The Plant Communities and Flora of Griffy Lake Nature Preserve

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Introduction

Plant Community Mapping and Purpose

Griffy Lake Nature Preserve is an approximately 1,200 acre park operated by Bloomington Parks and Recreation on the north side of Bloomington, Indiana. Centered in the park is the 109 acre namesake reservoir that was constructed as a water supply for the city of Bloomington in 1924. The surrounding woodlands were a result of many property acquisitions that occurred just prior to and following construction of the dam. The acquired woodlands have been left largely unmanaged since their acquisition. Succession has resulted in the reforestation of areas that had been cleared for agriculture or development prior to the construction of the reservoir and the creation of the park. The result is a large block of woodland of varying ages and quality that provides an outstanding documentation of local natural history within the suburban environment of Bloomington.

In order to better understand the current state of the plant communities, Eco Logic was contracted in March of 2019 to map the plant communities, their current state of succession, their quality, and their suitability for trail development in preparation for the planning of an improved trail system encircling the lake. While some of the existing trail system has been constructed, much of it consists of footpaths that were not designed to minimize environmental impact or maximize the safety of the public on steep and sometimes dangerous slopes.

Mapping Methods

In April of 2019, the entire park was walked to inventory the current state of the plant communities. The walking routes were chosen along topographic breaks and other physical features that tend to delineate the different types of wooded communities that occur within the park. During the approximately 100 miles of walking, about 1,200 GPS points were taken. At each point, the plant community type, the stage of succession, the quality of the natural area, and the level of invasive plants were recorded. These items were then entered in the ARCMAP GIS program and utilized to draw the polygons shown in the maps contained in Appendix A.

Floral Inventory

Eco Logic was also contracted to conduct a floral inventory of the vascular terrestrial plant species of the property in 2019. The property has been previously surveyed several times, including by John Theile Jr (1982), Cathy Meyer and Longmire (1998), and JF New and Associates (2007). These surveys varied in their level of accuracy and completeness according to the skill of the surveyors at difficult groups of the plants; however, the most recent survey performed by JF New and Associates was performed by highly capable botanists and is regarded as the most accurate and complete.

Floral Inventory Methods

The flora was inventoried throughout the growing season by walking a cross section of the various plant communities surveyed during the April plant community mapping. Floral inventory work was performed on April 8, April 23, May 17, May 24, June 14, June 21, July 19, August 12-13, August 30, September 18, and October 3-4. Field work was performed by Eco Logic Senior Ecologist Kevin Tungesvick, accompanied by Eco Logic Botanist Natalie Marinova on May 24, and DNR Division of Nature Preserves State Botanist Scott Namestnik on October 3rd. Each species witnessed on these surveys was recorded, including their relative abundance and characteristic plant communities. The location of plants that were not at a stage to key to species were noted so a return visit could be made later in the growing season to identify them to species. While this was a terrestrial plant survey and no attempt was made to inventory aquatic plants in the lake, aquatic species that were stranded on the seasonal mudflats in the late summer and early fall were identified wherever possible.

Since the last inventory was performed in 2007, extensive plantings of native prairie and wetland plants were installed along the lakeshore at the primary parking lot where the boat rental is located. Some of these species are reproducing outside the original planting. Those species freely escaping the planting are included in the inventory while those that remained contained within the original planting are not included.

The 2007 plant inventory performed as part of the 2008 Masterplan (Peel, et al., 2008) included an area east of Dunn Road below the dam that contains emergent wetlands and wet old field habitat. This area was not included in the mapping contract; however, it was included in the floral inventory to achieve comparable results since it contains habitat and species not found elsewhere in the park. A map showing this area is contained in Appendix A.

The plant species were input into the online FQA calculator utilizing the most recent values and nomenclature (Rothrock 2019) to calculate the floristic quality index for the park. Further the floristic quality index was calculated separately for the dry communities, the mesic communities, the wet wooded communities, the wet open communities, and the cultural communities.

Geology

Griffy Park is located in the Norman Upland near its boundary with the Mitchell Karst Plateau (Schneider, 1966). The Norman Upland is dominated by resistant siltstones and shales of the Borden Group. The border of the Mitchell Karst Plateau contains limestone of the Sanders Group. Both groups belong to the Mississippian geologic period. Since the bedrock is more recent to the west, the limestone caps the ridges with the Borden siltstones and shales lying beneath on the slopes and bottomlands of the park. A delineation of the limestone on the ridges is shown on the soil survey map; however, it should be considered approximate as the soil survey is not considered accurate at this scale. Alluvial deposits are found along Griffy Creek upstream from the reservoir and in the better developed stream valleys in the park.

The Norman Upland lies south of the glacial boundary resulting in relatively rugged relief. A long history of erosion has resulted in a dendritic watershed pattern that is exemplified by Griffy Creek. The ridges are relatively flat topped, dropping off to steep slopes and V-shaped valleys. The north facing slopes on the south side of Griffy Creek and reservoir are generally considerably steeper than the south facing slopes on the north side of the creek and reservoir. This is a result of the greater number of freeze-thaw cycles that occur on the south facing slope, breaking up the siltstones and shale on the slope and allowing it to erode to a gentler grade.

The natural regions of Indiana (Homoya et al., 1985) classifies this area as the border of the Brown County Hills Section and the Mitchell Karst Plain Section of the Highland Rim Natural Region. The bedrock and soils show characteristics of both of these sections, as do the plant communities.

Soils

The soils in Griffy Park can be divided into three primary categories.

Soils Derived from Siltstone and Shale

The first category contains soils derived from siltstone and shale. These soils are found on the slopes and V-shaped ravines. Because these soils occur on significant to very steep slopes, they are considered highly erodible. These soils are characteristic of the Brown County Hills. They are part of Berks-Weikert soil map unit. Soils found at Griffy Park that fall within this unit include:

BkF Berks-Weikert complex, 25-75% slopes – Moderate to shallow soils occurring over siltstone and shale on steep to very steep slopes with coarse fragment in the lower levels.

GpD Gilpin silt loam 12-18% slopes – Strongly sloping, moderately deep, well drained soils on convex, dissected uplands.

Soils Derived from Limestone Residuum and Loess

The second category of soils are derived from limestone residuum and loess. These soils are restricted to the ridgetops and upper slopes in the areas of limestone bedrock. These soils are typical of the Mitchell

Karst Plain and part of the Crider-Caneyville soil map unit. Soils found at Griffy Park that fall within this unit include:

BdB Bedford silt loam, 2-6% slopes – Gently sloping, moderately well drained soil with a fragipan at a depth of 20 to 50 inches occurring on narrow to broad ridgetops of loess-covered uplands.

CaD Caneyville silt loam, 12-18% slopes – Strongly sloping, moderately deep, well drained soil on side slopes of uplands

CrB Crider silt loam, 2-6% slopes - Gently sloping, deep, well drained soil on narrow to broadly convex ridgetops

CrC Crider silt loam, 6-12% slopes - Moderately sloping, deep, well drained soil on narrow to broadly convex ridgetops

HaD Hagerstown silt loam, 12-18% slopes – Moderately sloping, deep, well drained soil on narrow to broadly convex ridgetops

Soils Derived from Alluvium

The final category are soils derived from alluvium. These nearly level, well drained soils and somewhat poorly drained soils are restricted to the better-developed floodplains of Griffy Creek and its major tributaries. These soils are part of the Haymond-Stendal soil map unit.

Bo Bonnie silt loam – Deep poorly drained soil on broad flats and depressions in bottomlands subject to frequent flooding primarily in winter and spring.

Bu Burnside silt loam – Deep, well drained soil on narrow floodplains in non-calcareous rocks subject to infrequent brief flooding.

Hd Haymond silt loam – Nearly level, deep, well drained soil on bottomlands subject to frequent brief flooding primarily in winter and spring

Wa Wakeland silt loam – Nearly level, deep, somewhat poorly drained soil on broad flat bottomlands subject to frequent brief flooding

Maps of soil types, soil units, topography and percent slope are found in Appendix B.

Plant Community Descriptions of Griffy Lake Nature Preserve

The descriptions of the forested communities of Griffy Lake Nature Preserve largely follow the classification developed by Hoosier National Forest for the Brown County Hills as outlined in the Hoosier National Forest publication: "Field Guide: Ecological Classification of the Hoosier National Forest and Surrounding Areas of Indiana" (Van Kley et al.,1995). The overstory of the dry ridges and dry slopes varies from this publication due to the absence of chestnut oak (*Quercus montana*) from Griffy Lake Nature Preserve. This niche is largely replaced by the scarlet oak (*Quercus coccinea*).

Dry Ridges – 3.1 acres

This woodland type is confined to three narrow ridges in the park. These ridges are characterized by thin soil, steep side slopes, and south to west aspect. These ridges are differentiated from dry-mesic ridges by the large constituent of scarlet oak in the canopy, and an abundance of blueberry (*Vaccinium pallidum*) and serviceberries (*Amelanchier spp*) in the understory layer. Greenbriar (*Smilax rotundifolia*) is also abundant. Painted Sedge (*Carex picta*) is the characteristic herbaceous species.

Figure 1:Downy Serviceberry is a common understory tree of dry slopes and ridges

Due to their shallow soils and steep sides, these ridges should be regarded as fragile natural areas to be avoided. One of these ridges, known as Huckleberry Ridge, is already suffering from severe impacts from off-trail hiking. Closing these unauthorized footpaths should be a high priority. Further these ridges are important habitat for reptiles that prefer warm dry environments.

Figure 2: Male flowers of Carex picta

Dry Slopes – 20.6 acres

This community generally occurs on steep south and west-facing slopes below the limestone cap. Like the dry ridges, scarlet oak is often the dominant tree species; however, black oak may co-dominate. Some of these slopes, which lie to the north of the reservoir, have been created by their exposure to drying insolation. The reservoir has additionally increased exposure to the drying winds and reflected sunlight due to the open water to the south, increasing the xerification of the adjacent slopes. While the overstory reflects the dry mesic woods present prior to the reservoir, the abundance of blueberries and serviceberries reflect the more xeric post-reservoir conditions. Again, painted sedge is dominant in the herbaceous layer.

Due to thin soils, these slopes should be regarded as fragile natural areas to be avoided when possible. In areas where existing trails pass through them, the trails should follow the contours and be engineered to divert water from the trail. On the north side of the reservoir, the trail that passes through this community is already severely eroded and contains numerous footpaths down the slope to the waters' edge. This trail requires major reconstruction with constructed paths to the water for observation and fishing. Like the dry ridges, this community provides vital habitat for reptiles such as fence lizards.

Figure 3: Dry ridge with scarlet oak as the dominant overstory species.

Dry-Mesic Ridges – 7.0 acres

This woodland type tends to occur on the ends of long ridges where the ridge drops off the limestone cap. These ridges are typically dominated by white oak (*Quercus alba*) and black oak (*Quercus velutina*). Scarlet oak may be present but is not dominant. Shagbark (*Carya ovata*) and pignut hickory (*Carya glabra*) are also common. Greenbriar and maple-leaf viburnum (*Viburnum acerifolium*) are the most common shrubs in the understory. Blueberries may be present, but are a minor constituent.

Like the dry ridges, painted sedge is the most common herbaceous species. As elevation increase onto the limestone cap, the disappearance of the painted sedge indicates the transition to the mesic ridges on limestone described below.

Although these ridges general have deeper soils than the dry ridges, they are still very prone to damage from foot traffic and erosion, especially where they slope downward toward the lake. Trails that utilize these ridges should be engineered to frequently divert water from the trail to prevent downcutting erosion.

Figure 4: Carex picta often forms a nearly continuous groundcover on dry mesic ridges

Dry-Mesic Slopes – 104.4 acres

Also typically occurring below the limestone cap, these slopes generally have a more gentle grade and thicker soils than the dry slopes. White oak, black oak, pignut hickory, and shagbark hickory are the dominant tree species. Hophornbeam (*Ostrya virginiana*) and flowering dogwood (*Cornus florida*) are common in the understory layer. Greenbriar and maple-leaf viburnum dominate the shrub layer. Once again, painted sedge is the most common plant in the herbaceous layer, however other sedges and rushes such as *Carex albicans*, *Carex pensylvanica*, and *Luzula echinata* also occur.

These slopes are very prone to erosion and should be avoided as much as possible when developing trails. Trails that do traverse this community should be well engineered to divert water and utilize grade reversals when the trail elevation changes.

Figure 5: Dry mesic slopes occur on south and west-facing aspects

Mature Mesic Woodland on Limestone Ridges – 47.8 acres

The community occurs on the relatively flat limestone ridges that make up the highest elevations in the park. The soils are generally deeper than the dry and dry mesic communities. The mature expression of the woodland has a rather diverse canopy layer that includes white oak, northern red oak (*Quercus rubra*), black oak, American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), chinquapin oak (*Quercus muehlenbergii*), shagbark hickory, bitternut hickory (*Carya cordiformis*), pignut hickory, tulip tree (*Liriodendron tulipifera*) and black walnut (*Juglans nigra*). Where dominated by oaks, the ground surface is often covered by a heavy accumulation of oak leaves. This accumulation together with excessive browse from the large deer population creates a rather depauperate herbaceous layer. Culling of the deer population combined with prescribed fire would help restore herbaceous diversity to this community. Some spring wildflowers, however, are frequently seen including cutleaf toothwort (*Cardamine concatenata*), spring beauty (*Claytonia virginica*), and rue anemone *(Thalictrum thalictroides*).

Due to deeper soils and gentle grades, these ridges are one of the most resilient communities for trail development. Their wide, relatively flat tops provide ample space for trail placement. However, where the trail departs this community to drop to lower elevations, careful engineering must be applied to prevent the trail from being utilized as a conduit for runoff from the ridgetop.

Figure 6: Mature mesic woodland on limestone ridges.

Figure 7: Rue amemone is commonly seen on mesic ridges and slopes

Young Mesic Woodlands on Limestone Ridges – 173.2 acres

These woodlands occur where limestone ridges were cleared for crops and pasture prior to construction of the reservoir. They contain much younger trees and are characterized by a less diverse overstory than the mature ridgetop woodlands. Tulip trees make up the largest share of the canopy species. Other common species include red maple (*Acer rubrum*), northern red oak, black oak, chinquapin oak, and black cherry (*Prunus serotina*). Although the leaf litter accumulation is less than in the mature woodlands, the native herbaceous layer is still weak, a legacy of earlier land use. Further, in the southwest parcel of the park, this community harbors a dense layer of invasive shrubs.

Similar to the mature mesic woodland on limestone ridges, this relatively resilient community is excellent for upland trail placement. Due to its lower natural area value, recreation trails placed in this community have an even lower impact than those placed on ridges containing mature woodlands.

Figure 8: Young woodlands on mesic ridges with tulip trees as the dominant overstory tree

Pine Plantations – 9.4 acres

These areas also occur on the limestone ridges, but rather than allowing natural tree recruitment to occur, pines were planted. Most of the planting consisted of eastern white pine (*Pinus strobus*) and Virginia pine (*Pinus virginiana*) but some Scotch pine (*Pinus sylvestris*) were also included. A few native tree species, mostly tulip trees have established and are overtopping the pines. The understory of these woodlands is among the most degraded in the park, primarily consisting of invasive shrubs such as Amur honeysuckle (*Lonicera maackii*) and autumn olive (*Elaeagnus umbellata*).

This highly degraded community is an excellent choice for upland trail placement. Invasive shrub removal should be performed in conjunction with trail construction.

Figure 9: The pine plantings on limestone ridges are the lowest quality woodlands in the park

Sterile Old Field Habitat – 0.3 acres

This plant community occurs in one place on a limestone ridge in the northeastern part of the park. The dry sterile soil is likely at least partially the result of some prior land use as the surrounding area is young successional woodlands indicating it was cleared prior to construction of the reservoir. The open character of this community is also partially due to the excessive deer browse that limits tree recruitment. Herbaceous plants not found elsewhere in the park occurring in this area include purple milkwort (*Polygala sanguinea*), butterflyweed (*Asclepias tuberosa*), and beaked panic grass (C*oleataenia anceps*). This opening is threatened by the presence of the invasive autumn olive. Removal of this shrub from the vicinity should be a high stewardship priority.

Figure 10 Spiranthes cernua was discovered at the edge of the sterile old field

This community only occurs in one area of the park and should be protected from development. Further, nearby unauthorized trails and primitive structures should be closed and removed.

Mesic Sloping Woodlands – 553.0 acres

This is the most common plant community in the park. It also harbors the greatest diversity of canopy species of any of the communities in the park. Among these species are American beech, sugar maple, tulip tree, shagbark hickory, bitternut hickory, pignut hickory, northern red oak, white oak, black walnut, and American basswood (*Tilia americana*). The shrub layer contains spicebush (*Lindera benzoin*), blackhaw viburnum (*Viburnum prunifolium*), maple-leaf viburnum, and leatherwood (*Dirca palustris*). Herbaceous associates are varied and include a rich assemblage of spring ephemeral wildflowers, particularly in the ravines. Common spring wildflowers include prairie trillium (*Trillium recurvatum*), bent trillium (*Trillium flexipes*), squirrel corn (*Dicentra canadensis*), Dutchman's breeches (*Dicentra cucullaria*), celandine poppy (*Stylophorum diphyllum*), twinleaf (*Jeffersonia diphylla*), dwarf larkspur (*Delphinium tricorne*), cutleaf toothwort, spring beauty, harbinger of spring (*Erigenia bulbosa*), and Jack-in-the-pulpit (*Arisaema triphyllum*). A variety of woodland sedges occur in this habitat as well as beak grass (*Diarrhena americana*) and woodland fescue (*Festuca subverticillata*).

Figure 11: Mesic sloping woodlands contain a diverse variety of tree species sharing the canopy.

Mesic slopes represent the largest block of woodland in the park and also contains many of the areas of highest natural area value. All aspects and degrees of slope are represented in this area from gentle grades to vertical cliffs. Trails traversing this community must be constructed with carefully grading and diversion of rainwater away from the trail. Grade reversals should be utilized to mitigate the slope in steep sections.

Figure 12: Twinleaf is frequent on ridge sloping mesic woodlands where calcareous soils exist.

Figure 13:Leatherwood is a shrub occasionally present in mesic and wet mesic floodplains.

Mesic Floodplain Woodlands – 44.8 acre

These floodplains occur in the smaller side drainages as well as the higher terraces of Griffy Creek. They are rarely inundated during flood events. While some of the side drainages contain mature forests, the majority of the Griffy Creek floodplain is relatively young second growth, having been cleared prior to construction of the reservoir. Common trees include tulip tree, black walnut, beech, red maple, and American sycamore (*Platanus occidentalis*). Hornbeam (*Carpinus caroliniana*) is common in the understory. Spicebush is common in the shrub layer. Blackhaw viburnum and leatherwood occasionally occur in the shrub layer. Invasive multiflora rose (*Rosa multiflora*) and privet (*Ligustrum vulgare*) may be common in the shrub layer. A diverse array of spring

wildflowers occurs in this habitat including bent, prairie, and sessile trilliums (*Trillium sessile*), celandine poppy, dwarf larkspur, Dutchman's breeches, cutleaf toothwort, spring beauty, and Jack-in-the-pulpit. Woodland fescue and wild ryes (*Elymus spp.*) are common grasses.

Figure 14: Mesic floodplains occur on high terraces that rarely experience flooding.

Mesic floodplain woodlands are relatively flat and rarely flooded, so they have high potential for trail development. Many areas, however, are of very high quality, containing rich displays of spring wildflowers, so trails should be carefully constructed to minimize impacts.

Wet-Mesic Floodplain Woodlands – 42.8 acres

This community primarily occurs on the floodplains of the branches of Griffy Creek just upstream from the reservoir. Nearly the entirety of this area represents second growth woodland that established following the construction of the reservoir. It is generally inundated during flood events and showed much evidence of this during the survey in April 2019 from the flooding that occurred in early February 2019. Common tree species include American sycamore, American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), silver maple (*Acer sacharinum*), and black walnut. Spicebush is abundant in the shrub layer, as are the invasive privet and multiflora rose. Leatherwood occasionally occurs in the shrub layer. Spring wildflowers such as Virginia bluebells (*Mertensia virginica*), Jack-in-the pulpit, green dragon

(Arisaema dracontium), and prairie trillium are common. Common graminoids including woodland fescue and wild ryes.

This community is subject to frequent inundation during flood events, however, the inundation is typically brief ranging from just a few hours to a day for extreme rainfalls. The existing trail that travels east from the boat rental parking lot traverses this community for most of its length. Persistent muddy conditions and scour during flood events are the primary limitations for trail construction through this community. Trail surfaces must not be allowed to erode below the grade of the surrounding floodplain to prevent persistent ponding. Surfacing the trail with crushed stone will help prevent rutting and widening of the trail that results from persistent muddy conditions and ponding. Trail planning in this area should also account for the likelihood of more frequent and severe flooding from extreme rainfall events exacerbated by climate change.

Figure 15: Virginia bluebells are frequent on wet-mesic floodplains of Griffy Creek

Wet Floodplains Woodlands – 17.9 acres

The woods are characterized by frequent inundation during flood events as well as vernal pools that serve as amphibian breeding sites. Spring peepers, chorus frogs, wood frogs, and American toads were all heard in spring of 2019 calling from these pools. Sycamore and silver maple are the dominant tree species but are accompanied by cottonwood (*Populus detoides*), boxelder (*Acer negundo*), and red

maple. False nettle is abundant in the herbaceous layer. Common graminoids include wood reed (*Cinna arundinacea*), fowl manna grass (*Glyceria striata*), hop sedge (*Carex lupulina*) and awl-fruited oval sedge (*Carex tribuloides*).

Figure 16: Depressions like this one in the wet floodplain woodlands are important amphibian breeding habitat

These woodlands qualify as jurisdictional wetlands and should be avoided for trail construction. If trails must traverse them, an elevated boardwalk above the normal flood level would be required. Such a boardwalk would need to be firmly anchored in the substrate to avoid damage from flooding.

Wet Old Field – 7.2 acres

This area is below the dam and west of Dunn Street. It contains a mix of non-native grass such as tall fescue (*Schedonorus arundinaceus*) and redtop (*Agrostis gigantea*) as well as, many native sedges (*Carex spp.*) and rushes (*Juncus spp.*). Common forbs include tall ironweed (*Vernonia gigantea*), boneset (*Eupatorium perfoliatum*), and swamp milkweed (*Asclepias incarnata*). The forbs make this area an important resource for pollinators.

A greenway path already exists along the margin of this community. It is doubtful that additional trail construction would be required in this small area.

Emergent Wetlands – 5.0 acres

These wetlands occur in areas where sediment accumulation at the inflow end of the reservation has resulted in water shallow enough to harbor emergent plants. Halberd-leaved rose mallow (*Hibiscus leavis*), hybrid cattails (*Typha X glauca*), soft rush (*Juncus effusus*), lurid sedge (*Carex lurida*), hop sedge, and awl-fruited oval sedge are common herbaceous plants.

Another area of emergent wetlands occurs in an old field habitat below the dam west of Dunn Street. This area is also dominated by hybrid cattails. Other common herbaceous species include dark green bulrush (*Scirpus atrovirens*), lurid sedge, and swamp rose mallows (*Hibiscus moschuetos*).

Figure 17: Hybrid cattails dominate the emergent wetlands

The emergent wetlands are unsuitable for trail development and should be avoided as jurisdictional wetlands and sensitive habitat.

Seasonal Mudflats – 5.6 acres

This habitat appears in the middle of summer and often continues to expand until October as the reservoir levels recede due to declining stream inflow during the warm months. These mudflats provide important habitat for migratory shorebirds during the late summer and early fall. It also harbors a unique plant community of annual species that germinate as the water recedes and quickly mature and produce seeds. While some of the species also occur in other disturbed habitats such as agricultural fields, other species are mudflat specialists. Among the mudflat specialists are several species of nutsedges and flatsedges (*Cyperus spp.*), bur marigolds (*Bidens spp.*), Obe-Wan-Conobea (*Leucospora multifida*), false pimpernel (*Lindernia dubia*), slender fimbry (*Fimbristylis autumnalis*), and hooded arrowhead (*Sagittaria montevidensis ssp. calycina*).

Figure 18: Seasonal Mudflats harbor a unique community of annual plants

The seasonal mudflats are inundated during much of the year and are unsuitable for trail development. An observational platform, however could be constructed at the edge to provide opportunities for wildlife observation.

Cultural Communities – 5.2 acres

This community does not represent a natural area. Rather it consists of lawns, gravel parking lots, the causeway and road right-of ways. The plants inhabiting these areas are either non-native or weedy native species. All areas are already considered developed.

Mapping of Other Variables

Woodland Maturity

Since the construction of the reservoir nearly one hundred years ago, woodland succession has been allowed to reclaim the portions of the park that were formerly cleared. As a result, the maturity of woodlands of the park vary according to the prior land use. Woodlands growing in formerly cleared areas contain trees mostly less than 75 years old. These woodlands are classified as early successional woodlands on the maps and typically occur on flat ridgetops and the floodplain of Griffy Creek. Woodlands containing somewhat older and larger trees that are likely 100-150 years old are classified as mid-successional woodlands on the maps. Woodlands that contain very mature trees estimated to be 150-200 years old or older are classified as mature woodlands on the maps.

Natural Area Value

This variable describes the diversity and resemblance of the current plant community to what one would expect from a pre-settlement plant community located in that ecological context. As a result, this variable is somewhat subjective based on the experiences of the observer. Areas designated with a high natural area have an intact herbaceous layer along with the shrub and canopy layers that reflect the species composition and diversity typical for a high-quality plant community with few signs of degradation. Areas with medium natural area value still exhibit a resemblance to an intact plant community, however signs of degradation such as lower diversity and a less intact herbaceous layer are present. Areas designated as having low natural area value are generally not very diverse, show high levels of anthropogenic disturbance and are often heavily infested with invasive plants.

Invasive Plant Pressure

The variable refers to the percent coverage of invasive plants in the understory. Areas with under 2 percent coverage of invasive plants in the shrub layer and herbaceous understory are designated as having low invasive plant pressure. Areas between 2 and 30 percent coverage of invasive plants in these layers are considered to have medium invasive plant pressure. Areas that exceed 30 percent cover of invasive plant in the shrub layer or herbaceous understory are considered to have high invasive plant pressure. Further explanation of the threat of invasive plant species in the park is contained in the section on invasive plants later in the report.

Maps of the plant communities, as well as these additional variables are contained in Appendix A. A table of plant community characteristics and their limitations for trail placement is contained in Appendix E.

Habitat Value

Griffy Lake Nature Preserve is unique among urban parks for its large size and wild character. As a result, it provides habitat on a scale rare in municipal park systems. Important habitat for reptiles and amphibians, forest interior birds, rare plants, and mammals are all contained within the park.

Amphibians

Griffy provides outstanding habitat for amphibians. The backwaters, floodplain depressions, vernal streams, and an artificial pond created by an abandoned railroad grade all provide excellent breeding habitat for amphibians with aquatic larvae. The many streams provide habitat for stream-dwelling salamanders such as the two-lined salamander and the longtail salamander (Minton, 2001). Mature mesic ravine woodlands provide important habitat for redback salamanders, zigzag salamanders, and slimy salamanders.

The field work for the plant community mapping performed during the month of April coincided with the breeding season for many of the frogs and toads that inhabit the park. The locations of their vocalizations were noted and mapped as amphibian breeding habitat in Appendix A.

Below is a list of amphibians recorded in the 2008 Master Plan (Peel, et al., 2008) plus additional species observed in 2019 as noted:

Frogs and Toads

Cricket Frog (*Acris crepitans blanchardi*)

American Toad (*Bufo americanus*)

Fowler's Toad (*Bufo fowleri*)

Cope's Gray Tree Frog (*Hyla chrysoscelis*) - heard during 2019 survey

Bullfrog (*Rana catesbeiana*)

Green frog (*Rana clamitans melanota*)

Wood frog (*Rana sylvatica*)

Southern leopard frog (*Rana utricularia*)

Spring peeper (*Pseudaris crucifer crucifer*)

Western Chorus Frog (*Pseudacris triseriata triseridata*) - heard during 2019 survey

Salamanders

Two-lined salamander (*Eurycea cirrigera*)

Longtail salamander (*Eurycea longicauda longicauda*)

Four-toed salamander (*Hemidactulium scutatum*)

Northern slimy salamander (*Plethodon glutinosus*)

Redback salamander (*Plethondon cinereus*)

Zigzag salamander (*Plethodon dorsalis dorsalis*)

Jefferson's salamander (*Ambystoma jeffersonianum*)

Marbled salamander (*Ambystoma opcaum*)

Reptiles

The waters of Griffy Lake and the surrounding woodlands also provide excellent habitat for a variety of reptiles. Four species of aquatic turtles as well as midland banded water snakes are found in Griffy Lake. Eastern spiny softshell, midland painted turtle, red-eared sliders, and water snakes are frequently seen basking on logs near the shoreline.

Eastern box turtles were observed in the woodlands almost daily during the plant surveys. Garter snakes were also frequently observed during surveys in moist woodlands. The dry rocky woodlands on south facing slopes and ridges are favorable for uncommon reptiles such as northern copperheads and northern fence lizards as well as the much more common five-lined skink. Northern ringneck snakes and black rat snakes are frequent in a variety of woodland types at Griffy.

Reptiles recorded in surveys from the 2008 Master Plan (Peel, et al., 2008) plus additional species observed in 2019 as noted:

Turtles

Eastern spiny softshell (*Apalone spinifera spinifera*)

Common snapping turtle (*Chelydra serpentina serpentina*)

Midland painted turtle (*Chrysemys picta marginata*)

Red-eared slider (*Trachemys scripta elegans*)

Eastern Box Turtle (*Terrapene carolina carolina*)

Snakes

Northern copperhead (*Agkistrodon contortrix mokasen*)

Northern ringneck snake (*Diadophis punctatus edwardsi*)

Black rat snake (*Elaphe obsolete obsolete*)

Midland banded water snake (*Nerodia sipedon pleuralis*)

Figure 19: Midland banded water snakes are commonly seen along the edges of the reservoir

Rough green snake (*Opheodrys aestivus*)

Eastern garter snake (*Thamnophis sirtalis sirtalis*)

Eastern hognose snake (*Heterodon platirhinos*) – observed during 2019 survey

Figure 20: An eastern hognose snake was observed in early October on a mesic ridge

Lizards

Five-lined skink (*Euomeces fasciatus*)

Northern Fence Lizard (*Sceloporus undulatus hyacianthinus*)

Figure 21: Northern fence lizards are commonly seen on dry slopes

Bird Use of Griffy Park

Griffy Park represents an outstanding block of forest interior bird habitat, especially for an urban park. Further, it is less than 10 miles from three Important Bird Areas of global priority as ranked by the Audubon Society. Those areas are Morgan-Monroe State Forest, Yellowwood State Forest, and the Pleasant Run Unit of Hoosier National Forest. Nearly continuous wooded corridors link to these Important Bird Areas from the north and east sides of the park.

Neotropical migrant birds, those that winter in tropical America and breed in temperate habitats are a group of birds that have suffered significant declines in recent decades. Large blocks of woodland such as Griffy Lake Nature Preserve are imperative as breeding habitat. Below is a list from the survey performed as part of the Master Plan (Peel, et al., 2008) of the neotropical birds present during the breeding season in June, including both species that prefer woodland interior habitats and those that prefer early successional habitats.

Acadian flycatcher (*Empidonax virescens*)

Baltimore oriole (*Icterus galbula*)

Black-billed cuckoo (*Coccyzus erythropthalmus*)

Cerulean warbler (*Dendroica cerulean*)

Chimney swift (*Chaetura pelagica*)

Common yellowthroat (*Gothylpis trichas*)

Eastern kingbird (*Tryannus tyrannus*)

Eastern wood-peewee (*Contopus virens*)

Gray catbird (*Dumetella carolinensis*)

Great crested flycatcher (*Myiarchus crinitus*)

House wren (*Troglodytes aedon*)

Indigo bunting (*Passerina cyanea*)

Kentucky warbler (*Oporornis formosus*)

Louisiana waterthrush (*Seirurus motacilla*)

Northern parula (*Parula americana*)

Northern rough-winged swallow (*Stelgidopteryx serripennis*)

Orchard oriole (*Icterus spurius*)

Ovenbird (*Seiurus aurocapillus*)

Prairie warbler(*Protonotaria citrea*)

Red-eyed vireo (*Vireo olivaceus*)

Ruby-throated hummingbird (*Archilochus colubris*)

Scarlet tanager (*Piranga olivacea*)

Summer tanager (*Piranga rubra*)

Tree swallow (*Tachycineta bicolor*)

Warbling vireo (*Vireo gilvus*)

White-eyed vireo (*Vireo griseus*)

Wood thrush (*Hylocichla mustelina*)

Worm-eating warbler (*Helmiteros vermivorus*)

Yellow-billed cuckoo (*Coccyzus americanus*)

Yellow-throated vireo (*Vireo flavifrons*)

Yellow-throated warbler (*Dendroica dominica*)

Further, the aquatic habitats provide a migratory stopover important for both waterfowl and shorebirds. The seasonal mudflats provide an important stop for shorebirds migrating south in late summer and fall. Waterfowl utilize the lake in both spring and fall migration.

Mammals

Common mammals of woodlands are well represented at Griffy Lake Nature Preserve. Gray squirrels, fox squirrels, and eastern chipmunks are the most easily observed mammals in the park. A wide variety of other small mammals including mice, voles, and shrews were documented in the 2007 surveys that were performed as part of the Master Plan (Peel, et al., 2008)

Although they have not been recorded in the park and were not caught during 2007 mist-net surveys, plausible habitat exists in the park for the federally endangered Indiana bat (*Myotis sodalis*) and the federally threatened northern long-eared bat (*Myotis septentrionalis*).

White-Tailed Deer

White-tailed deer are abundant and problematic at Griffy Lake Nature Preserve. The large population is detrimental to native plant communities in several ways. They heavily browse favored herbaceous plants and woody shrubs in the understory, resulting in a distinct browse line at the level they can easily

reach. This browse extends to tree saplings, especially heavily favored oak and hickory saplings, contributing to the failure of these trees to replace themselves in the canopy. Finally, their hooves compact the soil and track invasive plant propagules into new areas. This is particularly true with herbaceous invasive plants such as Japanese stilt grass (*Microstegium vimineum*) and garlic mustard (*Allaria petiolata*), species that tend to first invade floodplains, but are spread by deer to mesic slopes and ridges. Further, these invasive plants are unpalatable to deer, so their browse favors them over more palatable native species.

A hunt utilizing contracted sharpshooters was conducted in fall of 2017 in an effort to reduce the size of the deer herd. Although the hunt succeeded in removing several dozen deer, browse surveys and observation show the excessive deer browse continues unabated. Only a consistent effort over many years will bring the deer herd down to a level that will permit the recovery of the plant community. A planned hunt in the fall of 2019 needs to become standard practice for several years until vegetation monitoring shows a substantial reduction in deer browse pressure.

Invasive Plant Pressure

While invasive plants are present in all sections of Griffy Lake Nature Preserve, there are two areas suffering from particularly dense infestations. The first is in the southwestern section south of the reservoir border by Dunn Street on the west and the Indiana University Research and Teaching Preserve on the east. While portions of this section, particularly the ravines and the north facing slope adjacent to the reservoir contain very high quality plant communities with few invasive plants, many of the flat-topped ridges that harbor young second-growth woodlands contain heavy infestations of invasive shrubs. While Amur honeysuckle (*Lonicera maackii*) and autumn olive (*Elaeagnus umbellata*) are the worst offenders, burning bush (*Euonymus alata*), Japanese barberry *(Berberis thunbergii*), and multiflora rose (*Rosa multiflora*) are also common. This portion of the property is dedicated as a State Nature Preserve under the Nature Preserves Act and should receive urgent attention to address the invasive plant issues.

The second area of high invasive plant density is along the two primary branches of Griffy Creek upstream from the reservoir in the eastern portion of the park. In this area, privet, multiflora rose, and Japanese stiltgrass are the most abundant invasive species. The privet forms particularly dense stands in the wet-mesic floodplains. Some of these stands form nearly impenetrable thickets that may preclude the establishment of native tree saplings. Multiflora rose is also abundant, forming sprawling thickets that suppress the native herbaceous understory.

Japanese stiltgrass is an annual warm-season grass that germinates in early May and sets abundant seed in September and October. It is extremely aggressive in moist woodland settings. The seeds are carried by floodwaters, hence it has become abundant on the floodplain of Griffy Creek. It is migrating upslope onto the mesic slopes and mesic ridges in the eastern portions of the parks along deer paths. Japanese stiltgrass represents a serious threat to native herbaceous communities in wet mesic and mesic environments in the park.

Other terrestrial invasive plants present in the park that have high potential to spread include lesser celandine (*Ranunculus ficara*), oriental bittersweet (*Celastris orbiculatus*), Amur cork tree (*Phellodendron amurense*), Japanese honeysuckle (*Lonicera japonica*), and garlic mustard (*Alliaria petiolata*).

Invasive plants represent a grave threat to the native plant communities at Griffy Lake Nature Preserve. Therefore, an invasive plant survey including maps of the locations and densities of each species should be performed. Such a survey will provide the information necessary to budget for their removal and prevent them from usurping additional acres within the park.

Prescribed Fire and Understory Thinning

The dry and dry-mesic woodlands as well as the mesic ridges at Griffy Park harbor large areas of oak-hickory woodland. Prescribed fire is an excellent tool for management of oak-hickory woodland to prevent invasion by mesic trees species and encourage regeneration of oaks and hickories by increasing light levels reaching the ground layer. Oak-hickory woodlands are well known for their importance to wildlife. In addition to the obvious production of hard mast, oaks been shown to harbor a greater diversity of Lepidoptera (butterflies and moths) larvae than any other group of trees. These larvae form the primary food source for migrating and breeding neotropical migrant songbirds, further highlighting the ecological importance of these woodlands. (Tallamy, 2007)

Further, mesic trees are likely to suffer from the higher moisture loss due to transpiration increases resulting from warmer temperatures associated with climate change (Purdue, 2018). Oak-hickory woodland are generally more drought resistant, so favoring them will increase the climate change resilience of the woodlands at Griffy Lake Nature Preserve.

Because the oak-hickory woodlands at Griffy have suffered from decades of fire suppression, most of them have an abundance of mesic trees in the sapling and mid-canopy layers. Many of these mesic trees are large enough to withstand low intensity ground fires. Therefore, it is recommended that prior to initiating prescribed fire in an area, mechanical thinning of the understory mesic trees be performed. Further, prescribed fire will not yield the desired result of regeneration of oak and hickory saplings until the deer herd is controlled by several years of hunting. Therefore, understory thinning and control of the deer herd should occur prior to initiation of a large-scale prescribed fire program.

Finally, the terrain of Griffy Park Nature Preserve presents a challenging environment for planning and managing prescribed fires. The slopes and uplands that harbor the oak-hickory woodlands are dissected by deep ravines containing steep slopes and rock outcrops. This terrain will require careful planning of burn units that utilize the lake, streams, topographic breaks, and unfavorable aspects as burn breaks. Overall, prior to initiating the use of prescribed fire in the park, a detailed plan including management goals, burn units, burn plans for each unit, and public relations should be completed.

Floral Inventory Results

Floristic Quality Assessment

A total of 574 taxa found in FQA calculator (Rothrock, 2019) were located during the survey. In addition, two non-native tree species, Amur cork tree (*Phellodendron amurense*) and ginkgo (*Ginkgo biloba*), not listed in FQA calculator, were found in park. A wetland iris that was past flower was not keyable to species and was also not included in the FQA. Finally, plants that are readily distinguishable in the field that were formerly regarded as distinct species or subspecies that are currently lumped in the FQA calculator such as white sweet clover (formerly *Melilotus alba*) and yellow sweet clover (*Melilotus officinalis*) are also listed in the plant taxa table so their continued existence in the park is documented and comparable to previous inventories. When these taxa are added to those found in Rothrock (2019), a total of 582 taxa were located in Griffy Lake Nature Preserve. The complete plant list is contained in Appendix C.

The floristic quality assessment (Rothrock, 2014) for the entire park yielded a floristic quality index of 79.1 for all species and 87.9 for native species. The mean coefficient of conservatism was 3.3 for all species and 4 for native species. These numbers are indicative of a highly diverse property of paramount importance as a natural area.

Since this is a large property of nearly 1200 acres that is actually composed of a variety of plant communities, a FQA assessment was also perform for the dry communities, the mesic wooded communities, and wet wooded communities, the wet open communities, and the cultural communities so a better diagnoses of their respective quality could be assessed.

The dry communities consisted of the dry slopes, dry ridges, dry mesic slopes, dry mesic ridges, and the sterile old field. The mesic wooded communities consisted of the mature mesic woodlands on limestone ridges, young mesic woodlands on limestone ridges, pine plantations, mesic sloping woodlands, and mesic floodplains. The wet wooded communities consisted of the wet mesic floodplains and the wet floodplains. The wet open communities consisted of the wet old field, the emergent wetlands, and the seasonal mudflats. Finally, the cultural communities consisted of the manmade communities not classified as natural areas such as lawns and roadsides.

The Floristic Quality Assessments of the park and its component communities is summarized in Appendix D. Not surprisingly, the mesic communities which represent the largest acreage in the park, also contain the greatest species diversity, the highest floristic quality index, and the highest native mean coefficient of conservatism.

New Species Recorded in this Survey

Fifty-six additional native taxa were documented in the park during this survey. The largest group of new species were sedges in the genus *Carex* with twelve additional species. The mudflats that develop late in the season as the reservoir levels recede also yielded a variety of new species including three new

flatsedges (*Cyperus spp*), purplestem beggarticks (*Bidens connata*), and hooded arrowhead (*Sagittaria montevidensis ssp. calycina*).

Figure 22: Carex plantaginea was one of 12 new Carex species found in the park

Figure 23: Hooded arrowhead(Sagittaria montevidensis spp calycina was discovered on the mudflats.

Surprisingly, an additional species of canopy tree, Shumard oak (*Quercus shumardii*) was found to be common in the mesic woodlands in the northwest corner of the park. They are easily confused with northern red oak and had apparently been overlooked on previous inventories. Shumard oak prefers calcareous soils, so its presence in the western edge of the park where the limestone is more prevalent is not surprising.

Figure 24: Leaves and acorns of Shumard oak, not previously reported in the park.

Figure 25: Prunus americana was discovered on the wet-mesic floodplain of Griffy Creek.

A single colony of American plum (*Prunus americana*) was found on the wet-mesic floodplain of Griffy Creek as well. Other small flowering trees that were identified and not previously recorded included roughleaf dogwood (*Cornus drummondii*) and downy hawthorn (*Crateagus mollis*). Finally, another understory tree that had not been confirmed on previous surveys was downy serviceberry (*Amelanchier arborea*). It is not readily separated from the closely related Allegheny serviceberry (*Amelanchier laevis*) except when in bloom. Fortunately, both species were blooming side by side on a dry wooded slope during the plant community mapping in April, facilitating an ID.

Figure 26: Amelanchier laevis (left) and Amelanchier arborea (right), the latter not previously identified in the park.

Cleft phlox (Phlox bifida) was a new herbaceous species found on a dry slope in the eastern portion of the park. Although it is common further east in dry woodlands in the Brown County Hills, it rare at Griffy Lake Nature Preserve.

Figure 27: Phlox bifida was found on a dry slope in the eastern portion of the park.

Figure 28: Ophioglossum vulgatum was the only new fern located in the survey

One new species of fern was located in the park. Several specimens of the obscure adder's tongue fern (*Ophioglossum vulgatum*) were observed in the mesic floodplain woods in the eastern portion of the park. This tiny fern was observed in April before it could be concealed by the lush floodplain vegetation.

Another interesting and rather obscure plant that was observed in the survey was pinesap (*Hypopitys monotropa*). This small saprophyte was found in an oak-hickory woodland on a dry-mesic slope in the north-central portion of the park just north of the causeway. Although previously recorded in a very old survey, it has not been seen in recent inventories.

Finally, one new orchid species was located in the park. Nodding ladies' tresses was found in two places on dry slopes and well as the sterile old field habitat. Recent taxonomic revisions to this genus may classify these plants as *Spiranthes*

incurva; however this species in not list in Rothrock (2019), so it is listed under the traditional nomenclature in the Appendices. A photo is included in the plant community descriptions.

Figure 29: Hypopitys montropa was found on a dry-mesic slope in June

Species Not Located from Previous Surveys

It is expected that any plant inventory is a snapshot of what was visible during that growing season. Further, no two surveys will cover the ground along the exact same paths, particularly in large property with diverse terrain such as Griffy Lake Nature preserve. Therefore, it is expected that any survey will likely find new species as well as fail to locate species from previous surveys.

However, it is expected that successive surveys would report similar results for canopy tree species due to their large size and long life spans, so I would like to note a couple of trees that were not located on this survey that were listed on most of the previous surveys of the park.

The first is chestnut oak (*Quercus montana*), which is a common and characteristic tree of dry acid sloping woodlands just east of Griffy Park in the Brown County Hills. During the plant community mapping performed in April, I walked every dry slope and ridge in the park without locating a single chestnut oak. Chestnut oak has perhaps the most distinctive bark of any oak species in Indiana, so it is difficult to imagine that I missed it. Further, on the driest non-calcareous slopes and ridges, the niche where one would expect chestnut oak, the habitat was dominated by scarlet oak as noted in the plant community mapping. I believe that all previous reports of chestnut oak in the park should be attributed to chinquapin oak (*Quercus muehlenbergii*) which is common on the limestone ridges in the park. While the leaves of chinquapin oak are similar, the bark and acorns bear no resemblance to chestnut oak, so the previous reports were likely based on saplings of chinquapin oak that had not yet developed the distinctive bark.

The second tree reported on all previous surveys that I was unable to locate is butternut (*Juglans cinerea*). Since young trees can be difficult to distinguish from black walnut, it is quite possible that it does still exist in the park, but I was unable to locate any fruit after an extensive fall walk on the Griffy Creek floodplain where it had been previously reported.

Further, butternut has undergone a serious decline in recent years due to butternut canker, so it is also possible that it formerly grew in park but has been locally extirpated by this disease.

I did, however, locate an unusual black walnut on the floodplain that had pointed nuts. It is possible these odd nuts are the source of some of the previous reports of butternut. All other characteristics of the tree including the bark, the surface of the husk, and the surface of the nut were typical of black walnut.

Due to the decline resulting from butternut canker, this species is currently listed as a threatened species in Indiana.

Figure 30: Unusual pointed black walnut found on the Griffy Creek floodplain

New Invasive Species Recorded in the Survey

Twenty additional non-native species were recorded in the park. Several of these are known to be pernicious invasive species. Among those are oriental bittersweet (*Celastrus orbiculatus*), sweet autumn clematis (*Clematis terniflora*), lesser celandine (*Ranunculus ficaria*), blunt-leaved privet *(Ligustrum obtusifolium*), showy fly honeysuckle (*Lonicera X bella*), Amur cork tree (*Phellodendron amurense*), common reed (*Phragmites australis subsp. australis*), and callery pear (*Pyrus calleryana*).

Endangered, Threatened, and Rare Plant Species at Griffy Lake Nature Preserve

Griffy Lake Nature Preserve is home to several plant species on the Indiana, Endangered, Threatened and Rare Species List.

Large-seeded mercury (*Acalypha deamii*) – This plant was found at the base of several wet-mesic ravines as they approached the reservoir on the northwest portion of the preserve. [Watch List]

False grass sedge (*Carex timida*) – This plant was observed on several dry-mesic to mesic ridges in various location throughout the park. [State Endangered]

Cigar tree (*Catalpa speciosa*) – This species is native to extreme southwest Indiana. A few specimens have escape from cultivation along disturbed woodland edges. [State Rare]

Wild sensitive plant (*Chamaecrista nictitans var. nictitans*) – This plant is confined to the sterile old field habitat in the northeast portion of the park. [Watch List]

Spotted wintergreen (*Chimaphila maculata*) – This plant was observed a few times on dry mesic slopes in the northern portion of the park. [Watch List]

Goldenseal (*Hydrastis canadensis*) – Colonies of this plant were observed on mesic slopes in the southwest and northeast portions of the park. [Watch List]

American ginseng (*Panax quinquefolius*) – This plant was also observed on mesic slopes in the southwest and northeast portions of the park. [Watch List]

White pine (*Pinus strobus*) – This tree was planted in the pine plantations in the northeast and southwest portions of the park. Isolated naturalized specimens also occur on the mesic-ridges and dry-mesic slopes. [State Rare]

Virginia pine (*Pinus virginiana*) – The tree was also planted in the pine plantations in the northeast and southwest portions of the park. Additional trees have naturalized on dry and dry-mesic slopes. [Watch List]

Gyandotte beauty (*Synandra hispidula*) – This showy species occurs as scattered individuals in the wet-mesic and mesic floodplains along Griffy Creek east of the reservoir. [Watch List]

A table of these plants in contained in Appendix C.

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