

Natural Features Inventory and Management Recommendations for Wolcott Mill and Metro Beach Metroparks



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Cover photo: Beverly Walters, MNFI botanist, in a floodplain forest along the Clinton River in Wolcott Mill Metropark.
(Photo by J. Cohen.)

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Introduction

During the summer of 2005, Michigan Natural Features Inventory conducted surveys for exemplary natural communities and rare plants in two Huron-Clinton Metroparks, Wolcott Mill and Metro Beach. In addition, management needs were assessed on lands considered to have good potential for supporting high quality natural communities with the implementation of active land management and restoration. This report summarizes the findings of MNFI's surveys and evaluations of Wolcott Mill and Metro Beach Metroparks. Previous reports have been completed for Delhi, Dexter-Huron, Hudson Mills, and Stony Creek Metroparks (Kost and Choberka 2002); Kensington and Oakwoods Metroparks (Kost and O'Connor 2003); Indian Springs, Lower Huron and Willow Metroparks (Kost et al. 2004); and Huron Meadows and Lake Erie Metroparks (Kost et al. 2005).

Landscape Context

Regional landscape ecosystems of Michigan have been classified and mapped at three hierarchical levels (section, subsection, and sub-subsection) based on an integration of climate, physiography (topographic form and geologic parent material), soil, and natural vegetation (Albert 1995). The regional classification provides a framework for understanding broad patterns of natural community and species occurrences and natural disturbance regimes across the state, which is useful for biological conservation and integrated resource management and planning. The classification is hierarchically structured, with three levels in a nested series, from broad landscape regions called sections, down to smaller subsections and sub-subsections.

All of the Huron-Clinton Metroparks occur within the Washtenaw Subsection (VI.1) of southern Lower Michigan (Figure 1, Albert 1995). The Washtenaw Subsection contains three sub-subsections that differ from each other in their soils, glacial landforms, climate, and vegetation (Albert 1995). Wolcott Mill and Metro Beach Metroparks occur on the Maumee Lake Plain Sub-subsection (VI.1.1). The local landforms within each Metropark reflect those typical of their regional landscape ecosystems and of their sub-subsection.

The Maumee Lake Plain Sub-subsection is comprised of a flat, clay lake plain, dissected by

broad glacial drainageways of sandy soil (Albert 1995). Beach ridges and small sand dunes are common in the sand channels, especially close to the Great Lakes shoreline. The soils of this lake plain are typically wet loams and clays of low permeability. Subtle differences in elevation along the lake plain correspond to differences in soil drainage. The forests of the clay lake plain strongly respond to differences in slope and drainage. In the past, flat, poorly-drained areas supported broad expanses of lowland hardwood forest, while flat but moderately drained portions of lake plain were characterized by mesic forest. Where microtopography varied at small scales, species typical of these communities intergraded with southern swamp and mesic southern forest species, creating a forest composition unique to the clay lake plain. In contrast, the soils on the upland beach ridges and dunes of the sandy glacial drainageways are excessively drained and supported extensive oak savannas (Albert 1995). The sandy glacial drainageways also supported vast wet prairies and marshes, which commonly occurred in depressions on poorly to very poorly drained soils and along the Great Lakes shoreline (Comer et al. 1993).

Wolcott Mill Metropark occurs in northwestern Macomb County on a broad, flat expanse of lacustrine clay and silt of the Maumee Lake Plain Sub-subsection (Figure 2). Both mesic southern forest and southern swamp communities occur within the flat lake plain; their distribution and degree of intergrading is determined by slope, soil characteristics (type and drainage), and microtopography. The Clinton River meanders through the park, flowing north to south through a narrow, steep-sided glacial outwash channel (too small to be mapped by Farrand and Bell, 1982) that dissects the flat lake plain. The floodplain of the Clinton River supports floodplain forest and, to a lesser degree, southern wet meadow and emergent marsh.

Metro Beach Metropark occurs entirely on a broad, flat expanse of lacustrine clay and silt (Figure 3). Within the park, portions of the clay lake plain, which once supported a vast Great Lakes marsh and sand spit, have been covered with fill to create roads, parking areas, and building sites.

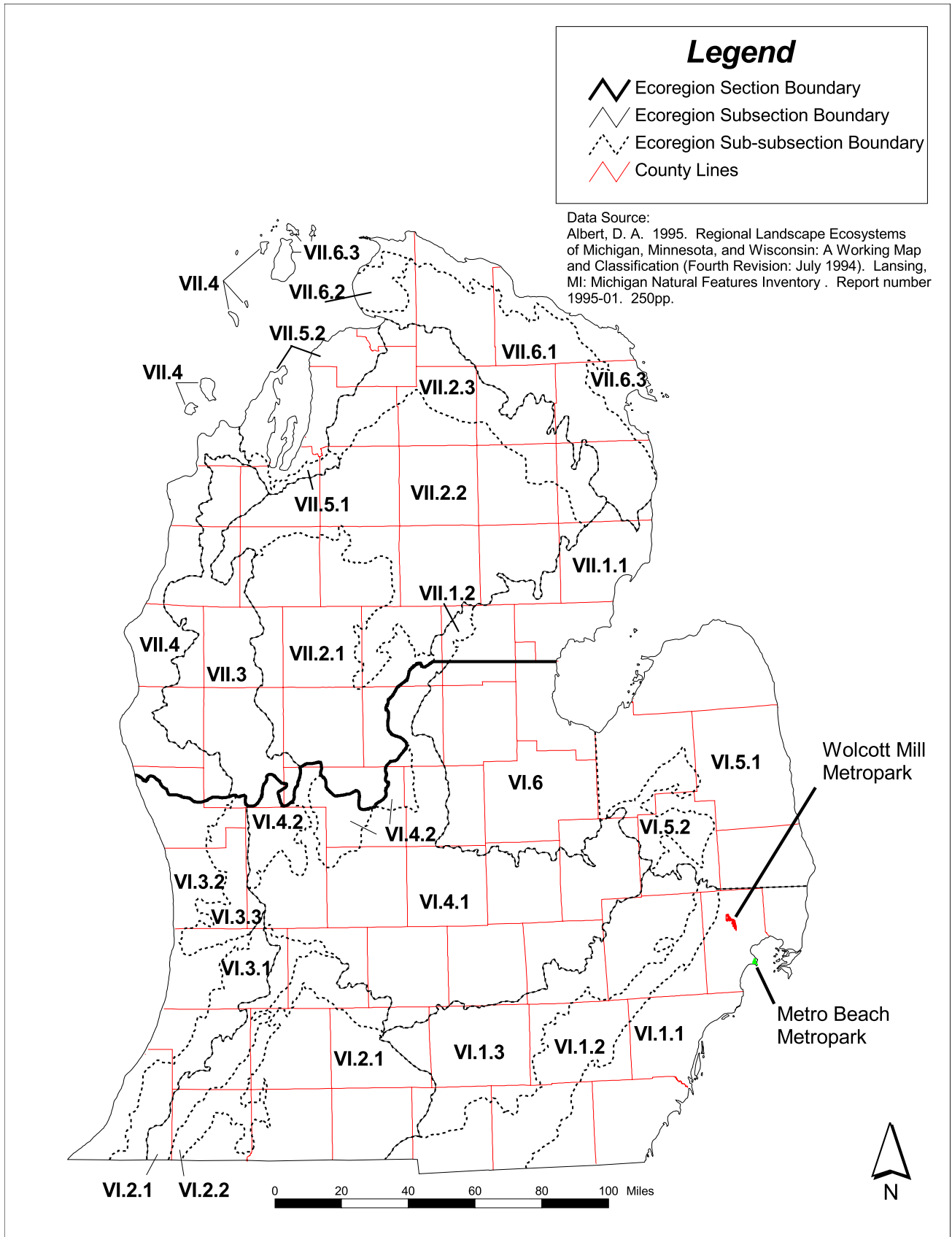


Figure 1. Ecoregions of Lower Michigan.

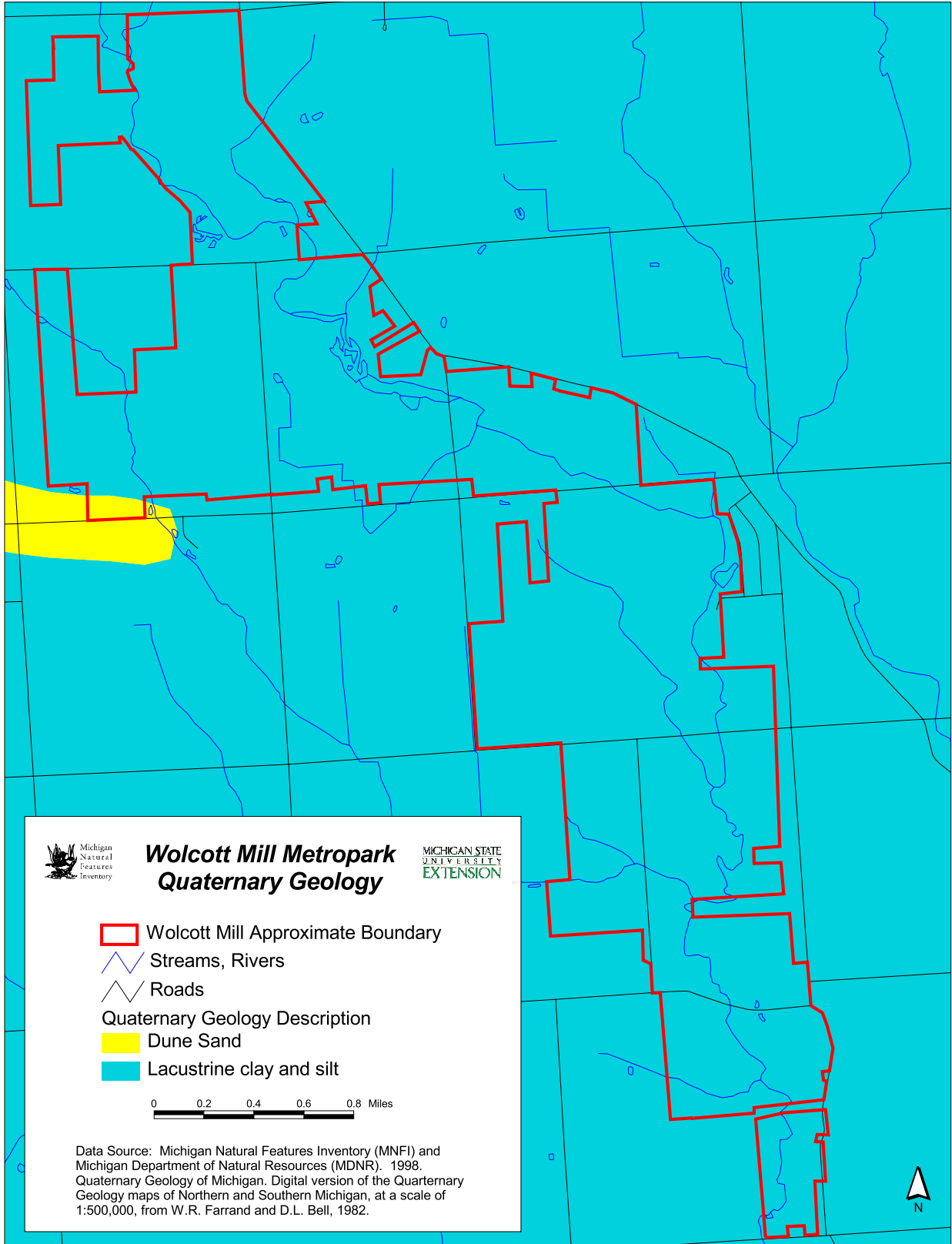


Figure 2. Surface Geology of Wolcott Mill Metropark.

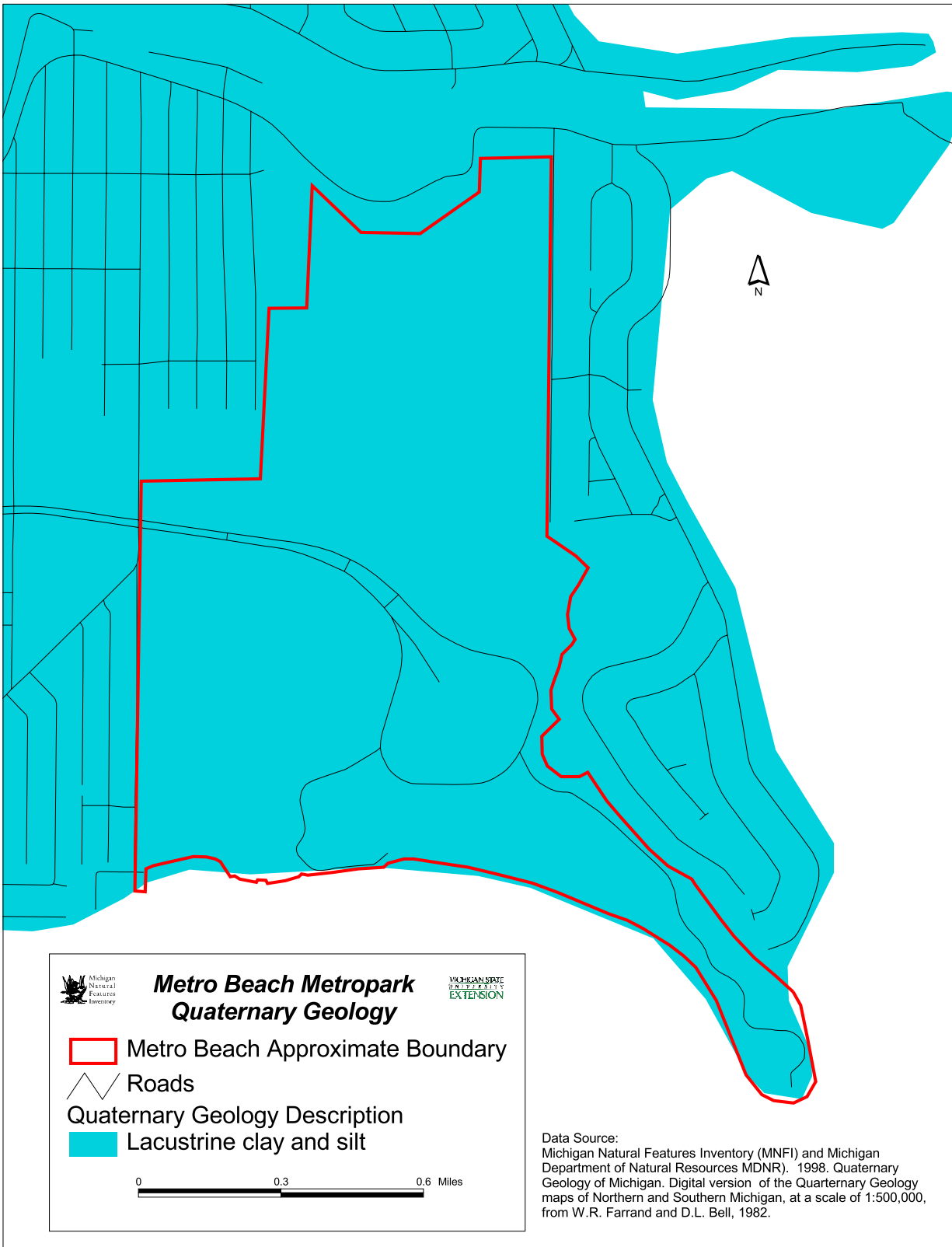


Figure 3. Surface Geology of Metro Beach Metropark.

Vegetation circa 1800

By interpreting the notes of the Michigan General Land Office surveyors (recorded from 1818-1856), MNFI ecologists were able to piece together a relatively accurate picture of the state's vegetation in the early 1800s (Comer et al. 1995). A digital map of vegetation encountered by the land surveyors during this period reveals that Wolcott Mill Metropark was almost entirely occupied by mesic southern forest, which is labeled as beech-sugar maple forest on Figure 4. In addition, the surveyors noted a small pocket of emergent marsh occurring in the southeast corner of section 16 along the bend in the Clinton River just north of 29 Mile road and also several blocks of black ash swamp and mixed hardwood swamp in the vicinity of the park (Figure 4).

The mean diameter at breast height (dbh) of trees recorded by the surveyors within the mesic southern forest was 25 cm (10 inches), with a wide range of diameters observed (10 to 46 cm, 4 to 18 inches). Several areas of windthrow were documented in the vicinity of the park. On this portion of lake plain, the mesic forest contained a diverse mix of tree species. In addition to canopy dominance by American beech (*Fagus grandifolia*), basswood (*Tilia americana*), and sugar maple (*Acer saccharum*), these forests contained additional mesic as well as wet-mesic and wet species. Canopy associates included white oak (*Quercus alba*), red oak (*Quercus rubra*), American elm (*Ulmus americana*), ash, likely white ash (*Fraxinus americana*) and red ash (*Fraxinus pennsylvanica*), soft maples, probably both red maple (*Acer rubrum*) and silver maple (*Acer saccharinum*), and yellow birch (*Betula alleghaniensis*). Additional components of the canopy included hickories (*Carya* spp.), bur oak (*Quercus macrocarpa*), black walnut (*Juglans nigra*), aspen (*Populus* spp.), and oaks, which could have included chinquapin oak (*Quercus muehlenbergii*) and Shumard's oak (*Quercus shumardii*). The surveyor for this region provided detailed documentation of the understory composition of the mesic forest, noting the prevalence in the understory layer of ironwood (*Ostrya virginiana*), prickly-ash (*Zanthoxylum americanum*), and spicebush (*Lindera benzoin*). Several small swamps dominated by black ash occurred near the park and were dominated by small-diameter black ash, which ranged from 15 to

30 cm dbh (6 to 12 inches). Mixed hardwood swamps were also noted in the area and were dominated by soft maples (probably with both silver maple and red maple), ash (likely red ash), and American elm. Within the boundaries of the Metropark, the surveyors only noted information for one tree within the floodplain along the Clinton River, an American beech. Information from the vicinity suggests that likely canopy dominants of the floodplain forest circa 1800 included American beech, red ash, American elm, and maples (silver maple and black maple). Because the original land surveyors did not differentiate between black maple and sugar maple, we assume that hard maples noted in floodplains in this area are black maple because of the current prevalence of large-diameter black maple within these systems today. Probable canopy associates would have included basswood, sycamore (*Platanus occidentalis*), swamp white oak (*Quercus bicolor*), bur oak, butternut (*Juglans cinerea*), black walnut, willows (*Salix* spp.), hickories, and cottonwood (*Populus deltoides*). Understory dominants probably included spicebush, prickly-ash, and hawthorns (*Crataegus* spp.).

Historically, the area now occupied by Metro Beach Metropark supported a vast delta of the Clinton River that formed a large Great Lakes marsh (Figure 5). The marsh extended from the Clinton River south to the open waters of Lake St. Clair. Nested within the central and eastern portions of the marsh, along the shoreline of Lake St. Clair, was a large sand spit, which likely fluctuated in size as Great Lakes water levels rose and receded. Local naturalist Richard Leasur recalls a time before the Metropark was constructed when the tip of the sand spit culminated in a series of small islands that supported large populations of shorebirds including several rare species such as the federally endangered (LE) piping plover (*Charadrius melodus*) and the state threatened (T) common tern (*Sterna hirundo*).

Present Land Cover

The 2000 Land Cover maps (Figures 6 and 7) were produced by overlaying circa 1980 National Wetlands Inventory data over the Southeast Michigan Council of Governments (SEMCOG) 2000 land cover data set. The accuracy of land cover types within each park was further enhanced through interpretation of aerial photos from each site (Figures 8 and 9) and ground truthing.

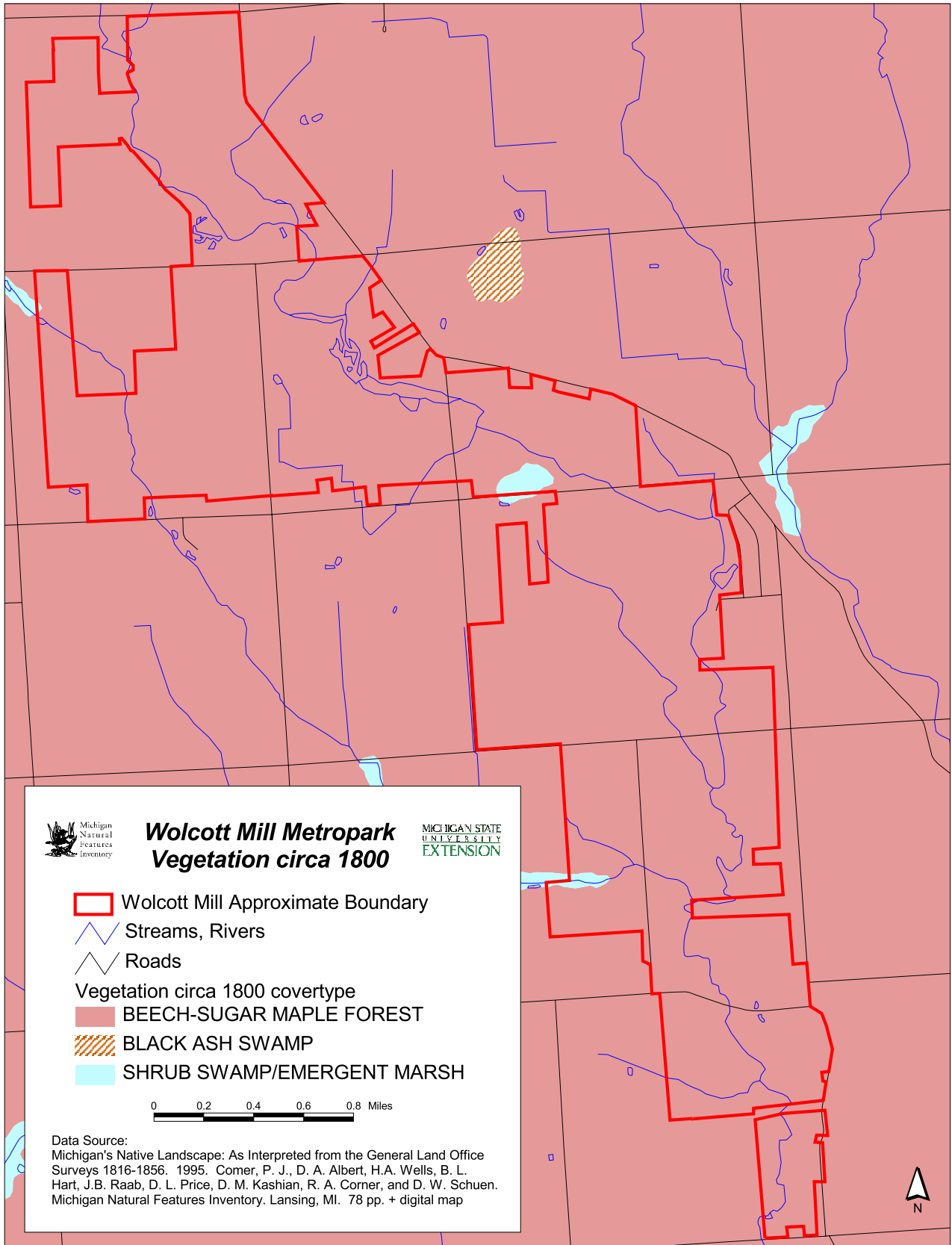


Figure 4. Vegetation circa 1800 of Wolcott Mill Metropark.

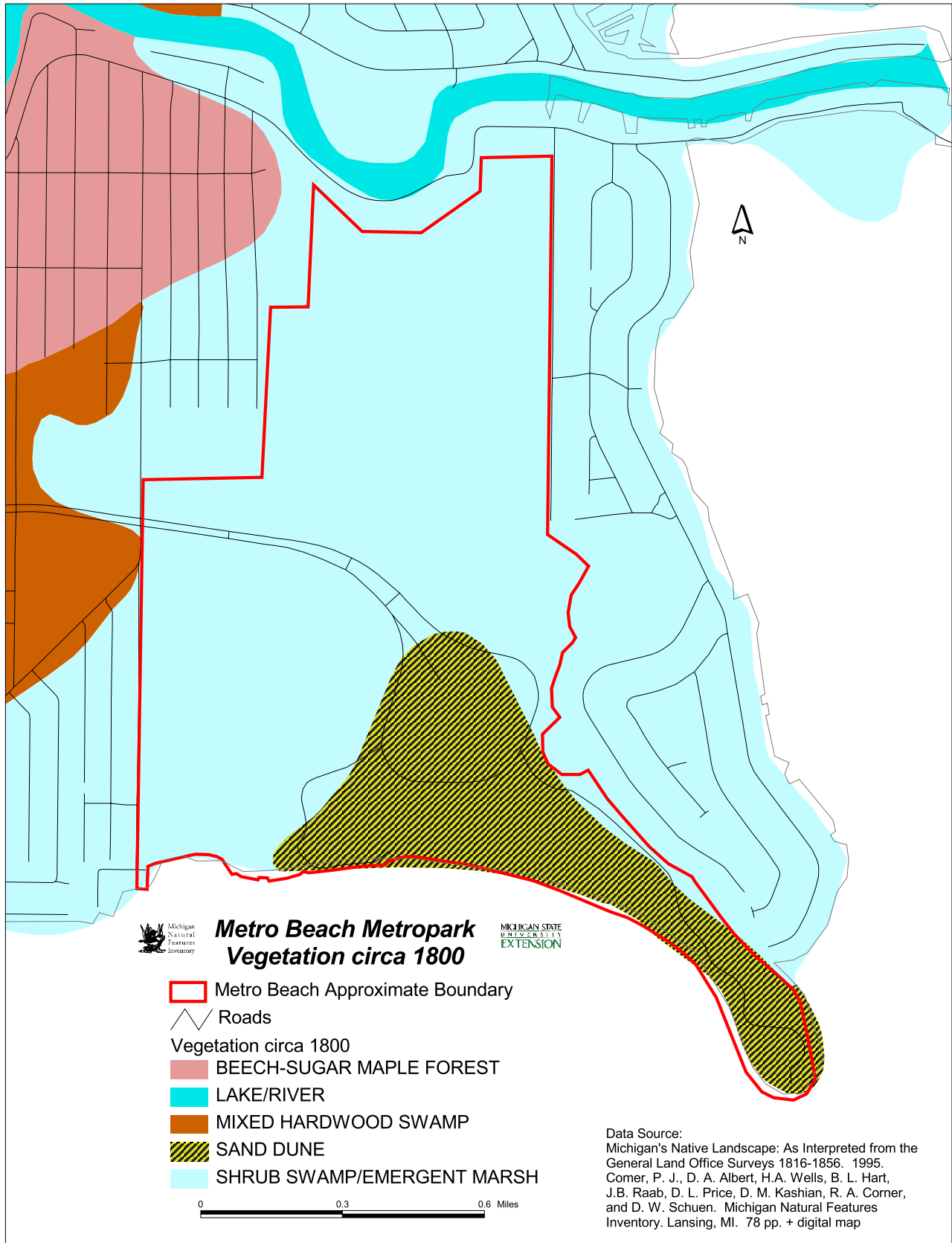


Figure 5. Vegetation circa 1800 of Metro Beach Metropark.

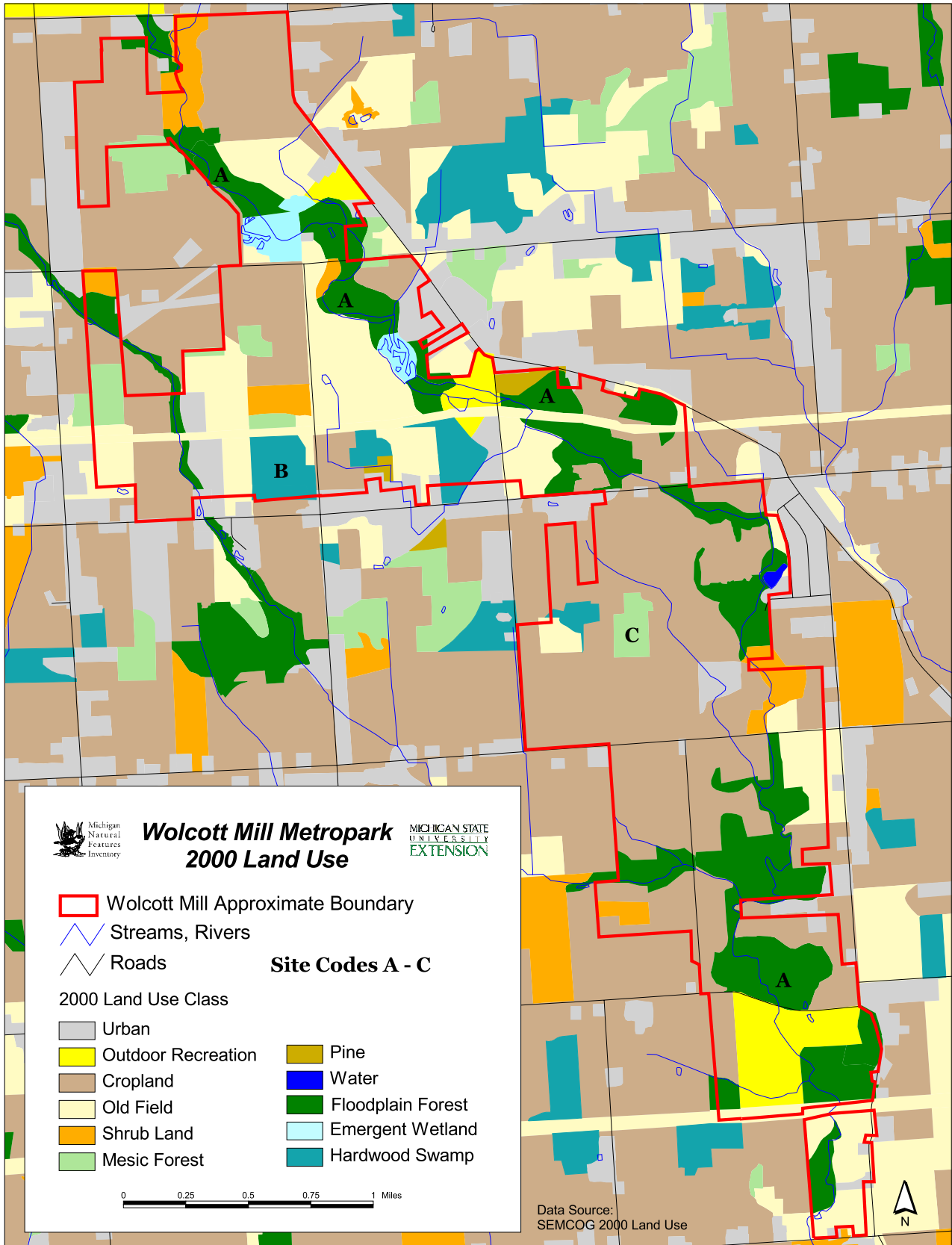


Figure 6. 2000 Land Cover of Wolcott Mill Metropark.

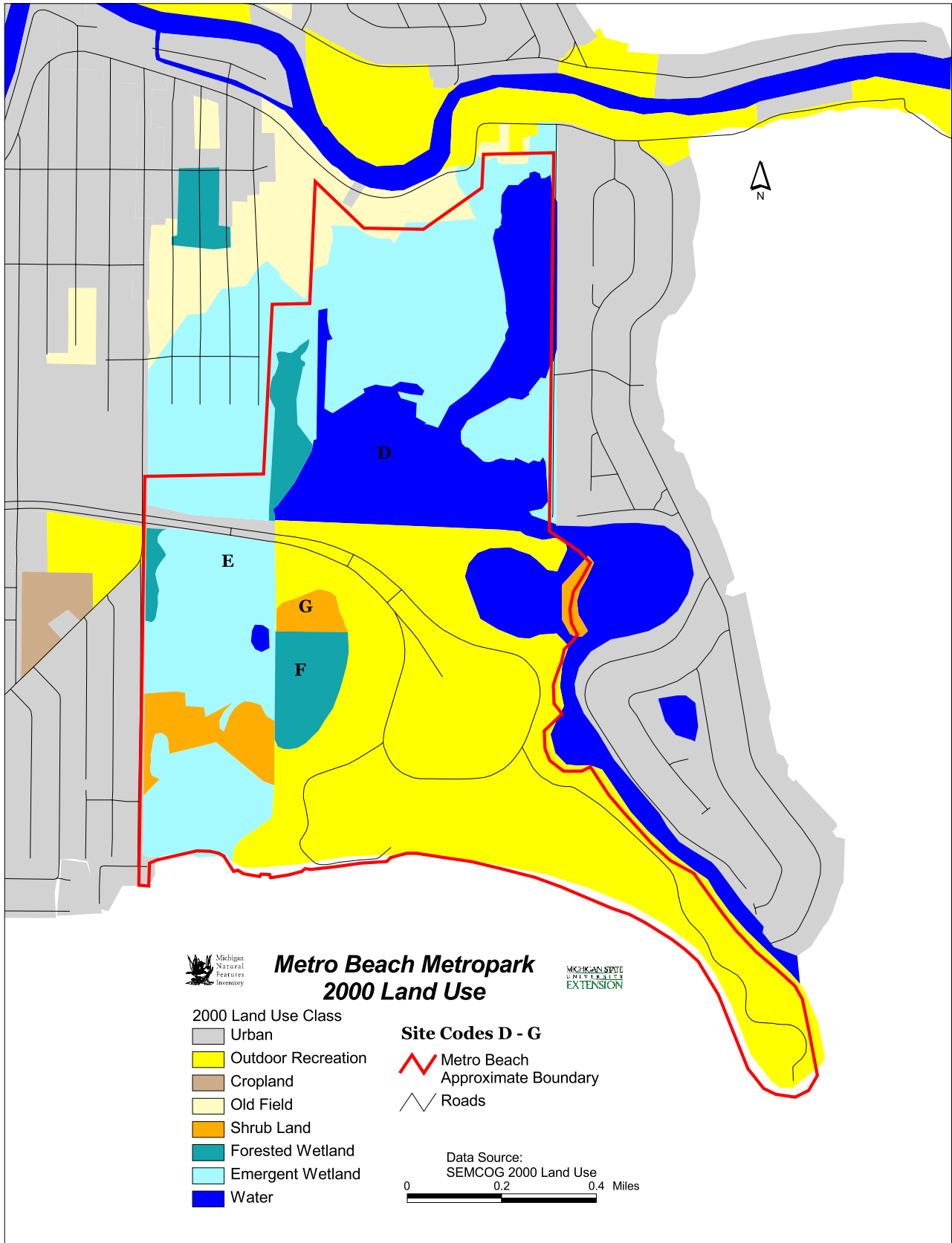


Figure 7. 2000 Land Cover of Metro Beach Metropark.

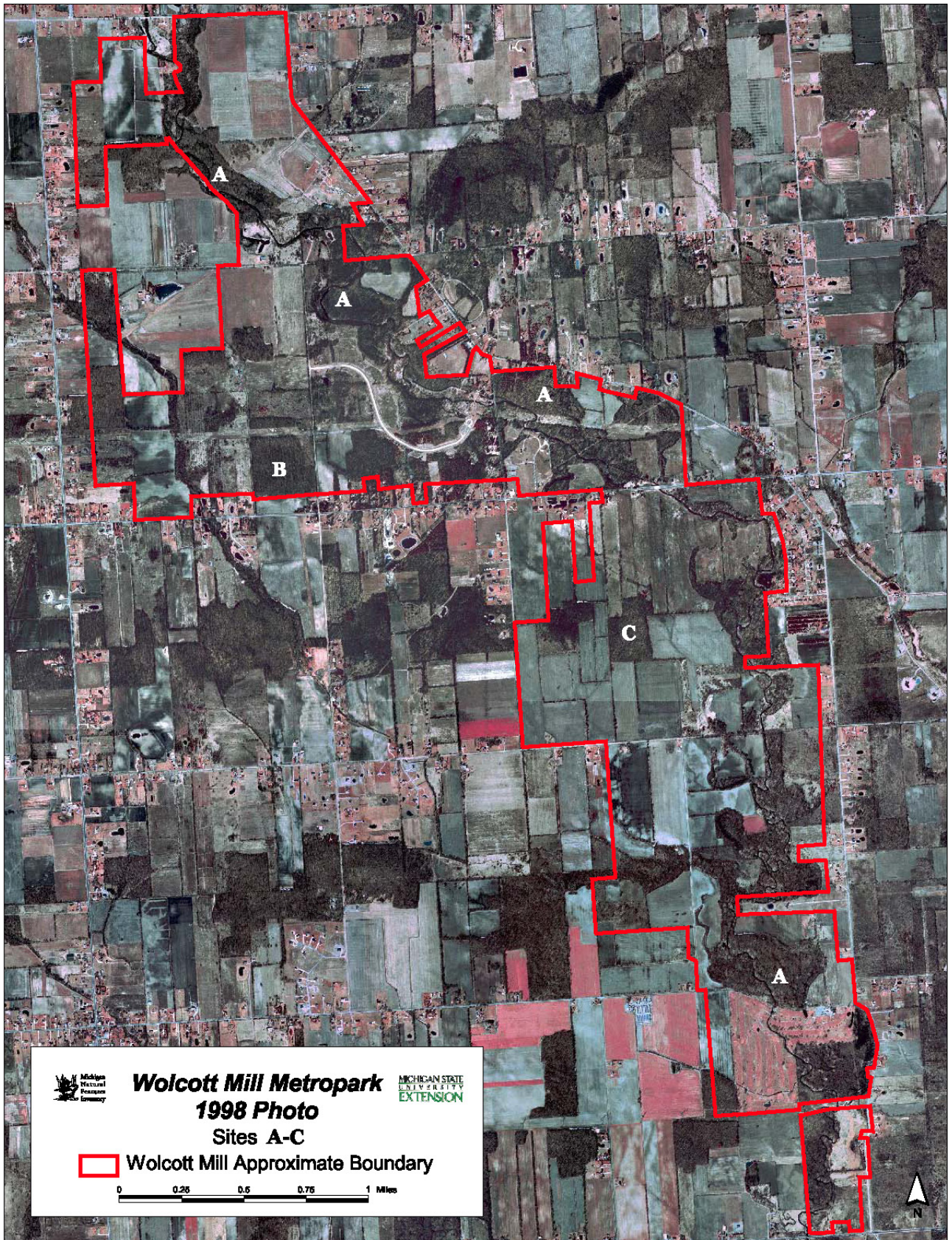


Figure 8. Aerial Photograph of Wolcott Mill Metropark, 1998.



Figure 9. Aerial Photo of Metro Beach Metropark, 1998.

Comparisons between *circa* 1800 vegetation and present land cover reveal drastic changes across the landscape (Figures 4–9). Most striking is the loss of forest due to agricultural conversion and resulting fragmentation of remaining forest blocks. The lake-moderated climate and productive loamy soils of the Maumee Lake Plain Sub-subsection resulted in early and intensive agricultural development (Albert 1995).

The primary land uses surrounding Wolcott Mill are agriculture and residential development (Figures 6 and 8). Numerous corn and soy fields occur within the park along with recreation areas (golf course, horse trails, mowed hiking trails, and picnic areas, etc.). As a result, the remaining blocks of mesic southern forest and southern swamp are small, isolated fragments with hard edges. The floodplain along the Clinton River remains primarily forested with active agricultural fields and old fields typically occupying the adjacent upland. Four stretches of mature floodplain forest persist within the park and are dispersed throughout the park. However, several portions of the floodplain have been converted to open wet meadow and the majority of the floodplain forest was cut in the last fifty years. The younger blocks of floodplain forest have been invaded by pervasive exotic species, such as multiflora rose (*Rosa multiflora*), honeysuckles (*Lonicera* spp.), and garlic mustard (*Alliaria petiolata*), which now dominate the understory and the ground cover, while the open overstory is contains early-successional species, including box elder (*Acer negundo*), red ash, and cottonwood.

The construction, in 1847, of the Grist Mill and its associated dam and channels along the Clinton River drastically altered the hydrologic regime of this portion of the river. It is likely that the presence of wet meadow and emergent marsh vegetation just upstream of the dam is the result of years of slowed

flow and ponding. In the southern portion of the park, the hydrologic regime has been altered by direct drainage from the Clinton River for agricultural uses. In addition, the proximity of agricultural fields to the floodplain and the Clinton River has probably resulted in increased nutrient input into the aquatic and terrestrial system. At a larger scale, the areas adjacent to Wolcott Mill have been transformed to a primarily agricultural and rural residential landscape, with the Metropark providing some of the only remaining natural habitats.

At Metro Beach, the vast delta of the Clinton River, which historically supported Great Lakes marsh, has been significantly reduced in size by filling (Figures 7 and 9). However, Metro Beach continues to support significant areas of Great Lakes marsh within the northern and southwestern portions of the park. The large sand spit that once occupied the central and eastern portions of the park along Lake St. Clair has been eliminated by the construction of a golf course, parking area, buildings, and bathing beach. A small block of forest occurs adjacent to the marsh within the Nature Study Area and is bordered by a very small, shrubby old field and wet meadow. Residential and suburban development now dominates the landscape outside the park.

The areas surrounding both Wolcott Mill and Metro Beach are rapidly converting to an urbanized landscape, thus raising the importance of protecting and stewarding the remaining natural habitats within the Metroparks. As development continues, the natural areas within the Metroparks will play an increasingly important role in the conservation of the region's biodiversity, as they will soon harbor some of the only remaining examples of native ecosystems and species.

Methods

Natural Communities

Natural community surveys were conducted in conjunction with rare plant surveys. Prior to surveys, aerial photos were interpreted to determine the types of natural communities likely to be present within each of the Metroparks. Field surveys concentrated on identifying high quality natural areas and recording ecological and management concerns such as evidence of excessive deer herbivory, hydrologic manipulation, fire suppression, farming, logging, and invasive species. Species lists were compiled for high-quality sites and those deemed to have potential to significantly improve with restoration. Site names and site codes used in the accompanying park maps (Figures 6–9) are listed in Table 1. Partial species lists were recorded for most of the areas visited and are included as separate appendices for Wolcott Mill and Metro Beach (Appendices 1 and 2). Site summaries were written for each site visited and for all high-quality natural communities and sites thought to have good potential for significant improvement with restoration and management. Species lists for this report were tabulated with the Floristic Quality Assessment Program and species nomenclature follows Herman et al. (2001).

Rare Plant Inventories

Rare plant species were targeted for survey based on the natural communities determined to be present in the park through aerial photo review and known historical and current rare plant distribution patterns within the region. Table 2 lists the rare species that were sought during surveys, with their associated natural communities. Rare plant inventories were performed by meander survey of appropriate habitat during periods when the plants are most recognizable (usually flowering or fruiting periods). Surveys of the open-water portions of the Great Lakes marsh at Metro Beach were conducted from a canoe.

Table 1. Survey site names and associated site codes for accompanying maps and photos (Figures 6–9).

Site Name	Site Code
Wolcott Mill Metropark	
Clinton River Floodplain Forest	A
Horse Trail Mesic Forest	B
Kunstman Road Swamp	C
Metro Beach Metropark	
Clinton River Delta	D and E
Metro Beach Swamp	F
Metro Beach Wet Meadow	G



Beverly Walters, MNFI botanist, examines a lightning-struck Shumard's oak (*Quercus shumardi*), a rare species that was found in Kunstman Road Swamp, as part of the ecological assessment of natural communities at Wolcott Mill. Natural disturbances, such as lightning and windthrow, can open gaps in the forest canopy, allowing in light, which stimulates the growth of understory and sapling trees. (Photo by M. Kost.)

Table 2. Rare plants sought by associated natural communities. Status abbreviations are as follows: E, state endangered; LT, federally threatened; T, state threatened; SC, state special concern.

Community	Scientific Name	Common Name	State Status
Mesic Southern Forest			
	<i>Castanea dentata</i>	American chestnut	E
	<i>Aristolochia serpentaria</i>	Virginia snakeroot	T
	<i>Carex oligocarpa</i>	Eastern few-fruited sedge	T
	<i>Carex platyphylla</i>	broad-leaved sedge	T
	<i>Dentaria maxima</i>	large toothwort	T
	<i>Galearis spectabilis</i>	showy orchis	T
	<i>Gentianella quinquefolia</i>	stiff gentian	T
	<i>Hybanthus concolor</i>	green violet	T
	<i>Hydrastis canadensis</i>	goldenseal	T
	<i>Panax quinquefolius</i>	ginseng	T
	<i>Polymnia uvedalia</i>	large-flowered leaf-cup	T
	<i>Spiranthes ovalis</i>	lesser ladies'-tresses	T
	<i>Tipularia discolor</i>	crane-fly orchid	T
	<i>Trillium recurvatum</i>	prairie trillium	T
	<i>Triphora trianthophora</i>	three-birds orchid	T
	<i>Adlumia fungosa</i>	climbing fumitory	SC
	<i>Jeffersonia diphylla</i>	twinleaf	SC
	<i>Liparis liliifolia</i>	purple twayblade	SC
	<i>Quercus shumardii</i>	Shumard oak	SC
Southern Floodplain Forest			
	<i>Chelone obliqua</i>	red turtlehead	E
	<i>Arabis perstellata</i>	rock-cress	T
	<i>Camassia scilloides</i>	wild hyacinth	T
	<i>Carex conjuncta</i>	sedge	T
	<i>Carex davisii</i>	Davis's sedge	T
	<i>Carex lupuliformis</i>	false hop sedge	T
	<i>Carex typhina</i>	cat-tail sedge	T
	<i>Corydalis flavula</i>	yellow fumewort	T
	<i>Diarrhena americana</i>	beak grass	T
	<i>Fraxinus profunda</i>	pumpkin ash	T
	<i>Justicia americana</i>	water-willow	T
	<i>Lycopus virginicus</i>	Virginia water-horehound	T
	<i>Mertensia virginica</i>	Virginia bluebells	T
	<i>Morus rubra</i>	red mulberry	T
	<i>Polemonium reptans</i>	Jacob's ladder	T
	<i>Silphium perfoliatum</i>	cup-plant	T
	<i>Trillium recurvatum</i>	prairie trillium	T
	<i>Valerianella chenopodifolia</i>	goosefoot corn-salad	T
	<i>Wisteria frutescens</i>	wisteria	T
	<i>Carex squarrosa</i>	squarrose sedge	SC
	<i>Euonymus atropurpurea</i>	wahoo	SC
	<i>Gymnocladus dioica</i>	Kentucky coffee tree	SC
	<i>Hybanthus concolor</i>	green violet	SC

Table 2, continued. Rare plants sought by associated natural communities. Status abbreviations are as follows: E, state endangered; LT, federally threatened; T, state threatened; SC, state special concern.

Community	Scientific Name	Common Name	State Status
Southern floodplain forest, continued			
	<i>Lithospermum latifolium</i>	broad-leaved puccoon	SC
	<i>Viburnum prunifolium</i>	black haw	SC
Southern Swamp			
	<i>Isotria medeoloides</i>	smaller whorled pogonia	E, LT
	<i>Plantago cordata</i>	heart-leaved plantain	E
	<i>Populus heterophylla</i>	swamp cottonwood	E
	<i>Dryopteris celsa</i>	log fern	T
	<i>Eupatorium fistulosum</i>	hollow-stemmed joe-pye-weed	T
	<i>Isotria verticillata</i>	whorled pogonia	T
	<i>Poa paludigena</i>	bog bluegrass	T
	<i>Cuscuta glomerata</i>	rope dodder	SC
	<i>Lysimachia hybrida</i>	swamp candles	SC
Great Lakes Marsh			
	<i>Nelumbo lutea</i>	American lotus	T
	<i>Sagittaria montevidensis</i>	broad-leaved arrowhead	T
	<i>Zizania aquatica</i> var. <i>aquatica</i>	wild rice	T
	<i>Hibiscus laevis</i>	smooth rose-mallow	SC
	<i>Hibiscus moscheutos</i>	swamp rose-mallow	SC
	<i>Strophostyles helvula</i>	trailing wild-bean	SC

Results

As shown in Tables 3 and 4, the surveys allowed for new information to be collected on one previously identified natural community element occurrence (EO) and resulted in the identification of two new rare plant element occurrences (EOs). (All state and federally listed rare species and high-quality natural communities are referred to as elements and their occurrence at a specific location is referred to as an element occurrence or EO.) It is possible that additional rare species may be found in the future, especially with active restoration and management. All previously existing records have been updated in the statewide database (Biotics) managed by MNFI.

Natural Community Inventory Results

While no new natural community element occurrences were identified in either Wolcott Mill

or Metro Beach, the surveys did allow valuable information to be collected on a previously identified occurrence of Great Lakes marsh at Metro Beach. In addition, Wolcott Mill contains several areas that have strong potential to become high quality natural communities with ecological restoration, particularly the floodplain forest, southern swamp, and mesic southern forest. The high-quality natural communities and sites with good potential for restoration are listed below along with their associated stewardship needs (Table 5). Detailed site descriptions and management recommendations for each area are included in the Site Summaries and Management Recommendations section (page 18).

Rare Plant Inventory Results

Rare plant surveys resulted in the location of two new rare plant occurrences for Shumard oak (*Quercus shumardii*) at Wolcott Mill (Table 4). The species occurs as a frequent tree within the southern

swamp on Kunstman Road and the mesic southern forest along the horse trail. This species was noticeably absent in the floodplain forest along the Clinton River.

Table 3. Natural Community Occurrences.

Community	Site Name (used for report)	Year First Observed	Year Last Observed	Metropark
Great Lakes marsh	Clinton River Delta	1988	2005	Metro Beach

Table 4. Rare Plant Occurrences. Status of SC indicates state special concern.

Species	Site Name (used for this report)	Status	Year First Observed	Year Last Observed	EO#	Metropark
<i>Quercus shumardii</i>	Kunstman Road Swamp	SC	2005	2005	6	Wolcott Mill
Shumard oak	Horse Trail Mesic Forest	SC	2005	2004	7	Wolcott Mill



The Clinton River Delta Marsh in Metro Beach Metropark provides habitat for numerous rare birds. Great Lakes marsh communities once covered much of the delta where the Clinton River drains into Lake St. Clair. As wetlands outside the park are filled, this marsh plays an increasingly important role for wildlife. (Photo by M. Kost.)



Mike Kost, MNFI ecologist, along with Paul Muelle and Dave Moilanen of HCMA, measure a large Shumard oak in the floodplain forest at Wolcott Mill Metropark. This tree species is rare in Michigan. (Photo by J. Cohen.)

Table 5. Stewardship needs for high-quality natural communities and sites with good potential for improvement through restoration and management.

Metropark	Site Name	Community Type	Management Recommendations
Wolcott Mill Metropark			
	Clinton River Floodplain Forest	southern floodplain forest	<ul style="list-style-type: none"> - remove invasive species - reduce deer densities - reduce impacts of forest fragmentation by allowing open areas along river to become floodplain forest and by directing succession of adjacent agricultural fields and old fields towards forest - restore hydrology of river by discontinuing drainage of river for agricultural use
	Kunstman Road Swamp	southern swamp	<ul style="list-style-type: none"> - remove invasive species - reduce deer densities - reduce impacts of forest fragmentation by directing succession of adjacent open fields towards forest
	Horse Trail Mesic Forest	mesic southern forest	<ul style="list-style-type: none"> - remove invasive species - reduce deer densities - reduce impacts of forest fragmentation by directing succession of adjacent open fields towards forest
Metro Beach Metropark			
	Clinton River Delta	Great Lakes marsh	<ul style="list-style-type: none"> - remove invasive species - implement prescribed burning program - restore hydrology

Site Summaries and Management Recommendations

Wolcott Mill Metropark

Clinton River Floodplain Forest (Site Code: A)

Mature floodplain forest was found along portions of the Clinton River (Figures 6 and 8). Four stretches of high-quality floodplain forest are found within the Metropark, occurring in the following locations: on the east side of the river north of 30 Mile Road and west of Wolcott Road; on the east side of the river just south of 30 Mile Road and west of Wolcott Road; on the east side of the river south of Indian Trail and east of Wolcott Road; and east of Teller Road on both sides of the river north of the golf course. These floodplain forests, though separated by younger degraded floodplain, share many structural and compositional characteristics. The mature forests occur in relatively broad portions of floodplain (estimates of width range from 50 to 200 meters) and contain fluvial landforms such as first bottoms, levees, point bars, meander channels, backswamps, and steep terrace slopes.

Each of the fluvial landforms has characteristic soil textures that influence drainage and species composition. The loamy soils of the floodplain forest are heterogeneous, with higher sand content closer to the river and greater concentrations of organic matter further from the river. The loamy soils overlay clay. **Levees** are high features adjacent to the river channel, where the coarsest sediment is deposited by the fastest moving floodwaters (Brinson 1990). In comparison to other parts of the floodplain, levees have soils of coarser texture and greater depth to the water table, which results in better soil drainage and soil aeration (Buccholz 1981). The **first bottom** is the low bottomland that dominates the floodplain and is subject to frequent over-the-bank flooding. The soil texture of the first bottom is finer than the levee. Fine-scale topographic variation in the first bottom results in large differences in the frequency and duration of flooding, floodwater depth, and the distribution of vegetation. **Point bars** are formed by the deposition of relatively coarse sediment on the inner side of a curve in the river and are often colonized by early successional vegetation that stabilizes the soil. **Meander channels** are former channels of the river that were cut off and abandoned by the meandering

stream. **Backswamps** are areas that are poorly drained, at a low elevation, and composed of finer-textured soil than the first bottom flat. Backswamps are located farther from the river than the first bottom flats and are formed because surface elevation decreases and progressively finer sediment is deposited with increasing distance from the river. Backswamps often experience prolonged soil saturation due to the lower elevation, higher water table, and more moderate water level fluctuations than the first bottom flats, and the soil organic matter content is typically higher (Baker and Barnes 1998). The **terrace slope** or **riser** is the steep slope between adjacent bottoms or terraces of a river valley. For an in-depth discussion of these fluvial landforms of floodplain forests, please refer to the MNFI natural community abstract for this community (Tepley et al. 2004).

Numerous large-diameter snags and coarse woody debris are found throughout the floodplain forest, and windthrow has created small canopy gaps. Large-diameter beech (*Fagus grandifolia*) trees make up a significant portion of the standing dead trees. The beech snags are characterized by



Photo 4. Snags, such as this large dead American beech, provide important habitat for wildlife. (Photo by J. Cohen.)

numerous cavities, and the coarse woody debris typically contains hollows, both of which are important structural attributes for a diverse array of wildlife species. Many of the canopy dominants within the floodplain forest, especially beech trees, have crotches that are suitable for nesting raptors. A raptor stick nest was observed in the northern portion of the floodplain forest south of Indian Trail. In addition, Cooper's hawk (*Accipiter cooperii*, SC) was observed west of the northernmost floodplain forest. Spring surveys for nesting raptors are therefore warranted. Crayfish burrows were common and signs of beaver were observed in the northernmost floodplain block.

The higher elevations within the floodplain are dominated by large beech and black maple trees that range in diameter from 20 to 89 cm (18 to 36 inches). Canopy associates in these areas include red oak (*Quercus rubra*), tulip tree (*Liriodendron tulipifera*), bitternut hickory (*Carya cordiformis*), and basswood (*Tilia americana*). Numerous red oak stumps occur in the floodplain forest south of Indian Trail. Based on tree-ring counts from a cut oak stump, canopy trees in these stands may be more than 160 years old. Present canopy-tree diameters are generally larger than those reported by the original land surveyors for surrounding areas, suggesting that the canopy dominants of these forests may pre-date European settlement.

More poorly drained areas are dominated by silver maple (*Acer saccharinum*) with red ash (*Fraxinus pennsylvanica*), cottonwood (*Populus deltoides*), basswood, sycamore (*Platanus occidentalis*), and butternut (*Juglans cinerea*) as important canopy associates. Backswamps are dominated by silver maple with black ash (*Fraxinus nigra*) and yellow birch (*Betula alleghaniensis*). Mature portions of the floodplain contain a sparse understory with spicebush (*Lindera benzoin*), blue-beech (*Carpinus caroliniana*), and prickly-ash (*Zanthoxylum americanum*) scattered throughout, and beech and black maple (*Acer nigrum*) in the understory as the prevalent advance regeneration. Understory species such as pawpaw (*Asimina triloba*) and blue ash (*Fraxinus quadrangulata*), which are unique to riparian systems, occur within portions of these floodplains, particularly in the southern portion of the park.



Photo 5. Coarse woody debris in the Wolcott Mill floodplain forest. As ash trees succumb to the emerald ash borer, their fallen trunks provide habitat and cover for many bird, small mammal, amphibian, and insect species. Nutrients from the rotting wood are slowly cycled back into the soil to become resources for the next generation of plants and animals. (Photo by J. Cohen.)

The ground cover throughout the floodplain is diverse, supporting over 216 species, and is characterized by species typical of floodplains and mesic forests with rich loamy soils. Important ground-cover species include blue cohosh (*Caulophyllum thalictroides*), doll's eyes (*Actaea pachypoda*), side-flowering aster (*Aster lateriflorus*), false nettle (*Boehmeria cylindrica*), wild leek (*Allium tricoccum*), green dragon (*Arisaema dracontium*), jack-in-the-pulpit (*Arisaema triphyllum*), wild ginger (*Asarum canadense*), white avens (*Geum canadense*), wild geranium (*Geranium maculatum*), wood nettle (*Laportea canadensis*), Virginia creeper (*Parthenocissus quinquefolia*), black snakeroot (*Sanicula* spp.), poison ivy (*Toxicodendron radicans*), jumpseed (*Polygonum virginianum*), riverbank grape (*Vitis riparia*), and spotted touch-me-not (*Impatiens capensis*).

Throughout the floodplain, patches of spotted touch-me-not, often associated with the backswamps and along the base of the terrace slopes, were found to be extensively browsed by deer. Deer herbivory was especially prevalent on the slopes adjacent to the floodplain. In addition, deer paths up and down these slopes have caused substantial loss of vegetative cover and subsequent erosion. The meander channels, when dry, function as thoroughfares for deer traffic. Reduction of deer densities is a pressing management need for the floodplain forests, because deer herbivory and trampling are reducing floristic and structural diversity and limiting seedling and sapling establishment and growth.

Numerous invasive exotic species were observed within the floodplain forests, including garlic mustard (*Alliaria petiolata*), Dame's rocket (*Hesperis matronalis*), moneywort (*Lysimachia nummularia*), European highbush cranberry (*Viburnum opulus*), Japanese barberry (*Berberis thunbergii*), and multiflora rose (*Rosa multiflora*). These pernicious invasive plants are most abundant along the edges of the floodplain forest, as well as closer to the river's edge, where disturbance is more frequent and the soils are sandier. In addition, an extremely invasive tree species, tree-of-heaven (*Ailanthus altissima*), was found in the northeastern portion of the floodplain forest south of Indian Trail (the pole-sized tree was girdled immediately upon discovery). These herbaceous invasives can best be controlled by hand-pulling or herbicide application, while tree-of-heaven should be cut, followed by an application of herbicide to the stumps to prevent resprouting.

Deer herbivory and exotic species invasions are both more likely to occur along forest edges. Thus, they can be reduced by permitting open fields and wet meadows adjacent to the floodplain forests to succeed to forest, and allowing young floodplain forest to mature without further anthropogenic disturbance. Portions of the Clinton River are being drained for agricultural use, which alters the hydrologic regime of the Clinton River and its surrounding floodplain. Prohibiting water withdrawals from the river would allow restoration of the floodplain forest.

We also recommend monitoring for ash mortality caused by the emerald ash borer (*Agrilus planipennis*) within the floodplain forest. Emerald ash borer is a recently discovered Asiatic beetle that

has already killed millions of ash trees in southeastern Michigan and southeastern Ontario and threatens to drastically alter the region's forests (USDA Forest Service 2004, USDA et al. 2006). A crucial research need is to determine if it is possible to prevent this pest from radically altering ash-dominated forests.

Horse Trail Mesic Forest (Site Code: B)

The Horse Trail Mesic Forest is a mesic southern forest dominated by a diverse assemblage of mesic to wet-mesic deciduous species. The site occurs on flat, moderately drained lake plain east of Wolcott Road between 28 Mile Road and 29 Mile Road. The soil is slightly acidic, fine-textured sandy clay loam overlaying clay. The formation of pits and mounds by fallen trees has resulted in a diverse microtopography of small rises and depressions, which provide numerous microhabitats for plants and animals. This diverse microtopography, along with fine-scale variation in the sand and clay content of the loamy soils, allows for a unique mixture of mesic and wet-mesic species. The forest is characterized by a supercanopy of large oaks, which include Shumard oak, bur oak, chinquapin oak (*Quercus muehlenbergii*), and red oak. As noted above, Shumard oak is a rare species, which, in Michigan, is found only in the southeastern counties along the lake plain. The supercanopy appeared to be roughly 100 feet high, while the canopy was estimated to be 60 feet high. Dominant canopy trees ranged in diameter from 41 to 122 cm (16 to 48 inches). Shumard, chinkapin, and bur oaks all measured over 100 cm (39 inches) in diameter. While no tree cores were taken to estimate age, canopy oaks within this forest, possibly left as mast trees while the land was pastured, are likely over 200 years old. The diameters of the supercanopy trees are much larger than diameters reported by the original land surveyors for the surrounding area, suggesting that the dominant trees in these forests may pre-date European settlement. Trees occupying the canopy beneath the supercanopy include the aforementioned oaks, beech, sugar maple, hickories, white oak, swamp white oak, and basswood. Large-diameter snags and coarse woody debris are scattered within the site, although the majority of the dead wood is composed of smaller trees that were suppressed and died before reaching the canopy.

The understory layer is dominated by blue-beech, ironwood, and seedlings and saplings of beech. Little oak regeneration was observed in either the seedling or sapling class for any of the numerous oak species. Shrubs are limited to scattered individuals of prickly-ash, downy arrowwood (*Viburnum rafinesquianum*), and multiflora rose, an invasive species. Common groundcover species include enchanter's nightshade (*Circaea lutetiana*), spinulose woodfern (*Dryopteris carthusiana*), wild geranium, fowl manna grass (*Glyceria striata*), jack-in-the-pulpit, sedges (*Carex grayi* and *C. radiata*), ostrich fern (*Matteuccia struthiopteris*), sensitive fern (*Onoclea sensibilis*), common water horehound (*Lycopus americanus*), May apple (*Podophyllum peltatum*), jumpseed, Christmas fern (*Polystichum acrostichoides*), bloodroot (*Sanguinaria canadensis*), and common trillium (*Trillium grandiflorum*). Garlic mustard, an invasive species, occurs within this forest, but has not yet become prevalent. In addition, purple loosestrife (*Lythrum salicaria*), another invasive plant, was located along the southeastern edge of this forest along the horse trail. For a detailed discussion of mesic southern forest, please refer to the MNFI abstract (Cohen 2004).

Management of this mesic forest should focus on invasive species control, with removal of the small garlic mustard colony as the main priority. Removal of multiflora rose is also important; for this species, cutting can be employed followed by herbicide treatment to prevent sprouting (Reinartz 1997). The purple loosestrife that was found along the edge of the forest was immediately removed. Metropark staff should monitor for this species along the edge of this forest, and for garlic mustard within the interior. Future encroachment by exotic species could be reduced by closing the horse trail through this stretch of forest and rerouting it along the forest edge.

Oak species are a significant canopy component of this mesic forest. However, oak regeneration in the form of seedlings and saplings is sparse, likely because of high deer densities. Metropark staff can encourage oak regeneration by planting acorns and oak seedlings within large light gaps, such as those created by recent treefalls. Where oak seedlings and saplings occur or are planted, staff can encourage

canopy ascension by these oaks by girdling or felling nearby competition and thereby direct the ecological succession of portions of the forest. Any management for oak recruitment must also include reducing densities of white-tailed deer and protecting seedlings from browsing. Reduction of deer densities is a pressing management need for this forest, because deer herbivory is reducing floristic and structural diversity and limiting seedling and sapling establishment and growth. The edge effects of both deer herbivory and exotic species invasion can be reduced by permitting the open fields surrounding the forest to succeed to forest. Allowing the agricultural fields to the east and west of this site to succeed to forest is highly recommended since this will allow the Horse Trail Mesic Forest to be connected with the woodlot to the west and floodplain forest to the east, thus creating a large block of contiguous forest. Promoting oaks within these fields by transplanting oak acorns and seedlings will help ensure oak regeneration at a broader scale than is presently possible.



Hard edges, created where an agricultural field abuts a forest (the field shown here is just east of the Horse Trail Mesic Forest in Site C), promote edge effects, such as invasion by exotic species. Purple loosestrife, an invasive species more typical of open wetlands, has begun to colonize this forest edge, but can easily be controlled now, while the population is small. (Photo by J. Cohen.)

Kunstman Road Swamp (Site Code: C)

The Kunstman Road Swamp is a forested wetland dominated by deciduous tree species. This southern swamp occurs west of Kunstman Road and just north of 29 Mile Road on flat, poorly drained lake plain. The soil is slightly acidic, fine-textured sandy loam overlaying clay (approximately two feet below the surface). Cobbles were abundant in the soil. Fallen trees have created a diverse microtopography of shallow pits and low mounds (pit-and-mound microtopography), which has resulted in fine-scale variations in soil sand and clay content. These variations in soil texture and microtopography provide diverse microsites for plants and animals adapted to both mesic and wet conditions.

The forest canopy is dominated by large trees that range in diameter from 46 to 91 cm (18 to 36 inches). More poorly drained areas are dominated by silver maple, red maple (*Acer rubrum*), yellow birch, cottonwood, swamp white oak (*Quercus bicolor*), basswood, and red ash. Mounds and other more well-drained microsites support Shumard oak, red oak, bur oak (*Quercus macrocarpa*), white oak (*Quercus alba*), tulip tree, hickories, and beech. Large-diameter snags and coarse woody debris are scattered throughout the site. Canopy oaks within this swamp, possibly left as mast trees while the land was pastured, are likely over 150 years old. An old, defunct drainage ditch occurs along the southern edge of the swamp and likely indicates that farmers unsuccessfully attempted to drain the swamp at some point in time.

The overwhelming dominant in the shrub layer is spicebush, which forms a dense understory in the western half of the forest block. Additional components of the shrub layer include blue-beech, witch-hazel (*Hamamelis virginiana*), ironwood (*Ostrya virginiana*), Michigan holly (*Ilex verticillata*), and prickly-ash. Japanese barberry is scattered throughout this swamp. Common ground-cover species include jack-in-the-pulpit, marsh marigold (*Caltha palustris*), sedges (*Carex intumescens* and *C. lupulina*), water hemlock (*Cicuta maculata*), fowl manna grass, southern blue flag (*Iris virginica*), northern bugle weed (*Lycopus uniflorus*), sensitive fern, royal fern (*Osmunda regalis*), and clearweed (*Pilea pumila*). An unidentified trillium, which could be the state endangered painted trillium (*Trillium undulatum*),

was found on top of several hummocks within this swamp. This species is known to occur in very similar hummocky swamp forests in other nearby sites, so future surveys for this species in early May are warranted. Garlic mustard has recently become established in the southeast corner of this swamp.

Management of this swamp forest should focus on invasive species control. Removal of the small garlic mustard colony is the main priority. Removal of Japanese barberry is also important. Many of the Japanese barberry shrubs within this swamp are small and can be manually pulled. For the few scattered larger invasive shrubs, cutting can be employed, followed by herbicide treatment to prevent sprouting (Reinartz 1997).

Oak species are a significant component of the canopy in this swamp system. However, oak regeneration in the form of seedlings and saplings is sparse, likely because of high deer densities. Metropark staff can encourage oak regeneration by planting acorns and oak seedlings within large light gaps, similar to those created by recent treefalls. Where oak seedlings and saplings occur or are planted, staff can encourage canopy ascension by these oaks by girdling or felling nearby competition and thereby directing the ecological succession of portions of the swamp. Any management for oak recruitment must also include reducing densities of white-tailed deer and protecting seedlings from browsing. Reduction of deer densities is a pressing management need for this swamp, because deer herbivory is reducing floristic and structural diversity and limiting seedling and sapling establishment and growth. The edge effects of both deer herbivory and exotic species invasions can be reduced by permitting the open fields surrounding the swamp to succeed to forest. The southernmost edge of this swamp forest, which is much younger in age, provides a unique glimpse into the likely course of succession within the adjacent old fields if the deer herd is not reduced. A distinct land-use boundary occurs along the southern portion of the swamp, where a 20-meter-wide swath of pole-sized swamp forest occurs. This younger forest is entirely dominated by cottonwood, silver maple, and red ash, demonstrating the need for decreasing deer densities and actively managing open fields to promote oak regeneration and overstory species diversity of future forests.

Metro Beach Metropark

Clinton River Delta (Site Codes: D and E)

A large Great Lakes marsh, which is represented as an element occurrence in the MNFI statewide database, occurs both north and south of the entrance road to the park, extending from the Clinton River south to Lake St. Clair. Historically, Great Lakes marsh areas were characterized by fluctuating water levels, and provided important habitat for waterfowl. (For a detailed discussion of the characteristics, biodiversity, and conservation value of Great Lakes marsh, please refer to the MNFI natural community abstract for this community, Albert 2001). This marsh, however, has experienced severe hydrologic disruption as a result of drainage channels, hardened shorelines, roads, fill, and residential construction. The flow of water, nutrients, and plant and animal species between the Clinton River and Lake St. Clair through this large Great Lakes marsh is now severely limited by the entrance road to the Metropark and numerous other roads that encircle the marsh.

Both areas of marsh, located north and south of the entrance road, are dominated by narrow-leaved cat-tail (*Typha angustifolia*) and reed (*Phragmites australis*). These aggressive, invasive plants were observed to have colonized previously open-water portions of the marsh following several low-water years in the late 1990's. However, the North Marsh (Site Code: D) still contains an area of shallow, open water.

The open-water portions of the North Marsh are characterized by highly eutrophic conditions (e.g., low dissolved oxygen and high levels of nutrients), which have resulted in domination by filamentous algae and duckweed (*Lemna minor*). Many native, aquatic plants dominate the open-water areas, but most of the species are considered very tolerant of extremely eutrophic waters. Aquatic species observed within the marsh include common waterweed (*Elodea canadensis*), hornwort (*Ceratophyllum demersum*), water star-grass (*Heteranthera dubia*), great duckweed (*Spirodela polyrhiza*), sweet-scented waterlily (*Nymphaea odorata*), Berchtold's pondweed (*Potamogeton berchtoldii*), pondweed (*P. gramineus*), Sage

pondweed (*P. pectinatus*), stonewort (*Chara* sp.), slender naiad (*Najas flexilis*), and great bladderwort (*Utricularia vulgaris*). Water celery (*Vallisneria americana*) and Richardson's pondweed (*Potamogeton richardsonii*), aquatic plants that are both considered to be indicators of good water quality, were also found growing at the site. Softstem bulrush (*Schoenoplectus taber-montanae*)—a native plant of emergent marshes that has largely been displaced by narrow-leaved cat-tail and reed—was observed growing locally on organic-rich sediments. The most common invasive plant within the open-water areas is Eurasian milfoil (*Myriophyllum spicatum*), which is an extremely aggressive species, especially in degraded eutrophic sites. Another locally common invasive plant in shallow water along the shoreline is flowering-rush (*Butomus umbellatus*).

During the summer of 2005, it appeared that no significant areas of open water remained within the South Marsh (Site Code: E); however, several seasonally inundated pools did occur. These open areas contribute to structural diversity and provide important breeding sites for amphibians and other organisms that require aquatic habitats for a portion of their lifecycles. A small forested wetland also occurs within a portion of the South Marsh and adds further structural and habitat diversity to the marsh.

At one time, Metro Beach and the surrounding area were occupied by a large delta at the mouth of the Clinton River, which extended two to three miles on either side of the river. Today, this coastal wetland it is one of the most highly altered deltas on Michigan's Great Lakes, with several marinas and hundreds of housing units built on the marsh itself. Due to the combination of hardened shoreline, ditching, eutrophication, and invasive plant introductions, complete restoration of the marsh community is not a practical management goal. However, the marsh does continue to provide habitat for native wildlife species, many of which are considered rare. Rare animal species that have been observed utilizing the marsh in the past include eastern fox snake (*Elaphe vulpina gloydi*, T), spotted turtle (*Clemmys guttata*, T), Blanding's

turtle (*Emydoidea blandingii*, state special concern (SC), king rail (*Rallus elegans*, state endangered (E)), Forester's tern (*Sterna forsteri*, SC), black tern (*Chlidonias niger*, SC), least bittern (*Ixobrychus exilis*, T), black-crowned night-heron (*Nycticorax nycticorax*, SC), marsh wren (*Cistothorus palustris*, SC), northern harrier (*Circus cyaneus*, SC), and Cooper's hawk (*Accipiter cooperii*, SC). In addition to providing critical habitat for rare and common wildlife, the marsh also provides local residents with important recreational and educational opportunities such as canoeing, fishing, bird watching, and nature study.

Management of the marsh should focus on controlling invasive species, especially European frog's bit (*Hydrocharis morsus-ranae*), reed, reed canary grass, narrow-leaved cat-tail, and purple loosestrife (*Lythrum salicaria*). European frog's bit was observed within a small pond and drainage ditch along the edge of the marsh (GPS coordinates: 42° 34' 42" N, 82° 48' 19" W). This plant is an aggressive invasive species, and its occurrence within the Metropark represents its first and only known location for Lake St. Clair. The other known population in Michigan occurs near Grosse Isle in Lake Erie. Because of its ability to rapidly spread and outcompete native aquatic plants, this population should be eliminated while it is still small enough to control. Within the South Marsh, the leaves of purple loosestrife were being consumed by beetles. While the presence of purple loosestrife typically represents a serious threat to biodiversity, its condition at the time of the survey (e.g., nearly defoliated by beetles) may indicate that management efforts to control this species are not necessary in the South Marsh. Reducing the dominance of reed, narrow-leaved cat-tail, and reed canary grass in at least some portions of the marsh will provide opportunities for other less robust plant species to colonize, and should result in increased habitat diversity. Prescribed fire may be a very useful management tool for creating habitat diversity that, if timed correctly, can be used to complement invasive species control efforts. For example, prescribed fires and herbicide application can be used complementarily to steadily drain resources from the rhizomes of these species. Burning any resprouts following herbicide application, or conversely, herbiciding the resprouts after a growing season fire, especially following a burn conducted soon after the plants have flowered,

will help reduce rhizome nutrient reserves to unsustainable levels. Repeated application of herbicide within the same year and over several years is likely to be needed to control these aggressive species (e.g., reed, narrow-leaved cat-tail, and reed canary grass). Long-term hydrologic restoration may not be practical, but any progress towards restoring hydrologic connectivity between Lake St. Clair and the Clinton River through the marsh will likely help in controlling invasive plant species while also increasing habitat heterogeneity.

Metro Beach Swamp (Site Code: F)

A small swamp forest occurs within the Nature Study Area adjacent to the Nature Center. Like other upland portions of Metro Beach, this forest occurs on fill that was brought in to create high ground within what was formerly a large Great Lakes marsh. The forest is dominated by large eastern cottonwood (*Populus deltoides*), many of which measure over 60 cm (24 inches) in diameter. These large trees probably sprouted shortly after the filling of this portion of the marsh was completed. Vines dominate large portions of all vegetative strata—the overstory, understory, shrub layer, and ground layer. The dominance by vines within this small patch of forest is striking and very unusual in comparison with other swamp forests previously surveyed in Michigan and other Midwest states. The dominant vines included two native species, riverbank grape (*Vitis riparia*) and Virginia creeper (*Parthenocissus quinquefolia*), and one pernicious invasive species, Oriental bittersweet (*Celastrus orbiculatus*).

Vernal pools, which dry down during the summer, are common throughout the forest and provide important breeding sites for many species. Similarly, drainage channels dissect the forest and add diversity to the habitats contained within the Nature Study Area. A water-filled drainage channel along the western edge of the forest supports a robust population of European frog's bit (*Hydrocharis morsus-ranae*), a pernicious invasive species known from only one other location in Michigan.

Management of the forest should include removing invasive species, especially European frog's bit and Oriental bittersweet. Other invasive species that occur within the forest and should be controlled include the following: glossy buckthorn (*Rhamnus frangula*); multiflora rose (*Rosa*

multiflora); European highbush cranberry (*Viburnum opulus*); reed (*Phragmites australis*); reed canary grass (*Phalaris arundinacea*); white mulberry (*Morus alba*); white willow (*Salix alba*); bitterweet nightshade (*Solanum dulcamara*); motherwort (*Leonurus cardiaca*), and curly dock (*Rumex crispus*). To provide critical habitat for wildlife, wherever possible, dead trees should be allowed to remain as standing snags or accumulate as large-diameter coarse woody debris on the forest floor.

Metro Beach Wet Meadow (Site Code: G)

A small wet meadow and old field occur within the Nature Study Area along the eastern and northern edges of the swamp forest. The forest edge provides diverse habitats for numerous plant and animal species. Habitats observed here include shrub thicket, old field with scattered young trees and shrubs, and an open sedge- and grass-dominated wet meadow. Staghorn sumac (*Rhus typhina*), prairie rose (*Rosa setigera*), and sandbar willow (*Salix exigua*) form dense thickets along the edge of the swamp and provide important cover for wildlife. Other native tree and shrub species

observed throughout the area include rough-leaved dogwood (*Cornus drummondii*), black raspberry (*Rubus occidentalis*), willow (*Salix eriocephala*), elderberry (*Sambucus canadensis*), white ash (*Fraxinus americana*), white pine (*Pinus strobus*), cottonwood, and bur oak. The open wet meadow is dominated by sedge (*Carex stricta*), tall fescue (*Festuca arundinacea*, an exotic grass), grass-leaved goldenrod (*Euthamia graminifolia*), and late goldenrod (*Solidago gigantea*).

Management of the area should include removing invasive plants, maintaining a diversity of habitats including open wet meadow, old field, and shrub thickets, and increasing the diversity of native plants associated with lakeplain prairies. Invasive species observed during the surveys that should be removed include the following: quack grass (*Agropyron repens*); flowering rush (*Butomus umbellatus*); Canadian thistle (*Cirsium arvense*), tall fescue; purple loosestrife; Scotch pine (*Pinus sylvestris*); Kentucky bluegrass (*Poa pratensis*); glossy buckthorn; curly dock; and bitterweet nightshade. Prescribed fire will be a useful management tool in helping to maintain open conditions and control invasive plants.



The rocky substrate of this section of the Clinton River, in Wolcott Mill Metropark, provides excellent habitat for mussels. Several species of native mussels that are rare in Michigan have been found in similar sections of the Clinton River. (Photo by M. Kost).

Discussion

Rare Plants

Shumard oak is listed as a species of special concern. Plants are given a status of special concern when the status of the plant is unknown due to lack of data. A species remains on the special concern list until it is determined whether the species should be elevated to threatened or endangered status, or is common enough to be untracked. Shumard oak is currently known from only five other sites in southeast Michigan, all of which are situated in the old Maumee lake plain region (Macomb, Wayne and Monroe Counties). It is a species more commonly found in southeast United States, and the populations encountered in Macomb County are at the very northern limit of its range. This tree can reach 120 ft. in height in warmer climates, and is usually found in wet to wet-mesic forests with heavy clay or clay loam soils. The bark and acorns are very similar to red oak, but it can be distinguished by the deep sinuses between the lobes of the sun leaves (Waldron et al. 1987). Shumard oak was common in two of the forests at Wolcott Mill and, although the existing trees appear healthy, the notable lack of oak regeneration at both sites is a great threat to its continued existence. Establishment of Shumard oak trees could be encouraged by planting acorns and seedlings in large light gaps created by recent treefalls and by girdling or felling nearby woody competition. Reducing the deer herd that likely feeds on the acorns, seedlings and young saplings is also likely to facilitate oak regeneration.

Opportunities for Forest Management and Reducing Forest Fragmentation

In the remaining forests on the flat lake plain of Wolcott Mill, oaks are being replaced by more shade-tolerant tree species. Metropark staff can increase oak regeneration by planting acorns or oak seedlings within large light gaps such as those created by recent tree-falls. Advance oak regeneration and planted oak seedlings can be favored by selectively removing competitors. Felling or girdling more shade-tolerant and common species like red maple can help direct the ecological succession of some portions of the forest.

Any management for oak recruitment must also include reducing densities of white-tailed deer and protecting seedlings from browsing. The edge effects of both deer herbivory and exotic species invasion can be reduced by permitting the open fields surrounding the remaining forests to succeed to forest.

Another important management goal at Wolcott Mill will be to reduce forest fragmentation. The effects of fragmentation on native plants and animals and ecosystem processes are profound and alarming (Heilman et al. 2002). The small and isolated nature of forest fragments may make them too small to support the full array of species formerly found in the landscape (Rooney and Dress 1997). Local population extinctions within fragments are accelerated by reduced habitat and small population size. Because of fragment isolation, inter-patch colonization may fail to compensate for local extinctions (Hewitt and Kellman 2004). Within fragmented forests, avian diversity is reduced by nest predation and nest parasitism. Numerous neotropical migrant songbirds are dependent on interior forest habitat and are highly susceptible to nest parasitism and predation (Robinson et al. 1995, Heske et al. 2001, Heilman et al. 2002). Forest succession within fragmented landscapes can be delayed or drastically modified, because seed exchange is greater for early-successional trees than for mid- or late-successional species (McEuen and Curran 2004). Native plant diversity within forested fragments is threatened by low seedling survivorship, infrequent seed dispersal, high levels of herbivory, and a growing prevalence of invasive species. Invasive species thrive along the edges of forest fragments and become widely dispersed throughout fragmented landscapes, especially along roads (Brosofske et al. 2001, Heilman et al. 2002, Hewitt and Kellman 2004).

At present, hard edges occur along many of the forest fragments within the Wolcott Mill Metropark. Along the edges of forest fragments, microclimatic and floristic edge effects can be reduced by encouraging the establishment and

growth of shade-tolerant species such as sugar maple, black maple, and beech. Both sugar maple and beech have well-developed lateral canopies that promote effective canopy closure, occlude high portions of sunlight, and insulate forest interiors from atmospheric edge effects (Mourelle et al. 2001). Within fragmented landscapes, forest species may decline or become locally extinct because of cessation of plant colonization. Large-seeded species (e.g. oaks, hickories, walnut, and butternut) are especially prone to population decline and reproductive failure due to high levels of predation within forest fragments. In such instances, seedling transplantation may be required to maintain the tree species composition (Hewitt and Kellman 2004). Allowing trees, especially oaks and hickories, to establish within the old fields and agricultural fields between blocks of forest, and then directing the succession of these fields towards mesic forest or southern swamp, will enable isolated blocks of forest to be enlarged and connected. This process can be expedited by broadcasting tree seeds and planting tree seedlings.

The formation of larger blocks of forest will help reduce deer herbivory and improve nesting success for raptors, neotropical migrant songbirds, and ground-nesting species, because nests are less likely to be parasitized and predated in larger blocks of forest (Wilcove et al. 1986). In addition, establishment of invasive species is reduced in larger blocks of contiguous habitat, since the ratio of interior habitat to edge typically increases with size.

Invasive Species

Invasive species pose a major threat to species and habitat diversity within the Metroparks. By outcompeting and replacing native species, invasives change species composition, alter vegetation structure and successional dynamics, and reduce native species diversity, often causing local or even complete extinction of native species (Harty 1986, Gorchoy and Trisel 2003). Invasive species can also upset delicately balanced ecological processes such as trophic relationships, interspecific competition, nutrient cycling, erosion control, hydrologic balance, and solar insolation (Bratton 1982). Lastly, invasive species often have no natural predators and spread aggressively through rapid sexual and asexual reproduction.

While numerous invasive species occur within Wolcott Mill and Metro Beach, the species highlighted below are likely to pose the greatest threat to biodiversity because of their ability to invade intact communities and quickly dominate. Invasive species abstracts, which include detailed methods for controlling invasive species, can be obtained at the following web site: <http://tncweeds.ucdavis.edu/>.

Garlic mustard and **Dame's rocket**, in particular, are of serious concern, even in very small numbers, because they are self-fertile, and thus a single plant can establish an entire population and quickly result in a large infestation. While they invade all types of forested habitats, they are especially aggressive in mesic and wet-mesic sites (Meekins and McCarthy 2001). Garlic mustard and Dame's rocket should be removed prior to seedset wherever they are encountered. Because they are capable of producing viable seed even after being pulled and discarded, plants that are pulled from the ground should be removed from any natural area.

Glossy buckthorn can also severely reduce species diversity, especially in alkaline, wetland habitats like prairie fen and relict conifer swamp. Left untreated, it can form large, impenetrable, monotypic stands in place of open, species diverse wetlands.

Purple loosestrife is another pernicious invader of wetland habitats, often completely replacing native emergent marsh communities. Some success in controlling purple loosestrife has recently occurred with the application of biological control agents, *Galerucella* beetles, which are native to purple loosestrife's European habitat (Hight and Drea 1991, Blossey 1992).

Reed and **narrow-leaved cat-tail** dominate vast stretches of Great Lakes marsh and have become widespread at Metro Beach. Because of its robust stature, reed displaces native marsh vegetation and degrades wildlife habitat. Narrow-leaved cat-tail is also very aggressive and is capable of displacing the native broad-leaved cat-tail. Many methods have been used to control both species, but repeated, multi-year applications of wetland appropriate herbicide have proven most effective.

European frog's-bit is a free-floating aquatic plant that can be found in both open and swamp habitats. It has been expanding its range in the Eastern Great Lakes region (Catling and Porebski, 1995) and recently was located in a canal at Metro

Beach. It is recommended that the species be aggressively controlled to limit potential future impacts within the park, and to prevent accidental spread of the species to other regions.

Several invasive species also threaten both the upland and lowland forests of Wolcott Mill. Among the most problematic of these are **common buckthorn**, **tree-of-heaven**, **Oriental bittersweet**, **Japanese barberry** and **honeysuckle** shrubs (**Amur**, **Morrow**, and **Tatarian** varieties). By invading the shrub layer of forest communities, these species severely reduce the amount of light available to the ground layer, causing the elimination of many ground layer species and preventing the reproduction of overstory dominants (Gorchov and Trisel 2003). Oriental bittersweet is especially problematic. A twining vine, it can literally strangle large trees by wrapping tightly around the trunk and preventing new growth of cambium tissue, effectively girdling the stem. These species can be effectively controlled by stem removal, but cutting without immediate herbicide application should be strictly avoided, since resprouting typically results in the proliferation of multiple stems, thus making it even more difficult to eliminate these problematic species.

Deer Densities

Many studies have shown that high deer densities adversely impact local ecosystems and vegetation (Alverson et al. 1988, Balgooyen and Waller 1995, Waller and Alverson 1997, Augustine and Frelich 1998, Rooney 2001, Horsely et al. 2003). At high densities, deer can act as keystone herbivores, drastically altering vegetative structure and composition, which can lead to cascading trophic effects (Alverson et al. 1988, Strole and Anderson 1992, Rooney and Dress 1997, Waller and Alverson 1997, Augustine and Frelich 1998, Van Deelen 1999, Rooney 2001, Rooney and Waller 2003). Chronically high deer densities over the last half century (or more) have limited tree recruitment of Great Lakes forests and drastically altered their floral composition and structure (Whitney 1984, Abrams and Orwig 1996, Rooney and Dress 1997, Waller and Alverson 1997, Woods 2000a, Zhang et al. 2000, Abrams 2001). High-intensity browsing has prevented the establishment in many locations of seedlings or saplings of palatable tree species (Peterson and Pickett 1995, Peterson 2000).

In addition to the drastic changes to tree recruitment, deer browsing has had perhaps an even greater impact to forb and shrub diversity. Most herbaceous species and shrubs never outgrow the “molar zone”—the zone of susceptibility to deer browse (Waller and Alverson 1997). With a single bite, deer can remove the leaf area and reproductive structures of long-lived understory forbs, many of which lack the capacity for regrowth after being browsed. Many spring herbs require decades to fully recover from deer browsing. Herbaceous plants constitute 87% of deer’s summer diet. Concentrated herbivory can reduce forb reproductive capacity and plant size, and even lead to the local extirpation of sensitive plants (Alverson et al. 1988, Rooney and Dress 1997, Augustine and Frelich 1998, Rooney and Waller 2003). Indirect impacts of deer herbivory can include the reduction of pollinators and seed dispersers of sensitive herbs (Waller and Alverson 1997, Ruhren and Handel 2003). Nearly one hundred threatened and endangered plants are jeopardized by deer herbivory (Miller et al. 1992), including painted trillium, which, as noted above, may occur within Wolcott Mill Metropark within the Kunstman Road Swamp. As a result of high deer densities across the Great Lakes, plants that are less palatable and more tolerant of browsing (e.g., ferns, graminoids, and club mosses) have increased in frequency in forested systems. Excessive deer browsing has contributed to the region-wide “homogenization” of forest flora, and to a reduction of floral genetic diversity (Van Deelen et al. 1996, Rooney and Dress 1997, Augustine and Frelich 1998, Rooney 2001, Rooney and Waller 2003, Kraft et al. 2004).

Excessive deer browse is evident throughout Wolcott Mill Metropark. Deer herbivory is likely reducing floristic diversity and limiting oak and yellow birch regeneration within the park’s forests (Strole and Anderson 1992). Through preferential grazing of native species, high deer densities are also thought to contribute to the spread of invasive species such as garlic mustard (Victoria Nuzzo pers. comm. 1998). Changes in herbaceous plant size and reproductive rates can be dramatically reversed when deer herbivory is eliminated for only two years (Augustine and Frelich 1998). Recovery of seedling and sapling banks (advance regeneration) requires a more prolonged period of low deer densities (8 to 10 years with < 4 deer/km) (Whitney 1984, Alverson et al. 1988, Tester et al. 1997,

Rooney et al. 2000). Conservation and restoration of forest communities require active long-term management of deer at low densities, which may be realized through increased hunting pressure (Alverson et al. 1988, Augustine and Frelich 1998). In addition, reducing forest fragmentation by allowing old fields, agricultural fields, and early-successional forest to succeed to mature forest will diminish suitable habitat for deer and reduce deer populations across the landscape. Where resources are available, deer exclosure fences may be erected around concentrations of sensitive herbs and susceptible saplings. It is recommended that the Huron-Clinton Metropolitan Authority continue working cooperatively with the Michigan Department of Natural Resources to assess Metropark deer densities, and to reduce deer densities to the levels recommended by the DNR.

Fire as an Ecological Process

Many of the areas within the parks we surveyed once supported fire-dependent communities, including Great Lakes marsh and southern swamp. In the past, lightning- and human-induced fires frequently spread over large areas of southern Michigan and other Midwestern states (Curtis 1959, Grimm 1984, Dorney 1981). In the absence of frequent fires, these non-forested wetlands frequently convert to shrub-carr and then tamarack swamp or hardwood swamp (Curtis 1959). The well-documented reduction of wildfires in Midwestern states following the loss of indigenous cultures in the early 1800s resulted in a loss of fire-dependent natural communities, both through active conversion of land to agriculture and through succession of many remaining natural areas from open barrens and wetlands to forested community types (Curtis 1959).

Plant communities, whether upland or lowland, benefit from prescribed fire in several ways. Depending on the season and intensity of a burn, prescribed fire may be used to decrease the cover of exotic, cool-season grasses and woody species, and increase the cover of warm-season grasses and native forbs (White 1983, Abrams and Hulbert 1987, Tester 1989, Anderson and Schwegman 1991, Collins and Gibson 1990, Glenn-Lewin et al. 1990). Prescribed fire helps reduce litter levels, allowing sunlight to reach the soil surface and to stimulate seed germination and enhance seedling establishment (Daubenmire 1968, Hulbert 1969,

Knapp 1984, Tester 1989, Anderson and Schwegman 1991, Warners 1997). Important plant nutrients (e.g., N, P, K, Ca, and Mg) are elevated following prescribed fire (Daubenmire 1968, Viro 1974, Reich et al. 1990, Schmalzer and Hinkle 1992). Prescribed fire has been shown to result in increased plant biomass, flowering, and seed production (Laubhan 1995, Abrams et al 1986, Warners 1997, Kost and De Steven 2000). Prescribed fire can also help express and rejuvenate seed banks, which may be especially important for maintaining species diversity (Leach and Givnish 1996, Kost and De Steven 2000).

Impacts to faunal communities should also be considered when planning a prescribed burn. Dividing a large area into smaller burn units that can be burned in alternate years or seasons can protect populations of many species. This allows unburned units to serve as refugia for immobile invertebrates and slow-moving amphibian and reptile species. When burning larger areas, it may be desirable to strive for patchy burns by igniting during times of high relative humidity. As mentioned above, the unburned patches may then serve as refugia, which facilitate recolonization of burned patches by fire-sensitive species. Burning under overcast skies and when air temperatures are cool (<55°F) can help protect reptiles, since they are less likely to be found basking above the surface when conditions are cloudy and cool. Lastly, conducting burns during the dormant season (late October through March) may also help minimize impacts to reptiles.

Setting Stewardship Priorities

While invasive species occur in nearly all natural communities surveyed in this study, management priority should be given to the highest quality sites. By concentrating effort on a few high quality sites, limited resources of time, personnel, volunteer effort, and money can be directed to make a significant impact on biodiversity. How should Metroparks' managers and naturalists determine which sites to manage? That decision is one best made by park resource professionals, but evaluation criteria should include the following:

1. A preference toward high quality sites with minimal infestations of invasive species. Biodiversity is most easily and effectively protected by preventing high quality sites from degrading, and invasives are much easier to eradicate when they are not yet well established.
2. A focus on sites that harbor high levels of native species diversity or unique elements of biodiversity (e.g., hardwood swamps, floodplain forests, springs, rare species, etc.). Wetlands, in particular, harbor a disproportionate number of rare species and provide critical habitat for many species.
3. Sites that enhance core areas of high quality habitat or act as critical corridors for wildlife. Reducing forest fragmentation at Wolcott Mill will enhance many of the existing high quality sites.
4. High profile sites that are viewed by many visitors such as well used trails or sites with scenic overlooks or picturesque views. Opportunities to educate the public on biodiversity and stewardship are maximized by actively working to restore frequently visited sites. Restoring sites that provide scenic vistas will promote an appreciation of the park's natural resources.

A brief summary of sites with high restoration potential in each park follows below. Detailed site descriptions and management recommendations are included in the Site Summaries and Management section (page 18).

High-Priority Sites at Wolcott Mill

At Wolcott Mill, we identified several sites with high restoration potential. The **Horse Trail Mesic Forest** and the **Kunstman Road Swamp** (Figures 6 and 8: sites B and C) are characterized by moderate levels of invasive species in the understory and ground cover that can be controlled with a concerted management effort. Both sites are highly visible and easily accessible. An equestrian trail passes through the Horse Trail Mesic Forest, while Kunstman Road forms the eastern border of Kunstman Road Swamp. In addition, both of these

sites support populations of the rare Shumard oak (SC) and are currently lacking advance regeneration of oak species. Planting acorns and oak seedlings in light gaps and directing succession of adjacent open fields towards forest by promoting oak establishment are high priority restoration activities for these sites.

Softening the edges of the **Clinton River Floodplain Forest** by allowing the succession of the adjacent open fields to closed canopy forest will increase the functionality of this floodplain as a wildlife corridor. Increasing forest cover within the floodplain and adjacent uplands will improve breeding habitat for forest species and help protect core areas of mature forest from edge effects like deer herbivory and infestation by invasive species. The most intensive restoration effort would involve invasive species control within the **Clinton River Floodplain Forest**. Though this process will require a heavy investment of time and money, a great number of native species depend on riparian ecosystems; thus, by controlling invasive species within the floodplain forest, park managers will directly aid many native species within the surrounding landscape. Other sites at Wolcott Mill may also merit attention and should be evaluated for restoration based on available resources.

High-Priority Sites at Metro Beach

The **Clinton River Delta** Great Lakes marsh at Metro Beach provides critical habitat for numerous rare birds and other wildlife species. Reducing dominance by invasive species, especially reed and narrow-leaved cat-tail, will result in increased habitat diversity and directly benefit a wide array of native plants and animals. Hydrologic restoration, which may include reducing impediments to water flow between the North and South Marshes and between the marsh and Lake St. Clair, should also be considered if funding becomes available to study and implement a large hydrologic restoration project. However, because of the profound changes within and around the marsh, restoration efforts should be carefully gauged and monitored so as not to draw a disproportionate amount of resources away from other more promising restoration opportunities at other Metroparks.

Conclusion

The Huron-Clinton Metropolitan Authority has the considerable responsibility of stewarding numerous populations of rare species and ecologically significant natural communities. As southeast Michigan becomes more developed, the prominence of natural features harbored by the Metroparks is substantially heightened. Both rare and common native species are threatened by the rapid pace of development in southeast Michigan. In addition, changes taking place outside the Metropark boundaries are having significant repercussions within their borders. For example, as new roads, subdivisions, shopping centers, and industries are built outside the parks, invasive plants used in landscaping quickly find their way into the park and degrade natural communities and their associated complement of native species. Historic wildlife corridors are disrupted, and cosmopolitan edge species, such as white-tailed deer, increasingly seek refuge within the confines of parks and other protected natural areas. The increased deer density within the Metroparks results in the local elimination of numerous plant and animal species, so that deer populations affect ecosystems on multiple trophic levels (McShea and Rappole 1992, Waller and Alverson 1997). As rare plants and high-quality natural communities are lost in the surrounding area due to development, the regional significance of safeguarding these natural features within the Metroparks becomes even more important.

Conservation scientists and practitioners are more aware today than ever before that protecting rare species and ecologically significant natural communities requires far more than simply building preserves to prevent their outright destruction (Janzen 1986). Because changes occurring outside park boundaries result in significant impacts within the park, protection of rare species and natural

communities today requires the active participation by Metroparks' staff in stewarding the land for ecological integrity. This formidable task requires staff to identify significant natural features, develop conservation strategies, and apply their considerable expertise in resource management to the active stewardship of ecological integrity.

Both Wolcott Mill and Metro Beach Metroparks support significant natural features that are threatened by events taking place within the parks as well as outside park boundaries. The parks have lost a considerable amount of their biodiversity as a result of filling, deforestation, forest fragmentation, infestation of pernicious invasive species, and high white-tail deer populations. Reducing the detrimental impacts of forest fragmentation at Wolcott Mill can be realized by allowing old fields and agricultural fields to succeed to forest. These reforestation efforts should focus on establishing species that are not reproducing in the remaining blocks of forest, such as oaks. Connecting isolated forest patches, enlarging current woodlands, and creating a more natural transition between open field and forest edge will help increase nesting success rates of ground-nesting birds and mammals, forest raptors, and neotropical migrant songbirds, many of which are experiencing sharp declines in their populations. The loss of biodiversity caused by infestations of invasive plants can be reversed by developing monitoring and eradication programs focused on protecting the centers of biodiversity, namely the mesic southern forests, floodplain forests, southern swamps, and Great Lakes marsh. Reducing the local deer herd is likely to result in the recovery of many native plants and ground- and shrub-nesting animal species over time.

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Appendix 1. Plant species observed at Wolcott Mill Metropark. "X" indicates the species occurred within the site. "-" indicates species was not observed at the site. Capitalized scientific and common names indicate non-native species. Life form acronyms are as follows: Nt, native; P, perennial; Ad, adventive; B, biannual; A, annual. "C" is the Coefficient of Conservation for each species (Herman et al. 2001).

Site Name	Site Abbreviation	Site Code
Clinton River Floodplain Forest	CRF	A
Horse Trail Mesic Forest	HTF	B
Kunstman Road Swamp	KRS	C

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
<i>Acer negundo</i>	BOX ELDER	Nt Tree	0	x	-	-
<i>Acer nigrum</i>	BLACK MAPLE	Nt Tree	4	x	x	-
<i>Acer rubrum</i>	RED MAPLE	Nt Tree	1	x	x	x
<i>Acer saccharinum</i>	SILVER MAPLE	Nt Tree	2	x	x	x
<i>Acer saccharum</i>	SUGAR MAPLE	Nt Tree	5	x	x	x
<i>Actaea pachypoda</i>	DOLL'S EYES	Nt P-Forb	7	x	-	x
<i>Actaea rubra</i>	RED BANE BERRY	Nt P-Forb	7	x	-	-
<i>Agastache nepetoides</i>	YELLOW GIANT HYSSOP	Nt P-Forb	5	x	-	-
<i>Agrimonia gryposepala</i>	TALL AGRIMONY	Nt P-Forb	2	x	x	-
<i>AILANTHUS ALTISSIMA</i>	TREE-OF-HEAVEN	Ad Tree	0	x	-	-
<i>ALLIARIA PETIOLATA</i>	GARLIC MUSTARD	Ad B-Forb	0	x	x	x
<i>Allium sp.</i>	ONION	P-Forb	0	x	-	-
<i>Allium tricoccum</i>	WILD LEEK	Nt P-Forb	5	x	-	-
<i>Amelanchier arborea</i>	JUNE BERRY	Nt Tree	4	x	-	-
<i>Amphicarpaea bracteata</i>	HOG PEANUT	Nt A-Forb	5	x	-	x
<i>Antennaria parlinii</i>	SMOOTH PUSSYTOES	Nt P-Forb	2	x	-	-
<i>Apios americana</i>	GROUNDNUT	Nt P-Forb	3	x	-	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
<i>Apocynum androsaemifolium</i>	SPREADING DOGBANE	Nt P-Forb	3	x	-	-
<i>Arabis laevigata</i>	SMOOTH BANK CRESS	Nt B-Forb	5	x	-	-
<i>Arisaema dracontium</i>	GREEN DRAGON	Nt P-Forb	8	x	-	-
<i>Arisaema triphyllum</i>	JACK IN THE PULPIT	Nt P-Forb	5	x	x	X
<i>Asarum canadense</i>	WILD GINGER	Nt P-Forb	5	x	-	-
<i>Asimina triloba</i>	PAWPAW	Nt Tree	9	x	-	-
<i>Aster cordifolius</i>	HEART LEAVED ASTER	Nt P-Forb	4	x	-	-
<i>Aster lanceolatus</i>	EASTERN LINED ASTER	Nt P-Forb	2	x	-	-
<i>Aster lateriflorus</i>	SIDE FLOWERING ASTER	Nt P-Forb	2	x	-	X
<i>Aster ontarionis</i>	ONTARIO ASTER	Nt P-Forb	6	-	x	-
<i>Athyrium filix-femina</i>	LADY FERN	Nt Fern	4	x	x	x
BERBERIS THUNBERGII	JAPANESE BARBERRY	Ad Shrub	0	x	-	x
<i>Betula alleghaniensis</i>	YELLOW BIRCH	Nt Tree	7	x	x	x
<i>Betula papyrifera</i>	PAPER BIRCH	Nt Tree	2	-	-	x
<i>Bidens cernuus</i>	NODDING BUR MARIGOLD	Nt A-Forb	3	x	-	-
<i>Bidens frondosus</i>	COMMON BEGGAR TICKS	Nt A-Forb	1	x	-	-
<i>Boehmeria cylindrica</i>	FALSE NETTLE	Nt P-Forb	5	x	-	-
<i>Brachyelytrum erectum</i>	LONG AWNED WOOD GRASS	Nt P-Grass	7	x	-	-
<i>Bromus latiglumis</i>	EAR LEAVED BROME	Nt P-Grass	6	x	-	-
<i>Caltha palustris</i>	MARSH MARIGOLD	Nt P-Forb	6	x	-	x
<i>Calystegia sepium</i>	HEDGE BINDWEED	Nt P-Forb	2	x	-	-
<i>Carex albursina</i>	SEDGE	Nt P-Sedge	5	x	-	x
<i>Carex blanda</i>	SEDGE	Nt P-Sedge	1	x	x	x
<i>Carex bromoides</i>	SEDGE	Nt P-Sedge	6	-	-	x
<i>Carex cephalophora</i>	SEDGE	Nt P-Sedge	3	x	-	-
<i>Carex cristatella</i>	SEDGE	Nt P-Sedge	3	-	x	-
<i>Carex gracillima</i>	SEDGE	Nt P-Sedge	4	x	x	x
<i>Carex grayi</i>	SEDGE	Nt P-Sedge	6	x	x	-
<i>Carex grisea</i>	SEDGE	Nt P-Sedge	3	x	-	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
<i>Carex hirtifolia</i>	SEDGE	Nt P-Sedge	5	x	x	-
<i>Carex intumescens</i>	SEDGE	Nt P-Sedge	3	x	x	x
<i>Carex lacustris</i>	SEDGE	Nt P-Sedge	6	x	-	-
<i>Carex laxiculmis</i>	SEDGE	Nt P-Sedge	8	x	x	-
<i>Carex lupulina</i>	SEDGE	Nt P-Sedge	4	x	-	x
<i>Carex muskingumensis</i>	SEDGE	Nt P-Sedge	6	x	-	-
<i>Carex normalis</i>	SEDGE	Nt P-Sedge	5	-	-	x
<i>Carex pennsylvanica</i>	SEDGE	Nt P-Sedge	4	x	x	-
<i>Carex radiata</i>	STRAIGHT STYLED WOOD SEDGE	Nt P-Sedge	2	-	x	-
<i>Carex retroflexa</i>	SEDGE	Nt P-Sedge	1	x	-	x
<i>Carex rosea</i>	CURLY STYLED WOOD SEDGE	Nt P-Sedge	2	x	x	-
<i>Carex stipata</i>	SEDGE	Nt P-Sedge	1	x	-	-
<i>Carex stricta</i>	SEDGE	Nt P-Sedge	4	x	-	-
<i>Carex tenera</i>	SEDGE	Nt P-Sedge	4	x	x	-
<i>Carex tuckermanii</i>	SEDGE	Nt P-Sedge	8	x	-	-
<i>Carex woodii</i>	SEDGE	Nt P-Sedge	8	-	x	-
<i>Carpinus caroliniana</i>	BLUE-BEECH	Nt Tree	6	x	x	x
<i>Carya cordiformis</i>	BITTERNUT HICKORY	Nt Tree	5	x	x	x
<i>Carya laciniosa</i>	SHELLBARK HICKORY	Nt Tree	9	-	-	x
<i>Carya ovata</i>	SHAGBARK HICKORY	Nt Tree	5	x	x	x
<i>Caulophyllum thalictroides</i>	BLUE COHOSH	Nt P-Forb	5	x	-	-
<i>Celtis occidentalis</i>	HACKBERRY	Nt Tree	5	x	-	-
<i>Cephalanthus occidentalis</i>	BUTTONBUSH	Nt Shrub	7	x	-	-
<i>Chelone glabra</i>	TURTLEHEAD	Nt P-Forb	7	x	-	-
CHENOPODIUM ALBUM	LAMB'S QUARTERS	Ad A-Forb	0	-	x	-
<i>Cicuta maculata</i>	WATER HEMLOCK	Nt B-Forb	4	x	-	x
<i>Cinna arundinacea</i>	WOOD REEDGRASS	Nt P-Grass	7	x	-	-
<i>Circaea lutetiana</i>	ENCHANTER'S NIGHTSHADE	Nt P-Forb	2	x	x	x
<i>Clinopodium vulgare</i>	WILD BASIL	Nt P-Forb	3	x	-	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
<i>Collinsonia canadensis</i>	RICHWEED	Nt P-Forb	8	x	-	x
<i>Conopholis americana</i>	SQUAWROOT	Nt P-Forb	10	-	x	-
CONVALLARIA MAJALIS	LILY OF THE VALLEY	Ad P-Forb	0	x	-	-
<i>Cornus alternifolia</i>	ALTERNATE LEAVED DOGWOOD	Nt Tree	5	x	-	-
<i>Cornus amomum</i>	SILKY DOGWOOD	Nt Shrub	2	x	-	-
<i>Cornus foemina</i>	GRAY DOGWOOD	Nt Shrub	1	x	-	-
<i>Crataegus crus-galli</i>	COCKSPUR THORN	Nt Tree	5	x	-	-
<i>Crataegus mollis</i>	HAWTHORN	Nt Tree	2	x	-	-
<i>Crataegus</i> sp.	HAWTHORN	Tree	0	x	-	x
<i>Cryptotaenia canadensis</i>	HONEWORT	Nt P-Forb	2	x	-	x
<i>Cuscuta gronovii</i>	COMMON DODDER	Nt A-Forb	3	x	-	-
<i>Cystopteris protrusa</i>	FRAGILE FERN	Nt Fern	5	x	-	-
DACTYLIS GLOMERATA	ORCHARD GRASS	Ad P-Grass	0	x	-	-
<i>Dryopteris carthusiana</i>	SPINULOSE WOODFERN	Nt Fern	5	-	x	x
<i>Echinocystis lobata</i>	WILD CUCUMBER	Nt A-Forb	2	x	-	-
<i>Elymus riparius</i>	RIVERBANK WILD RYE	Nt P-Grass	8	x	-	-
<i>Elymus virginicus</i>	VIRGINIA WILD RYE	Nt P-Grass	4	x	-	-
<i>Epifagus virginiana</i>	BEECH DROPS	Nt P-Forb	10	x	x	x
<i>Epilobium coloratum</i>	CINNAMON WILLOW HERB	Nt P-Forb	3	x	-	-
EPIPACTIS HELLEBORINE	HELLEBORINE	Ad P-Forb	0	x	-	-
<i>Equisetum arvense</i>	COMMON HORSETAIL	Nt Fern Ally	0	x	-	-
<i>Equisetum hyemale</i>	SCOURING RUSH	Nt Fern Ally	2	x	-	-
<i>Equisetum laevigatum</i>	SMOOTH SCOURING RUSH	Nt Fern Ally	2	x	-	-
<i>Equisetum variegatum</i>	VARIEGATED SCOURING RUSH	Nt Fern Ally	8	-	-	x
<i>Erigeron annuus</i>	ANNUAL FLEABANE	Nt B-Forb	0	x	-	-
<i>Erigeron philadelphicus</i>	MARSH FLEABANE	Nt P-Forb	2	-	-	x
<i>Euonymus obovata</i>	RUNNING STRAWBERRY BUSH	Nt Shrub	5	x	-	-
<i>Eupatorium maculatum</i>	JOE PYE WEED	Nt P-Forb	4	x	-	-
<i>Eupatorium purpureum</i>	PURPLE JOE PYE WEED	Nt P-Forb	5	x	-	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
Eupatorium rugosum	WHITE SNAKEROOT	Nt P-Forb	4	x	-	-
Fagus grandifolia	AMERICAN BEECH	Nt Tree	6	x	x	x
Festuca subverticillata	NODDING FESCUE	Nt P-Grass	5	x	-	-
Fraxinus americana	WHITE ASH	Nt Tree	5	x	x	x
Fraxinus nigra	BLACK ASH	Nt Tree	6	x	-	-
Fraxinus pennsylvanica	RED ASH	Nt Tree	2	x	-	-
Fraxinus quadrangulata	BLUE ASH	Nt Tree	8	x	-	-
Galium circaezans	WHITE WILD LICORICE	Nt P-Forb	4	x	-	-
Galium obtusum	WILD MADDER	Nt P-Forb	5	-	-	x
Galium triflorum	FRAGRANT BEDSTRAW	Nt P-Forb	4	x	-	-
Geranium maculatum	WILD GERANIUM	Nt P-Forb	4	x	x	x
Geum aleppicum	YELLOW AVENS	Nt P-Forb	3	x	-	-
Geum canadense	WHITE AVENS	Nt P-Forb	1	x	-	-
GLECHOMA HEDERACEA	GROUND IVY	Ad P-Forb	0	x	-	-
Glyceria striata	FOWL MANNA GRASS	Nt P-Grass	4	x	x	x
Hackelia virginiana	BEGGAR'S LICE	Nt P-Forb	1	x	x	-
Hamamelis virginiana	WITCH-HAZEL	Nt Shrub	5	x	-	x
Helianthus giganteus	TALL SUNFLOWER	Nt P-Forb	5	x	-	-
Hepatica acutiloba	SHARP LOBED HEPATICA	Nt P-Forb	8	x	-	-
Heracleum maximum	COW PARSNIP	Nt P-Forb	3	x	-	-
HESPERIS MATRONALIS	DAME'S ROCKET	Ad P-Forb	0	x	-	-
Hydrophyllum virginianum	VIRGINIA WATERLEAF	Nt P-Forb	4	x	-	-
Hystrix patula	BOTTLEBRUSH GRASS	Nt P-Grass	5	x	-	x
Ilex verticillata	MICHIGAN HOLLY	Nt Shrub	5	-	-	x
Impatiens capensis	SPOTTED TOUCH ME NOT	Nt A-Forb	2	x	-	-
Iris virginica	SOUTHERN BLUE FLAG	Nt P-Forb	5	x	-	x
Juglans cinerea	BUTTERNUT	Nt Tree	5	x	-	x
Juglans nigra	BLACK WALNUT	Nt Tree	5	x	-	-
Laportea canadensis	WOOD NETTLE	Nt P-Forb	4	x	-	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
Leersia virginica	WHITE GRASS	Nt P-Grass	5	x	-	-
LEONURUS CARDIACA	MOTHERWORT	Ad P-Forb	0	x	-	-
LIGUSTRUM VULGARE	COMMON PRIVET	Ad Shrub	0	x	-	-
Lilium michiganense	MICHIGAN LILY	Nt P-Forb	5	x	-	-
Lindera benzoin	SPICEBUSH	Nt Shrub	7	x	-	x
Liriodendron tulipifera	TULIP TREE	Nt Tree	9	x	-	x
Lobelia siphilitica	GREAT BLUE LOBELIA	Nt P-Forb	4	x	-	-
Lonicera dioica	RED HONEYSUCKLE	Nt W-Vine	5	-	x	-
LONICERA TATARICA	SMOOTH TARTARIAN HONEYSUCKLE	Ad Shrub	0	x	-	-
Luzula acuminata	HAIRY WOOD RUSH	Nt P-Forb	5	x	-	-
Lycopus americanus	COMMON WATER HOREHOUND	Nt P-Forb	2	-	x	-
Lycopus uniflorus	NORTHERN BUGLE WEED	Nt P-Forb	2	-	-	x
Lysimachia ciliata	FRINGED LOOSESTRIFE	Nt P-Forb	4	x	-	-
LYSIMACHIA NUMMULARIA	MONEYWORT	Ad P-Forb	0	x	-	-
Maianthemum canadense	CANADA MAYFLOWER	Nt P-Forb	4	-	-	x
MALUS PUMILA	APPLE	Ad Tree	0	x	-	-
Matteuccia struthiopteris	OSTRICH FERN	Nt Fern	3	x	x	-
Menispermum canadense	MOONSEED	Nt W-Vine	5	x	x	-
Mitchella repens	PARTRIDGE BERRY	Nt P-Forb	5	-	x	-
MORUS ALBA	WHITE MULBERRY	Ad Tree	0	x	-	-
MYOSOTIS SCORPIOIDES	FORGET ME NOT	Ad P-Forb	0	x	-	-
Onoclea sensibilis	SENSITIVE FERN	Nt Fern	2	x	x	x
Osmorhiza claytonii	HAIRY SWEET CICELY	Nt P-Forb	4	x	-	-
Osmorhiza longistylis	SMOOTH SWEET CICELY	Nt P-Forb	3	x	-	-
Osmunda regalis	ROYAL FERN	Nt Fern	5	-	-	x
Ostrya virginiana	IRONWOOD; HOP HORNBEAM	Nt Tree	5	x	x	x
Oxalis fontana	YELLOW WOOD SORREL	Nt P-Forb	0	x	x	-
Parthenocissus inserta	THICKET CREEPER	Nt W-Vine	4	x	-	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
Parthenocissus quinquefolia	VIRGINIA CREEPER	Nt W-Vine	5	x	x	x
Phalaris arundinacea	REED CANARY GRASS	Nt P-Grass	0	x	-	-
Phryma leptostachya	LOPSEED	Nt P-Forb	4	x	-	-
PICEA ABIES	NORWAY SPRUCE	Ad Tree	0	x	-	-
Pilea fontana	BOG CLEARWEED	Nt A-Forb	5	x	-	-
Pilea pumila	CLEARWEED	Nt A-Forb	5	x	-	x
Pinus strobus	WHITE PINE	Nt Tree	3	x	-	-
PINUS SYLVESTRIS	SCOTCH PINE	Ad Tree	0	x	-	-
Platanus occidentalis	SYCAMORE	Nt Tree	7	x	-	-
POA COMPRESSA	CANADA BLUEGRASS	Ad P-Grass	0	x	-	-
POA PRATENSIS	KENTUCKY BLUEGRASS	Ad P-Grass	0	x	-	-
POA TRIVIALIS	BLUEGRASS	Ad P-Grass	0	x	-	-
Podophyllum peltatum	MAY APPLE	Nt P-Forb	3	x	x	x
Polygonatum pubescens	DOWNY SOLOMON SEAL	Nt P-Forb	5	x	-	x
POLYGONUM PERSICARIA	LADY'S THUMB	Ad A-Forb	0	x	-	-
Polygonum virginianum	JUMPSEED	Nt P-Forb	4	x	x	x
Polystichum acrostichoides	CHRISTMAS FERN	Nt Fern	6	x	x	-
Populus deltoides	COTTONWOOD	Nt Tree	1	x	x	x
Populus grandidentata	BIG TOOTHED ASPEN	Nt Tree	4	x	-	-
Populus tremuloides	QUAKING ASPEN	Nt Tree	1	x	-	-
Prenanthes altissima	TALL WHITE LETTUCE	Nt P-Forb	5	-	x	-
PRUNELLA VULGARIS	LAWN PRUNELLA	Nt P-Forb	0	x	-	-
PRUNUS AVIUM	SWEET CHERRY	Ad Tree	0	-	x	-
Prunus serotina	WILD BLACK CHERRY	Nt Tree	2	x	-	x
Prunus virginiana	CHOKE CHERRY	Nt Shrub	2	x	-	x
Quercus alba	WHITE OAK	Nt Tree	5	x	x	x
Quercus bicolor	SWAMP WHITE OAK	Nt Tree	8	x	x	x
Quercus macrocarpa	BUR OAK	Nt Tree	5	x	x	x
Quercus muehlenbergii	CHINQUAPIN OAK	Nt Tree	5	x	x	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
Quercus rubra	RED OAK	Nt Tree	5	x	x	x
Quercus shumardii	SHUMARD OAK	Nt Tree	8	-	x	x
Ranunculus hispidus	SWAMP BUTTERCUP	Nt P-Forb	5	x	-	x
Ranunculus recurvatus	HOOKEED CROWFOOT	Nt A-Forb	5	x	-	x
RHAMNUS FRANGULA	GLOSSY BUCKTHORN	Ad Shrub	0	x	-	-
Ribes americanum	WILD BLACK CURRANT	Nt Shrub	6	x	-	-
Ribes cynosbati	PRICKLY or WILD GOOSEBERRY	Nt Shrub	4	x	-	x
ROSA MULTIFLORA	MULTIFLORA ROSE	Ad Shrub	0	x	x	x
Rubus allegheniensis	COMMON BLACKBERRY	Nt Shrub	1	x	-	x
Rubus occidentalis	BLACK RASPBERRY	Nt Shrub	1	x	x	-
Rudbeckia laciniata	CUT LEAVED CONEFLOWER	Nt P-Forb	6	x	-	-
SALIX ALBA	WHITE WILLOW	Ad Tree	0	x	-	-
Salix amygdaloides	PEACH LEAVED WILLOW	Nt Tree	3	x	-	-
Salix sp.	WILLOW SP.	Tree	0	x	-	-
Sambucus canadensis	ELDERBERRY	Nt Shrub	3	x	-	-
Sanguinaria canadensis	BLOODROOT	Nt P-Forb	5	x	x	-
Sanicula canadensis	BLACK SNAKEROOT	Nt B-Forb	8	x	-	-
Sanicula gregaria	BLACK SNAKEROOT	Nt P-Forb	2	x	-	-
Sanicula trifoliata	BLACK SNAKEROOT	Nt B-Forb	6	x	-	-
Sassafras albidum	SASSAFRAS	Nt Tree	5	x	-	-
Scutellaria lateriflora	MAD DOG SKULLCAP	Nt P-Forb	5	x	-	-
Smilacina racemosa	FALSE SPIKENARD	Nt P-Forb	5	x	-	-
Smilacina stellata	STARRY FALSE SOLOMON SEAL	Nt P-Forb	5	x	x	-
Smilax ecirrhata	UPRIGHT CARRION FLOWER	Nt P-Forb	6	x	-	-
Smilax lasioneura	CARRION FLOWER	Nt P-Vine	5	x	-	-
Smilax tamnoides	BRISTLY GREEN BRIER	Nt W-Vine	5	x	-	x
SOLANUM DULCAMARA	BITTERSWEET NIGHTSHADE	Ad P-Forb	0	x	-	-
Solidago caesia	BLUE STEMMED GOLDENROD	Nt P-Forb	7	x	-	-
Solidago canadensis	CANADA GOLDENROD	Nt P-Forb	1	x	x	-

Appendix 1, continued. Plant species observed at Wolcott Mill Metropark.

Scientific Name	Common Name	Life Form	Site Name	CRF	HTF	KRS
			Site Code	A	B	C
Solidago flexicaulis	BROAD LEAVED GOLDENROD	Nt P-Forb	6	x	-	-
Solidago gigantea	LATE GOLDENROD	Nt P-Forb	3	x	-	-
Stachys tenuifolia	SMOOTH HEDGE NETTLE	Nt P-Forb	5	x	-	-
Symplocarpus foetidus	SKUNK CABBAGE	Nt P-Forb	6	x	-	x
Thalictrum dasycarpum	PURPLE MEADOW RUE	Nt P-Forb	3	x	-	-
Thalictrum dioicum	EARLY MEADOW RUE	Nt P-Forb	6	x	x	-
Thelypteris noveboracensis	NEW YORK FERN	Nt Fern	5	x	-	x
Thelypteris palustris	MARSH FERN	Nt Fern	2	x	-	-
Tilia americana	BASSWOOD	Nt Tree	5	x	x	x
Toxicodendron radicans	POISON IVY	Nt W-Vine	2	x	x	x
Trillium grandiflorum	COMMON TRILLIUM	Nt P-Forb	5	x	x	x
Trillium sp.	TRILLIUM	Nt P-Forb	0	-	-	x
Ulmus americana	AMERICAN ELM	Nt Tree	1	x	x	x
Urtica dioica	NETTLE	Nt P-Forb	1	x	-	-
Uvularia sessilifolia	MERRYBELLS	Nt P-Forb	5	x	-	-
Verbena urticifolia	WHITE VERVAIN	Nt P-Forb	4	x	-	-
Viburnum lentago	NANNYBERRY	Nt Shrub	4	x	-	-
VIBURNUM OPULUS	EUROPEAN Highbush CRANBERRY	Ad Shrub	0	x	-	-
Viburnum rafinesquianum	DOWNY ARROW-WOOD	Nt Shrub	5	-	x	-
Viola pubescens	YELLOW VIOLET	Nt P-Forb	4	x	-	-
Viola sororia	COMMON BLUE VIOLET	Nt P-Forb	1	x	-	-
Viola sp.	VIOLET	P-Forb	0	-	-	x
Vitis riparia	RIVERBANK GRAPE	Nt W-Vine	3	x	x	x
Zanthoxylum americanum	PRICKLY-ASH	Nt Shrub	3	x	x	x
Total number of species observed in survey site:				216	69	80
Total number of species observed in Wolcott Mill Metropark:		243				

Appendix 2. Plant species observed at Metro Beach Metropark. "X" indicates the species occurred within the site. "-" indicates species was not observed at the site. Capitalized scientific and common names indicate non-native species. Life form acronyms are as follows: Nt, native; P, perennial; Ad, adventive; B, biannual; A, annual. "C" is the Coefficient of Conservation for each species (Herman et al. 2001).

Site Name	Site Abbreviation	Site Code
Clinton River Delta		D, E
North Marsh	NM	D
South Marsh	SM	E
Metro Beach Swamp	MBS	F
Metro Beach Wet Meadow	WM	G

Scientific Name	Common Name	Life Form	C	Site Name	NM	SM	MBS	WM
				Site Code	D	E	F	G
ABUTILON THEOPHRASTI	VELVETLEAF	Ad A-Forb	0	-	x	-	-	-
Acer negundo	BOX ELDER	Nt Tree	0	-	x	x	-	-
Acer rubrum	RED MAPLE	Nt Tree	1	-	x	x	-	-
Acer saccharinum	SILVER MAPLE	Nt Tree	2	-	x	x	-	-
Achillea millefolium	YARROW	Nt P-Forb	1	-	x	-	-	-
Agastache nepetoides	YELLOW GIANT HYSSOP	Nt P-Forb	5	-	-	x	-	-
Agrimonia parviflora	SWAMP AGRIMONY	Nt P-Forb	4	-	x	x	-	-
Agrimonia pubescens	SOFT AGRIMONY	Nt P-Forb	5	-	x	-	-	-
AGROPYRON REPENS	QUACK GRASS	Ad P-Grass	0	-	x	-	x	-
Apocynum cannabinum	INDIAN HEMP	Nt P-Forb	3	-	x	x	x	-
Apocynum sibiricum	CLASPING DOGBANE	Nt P-Forb	3	-	x	-	-	-
ARCTIUM MINUS	COMMON BURDOCK	Ad B-Forb	0	-	x	-	-	-
Arisaema triphyllum	JACK IN THE PULPIT	Nt P-Forb	5	-	-	x	-	-
Asclepias incarnata	SWAMP MILKWEED	Nt P-Forb	6	-	x	x	-	-
Asclepias syriaca	COMMON MILKWEED	Nt P-Forb	1	-	x	-	-	x
Aster lanceolatus	EASTERN LINED ASTER	Nt P-Forb	2	-	-	x	-	-

Appendix 2, continued. Plant species observed at Metro Beach Metropark.

Scientific Name	Common Name	Life Form	C	Site Name	NM	SM	MBS	WM
				Site Code	D	E	F	G
Aster ontarionis	ONTARIO ASTER	Nt P-Forb	6	-	-	x	-	-
Aster pilosus	HAIRY ASTER	Nt P-Forb	1	-	-	-	-	x
BARBAREA VULGARIS	YELLOW ROCKET	Ad B-Forb	0	-	x	-	-	-
Bidens cernuus	NODDING BUR MARIGOLD	Nt A-Forb	3	-	x	-	-	-
Boehmeria cylindrica	FALSE NETTLE	Nt P-Forb	5	-	x	x	x	x
Bolboschoenus fluviatilis	BULRUSH	Nt P-Sedge	6	-	x	-	-	-
BROMUS COMMUTATUS	HAIRY CHESS	Ad A-Grass	0	-	x	-	-	-
BUTOMUS UMBELLATUS	FLOWERING RUSH	Ad P-Forb	0	x	x	-	-	x
Calamagrostis canadensis	BLUE JOINT GRASS	Nt P-Grass	3	-	x	x	-	-
Calystegia sepium	HEDGE BINDWEED	Nt P-Forb	2	-	x	-	-	x
Campanula aparinoides	MARSH BELLFLOWER	Nt P-Forb	7	-	x	-	-	-
Carex blanda	SEDGE	Nt P-Sedge	1	-	x	-	-	-
Carex lacustris	SEDGE	Nt P-Sedge	6	-	x	x	-	-
Carex stipata	SEDGE	Nt P-Sedge	1	-	x	x	-	-
Carex stricta	SEDGE	Nt P-Sedge	4	-	x	-	-	x
CELASTRUS ORBICULATA	ORIENTAL BITTERSWEET	Ad W-Vine	0	-	-	x	-	-
Celtis occidentalis	HACKBERRY	Nt Tree	5	-	-	x	-	-
CENTAUREA MACULOSA	SPOTTED BLUET	Ad B-Forb	0	-	x	-	-	-
Ceratophyllum demersum	COONTAIL	Nt P-Forb	1	x	x	-	-	-
Cicuta maculata	WATER HEMLOCK	Nt B-Forb	4	-	x	-	-	-
Circaea lutetiana	ENCHANTER'S NIGHTSHADE	Nt P-Forb	2	-	-	x	-	-
CIRSIUM ARVENSE	CANADIAN THISTLE	Ad P-Forb	0	-	x	-	-	x
CIRSIUM VULGARE	BULL THISTLE	Ad B-Forb	0	-	x	-	-	-
CONVOLVULUS ARVENSIS	FIELD BINDWEED	Ad P-Forb	0	-	x	-	-	-
Cornus drummondii	ROUGH LEAVED DOGWOOD	Nt Shrub	6	-	x	x	x	x
Cornus foemina	GRAY DOGWOOD	Nt Shrub	1	-	x	x	-	-
Corylus americana	HAZELNUT	Nt Shrub	5	-	-	x	-	-
Cuscuta gronovii	COMMON DODDER	Nt A-Forb	3	-	x	-	-	-

Appendix 2, continued. Plant species observed at Metro Beach Metropark.

Scientific Name	Common Name	Life Form	C	Site Name	NM	SM	MBS	WM
				Site Code	D	E	F	G
Cyperus strigosus	LONG SCALED NUT SEDGE	Nt P-Sedge	3	-	x	-	-	-
DILOTAXIS MURALIS	WALL ROCKET	Ad A-Forb	0	-	x	-	-	-
Echinocystis lobata	WILD CUCUMBER	Nt A-Forb	2	-	x	-	-	-
Elodea canadensis	COMMON WATERWEED	Nt P-Forb	1	x	-	-	-	-
Equisetum arvense	COMMON HORSETAIL	Nt Fern Ally	0	-	-	-	-	x
Eupatorium maculatum	JOE PYE WEED	Nt P-Forb	4	-	x	-	-	-
Eupatorium perfoliatum	COMMON BONESET	Nt P-Forb	4	x	-	-	-	x
Euphorbia maculata	NODDING SPURGE	Nt A-Forb	0	-	-	-	-	x
Euthamia graminifolia	GRASS LEAVED GOLDENROD	Nt P-Forb	3	-	-	-	-	x
FESTUCA ARUNDINACEA	TALL FESCUE	Ad P-Grass	0	-	x	-	-	x
Fraxinus americana	WHITE ASH	Nt Tree	5	-	x	x	x	x
Fraxinus pennsylvanica	RED ASH	Nt Tree	2	-	-	x	-	-
Geum aleppicum	YELLOW AVENS	Nt P-Forb	3	-	-	-	-	x
Glyceria striata	FOWL MANNA GRASS	Nt P-Grass	4	-	x	x	-	-
Heteranthera dubia	WATER STAR GRASS	Nt P-Forb	6	x	-	-	-	-
HYDROCHARIS MORSUS-RANAE	EUROPEAN FROG'S BIT	Nt P-Forb	0	-	x	-	-	-
HYPERICUM PERFORATUM	COMMON ST. JOHN'S WORT	Ad P-Forb	0	-	x	-	-	-
Impatiens capensis	SPOTTED TOUCH ME NOT	Nt A-Forb	2	-	x	x	x	x
Iris virginica	SOUTHERN BLUE FLAG	Nt P-Forb	5	-	x	-	-	-
Juglans cinerea	BUTTERNUT	Nt Tree	5	-	-	x	-	-
Juglans nigra	BLACK WALNUT	Nt Tree	5	-	-	x	-	-
Laportea canadensis	WOOD NETTLE	Nt P-Forb	4	-	x	-	-	-
Lathyrus palustris	MARSH PEA	Nt P-Forb	7	-	x	-	-	-
Leersia oryzoides	CUT GRASS	Nt P-Grass	3	-	x	x	-	-
Lemna minor	SMALL DUCKWEED	Nt A-Forb	5	x	x	-	-	-
LEONURUS CARDIACA	MOTHERWORT	Ad P-Forb	0	-	-	x	-	-
Lindera benzoin	SPICEBUSH	Nt Shrub	7	-	-	x	-	-
LONICERA sp.	HONEYSUCKLE	Ad Shrub	0	-	x	-	-	-
Lycopus americanus	COMMON WATER HOREHOUND	Nt P-Forb	2	x	-	-	-	x

Appendix 2, continued. Plant species observed at Metro Beach Metropark.

Scientific Name	Common Name	Life Form	C	Site Name	NM	SM	MBS	WM
				Site Code	D	E	F	G
<i>Lycopus uniflorus</i>	NORTHERN BUGLE WEED	Nt P-Forb	2	-	x	-	x	
LYTHRUM SALICARIA	PURPLE LOOSESTRIFE	Ad P-Forb	0	-	x	-	x	
<i>Mimulus ringens</i>	MONKEY FLOWER	Nt P-Forb	5	-	x	-	-	
MORUS ALBA	WHITE MULBERRY	Ad Tree	0	-	-	x	-	
MYRIOPHYLLUM SPICATUM	EURASIAN WATER MILFOIL	Ad P-Forb	0	x	-	-	-	
<i>Najas flexilis</i>	SLENDER NAIAD	Nt A-Forb	5	x	-	-	-	
NEPETA CATARIA	CATNIP	Ad P-Forb	0	-	x	-	-	
<i>Nymphaea odorata</i>	SWEET SCENTED WATERLILY	Nt P-Forb	6	x	-	-	-	
<i>Onoclea sensibilis</i>	SENSITIVE FERN	Nt Fern	2	-	x	x	-	
<i>Parthenocissus inserta</i>	THICKET CREEPER	Nt W-Vine	4	-	x	-	-	
<i>Parthenocissus quinquefolia</i>	VIRGINIA CREEPER	Nt W-Vine	5	x	x	x	-	
<i>Penthorum sedoides</i>	DITCH STONECROP	Nt P-Forb	3	-	x	-	-	
<i>Phalaris arundinacea</i>	REED CANARY GRASS	Nt P-Grass	0	-	x	x	x	
<i>Phragmites australis</i>	REED	Nt P-Grass	0	x	x	x	x	
<i>Pinus strobus</i>	WHITE PINE	Nt Tree	3	-	-	-	x	
PINUS SYLVESTRIS	SCOTCH PINE	Ad Tree	0	-	-	-	x	
<i>Platanus occidentalis</i>	SYCAMORE	Nt Tree	7	-	x	-	-	
POA PRATENSIS	KENTUCKY BLUEGRASS	Ad P-Grass	0	-	-	-	x	
<i>Polygonum amphibium</i>	WATER SMARTWEED	Nt P-Forb	6	-	x	-	-	
<i>Polygonum hydropiper</i>	WATER PEPPER	Nt A-Forb	1	-	x	-	-	
<i>Polygonum sagittatum</i>	ARROW LEAVED TEAR THUMB	Nt A-Forb	5	-	x	-	-	
<i>Populus deltoides</i>	COTTONWOOD	Nt Tree	1	-	x	x	x	
<i>Potamogeton berchtoldii</i>	BERCHTOLD'S PONDWEED	Nt P-Forb	4	x	-	-	-	
<i>Potamogeton gramineus</i>	PONDWEED	Nt P-Forb	5	x	-	-	-	
<i>Potamogeton pectinatus</i>	SAGO PONDWEED	Nt P-Forb	3	x	-	-	-	
<i>Potamogeton richardsonii</i>	RICHARDSON'S PONDWEED	Nt P-Forb	5	x	-	-	-	
<i>Potentilla norvegica</i>	ROUGH CINQUEFOIL	Nt A-Forb	0	-	x	-	-	
<i>Quercus macrocarpa</i>	BUR OAK	Nt Tree	5	-	-	-	x	
RHAMNUS CATHARTICA	COMMON BUCKTHORN	Ad Tree	0	-	x	-	-	
RHAMNUS FRANGULA	GLOSSY BUCKTHORN	Ad Shrub	0	x	x	x	x	

Appendix 2, continued. Plant species observed at Metro Beach Metropark.

Scientific Name	Common Name	Life Form	C	Site Name	NM	SM	MBS	WM
				Site Code	D	E	F	G
Rhus typhina	STAGHORN SUMAC	Nt Tree	2	-	x	x	x	x
Ribes americanum	WILD BLACK CURRANT	Nt Shrub	6	-	-	x	-	-
ROSA MULTIFLORA	MULTIFLORA ROSE	Ad Shrub	0	-	-	x	-	-
Rosa palustris	SWAMP ROSE	Nt Shrub	5	-	x	x	-	-
ROSA RUGOSA	JAPANESE ROSE	Ad Shrub	0	-	x	-	-	-
Rosa setigera	PRAIRIE ROSE	Nt Shrub	5	-	x	-	-	x
Rubus occidentalis	BLACK RASPBERRY	Nt Shrub	1	-	x	x	x	x
RUMEX CRISPUS	CURLY DOCK	Ad P-Forb	0	-	x	x	x	x
Sagittaria cuneata	ARUM LEAVED ARROWHEAD	Nt P-Forb	6	-	x	-	-	-
Sagittaria latifolia	COMMON ARROWHEAD	Nt P-Forb	1	-	x	-	-	-
SALIX ALBA	WHITE WILLOW	Ad Tree	0	-	x	x	-	-
Salix amygdaloides	PEACH LEAVED WILLOW	Nt Tree	3	-	x	x	-	-
Salix eriocephala	WILLOW	Nt Shrub	2	-	x	-	-	x
Salix exigua	SANDBAR WILLOW	Nt Shrub	1	x	x	-	-	x
SALIX FRAGILIS	CRACK WILLOW	Ad Tree	0	-	x	-	-	-
Salix nigra	BLACK WILLOW	Nt Tree	5	-	-	x	-	-
Sambucus canadensis	ELDERBERRY	Nt Shrub	3	-	x	x	x	x
Schoenoplectus pungens	THREE SQUARE	Nt P-Sedge	5	-	-	-	-	x
Schoenoplectus tabernaemontani	SOFTSTEM BULRUSH	Nt P-Sedge	4	x	x	-	-	-
Scirpus atrovirens	BULRUSH	Nt P-Sedge	3	-	x	-	-	x
Scutellaria galericulata	COMMON SKULLCAP	Nt P-Forb	5	-	x	-	-	-
Scutellaria lateriflora	MAD DOG SKULLCAP	Nt P-Forb	5	-	-	-	-	x
Sium suave	WATER PARSNIP	Nt P-Forb	5	-	x	-	-	-
SOLANUM DULCAMARA	BITTERSWEET NIGHTSHADE	Ad P-Forb	0	x	x	x	x	x
Solanum ptycanthum	BLACK NIGHTSHADE	Nt A-Forb	1	-	x	-	-	-
Solidago altissima	TALL GOLDENROD	Nt P-Forb	1	-	x	-	-	x
Solidago canadensis	CANADA GOLDENROD	Nt P-Forb	1	-	-	-	-	x
Solidago gigantea	LATE GOLDENROD	Nt P-Forb	3	x	x	x	x	x
SONCHUS ARVENSIS	PERENNIAL SOW THISTLE	Ad P-Forb	0	-	x	-	-	-
Sparganium chlorocarpum	GREEN FRUITED BUR REED	Nt P-Forb	6	-	-	x	-	-

Appendix 2, continued. Plant species observed at Metro Beach Metropark.

Scientific Name	Common Name	Life Form	C	Site Name	NM	SM	MBS	WM
				Site Code	D	E	F	G
Sparganium eurycarpum	COMMON BUR REED	Nt P-Forb	5	-	x	-	-	-
Spartina pectinata	CORDGRASS	Nt P-Grass	5	-	-	x	-	-
Spiraea alba	MEADOWSWEET	Nt Shrub	4	-	x	-	-	-
Spirodela polyrhiza	GREAT DUCKWEED	Nt A-Forb	6	x	-	-	-	-
Stachys tenuifolia	SMOOTH HEDGE NETTLE	Nt P-Forb	5	-	x	-	-	-
Teucrium canadense	WOOD SAGE	Nt P-Forb	4	-	x	-	-	x
Thelypteris palustris	MARSH FERN	Nt Fern	2	-	x	-	-	-
Tilia americana	BASSWOOD	Nt Tree	5	-	-	x	-	-
Toxicodendron radicans	POISON IVY	Nt W-Vine	2	-	x	x	-	-
TYPHA ANGUSTIFOLIA	NARROW LEAVED CATTAIL	Ad P-Forb	0	x	x	-	-	-
Typha latifolia	BROAD LEAVED CATTAIL	Nt P-Forb	1	x	x	x	-	-
Ulmus americana	AMERICAN ELM	Nt Tree	1	-	x	x	-	-
Urtica dioica	NETTLE	Nt P-Forb	1	-	x	x	-	-
Utricularia vulgaris	GREAT BLADDERWORT	Nt P-Forb	6	x	-	-	-	-
Vallisneria americana	EEL GRASS	Nt P-Forb	7	x	-	-	-	-
VERBASCUM THAPSUS	COMMON MULLEIN	Ad B-Forb	0	-	x	-	-	-
Verbena hastata	BLUE VERVAIN	Nt P-Forb	4	-	x	-	-	-
VIBURNUM OPULUS	EUROPEAN HIGHBUSH	Ad Shrub	0	-	x	x	-	-
	CRANBERRY							
Vitis riparia	RIVERBANK GRAPE	Nt W-Vine	3	x	x	x	-	x
Total number of species observed in survey site:				27	106	57	45	
Total number of species observed in Metro Beach Metropark:			152					