremely vigorous, with deep root systems, and even small fragments of roots can regenerate. It is debatable whether any mechanical control techniques are effective. Chemical control requires several rounds. Biocontrols have been under development and may be worth examining. It may be beneficial to consult with a professional in developing a control plan, or to contract out the work entirely.

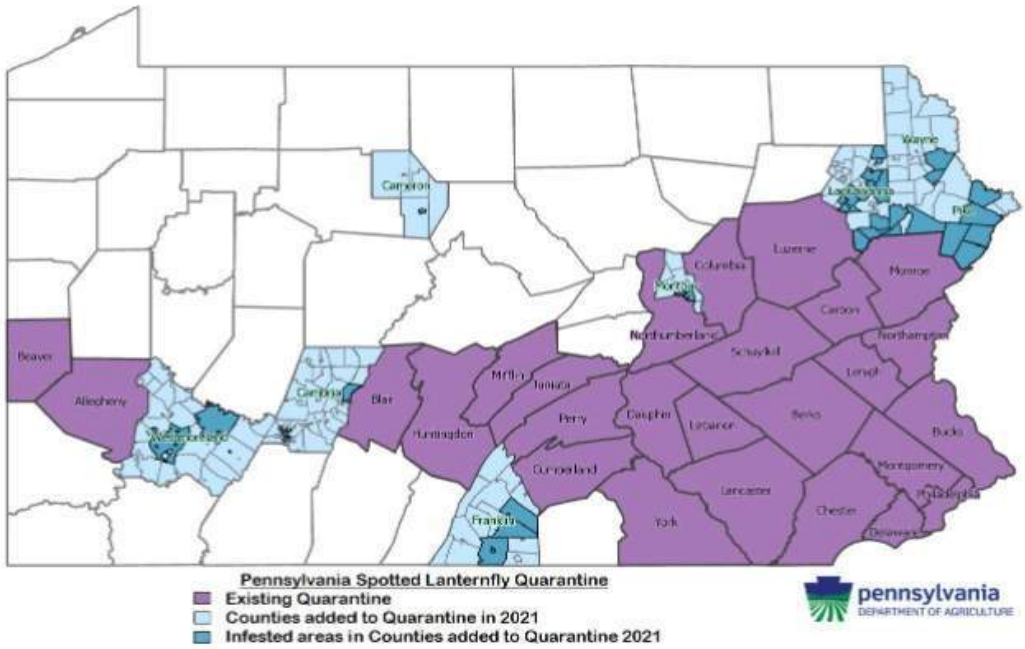
Invasive Plant Control			
Description	**$ per Acre**	**$ per 1/4 Acre**	**Species Treated**
Invasive Plant Control, Foliar Spray w/ Backpacks	$2,200.00	$550.00	Mile a Minute, Garlic Mustard
Invasive Vine Control	$4,000.00	$1,000.00	Grapevine, Oriental Bittersweet & Porcelain Berry
Invasive Tree/Brush Control	$7,000.00	$1,750.00	Norway Maple, Tree of Heaven, Honeysuckle, Winged Euonymus, Barberry, Autumn Olive, Buckthorn & Multiflora Rose
Herbaceous Plant Control	$5,400.00	$1,350.00	Knotweed

4.4 SPOTTED LANTERNFLY IN PENNSYLVANIA

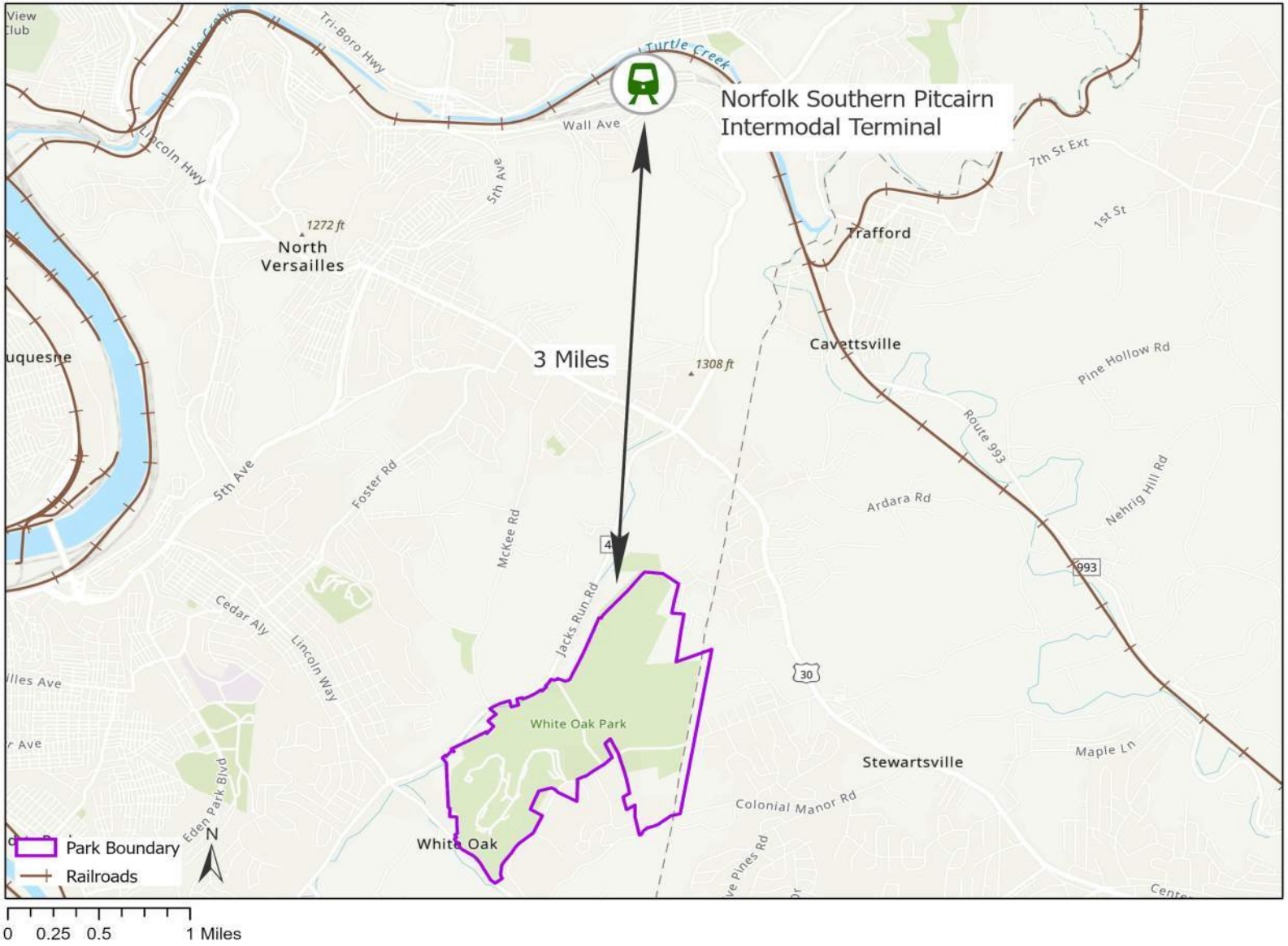
The spotted lanternfly (*Lycorma delicatula*) (SLF) is an invasive pest native to China, India, and Vietnam. This insect is a type of planthopper with colorful markings on its wings and body. Though it may appear attractive on the surface, the spotted lanternfly continues to cause significant economic damage to the agricultural, forestry, and tourism industries and poses a severe threat to our local and regional ecosystems. It's also a nuisance to business and homeowners due to the sticky "honey dew" it excretes that encourages the growth of a black, sooty mold. This mold is not harmful to humans, but can cause damage to plants and make outside recreational areas unusable.

Spotted lanternflies are often found on vegetation and are known to feed on the sap of over 70 different plant species. These include grapevines, maple trees, black walnut, birch, willow, and other trees. It also has a strong preference for the invasive tree-of-heaven (Ailanthus altissima) which is (unfortunately) quite prevalent in much of Pennsylvania.

Spotted lanternfly was first found in the United States in September 2014 in Berks County, PA. It has since spread to 34 counties in Pennsylvania (or half of the state), as well as several other states.



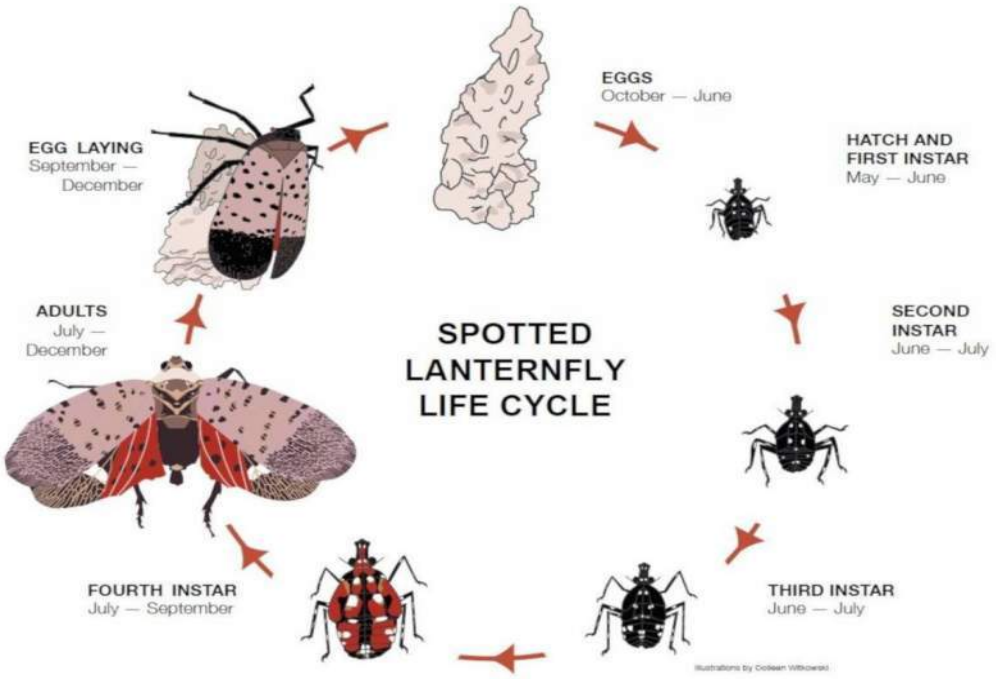
White Oak Park: Proximity to Pitcairn Spotted Lanternfly Infestation



White Oak Park has an elevated risk of spotted lanternfly infestation due to its close proximity to a large railroad yard in the nearby town of Pitcairn. Railroads have been one of the key vectors for spreading spotted lanternflies westward. Norfolk Southern Corporation is the only east-west railroad spanning the entire width of Pennsylvania. Adult lanternflies lay numerous egg masses on parked rail stock. These infested trains then travel west, out of the initial infestation regions in eastern PA, carrying the egg masses with them.

The ribbon of affected counties in the Pennsylvania infestation map above follows one of the most highly trafficked rail corridors in the state. In western PA, many of the primary lanternfly infestations have originated in areas with large railyard facilities.

The Norfolk Southern Pitcairn Intermodal Terminal along Turtle Creek is only three miles from the northern park boundary. A large population of spotted lanternflies has been observed in the Pitcairn and Wilmerding areas. The WPC Forester recommends that County Park staff frequently monitor White Oak Park for spotted lanternfly infestations. Unlike other parks in the County Park system, White Oak Park is almost entirely comprised of contiguous forested land. Therefore this park may risk substantially higher impacts should a spotted lanternfly infestation emerge.



The lifecycle of spotted lanternfly begins with a female laying her eggs (i.e., an egg mass) on any hard surface she can find such as a tree, picnic bench, car, truck, trailer, etc. Eggs are laid from September through December and will overwinter into spring. The first instars (or nymphs) of spotted lanternfly are black in color with white dots on their back. These nymphs emerge from an egg mass in May-June and molt into larger instars throughout the summer months. They eventually change their color from black to red, and beginning in July, will transform into adults that resemble colorful moths. Adult spotted lanternflies are noticeable from July through December, and beginning in September, will begin the life cycle over again with the females laying their eggs.

If any life stage of a spotted lanternfly is observed (egg mass, instars, adults), it's important to report your finding to the Pennsylvania Department of Agriculture and Penn State Extension. An easy-to-use online tool has been developed for this specific purpose and is accessible at https://services.agriculture.pa.gov/SLFReport/.

Spotted lanternfly is just one of several other tree pests to be on the lookout for in the Commonwealth. Other insects that can cause harm to our urban and natural forests include:

Common Name	***Scientific Name***	**Notes**
Asian Longhorned Beetle (ALB)	*Anoplophora glabripennis*	To date, ALB has not been found in PA.
Hemlock Woolly Adelgid	*Adelges tsugae*	-
Elongate Hemlock Scale	*Fiorinia externa Ferris*	-
-	*Lymantria Dispar*	Formerly known as Gypsy Moth
Oak Wilt	*Ceratocystis fagacearum*	Also known as *Bretziella fagacearum*
Root Rot	*Phytophthora spp.*	Also known as Sudden Oak Death

More information about the spotted lanternfly can be obtained from:

- Penn State Extension
- Pennsylvania Department of Agriculture
- Cornell College of Agriculture and Life Sciences

4.5 PARK STAFF TRAINING

Tree Planting and Care (Tree Tender Training)

WPC has been working with the non-profit Tree Pittsburgh since 2008 through the TreeVitalize Pittsburgh project. An important component of the success of that project has been the training of volunteers through Tree Pittsburgh's "Tree Tender" program. Tree Pittsburgh has trained over 1,600 Tree Tenders in Allegheny County through an eight hour workshop that covers everything from the benefits of trees to communities to the planting and care of trees over the long term. Based on past recommendations from earlier Ecological Assessments, the Allegheny Count Parks staff have undergone Tree Tender training to support the long term health of newly planted trees. WPC continues to recommend that new Allegheny County Parks Maintenance staff undergo Tree Tender Training to promote the sustainability of ongoing tree plantings in the parks.

4.6 REDUCE MOWING, PRIORITIZE ECOLOGICAL MANAGEMENT AND MAINTENANCE OF CAPITAL PROJECTS

As staff time availability increases with reduced mowing obligations, staff capacity should be re-allocated more heavily toward ongoing maintenance and management of the capital projects mentioned above.

- Invasive Weed Management
  - As described in previous sections of this report, managing invasive weed infestations impacting mature forest areas of White Oak Park is a priority management concern, and will continue to be into the future. Investments in tools and staff training are priority recommendations also mentioned in this section.

- Trail System Maintenance

- Green Infrastructure Maintenance

- Meadows and Reforested Areas Maintenance

4.7 PROCURE TOOLS AND EQUIPMENT

For invasive weed management, trail maintenance, meadow management, tree planting, fence building and maintenance. Procuring an adequate supply of the tools listed below will cost approximately $20,000 total, although the tools could be acquired as needed over the course of several months/years.

Hand Tools:

Hedge shears:	$20-$75 each (depending on size)
Hand pruners:	$15-$45 each
Loppers:	$20-$80 each (depending on size)
Bow saws:	$15-$30 each
Long reach pruners:	$75-$150 each
Picks mattock:	$15-$40 each

Specialty Tools:

Tree and root puller (Pullerbear):	$200
Root Talon:	$70
Root Buster:	$45
Tree planting dibble bar:	$35-$45 each

Power Tools:

Professional-grade chain saws:	$350-$600 each (depending on size and brand)
Professional-grade Pole saws:	$400-$700 each (depending on size)
Walk-behind brush cutter:	$1,500 - $3,000
Brush hog tractor attachment:	$2,000 - $4,000
Tree hole auger:	
Attachment for tractor with 3-point hitch:	$450-$1,000
Hand-held:	$200-$400

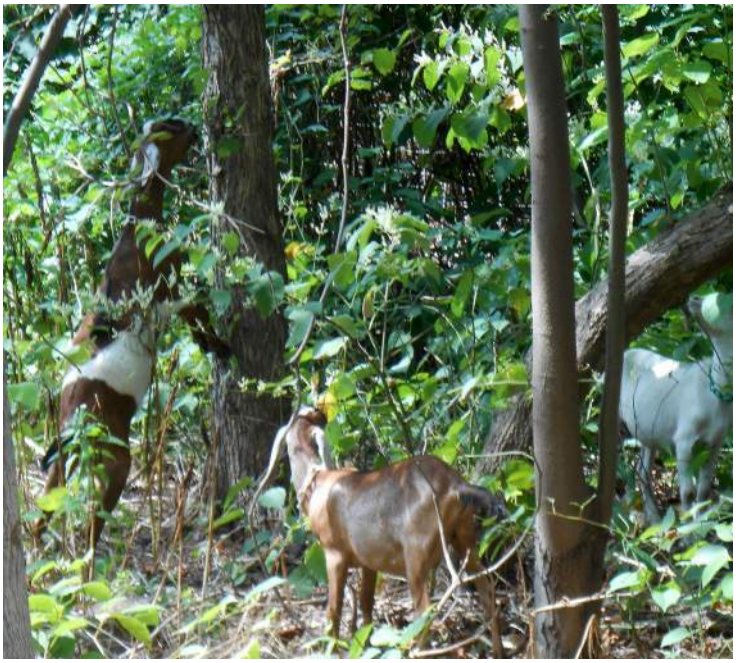
Goat herd:

- Use of goat herds to graze on invasive weeds has emerged locally as a potentially high impact, low cost strategy to be used in combination with other treatment methods, either chemical or mechanical. For example, spraying a systemic herbicide (i.e. tryclopyr or glyphosate) immediately following grazing by goats can create good conditions for herbicide absorb into the plants' vascular system, increasing the chances of a total kill of the unwanted vegetation.

- There is one location non-profit organization that uses goats as a way to manage invasive and unwanted plant species - Alegheny GoatScape - that used to to business as Steel City Grazers. WPC engaged Steel City Grazers on one project to control a small patch of Japanese knotweed and other invasives in the City of Pittsburgh that proved to be highly effective. The fee for that project was based on a $500 base fee plus $100 per day for a 10-goat herd with an expectation that it could take two to three weeks per acre to be cleared. Those fees included transportation of the goats, temporary electric fencing to contain the goats to the area being managed, a donkey whose role was to protect the goats from predators such as coyotes and feral dogs and daily care of the animals.

- Interest was also raised by County Park staff and others during the meetings conducted in conjunction with this project about the possibility of acquiring a permanent goat herd (or herds) to manage invasive weeds across the County Parks system. Because of recent notoriety, demand is quite high for privately owned goat herds. Acquiring a goat herd would help to ensure goats are always available for weed management.

- Goats themselves are relatively inexpensive to buy (sometimes even free). However, they do require good fencing, food and shelter during winter and inclement weather, transportation to and from weed management projects, protection from predators, and a knowledgeable caretaker.



4.8 DEVELOP A SUSTAINABLE TRAIL MANAGEMENT PLAN

In conjunction with training Parks staff on trail management and maintenance, developing a sustainable trail management plan that provides a comprehensive vision and management framework for all trails in White Oak Park is a top priority. Such a plan should include broad stakeholder and public input, as well as engagement of trail design, construction and maintenance professionals.

The scope of the plan should include the following:

- Survey and evaluation of current and future trail usage.
- A comprehensive assessment and evaluation of the existing trail system by trail consultants.
- Identifying most appropriate trails for each permitted use.
- Identifying locations for development of new trailheads.
- A plan for interpretive signage and other outreach and educational ssets.
- Prioritizing trails/trail sections will be the focus of future maintenance efforts and developing detailed work logs.
- Garner broad stakeholder and public input.
- Training and project oversight for County Parks staff on trail construction and maintenance BMPs.
- Identifying trails to close/eliminate due to redundancy, illegal vehicle use or other problems.
- Plan for accessibility in compliance with the ADA.

A more detailed budget estimate should be developed based on soliciting proposals from outside consultants, but the total cost to develop the plan is likely to cost fanywhere from $25,000 to $120,000 depending on the contractor. The planning process would likely take at least two years to complete. For fundraising purposes, developing the Sustainable Trail Management Plan could be packaged with other recommended initiatives to develop an interpretive plan for White Oak Park and to train County Parks' staff on trail management and maintenance.

Based on discussions held in conjunction with this project, it was also mentioned that the plan could be done in conjunction with a broader County Parks system wide trail planning effort that leverages the skill and expertise of the Allegheny County Park Rangers and Trail Pittsburgh, an organization that conducts extensive volunteer activities to protect and enhance trails for all park user groups.

THE POWER OF GREEN

White Oak Park is in a great position to use the power of green to enhance its immediate present and support its future. With the engagement and leadership of the Allegheny County Parks Foundation and the Allegheny County Parks, it has many of the elements that are necessary for successful greening projects. Strategic greening has the potential to be a rallying point for community improvement that can involve citizens from school children to seniors, from business owners to cultural institutions, from novices to skilled members of the community. The power of green is found in the multifaceted benefits and the profoundly satisfying experience of improving the living landscape of the community. White Oak Park has the elements in place to harness this power for all its constituents, employees and its landscape.