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WETLAND FLORA OF THE GRAND CALUMET RIVER IN NORTHWEST INDIANA: POTENTIAL IMPACTS OF SEDIMENT REMOVAL AND RECOMMENDATIONS FOR RESTORATION

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ABSTRACT. Northwestern Indiana supports unusually diverse floras. However, rapid industrialization and urbanization since the late 19th Century have changed much of the natural character of the wetlands along Grand Calumet River. Of more than 1400 species that occurred historically in the northwestern Indiana, 19 species were identified as extirpated species; and only 653 species, including 1 extirpated, 17 endangered, 14 threatened, and 18 rare species were documented during the recent surveys in the Grand Calumet River wetlands. Over 97% the wetlands along the Grand Calumet River were disturbed by fragmentation, infestation by alien species (120 of 653 species were alien), and anthropogenic disruption of ecosystem processes (e.g., fire suppression, draining, filling, and sedimentation). Among the wetlands along the Grand Calumet River, Roxanna Marsh, DuPont Tract, Clark & Pine East Nature Preserve, and Miller Woods were identified as high quality habitats with special needs of conservation. The proposed sediment dredging may cause direct physical damage to wetland floras, shoreline erosion along the stream banks, and "probable" drainage by deepening the riverbed. Restoration of ecosystem structure and function is needed to minimize such negative impacts that would potentially be incurred by the proposed sediment dredging.

Keywords: Wetland, flora, dredging, conservation, restoration

With its 14,000-year geologic history, northwestern Indiana natural areas support unusually diverse biological communities (Reshkin 1990). The diverse flora on the dune-and-swale complex on the southern shore of Lake Michigan has been noted by Cowles' (1899) bench-mark study, followed by Fuller (1935), Olson (1958), and Wilhelm (1990). Many factors caused drastic changes in species of the plant communities along the Grand Calumet River. The geomorphology of this river system has been altered significantly by human activities. The rivers have become straighter and narrower as a result of channelization. In addition, drainage and filling, along with industrial pollution of marshes and ponds adjacent to the river, altered local hydrology (Hiebert et al. 1986; Wilcox et al. 1986; Bowles 1990). This chapter discusses (1) pre-settlement and present-day wetland plant communities, (2) potential impacts of the proposed dredging project on wetland vegetation in the Grand Calumet River basin, and (3) restoration potentials of native wetland flora in conjunction with sediment removal.

NATIVE FLORA OF PRE-SETTLEMENT TIMES

Extirpated species.—Peattie (1930), in his publication *Flora of the Indiana Dunes*, estimated that 1400 plant species inhabited the Indiana Dunes area. Nineteen of these species have not been seen in Indiana since Peattie's sightings, and they have now been classified as extirpated species (species that had not been seen in Indiana for 50 years) by Aldrich et al. (1986). They are *Betula populifolia* (gray birch), *Carex scabrata*, *Corallorrhiza trifida* (coral root), *Gerardia pedicularia ambigens* (clammy false foxglove), *Hemicarpa drummondii*, *Hippuris vulgaris* (mare's tail), *Lechea stricta* (bush pinweed), *Lemna perpusilla* (least duckweed), *Linnaea borealis* (twin flower), *Lonicera canadensis* (American fly honeysuckle), *Oryzopsis pungens* (short-horned rice grass), *Panicum lucidum* (bog panic grass), *Psilocarya nitens* (bald rush), *Pyrola secunda* (one-sided shinleaf), *Scleria reticularis* (netted nut rush), *Shepherdia canadensis* (russet buffaloberry), *Trillium cernuum macranthum* (nodding trillium), and *Utricularia resupinata* (small purple bladderwort).

Historic plant community types.—Bacone et al. (1980) reconstructed the pre-settlement vegetation characteristics of northwestern Indiana by analyzing land survey records that were compiled between 1829 and 1834. The wetland community types recognized by this study are aquatic communities, marshes, swamps, bottomland forests, beach communities, and pannes.

Aquatic communities consist of macrophytes and phytoplankton in standing or running water. The 1829–1834 survey record noted *Polygonum* spp., *Nuphar advena*, and *Nymphaea tuberosa* as typical macrophytes (Bacone et al. 1980). Since European settlement, species composition of this community has been changed significantly by numerous human activities such as loading of nutrients, silts and other pollutants, alteration of local hydrology through channelization, drainage, and filling of the river and its adjacent wetlands.

Marshes are probably the most prominent plant community types along the Grand Calumet River. Marshes are open (non-forested) wetlands that are dominated by sedges and/or grasses communities (Bacone et al. 1980). On the wet end of the moisture gradient, sedge meadow is found directly adjacent to aquatic. At the other extreme, wet prairie overlaps with the borders of mesophytic prairies and savanna complex (Wilhelm 1990). As is indicated by its name, sedge meadow is characterized by abundant sedges (Cyperaceae); wet prairies are dominated by grasses (Poaceae). Typical plant species in this community type include *Aster puniceus firmus*, *Bidens coronata tenuiloba*, *Carex aquatilis altior*, *Decodon verticillatus*, *Polygonum punctatum*, and *Scirpus acutus*. Historically, periodic fires—both natural and man-made—have been a crucial factor in maintaining marshes because fires prohibit the invasion of woody shrubs and trees. Since European settlement, however, most marshes have been heavily disturbed by drainage, by invasion of woody species facilitated by artificial fire suppression and by intentional or accidental introduction of alien species (Labus et al. 1999).

Shrub carr is a transitional wetland from marsh to swamp. Typical woody species include *Alnus* spp. and *Salix* spp. According to the 1829–1834 survey record, woody species (e.g., *Populus tremuloides*, and *Populus grandidentata*) were less abundant in pre-settlement than the present times (Bacone et al. 1980). However, significant alterations in the level of the water table, and a long-lasting policy of fire suppression, have resulted in significant invasion of overgrown shrubs into marshes, sedge meadows and wet prairies (Wilcox et al. 1986).

Swamps are forested wetlands where the water level is maintained near the surface of the substrate by ground water or by rain (Wilhelm 1990). In the land survey records, the swamps in northwestern Indiana were classified into three major types. Coniferous swamps occurred only in dune-swale systems, and were dominated by *Pinus banksiana* and *Thuja occidentalis*. Timbered swamps, now classified as green ash (*Fraxinus pennsylvanica subintegerrima*) swamps, are inhabited by *Populus deltoides*, *Platanus occidentalis*, *Fraxinus nigra*, *Acer saccharinum*, and *Ulmus* spp. This type of swamp occurred along the Kankakee River. Extensive draining and logging in this century has destroyed much of this community. The species composition of these two community types is quite similar. Shared species include *Alnus rugosa americana* and *Salix* spp. This type of swamp, like the shrub carrs, has become more common than during pre-settlement times as a result of long-term drainage and fire suppression (Bacone et al. 1980).

Bottomland forests consist of several woody strata underlain by herbaceous cover, and they are located along the stream banks and are characterized by annual deposition of silt during flooding. Major canopy species in these forests include *Acer negundo*, *Acer saccharinum*, *Platanus occidentalis*, *Salix nigra*, *Ulmus americana*, and *Ulmus rubra*. Small, scattered patches of bottomland forest still occur today, although most of these have been heavily disturbed (Bacone et al. 1980; Wilhelm 1990).

Beach communities are narrow specialized strips adjacent to the littoral zone of the lakeshore, and they are dominated by *Ammophila breviligulata* (Cowles 1899; Wilhelm 1990; Poulson 1999). Pannes are moist interdunal depressions in calcareous sands on the leeside of dune, containing such species as *Aster ptarmicoides* and *Carex* spp. (Hiebert et al. 1986; Wilcox & Simonin 1987; Wilhelm 1990).

Table 1.—Eleven natural plant communities listed by Bowles et al. (1990) in Indiana Dunes National Lakeshore. Wetland types are signified by *italics.*

Community	Characteristics
Beach/Foredune	Wave actions and sandy substrate Annuals and rhizomatous perennial plants
Dune complex	Cycle of sand erosion in steep topography & blow-outs
Sand savanna	Dominant presettlement plant community type on irregular dune topography Open dune conditions with frequent fires
Sand prairie	Flat topography with frequent burns
Upland forest	Protected from intense fires (e.g., dune hollow and ravine slopes) Occasional ground fires
Forested Fen	Calcareous peat soils Relict boreal community Structure affected by fire and water table
Graminoid fen	Calcareous peat soils Boreal and prairie affinities Open conditions with frequent fires and high water table
Forested bog	Acid peat soils Relict boreal community High species diversity in openings and pools
Flatwoods	Wet mineral soils or seepages with high species diversity
Graminoid wetlands	Complex of fen and marsh in interdunal areas High water tables and frequent fires

EXISTING WETLAND PLANT COMMUNITIES

Recent vegetation survey and classification.—Bowles et al. (1990) listed 10 natural communities within the boundary of Indiana Dunes National Lakeshore (INDU). Six of these communities are considered wetland communities (Table 1). These communities include beach, forested fens, graminoid fens, forested bogs, flatwoods, and graminoid wetlands. Wilhelm (1990) also described 11 community types along the gradients of moisture and arborescent development. Among these communities, swamp complex, bog, marsh complex bottomland, and beach are considered as wetland communities. Wilhelm's (1990) list of vascular plants in the Miller Woods area, along with the species list compiled by Peloquin & O'Brien (1990), provides invaluable information on the floristic compositions of wetlands adjacent to the Grand Calumet River.

Natural communities in Lake, LaPorte and Porter Counties, excluding those found at INDU, were surveyed by Kurz et al. (1978). In this inventory, a total of 258 potential natural areas (PNA) was identified. These PNAs were then placed into three categories. Natural areas are of statewide significance, whereas notable areas are those which do not meet the criteria established for natural areas but do have considerable importance for education, research, and recreation. The third category, eliminated areas, consists of areas that still retain some traces of natural characters but which have been so severely disturbed that it is highly unlikely that they will recover the functions or structure of undisturbed natural areas. Kurz et al. (1978) also listed a total of 49 natural community types, including 26 aquatic and wetland types, that they had observed in the northwestern Indiana (Table 2). In Lake County, a total of 38 wetlands were identified, and seven of them were found adjacent to the Grand Calumet River. These wetlands were located in the DuPont tract, in the Ivanhoe Nature Preserve and in the Clark and Pine Nature Preserve (Fig. 1). Of the seven wetlands, three were placed in the natural area category, one was in the notable category, and three were in the eliminated category. In addition, an environmental assessment report that was submitted by the TAMS Consultants, Inc. (Mierzwa et al. 1991) for the Illinois-In-

diana regional airport project, updated the lists of plant species for the DuPont tract, and for the Clark and Pine nature preserve.

Recent vegetation classification systems.—Concurrent use of different classification systems for the same natural areas (e.g., Kurz et al. 1978; Bowles 1990; Wilhelm 1990) often causes a great deal of confusion because (1) different terms are used to refer to the same community type, (2) similar terms are used for different communities, and/or (3) the borders between community categories are delineated differently. To reduce such confusion, a standardized classification system is proposed, based on the classification scheme of Indiana Department of Natural Resources (Table 3). In this table, for example, Wilhelm's (1990) "marsh complex" is separated into marsh, fen and sedge meadow. The "wet prairie" is a part of "marsh complex" in the Wilhelm's classification, but the proposed classification places it in the category of "prairie." In addition, "hydromesophytic forest" is a part of Wilhelm's "swamp complex," but it is placed the categories of "forest" and "shrub swamp" in the proposed classification system.

Special conservation needs.—Among the riparian wetlands of the Grand Calumet River, Roxanna marsh, DuPont tract, Clark & Pine East Nature Preserve (also known as Bongi Pond), and Grand Calumet Lagoons are especially in need of conservation because they are considered as high quality habitats for endangered, threatened and/or rare animals and plants. After a compilation of the existing plant species records (Wilhelm 1990; Mierzwa et al. 1991; IDNR unpubl.), 653 plant species (533 natives and 120 aliens) were found in DuPont tract, Clark & Pine East, and Miller Woods (Appendix). These species included 1 extirpated species (never found in its historical sites for last 50 years), 17 endangered species (inhabit between 1–5 extant sites), threatened species (inhabit between 6–10 sites), and 18 rare species (inhabit between 11–20 sites) (Aldrich et al. 1986; IDNR unpubl.).

Roxanna marsh is a severely degraded riparian wetland that is located where the Grand Calumet River intersects Route 41 in Hammond (Fig. 1). There has been no systematic survey for plant species or community types in this area. According to the author's visual

Table 2.—Forty-nine plant community types of Indiana coastal zone listed by Kurz et al. (1978). Wetland types are signified by *italics*.

Community type
Forest
Dry-mesic upland forest
Mesic upland forest
Wet-mesic upland forest
Dry dune forest
Dry-mesic dune forest
Mesic floodplain forest
Wet-mesic floodplain forest
Wet floodplain forest
Flatwoods
Prairie
Dry-mesic prairie
Mesic prairie
Wet-mesic prairie
Wet prairie
Dry sand prairie
Dry-mesic sand prairie
Mesic sand prairie
Wet-mesic sand prairie
Wet sand prairie
Glacial drift hill prairie
Gravel hill prairie
Sand hill (dune) prairie
Shrub prairie
Savanna
Dry-mesic savanna
Mesic savanna
Dry sand savanna
Dry-mesic sand savanna
Mesic sand savanna
Aquatic
Perennial stream
Lake
Pond
Marsh
Shrub swamp
Graminoid bog
Low shrub bog
Tall shrub bog
Forested bog
Calcareous floating mat
Graminoid fen
Low shrub fen
Tall shrub fen
Forested fen
Sedge meadow
Panne
Seep
Calcareous seep
Sand seep
Spring
Primary
Beach
Foredune/Blowout

Table 3.—Synthesized wetland plant community types under the classification scheme of the Indiana Department of Natural Resources. * = Wetland communities classified by Wilhelm (1990). ** = Wetland Communities classified by Bowles et al. (1990).

Communities by Kurz et al. (1978)	Communities by Bowles et al. (1990) and Wilhelm (1990)
Wet-mesic floodplain forest Wet floodplain forest	Bottomland forest* Hydromesophytic forest in the Swamp Complex*
Flatwoods	Flatwoods in the Swamp Complex* Flatwoods**
Wet-mesic prairie Wet prairie Wet-mesic sand prairie Wet sand prairie	Mesophytic prairie* Wet prairie of in the Marsh Complex* Graminoid wetlands**
Perennial stream Lake Pond	Aquatic*
Marsh	Marsh in the Marsh Complex* Graminoid wetlands**
Shrub swamp	Hydromesophytic forest and conifer swamp in the Swamp Complex*
Graminoid bog Low shrub bog Tall shrub bog Forested bog Calcareous floating mat	Bog* Forested bog** Graminoid wetlands**
Graminoid fen Low shrub fen Tall shrub fen Forested fen	Fen in the Marsh Complex* Forested fen** Graminoid fen**
Sedge meadow	Sedge meadow in the Marsh Complex* Graminoid wetlands**
Panne	Panne*
Seep Calcareous seep Sand seep Spring	Flatwoods**

inspection, the entire area was infested by undesirable species (alien, invasive, or both) such as *Lythrum salicaria*, *Phragmites communis*, *Typha angustifolia*, and *T. latifolia*. Several woody species (e.g., *Acer negundo*, *Populus deltoides*, and *Salix* spp.) have also invaded the wetland from adjacent riverbanks or woodlands. All of these species have very little or no value as elements of natural communities (Wilhelm 1990), and thus restoration of native vegetation is urgent in this area. Marsh, sedge meadow, and wet prairie are beneficial models for restoration because these were probably the most common wetland community types in the region's pre-settlement landscape. Their abundance has since been decreased significantly. The introduction of several species has been suggested for restoring marsh, sedge meadow, and wet prairie (Table 4; Wilhelm 1990).

After restoration of any of the above wetlands, periodic fires would be necessary to discourage the invasion of shrubs and trees (Henderson & Long 1984). Wet flood plain forest is very commonly found in the riparian community in the flood plains of streams and riv-

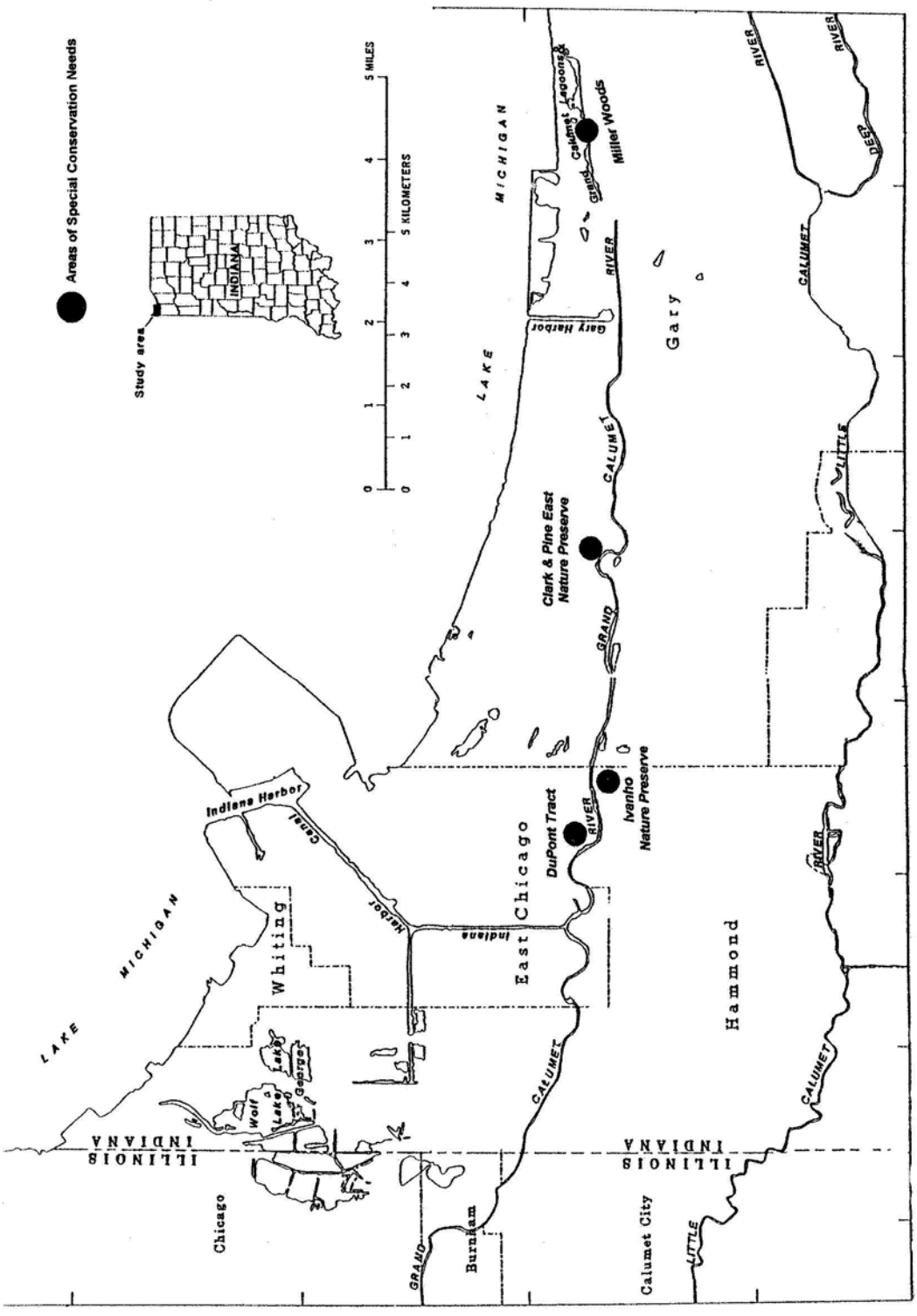

Figure 1.—Natural areas with special conservation needs along the Grand Calumet River in northwest Indiana. The dark circles indicate "Areas of Special Conservation Needs."

ers, so it may serve as a model of restoration for Roxanna Marsh. According to Wilhelm (1990), the following plants are typical of wet flood plain forest: *Acer saccharinum* (silver maple), *Cardamine bulbosa* (smooth spring cress), *Carex amphibola turgida* (gray sedge), *Carya laciniosa* (big shellbark hickory), *Chaerophyllum procumbens* (wild chevil), *Floerkea proserpinacoides* (false mermaid), *Fraxinus pennsylvanica* (green ash), *Populus deltoides* (cottonwood), *Salix nigra* (black willow), and *Viola striata* (striped white violet). Among the suggested species for wet floodplain forest restoration are highly invasive shrubs (e.g., *Populus deltoides* and *Salix nigra*) that produce quantities of seeds or that exhibit rapid vegetative growth. Periodic fires may be necessary to prevent over-growth of these species.

DuPont tract, owned by DuPont Chemical Company, is located to the east of Cline Avenue in Hammond, Indiana (Fig. 1). Despite extensive industrial development during the 1950s and the 1970s, significant portions of classical "dune and swale systems" are preserved in this property. TAMS Consultants (Mierzwa et al. 1991) and IDNR (unpubl.) documented 240 vascular plant species (203 natives and 37 aliens) including 1 endangered, 2 threatened, and 4 rare species (Tables 5, 6, 7 and Appendix). Clark & Pine East Nature Preserve is located in the southeastern corner of the East Chicago-Gary Regional Airport property (Fig. 1). Like the DuPont tract, this area is a classical example of a dune and swale system. TAMS Consultants (Mierzwa et al. 1991) and IDNR records for the area (unpubl.) list 271 species (245 natives and 26 aliens) including 7 endangered, 4 threatened, and 7 rare species (Tables 5, 6, 7 and Appendix). Aggressive expansions of invasive species, both alien and native, pose serious threats to populations of native species in the Clark & Pine East Nature Preserve. The riverbanks in these natural areas are heavily infested with *Phragmites communis berlandieri*, *Lythrum salicaria*, and *Typha angustifolia*. Spread of these species is generally facilitated by their effective pollination systems, seed dispersal (mostly by wind), breeding systems (e.g., facultative apomixis) and, in many circumstances, rapid vegetative growth by "root-suckering" or "stem sprouts" (Baker 1986). These characteristics make this group of species very likely to continue expand aggressively in the wetlands of this tract, thereby out-competing native species. Forty alien species have already been found in the natural areas of DuPont and Clark and Pine East tracts. Most wetlands of the Grand Calumet Lagoons are located within the Miller Woods area, which is a part of INDU (Fig. 1). This is home to what probably is the best-preserved and most diverse flora in northwestern Indiana. *Potamogeton pulcher* (spotted pondweed), presumed to be an extirpated species, was found by Wilhelm (1990). Whilhelm (1990) also documented 555 species (453 natives and 102 aliens) including 12 endangered, 12 threatened, and 12 rare species (Tables 5, 6, 7 and Appendix).

POTENTIAL IMPACTS OF SEDIMENT REMOVAL

The U.S. Army Corps of Engineers (1997), after a comparison of 18 different methods for sediment treatment, recommended "mechanical dredging" with a closed bucket (often called a "clam-shell bucket"). Three potential impacts of the dredging operation on the Grand Calumet River riparian wetlands are possible. First, mechanical dredging may cause direct physical damages (e.g., trampling) to the riparian wetlands. Preparation of staging areas and an access road would inevitably remove some riparian vegetation. Physical damages could be critically disruptive if done in sensitive wetland habitats such as the DuPont tract, Clark & Pine East, and Miller Woods. Second, the removal of sediments would certainly deepen the riverbed, steepen the shores and eventually facilitate soil erosion on the stream-banks, and this would lower water quality. Third, local wetland hydrology could be modified by a deepening the river; i.e., deepening of the river bed may facilitate drainage from the adjacent wetlands, and this "probable" drainage may cause drastic changes in plant species composition (e.g., from *Carex* spp. to *Typha* spp.) as evidenced in the nearby Cowles Bog in the Indiana Dunes National Lakeshore (Wilcox & Simonin 1987). To minimize these impacts, I suggest the following considerations for the proposed sediment removal project in the Grand Calumet River and Indiana Harbor Ship Canal:

1. Any sediment removal project should aim to restore full ecosystem function and

Table 4.—Suggested species matrices for restoration of marsh, sedge meadow, and wet prairie along the Grand Calumet River (Wilhelm 1990).

Marsh
Aster puniceus firmus (marsh aster)
Carex comosa (bristle sedge)
C. haydenii (long-scaled meadow sedge)
C. lacustris
C. lanuginosa (woolly sedge)
C. lasiocarpa americana (narrow-leaved woolly sedge)
C. starwellii
C. stricta (meadow sedge)
C. tribuloides
Decodon verticillatus (swamp loosestrife)
Lysimachia thyrsiflora (tufted loosestrife)
Polygonum hydropiperoides (mild water pepper)
Potentilla palustris (marsh cinqefoil)
Proserpinaca palustris crebra (mermaid weed)
Rumex orbiculatus (great water dock)
Scirpus acutus (hard-stemmed bulrush)
S. validus creber (great bulrush)
Scutellaria epilobiifolia (marsh skullcap)
Sium suave (water parsnip)
Sedge meadow
Aster junciformis (rush aster)
Bidens comosa (swamp tickseed)
Dryopteris thelyteris pubescens (marsh shield fern)
Eupatorium perfoliatum (common boneset)
Hypericum virginicum fraseri (marsh St. John's wort)
Lycopus uniflorus (northern bugle weed)
Mentha arvensis villosa (wild mint)
Polygonum punctatum (smartweed)
P. sagittatum (arrow-leaved tear-thumb)
Wet prairie
Aletris farinosa (colic root)
Cladium marsicoides (twig rush)
Eleocharis melanocarpa (black-fruited spike rush)
Gentiana crinita (fringed gentian)
Juncus canadensis (Canadian rush)
Ludwigia alternifolia (seedbox)
Oxypolis rigidior (cowbane)
Rubus hispidus obovalis (swamp dewberry)
Sisyrinchium atlanticum (eastern blue-eyed grass)
Spiranthes cernua (nodding lady's tresses)

structure of the Grand Calumet River and its adjacent wetlands. The project should not be limited to the simple activity of "getting the dirt out." The river cannot attain full ecological functioning without having its riparian wetlands restored. Only removing the sediment will certainly waste resources. For this reason, it is critical that the proposed sediment dredging be accompanied by the restoration of riparian wetlands.

2. Physical damages to the wetland communities must be avoided, or at least minimized, during the sediment removal operation. Toward this end, the staging areas must be located as far as possible from the sensitive habitats, such as DuPont tract, Clark and Pine East Nature Preserve, and Miller Woods. The Roxanna Marsh area is an ideal candidate for a staging area, provided that the operation is not done during the breeding seasons for fish and wildlife. The area is considered to be severely degraded land. Such undesirable plants as *Typha* spp. and *Phragmites* spp. would be removed during the preparation of staging area. After sediment-removal operations, this area could be restored as wildlife habitat by establishing native plant communities such as sedge meadow or wet prairie.

3. Disposal sites for removed sediment should be located a safe distance from sensitive wetland habitats. Ecological feasibility of disposal at any proposed disposal site should be evaluated. Restoration of wetland ecosystems in the riparian lands (the areas immediately adjacent to the river) are crucial for establishing full ecological functions of the Grand Calumet River. Therefore, it is recommended that all riparian lands along the Grand Calumet River be excluded from the sediment disposal.

4. Stream-bank erosion should be prevented by the construction of appropriate anti-erosion structures. For example, BioLogs™ (long rolls of coconut fiber encased in coconut netting) may serve as submersible substrate to anchor native aquatic plants and create calm "eddies" that protect and enhance wildlife. These structures are commercially available, and they have been used successfully (e.g., marsh restoration in Hackensack Meadowlands, New Jersey; Driver 1993).

5. After removing the sediments, it is recommended that the riverbeds be lined with sand to make a gentle slope from the shores to the center. This approach has been used for stream bank stabilization (Abt et al. 1995). The gentle slopes not only prevent drastic bank erosion, but they also provide an important feeding habitat for wildlife because birds (especially wading birds and possibly other

Table 5.—Endangered plant species, as listed by Indiana Department of Natural Resources, in the wetlands of DuPont Tract, Clark & Pine Nature Preserve (C&P), and Miller Woods.

Species		Location		
Scientific name	Common name	DuPont	C&P	Miller
Agalinis purpurea	Purple foxglove		X	
Carex brunnescens sphaerostachya	Brown sedge		X	
Carex bushii	Long-scaled sedge		X	
Carex richardsonii	Prairie hummock sedge		X	
Eleocharis geniculata	Knee spike bush		X	X
Equisetum variegatum	Small scouring rush			X
Glyceria borealis	Northern manna grass			X
Juncus scripoides	Round-headed rush			X
Ludwigia sphaerocarpa deamii	Round-fruited loosestrife			X
Lycopus americana	Common water horehound	X	X	X
Panicum columnianum	Hemlock panic grass			X
Panicum dichotomiflorum	Knee grass			X
Polygonum hydropiperoides	Mild water pepper			X
Potamogeton robbinsii	Fern pondweed			X
Satureja arkansana	Dogmint			X
Scleria pauciflora caroliana	Few-flowered nut rush		X	
Talinum rugospermum	Fame flower			X

animals, too) favor gentle dish-shaped basins over steep cup-shaped ones (Smith et al. 1994).

6. To investigate the impact of the proposed sediment removal on the local hydrology and plant communities of adjacent wetlands, an experimental pilot dredging project is recommended.

THREATS AND RESTORATION POTENTIALS FOR WETLAND FLORA

Shuey (1996) listed three major threats to biodiversity in the southern shore of Lake Michigan as follows: (1) habitat fragmentation and natural land conversion, (2) infestation of exotic species and (3) anthropogenic disruption of ecosystem processes. Industrial and ur-

Table 6.—Threatened plant species, as listed by Indiana Department of Natural Resources, in the wetlands of DuPont Tract, Clark & Pine Nature Preserve (C&P), and Miller Woods.

Species		Location		
Scientific name	Common name	DuPont	C&P	Miller
Arenaria stricta	Stiff sandwort			X
Aristata intermedia	False arrow feather		X	X
Aster ptarmicoides	Stiff aster		X	X
Cakile edentula	Sea rocket			X
Carex aurea	Golden sedge	X	X	X
Carex bebbi	Bebb's oval sedge	X		
Carex garberi	False golden sedge			X
Cirsium picheri	Dune thistle			X
Eriophorum angustifolium	Narrow-leaved cotton grass		X	
Juncus pelocarpus	Brown-fruited rush			X
Lathyrus orchtoleucus	Pale vetchling			X
Myriophyllum verticullatum pentinatum	Whorled water milfoil			X
Polygonella articulata	Jointweed			X
Utricularia cornuta	Horned bladderwort			X

Table 7.—Rare plant species, as listed by Indiana Department of Natural Resources, in the wetlands of DuPont Tract, Clark & Pine Nature Preserve (C&P), and Miller Woods.

Species		Location		
Scientific name	Common name	DuPont	C&P	Miller
Aralia nudicularis	Wild sarsaparilla		X	X
Arctostaphylos uva-ursi coatilis	Arctic bearberry		X	X
Aster borealis	Rush aster			X
Baptisia leucantha	White wild indigo	X		X
Betula papyrifera	Paper birch	X	X	
Catalpa speciosa	Northern catalpa	X		
Cypripedium caleolus parviflorum	Small yellow lady's slipper		X	
Diervilla lonicera	Dwarf honeysuckle			X
Drosera intermedia	Narrow-leaved sundew			X
Hypericum kalmianum	Kalm's St. John's wort	X	X	
Liparis loeselii	Green twayblade		X	X
Pinus banksiana	Jack pine			X
Pogonia ophioglossoides	Snake-mouth orchid			X
Potamogeton pusillus	Small pondweed			X
Rhynchospora macrostachya	Horned beak rush			X
Solidago ptarmicoides	Prairie golden rod			X
Tofieldia glutinosa	False asphodel		X	

ban development not only eliminated most natural habitats but also fragmented remaining patches of natural lands. Habitat fragmentation has several negative effects. Decline of species richness in isolated small habitats is a classic example of island biogeography that is supported by numerous filed evidences (e.g., Schonewald-Cox 1983; Newmark 1995). As distance between habitat patches increases, recolonization following local population crash becomes less likely, which can ultimately lead to the regional collapse and extirpation of highly-sensitive species such as Karner blue butterfly (*Lycaeides melissa samuelis*), an endangered species as listed by U.S. Endangered Species Act, on the southern shore of Lake Michigan (Shuey 1996; Knutson et al. 1999). Fragmentation may also disrupt the life cycles of species with complex habitat requirements, such as species that may require wetlands for reproduction but uplands for foraging. Edge effects from fragmentation are also problematic. Severe fragmentation increases vulnerability to invasion of exotic species into core natural areas (Shuey 1996) and unnatural predation from disturbance-adapted predators, such as raccoons (*Procyon lotor*), skunks (*Spilogale* spp.), and blue jays (*Cyanocitta cristata*) (Yahner 1988; Shuey 1996).

Exotic species overrun native habitats, often eliminating entire flora on the southern shore of Lake Michigan. Severe land disturbance by physical forces (Bowles et al. 1990; Shuey 1996), nutrient enrichment (Inouye & Tilman 1995), and altered hydrology (Wilcox et al. 1986) generally favor exotic species over native plants. The wetlands on the southern shore of Lake Michigan, as well as entire Midwestern U.S., are overrun by *Phragmites communis* (giant reeds), *Typha angustifolia* (narrow-leaf cattail), *Lythrum salicaria* (purple loosestrife), and an exotic genotype of *Phalaris arundinacea* (reed canary grass), whereas the upland fields and oak-savannas are overrun by *Robinia pseudoacacia* (black locust), *Rosa multiflora* (multiflora rose), *Ulmus pumila* (Siberian elm), *Lonicera japonica* (Japanese honeysuckle), *Rhamnus* spp. (buckthorns), *Melilotus* spp. (sweet clovers), *Coronilla varia* (crown vetch), *Allaria officinalis* (garlic mustard), and other exotic plants (Bowles et al. 1990; Wilhelm 1990; Shuey 1996; Choi & Pavlovic 1998; Peloquin & Hiebert 1999).

Closely related to the impact of habitat loss is the elimination or alteration of ecosystem processes. The ecological communities of the southern shore of Lake Michigan were among the most dynamic in the midwestern U.S., created and maintained by wildfires, hydrological fluctuations, and onshore transport of sands and sediments. Wildfires originally played a

critical role in maintaining open habitats in the area. Habitats such as oak-savanna, tall-grass prairie, and sedge meadow have been maintained by periodic wildfires that discouraged the invasions by woody plants such as *Robinia pseudoacacia*, *Sassafras albidum* (sassafras), *Populus deltoides* (cottonwoods), *Cornus* spp. (dogwoods), and *Salix* spp. (willows) and the over-growth and over-reproduction of oaks (*Quercus* spp.) (Taylor 1990; Wilhelm 1990; Choi & Pavlovic 1998). Unfortunately, modern culture has traditionally abhorred wildfires because of the perceived destructive nature of fire, and this mentality led to artificial suppression of wildfires for more than a century. Without the influence of fire, open habitats such as oak-savannas have succeeded to oak forests with full closure of their canopies now interrupting penetration of sunlight to ground layer. This transformation of community types has caused significant decline of *Lupinus perennis* (wild lupine) which favors openings in oak-savannas, and the decline of *L. perennis* lead to the endangerment of the endemic Karner blue butterfly whose larvae forage exclusively on the leaves of lupines (Grundel et al. 1998).

Historically, fluctuations of the local water table played a critical role in maintaining lakeplain and marsh communities. The swales collect water from well-drained soils of ridges as well as from underground. Therefore, water levels in the swales are dependents of aboveground runoff, seepage from sandy ridges, underground water table depths, short term fluctuations of Lake Michigan water level and the long term retreat of the lake (Thompson 1992; Chrzastowski et al. 1994; Brown 1997; Labus et al. 1999). Periodic episodes of elevated water tables re-set succession and maintain the highly productive herb-dominated systems. Many rare species, such as *Utriculata* spp. (bladderworts), and *Cypripedium* spp. (lady's slippers), in the lakeplain ponds are annuals. These annuals are dormant until a favorable moisture condition stimulates germination. When this happens, they quickly reach maturity and set seed before drought or inundation ensues. Alteration of ground water regime has disrupted these delicate cycles (Keddy 1990). On the other hand, *Carex* spp., *Scirpus* spp., and *Juncus* spp. (sedges and rushes) were dominant perennials in the lakeplain wetlands because they could tolerate seasonal droughts better than other perennials such as cattails. However, extensive runoff from impervious land surfaces (e.g., highways, parking lots, and residential discharge) inundated the soil all year long causing massive invasions of *Typha*, followed by *Phragmites*, *Lythrum*, and *Phalaris* (Wilcox et al. 1986; Choi 2001).

The onshore deposition of sandy sediments has been responsible for the formation of dunes and beaches in the southern shore of Lake Michigan. Sand grains from eroding banks and tributary mouths are carried by onshore currents and winds and accrete to form dunes, beaches, sandbars, and spits that shelter the pannes (wetlands with highly alkaline water) in intradunal depressions (Thomson 1992; Chrzastowski et al. 1994). Today, lakefront development (e.g., marinas, piers, and concrete walkways) in Chicago in Illinois, and Hammond and Gary in Indiana interrupts much of the sediment movements and depositions along the shoreline. These interruptions arrest the formation of new beaches, dunes, swales, and pannes (Shuey 1996; Labus et al. 1999).

Choi (2001) identified 34,771 ha of wetlands (from the National Wetland Inventory (NWI) - a Geographic Information System (GIS) database) along the Grand Calumet River. Of these wetlands, only 197 ha (0.6%) were high quality and 657 ha (1.9%) are restorable to natural conditions. Much of the others (33,917 ha, 97.5%) are also restorable to certain conditions; however, limited technology, high financial cost, and social and political ramifications (i.e., conflicts between economic growth and environmental conservation) only solidify the unlikelihood of restoration in this highly industrialized region (PAHLS 1993).

Appendix.—Check list of plant species in DuPont tract (DT), Clark and Pine East Nature Preserve (CP), and Miller Woods (MW). Three classes of protection (status) by State of Indiana, extirpated (Ex), endangered (E), threatened (T), rare (R), and watch list (W) are indicated. Alien species (A) are also indicated. Data compiled from Wilhelm (1990), Mierzwa et al. (1991), and unpublished data from the Indiana Department of Natural Resources.

Scientific name	Common name	DT	CP	MW	Status
Abutilon theophrasti	Velvetleaf			X	A
Acer negundo	Boxelder	X		X	
Acer platanoides	Norway maple			X	A
Acer rubrum	Red maple		X	X	
Acer saccharinum	Silver maple	X	X	X	
Achillia millefolium	Yarrow	X		X	A
Agalinis purpurea	Purple false foxglove	X	X	X	
Agalinis skinneriana	Pale false foxglove		X		E
Agalinis tenuifolia	Slender false foxglove			X	
Agropyron repens	Quack grass			X	A
Agropyron smithii	Western wheat grass			X	A
Agropyron trachycaulum unilaterale	Bearded wheat grass		X	X	
Agrostis alba	Redtop	X	X	X	A
Agrostis hymalis	Tickle grass			X	
Ailanthus altissima	Tree of heaven	X			A
Alestris farinosa	Colic root			X	
Alisma subcordatum	Common water plantain		X	X	
Alisma trivale	Large-flowered water plantain	X		X	
Allaria officinalis	Garlic mustard			X	A
Allium cernuum	Nodding wild onion			X	
Althaea rosea	Hollyhock	X			A
Ambrosia artemisiifolia elatior	Common ragweed	X		X	
Ambrosia psilostachya coronopifolia	Western ragweed			X	A
Ambrosia trifida	Giant ragweed	X	X	X	
Amelanchier arborea	Serviceberry		X		
Amelanchier interior	Inland shadbush			X	
Amelanchier laevis	Allegheny shadbush			X	
Ammophila breviligulata	Merram grass			X	W
Amorpha canescens	Lead plant	X			
Amphicarpa bracteata	Upland hog peanut			X	
Andropogon gerardii	Big bluestem grass	X	X	X	
Anemone canadensis	Meadow anemone			X	
Anemone cylindrica	Thimbleweed	X	X	X	
Antennaria neglecta	Cat's foot		X		
Antennaria plantaginifolia	Pussy toes		X	X	
Anthriscus caucalis	Bur chervil			X	
Apios americana	Ground nut	X		X	
Apocynum androsemifolium	Spreading dogbane			X	
Apocynum cannabinum	Indian hemp	X	X	X	
Apocynum sibiricum	Prairie Indian hemp	X	X	X	
Aquilegia canadensis	Wild columbine	X	X		
Arabis lyrata	Sand cress	X	X	X	
Aralia nudicaulis	Wild sarsaparilla		X	X	R
Arctostaphylos uva-ursi coatilis	Arctic bearberry	X	X	X	R
Arenaria lateriflora	Wood sandwort	X			
Arenaria serpyllifolia	Thyme-leaved sandwort			X	A
Arenaria stricta	Stiff sandwort			X	T
Aristata intermedia	False arrow feather		X	X	T
Aristata oligantha	Plains three-awn grass			X	A
Aristata purpurascens	Arrow feather			X	A
Aronia melanocarpa	Black chokeberry			X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Aronia prunifolia	Chokeberry		X	X	
Artemisia caudata	Beach wormwood	X	X	X	
Artemesia vulgaris	Mugwort			X	A
Asclepias amplexicaulis	Sand milkweed			X	
Ascelpias incarnata	Swamp milkweed	X	X	X	
Ascelpias syriaca	Common milkweed	X	X	X	
Asclepias tuberosa	Butterfly weed	X	X	X	
Asclepias verticillata	Whorled milkweed	X	X	X	
Asclepias viridiflora	Short green milkweed			X	
Asparagus officinalis	Asparagus	X	X	X	A
Aster azureus	Sky-blue aster	X	X	X	
Aster borealis	Rush aster			X	R
Aster dumosus	Rice-button aster	X	X		
Aster ericoides	Heath aster	X		X	
Aster laevis	Smooth blue aster			X	
Aster lateriflorus	Side-flowering aster		X	X	
Aster liniariifolius	Flax-leaved aster			X	
Aster novae-angliae	New England aster		X	X	
Aster pilosus	Hairy aster			X	
Aster ptarmicoides	Stiff aster		X	X	T
Aster puniceus firmus	Shining aster			X	
Aster sagittifolius	Arrow-leaved aster			X	
Aster sagittifolius drummondii	Drummond's aster			X	
Aster simplex	Panicled aster	X	X	X	
Aster umbellatus	Flat-top aster		X	X	
Aureolaria pedicularia ambigens	Clammy false foxglove			X	
Baptisia leucantha	White wild indigo	X		X	R
Babarea vulgaris	Yellow rocket			X	A
Betula papyrifera	Paper birch	X	X		R
Bidens cernua	Nodding bur marigold			X	
Bidens comosa	Swamp tickseed			X	
Bidens coronata	Tall swamp marigold		X	X	
Boehmeria cyclindrica	False nettle	X		X	
Boltonia latisquama recognita	False aster			X	
Bromus inermis	Hungarian brome			X	A
Bromus japonicus	Japanese chess			X	A
Bromus kalmii	Prairie brome		X	X	
Bromus tectorum	Downy brome	X		X	A
Bulbostylis capillaris	Hair sedge			X	
Cacalia plantaginea	Prairie Indian plantain			X	
Cakile edentula	Sea rocket			X	T
Calamagrostis canadensis	Blue joint grass	X	X	X	
Calamovilfa longifolia	Sand reed	X	X	X	
Camassia scilloides	Wild hyacinth			X	
Campanula aparinoides	Marsh bellflower	X	X	X	
Campanula rotundifolia	Harebell		X		
Campanula uliginosa	Marsh bellflower	X			
Cannabis sativa	Hemp		X		A
Capsella bursa-pastoris	Shepherd's purse			X	A
Carduus nutans	Musk thistle	X			A
Carex alata	Winged oval sedge			X	R
Carex aurea	Golden sedge	X	X	X	T
Carex bebbii	Beb's oval sedge	X			T
Carex brevior	Plains oval sedge	X	X		
Carex buxbaumii	Dark-scaled sedge	X	X		

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Carex brunnescens sphaerostachya	Brown sedge		X		E
Carex bushii	Long-scaled green sedge		X		E
Carex comosa	Bristly sedge			X	
Carex crawei	Early fen sedge		X		T
Carex emoryi	Riverbank sedge			X	
Carex garberi	False golden sedge		X	X	T
Carex granularis	Pale sedge			X	
Carex haydenii	Long-scaled tussock sedge			X	
Carex hystrixina	Porcupine sedge		X		
Carex interia	Prairie star sedge			X	
Carex lanuginosa	Woolly sedge	X	X	X	
Carex muhlenbergii	Sand bracted sedge	X		X	
Carex pensylvanica	Common oak sedge	X		X	
Carex richardsonii	Prairie hummock sedge		X		E
Carex starwellii	Running marsh sedge	X		X	
Carex siccata	Running savanna sedge			X	
Carex stricta	Common tussock sedge	X	X	X	
Carex suberecta	Wedge-fruited oval sedge	X	X		
Carex tenera	Narrow-leaved oval sedge		X		
Carex tetanica	Common stiff sedge	X			
Carex tonsa	Smooth-fruited sedge			X	
Carex tribuloides	Awl-fruited oval sedge			X	
Carex umbellata	Early oak sedge	X	X	X	
Carex viridula	Green yellow sedge		X	X	
Carex vulpinoidea	Brown fox sedge		X		
Cassia fasciculata	Patridge pea			X	W
Cassia nictitans	Wild sensitive plant			X	
Castilleja coccinea	Indian paintbrush	X	X	X	
Catalpa speciosa	Northern catalpa	X			R
Ceanothus americanus	New Jesey tea	X		X	
Celastrus scandens	Climbing bittersweet	X	X		
Cenchrus longispinus	Sandbur	X		X	
Centaurium pulchellum	Showy centaury	X	X		A
Cephalanthus occidentalis	Buttonbush	X	X	X	
Chelone glabra	Turtlehead	X			A
Chenopoodium album	Lamb's quarters			X	A
Chenopodium leptophyllum	Narrow-leaved goosefoot			X	
Chenopodium standleyanum	Woodland goosefoot			X	
Cicuta bulbifera	Bulblet-bearing water hemlock			X	
Cinna arundinacea	Common wood reed	X	X		
Cirsium arvense	Field thistle		X	X	A
Cirsium discolor	Pasture thistle	X	X	X	
Circium muticum	Swamp thistle	X	X	X	
Cirsium pitcheri	Dune thistle			X	T
Cirsium vulgare	Bull thistle	X	X	X	A
Cladium maricoides	Twig rush	X	X	X	
Commandra umbellata	False toadflax	X		X	
Commelina communis	Common day flower	X			A
Commelina erecta deamiana	Narrow-leaved day flower			X	
Conium maculatum	Poison hemlock	X			A
Convolvulus arevensis	Field bindweed	X			A
Convolvulus sepium	Hedge bindweed	X		X	
Coreopsis lanceolata	Sand coreopsis	X	X	X	
Coreopsis palmata	Prairie coreopsis		X	X	
Coreopsis tripteris	Tall coreopsis	X	X	X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Corispermum hyssopifolium	Bugseed			X	
Cornus obliqua	Pale dogwood	X	X	X	
Cornus racemosa	Gray dogwood	X	X		
Cornus rugosa	Round-leaved dogwood		X		T
Cornus stolonifera	Red-osier dogwood	X	X	X	
Cornus stolonifera baileyi	Dunes dogwood			X	
Crepis capillaris	Hawk's bear			X	A
Cuscuta coryli	Hazel dodder			X	
Cuscuta gornovii	Common dodder			X	
Cycloloma atriplicifolium	Winged pigweed		X	X	
Cyperus erythrorhizos	Red-footed nut sedge			X	
Cyperus esculentus	Field nut sedge		X		
Cyperus ferruginescens	Rusty nut sedge	X	X	X	
Cyperus filiculmis	Slender sand cyperus		X		
Cyprerus rivularis	Brook nut sedge	X	X	X	
Cyperus schweinitzii	Rough sand cyperus	X		X	
Cyperus strigosus	Long-scaled nut sedge	X		X	
Cypripedium acaule	Stemless lady's slipper				W
Cypripedium calceolus parviflorum	Small yellow lady's slipper		X		R
Cypripedium calceolus pubescens	Large yellow lady's slipper		X		W
Daucus carota	Wild carrot	X	X	X	A
Descurainia sophia	Flixweed		X	X	A
Desmodium canadense	Showy tick trefoil	X	X	X	
Desmodium paniculatum	Panicled tick trefoil	X	X	X	
Desmodium sessilifolium	Sessile-leaved trefoil	X			
Dianthus armeria	Deptford pink			X	A
Diervilla lonicera	Dwarf honeysuckle			X	R
Digitaria ischaemum	Smooth crab grass			X	A
Digitaria sanguinalis	Ciliate crab grass			X	A
Diplotaxis muralis	Wall rocket		X	X	A
Diplotaxis tenuifolia	Sand rocket		X		A
Drosera intermedia	Narrow-leaved sundew			X	R
Dryopteris spinulosa	Spinulose shield fern			X	
Dryopteris thelypteris	Marsh shield fern	X	X	X	
Dulichium arundinaceum	Three-way sedge			X	
Echinochloa crusgalli pubescens	Barnyard grass		X	X	
Echinocystis lobata	Wild cucumber		X		
Echium vulgare	Viper's bugloss	X			A
Eleocharis acicularis	Needle spike rush			X	
Eleocharis compressa	Flat-stemmed spike rush			X	
Eleocharis elliptica	Golden-seeded spike rush	X	X	X	
Eleocharis engelmannii	Engleman's spike rush		X		
Eleocharis erythropoda	Red-footed spike rush	X	X	X	
Eleocharis geniculata	Knee spike rush		X	X	E
Eleocharis intermedia fernaldii	Matted spike rush			X	
Eleocharis smallii	Marsh spike rush			X	
Elodea canadensis	Common waterweed			X	
Elodea nuttallii	Slender waterweed			X	
Elymus canadensis	Canada rye	X	X	X	
Epilobium ciliatum	Northern willow herb			X	
Equisetum arvense	Horsetail	X	X	X	
Equisetum hymale	Tall scouring rush	X	X	X	
Equisetum variegatum	Small scouring rush			X	E
Eqiusetum × ferrissii				X	
Equisetum × laevigatum	Smooth scouring rush	X		X	
Equisetum × trachyodon			X		

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Eragrostis cilianensis	Stink grass			X	A
Eragrostis hypnoides	Creeping love grass				A
Eragrostis pectinacea	Small love grass	X		X	
Eragrostis poaeoides	Low love grass		X	X	A
Eragrostis spectabilis	Purple love grass	X		X	
Eragrostis trichodes	Tall love grass			X	A
Erechitites hieracifolia	Fireweed				
Erigeron annuus	Annual fleabane			X	
Erigeron canadensis	Horseweed	X	X	X	
Erigeron philadelphicus	Marsh fleabane			X	
Erigeron pulchellus	Robin's plaintain		X	X	
Erigeron strigosus	Daisy fleabane	X	X		
Eriophorum angustifolium	Narrow-leaved cotton grass		X	X	T
Eryngium yuccifolium	Rattlesnake master		X		
Eupatorium altissimum	Tall boneset	X	X	X	
Eupatorium maculatum	Spotted joe pye weed	X	X	X	
Eupatorium perfoliatum	Common boneset	X	X	X	
Eupatorium rugosum	White snakeroot		X		
Eupatorium serotinum	Late boneset	X	X	X	
Euphorbia corollata	Flowering spurge	X	X	X	
Euphobia dentata	Toothed spurge			X	A
Euphorbia maculata	Nodding spurge			X	A
Euphobia polygonifolia	Seaside spurge			X	
Euphobia supina	Spotted creeping spurge			X	A
Festuca elatior	Tall fescue		X		A
Fragaria virginiana	Wild strawberry	X	X	X	
Fraxinus americana	White ash			X	
Fraxinus pennsylvanica subintegerrima	Green ash		X		
Galium aparine	Annual bedstraw			X	
Galium concinnum	Shining bedstraw			X	
Galium obtusum	Wild madder	X	X		
Galium pilosum	Hairy bedstraw				
Galium tinctorium	Stiff bedstraw			X	
Gaylussacia baccata	Box huckleberry			X	
Gentiana andrewsii	Closed gentain			X	
Gentiana crinita	Fringed gentain		X	X	
Gentiana procera	Small fringed gentain		X	X	
Geranium carolinianum	Carolina cranesbill			X	
Geranium maculatum	Wild geranium			X	
Geum laciniatum trichocarpum	Rough avens		X		
Glechoma hederacea	Ground ivy			X	A
Gleditsia triacanthos	Honey locust	X		X	A
Glyceria borealis	Northern manna grass			X	E
Glyceria septentrionalis	Floating manna grass			X	
Glyceria striata	Fowl meadow grass	X	X	X	
Gnaphalium obtusifolium	Old-field balsam			X	
Habenaria ciliaris	Orange fringed orchid			X	
Habenaria clavellata	Club-spur orchid			X	
Habenaria flava herbiola	Tubercled orchid	X		X	
Habenaria hyperborea huronesis	Northern bog orchid			X	
Habenaria psycodes	Purple fringed orchid			X	
Hamamelis virginiana	Witch hazel			X	
Helianthemum canadense	Common rockrose			X	
Helianthus divaricatus	Woodland sunflower	X	X	X	
Helianthus grosseserratus	Sawtooth sunflower	X		X	
Helianthus occidentalis	Western sunflower	X		X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Helianthus petiolarus	Petioled sunflower			X	A
Helianthus rigidus	Prairie sunflower			X	
Heliopsis helianthoides	False sunflower		X		
Heteranthera dubia	Water star grass			X	
Hieracium caespitosum	Field hawkweed			X	A
Hieracium canadense fasciculatum	Canada hawkweed			X	
Hieracium gronovii	Hairy hawkweed			X	
Hieracium scabrum	Rough hawkweed			X	
Hordeum jubatum	Squirrel-tail grass			X	A
Hypericum canadense	Canadian St. John's wort			X	
Hypericum lamianum	Kalm's St. John's wort	X	X		
Hypericum majus	Sand St. John's wort			X	R
Hypericum virginicum fraseri	Marsh St. John's wort			X	
Hypoxis hirsuta	Yellow star grass	X			
Hystrix patula	Bottlebrush grass			X	
Ilex verticillata	Winterberry		X	X	
Impatiens capensis	Spotted touch-me-not	X	X	X	
Impatiens pallida	Pale touch-me-not	X	X	X	
Iris germanica	German iris			X	A
Iris pseudacorus	Tall yellow iris			X	A
Iris virginica shrevei	Blue flag	X	X	X	
Juncus balticus littoralis	Lake shore rush	X	X	X	W
Juncus brachycephalus	Short-headed rush		X	X	
Juncus canadensis	Canadian rush		X	X	
Juncus diffusissimus	Slimpod rush			X	
Juncus dudleyi	Dudley's rush	X	X	X	
Juncus effusus solutus	Common rush			X	
Juncus greenei	Greene's rush			X	
Juncus interia	Inland rush		X		
Juncus marginatus	Grass-leaved rush			X	
Juncus nodosus	Joint rush	X	X	X	
Juncus pelocarpus	Brown-fruited rush			X	T
Juncus scripoides	Round-headed rush			X	E
Juncus tenuis	Path rush	X	X	X	
Juncus torreyi	Torrey's rush	X	X	X	
Juniperus virginiana crebra	Eastern red cedar			X	
Koeleria cristata	June grass	X		X	
Krigia biflora	False dandelion	X		X	
Krigia virginica	Dwarf dandelion			X	
Kuhnia eupatroioides corymbulosa	False boneset			X	
Lactuca canadensis	Wild lettuce	X		X	
Lactuca serriola	Prickly lettuce	X			A
Lathyrus japonicus glaber	Beach pea			X	
Lathyrus orchroleucus	Pale vetchling			X	T
Lathyrus palustris myrtifolius	Marsh vetchling	X		X	
Lechea villosa	Hairy pinweed			X	
Leersia oryzoides	Rice cut grass		X	X	
Leersia virginica	White grass	X			
Lepidium virginicum	Common peppergrass			X	
Leptoloma cognatum	Fall witch grass			X	
Lespedeza capitata	Round-headed bush clover	X		X	
Lespedeza virginica	Slender bush clover			X	
Liatris aspera	Rough blazing star	X	X	X	
Liatris cyclindracea	Cylindrical blazing star	X	X	X	
Liatris spicata	Marsh blazing star	X	X	X	
Lilium philadelphicum andinum	Prairie lily	X	X	X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Linaria canadensis	Blue toadflax			X	
Linaria vulgaris	Butter-and-eggs			X	A
Linum medium texanum	Small yellow flax		X	X	
Liparis lilifolium	Purple twayblade	X		X	
Liparis loeselii	Green twayblade		X	X	R
Liriodendron tulipifera	Tulip tree		X		
Lithospermum canescens	Hoary puccoon	X	X	X	
Lithospermum croceum	Hairy puccoon	X	X	X	
Lobelia kalmii	Bog lobelia		X	X	
Lobelia siphilitica	Great blue lobelia	X		X	
Lobelia spicata	Pale spiked lobelia	X	X		
Lonicera dioica	Red honeysuckle		X	X	
Lonicera × muendenuensis	Common fly honeysuckle	X	X	X	A
Lonicera tatarica	Tartarian honeysuckle	X	X		A
Ludwigia alternifolia	Seedbox			X	
Ludwigia palustris ameriana	Marsh purslane			X	
Ludwigia polycarpa	False loosestrife			X	
Ludwigia sphaerocarpa deamii	Round-fruited loosestrife			X	E
Lupinus perennis occidentalis	Wild lupine	X		X	
Lychnis alba	White campion	X		X	A
Lycopus americanus	Common water horehound	X	X	X	E
Lycopus asper	Rough water horehound	X		X	A
Lycopus rubellus	Stalked water horehound			X	
Lycopus uniflorus	Northern bugle weed		X	X	
Lycopus virginicus	Bugle weed			X	
Lysimachia lanceolata	Lance-leaved loosestrife	X		X	
Lysimachia quadriflora	Four-leaved loosestrife	X	X		
Lysimachia terrestris	Swamp candles	X		X	
Lysmachia thysiflora	Tufted loosestrife			X	
Lythrum alatum	Winged loosestrife	X	X	X	
Lythrum salicaria	Purple loosestrife	X	X	X	A
Maianthemum canadense interius	Hairy Canada mayflower	X	X	X	
Malus ioensis	Iowa crabapple	X	X	X	
Medicago lupulina	Black medic	X		X	A
Melampyrum lineare latifolium	Cow wheat			X	
Melilotus alba	Sweet white clover	X	X	X	A
Melilotus officinalis	Sweet yellow clover			X	A
Mentha arvensis villosa	Wild mint			X	
Mimulus ringens	Monkey flower		X	X	
Mirabilis nyctaginea	Wild four o'clock			X	A
Mollugo verticillata	Carpet weed			X	A
Monarda fistulosa	Wild bergamot	X	X	X	
Monarda punctata villicaulis	Horse mint	X	X	X	
Monotropa uniflora	Indian pipe			X	
Morus alba	White mulberry		X	X	A
Muhlenbergia mexicana	Leafy stain grass			X	
Muhlenbergia racemosa	Upland wild timothy			X	A
Myosotis scorpioides	Common forget-me-not			X	A
Myriophyllum exalbescens	Spiked water milfoil			X	
Myriophyllum verticullatum pentinatum	Whorled water milfoil			X	T
Najas flexilis	Slender naiad			X	
Nepeta cataria	Catnip	X		X	A
Nuphar advena	Yellow pond lily			X	
Nymphaea tuberosa	White water lily		X	X	
Nyssa sylvatica	Sour gum			X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Oenothera biennis	Common evening primrose	X	X	X	
Oenothera rhombipetala	Western sand evening primrose		X	X	
Onoclea sensibilis	Sensitive fern	X		X	
Opuntia humifusa	Eastern prickly pear	X	X	X	
Orobanche uniflora	One-flowered broom rape			X	
Osmunda cinnamomea	Cinnamon fern			X	
Osmunda regalis spectabilis	Royal fern	X	X	X	
Oxalis europaea	Tall wood sorrel			X	
Oxypolis rigidior	Cowbane	X	X	X	
Panicum capillare	Old witch grass			X	
Panicum columnianum	Hemlock panic grass			X	E
Panicum depauperatum	Starved panic grass			X	
Panicum dichotomiflorum	Knee grass			X	E
Panicum flexile	Wiry panic grass		X	X	
Panicum implicatum	Old-field panic grass	X	X	X	
Panicum latiflorum	Broad-leaved panic grass			X	
Panicum lindheimeri	Smooth woolly panic grass			X	
Panicum oligosanthes scribnerianum	Scribner's panic grass		X	X	
Panicum perlongum	Long-stalked panic grass			X	
Panicum rigidulum	Munro grass			X	
Panicum villosissimum	White-haired panic grass		X	X	
Panicum villosissimum pseudopubescens	False white-haired panic grass			X	
Panicum virgatum	Switch grass	X	X	X	
Parnassia glauca	Grass of parnassus			X	
Parthenocissus inserta	Thicket creeper	X	X	X	
Parthenocissus quinquefolia	Virginia creeper	X	X	X	
Pedicularis canadensis	Wood betony	X	X	X	
Penthorum sedoides	Ditch stonecup			X	
Petalostemum purpureum	Purple prairie clover		X		
Phalaris arundinacea	Reed canary grass	X		X	A
Phleum pratense	Timothy			X	A
Phlox divaricata	Blue phlox		X		
Phlox glaberrima interior	Marsh phlox			X	
Phlox peniculata	Garden phlox			X	A
Phlox pilosa	Sand prairie phlox	X	X	X	
Phragmites australis	Common reed	X	X	X	A
Physalis heterophylla	Clammy ground cherry	X			
Physalis pubescens	Hairy ground cherry			X	A
Physalis subglabrata	Tall ground cherry			X	
Physalis virginiana	Lance-leaved ground cherry				
Physocarpus opulifolius	Ninebark		X	X	
Physostegia virginiana	False dragonhead	X	X		
Phytolacca americana	Pokeweed	X			
Pinus banksiana	Jack pine			X	R
Plantato major	Common plantain			X	A
Plantato rugelii	Red-stalked plantain	X		X	
Platanus occidentalis	Sycamore			X	
Poa annua	Annual blue grass			X	A
Poa compressa	Canada blue grass	X	X	X	A
Poa pratensis	Kentucky blue grass	X	X	X	A
Pogonia ophioglossoides	Snake-mouth orchid			X	R
Polanisia graveolens	Slammy weed			X	A
Polygala cruciata aquilonia	Cross milkwort			X	
Polygala polygama obtusata	Purple milkwort			X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Polygonatum canaliculatum	Smooth Solomon's seal	X	X	X	
Polygonella articulata	Jointweed			X	T
Polygonum amphibium stipulaceum	Water knotweed	X	X	X	
Polygonum aviculare	Common knotweed			X	A
Polygonum coccineum	Water heartease		X	X	
Polygonum convolvulus	Black bindweed			X	A
Polygonum hydropiperoides	Mild water pepper			X	E
Polygonum lapathifolium	Heartease			X	
Polygonum pensylvanicum	Pennsylvania knotweed			X	
Polygonum persicaria	Lady's thumb			X	A
Polygonum punctatum	Smartweed	X		X	
Polygonum scandens	Climbing false buckweat			X	
Polygonum tenue	Slender knotweed			X	
Pontederia cordata	Pickerel weed			X	
Populus deltoides	Eastern cottonwood	X	X	X	
Populus grandidentata	Large-toothed aspen		X		
Populus tremuloides	Quaking aspen	X	X	X	
Portulaca oleracea	Purslane		X		A
Potamogeton amplifolius	Large-leaved pondweed			X	
Potamogeton foliosus	Leafy pondweed			X	
Potamogeton gramineus	Grass-leaved pondweed			X	
Potamogeton illinoensis	Illinois pondweed			X	
Potamogeton natans	Common pondweed			X	
Potamogeton nodosus	Long-leaved pondweed			X	
Potamogeton pectinatus	Sago pondweed			X	
Potamogeton pulcher	Spotted pondweed			X	Ex
Potamogeton pusillus	Small pondweed			X	R
Potamogeton robbinsii	Fern pondweed			X	E
Potentilla fruticosa	Shrubby cinquefoil		X	X	
Potentilla palustris	Marsh cinquefoil		X	X	
Potentilla recta	Sulfur cinquefoil			X	A
Potentilla simplex	Common cinquefoil			X	
Prenanthes alba	White lettuce		X	X	
Prenanthes racemosa	Glaucous white lettuce		X	X	
Proserpinaca palustris crebra	Mermaid weed		X	X	
Prunella vulgaris lanceolata	Self heal		X	X	
Prunus pumila	Sand cherry		X	X	
Prunus serotina	Wild black cherry	X	X	X	
Prunus virginiana	Choke cherry	X	X	X	
Ptelea trifoliata	Hop tree			X	
Ptelea trifoliata millis	Downy hop tree			X	
Pteridium aquilinum latiuscuum	Bracken fern	X	X	X	
Pycnanthemum virginianum	Common mountain mint	X	X	X	
Quercus alba	White oak	X	X	X	
Quercus ellipsoidalis	Hill's oak	X			
Quercus velutina	Black oak	X	X	X	
Ranunculus flabellaris	Yellow water crowfoot			X	
Ranunculus sceleratus	Cursed buttercup			X	
Ratibida pinnata	Yellow coneflower	X			
Rhamnus cathartica	Common buckthorn	X	X		A
Rhamnus frangula	Glossy buckthorn	X	X	X	A
Rhus aromatica	Fragrant sumac	X	X	X	
Rhus aromatica arenaria	Dwarf fragrant sumac		X	X	
Rhus copallina latifolia	Winged sumac	X	X	X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Rhus glabra	Smooth sumac				
Rhus toxicodendron	Poison ivy	X	X	X	
Rhus typhina	Staghorn sumac	X	X	X	
Rhynchospora capiillacea	Hair beak rush		X	X	
Rhynchospora macrostachya	Horned beak rush		X	X	R
Ribes americanum	Wild black currant	X			
Robinea pseudoacacia	Black locust			X	A
Rorippa palustris hispida	Rough marsh cress			X	
Rosa blanda	Early wild rose			X	
Rosa multiflora	Multiflora rose	X		X	A
Rosa palustris	Swamp rose		X	X	
Rotala ramosior	Wheelwort			X	
Rubus flagellaris	Common dewberry	X		X	
Rubus hispidus	Swamp dewberry			X	
Rubus idaeus strigosus	Red raspberry		X	X	
Rubus occidentalis	Black raspberry			X	
Rudbeckia hirta	Black-eyed Susan	X	X	X	
Rumex acetosella	Field sorrel			X	A
Rumex altissimus	Pale dock			X	
Rumex crispus	Curley dock			X	
Satabia angularis	Rose gentain		X	X	A
Sagittaria graminea	Grass-leaved arrowhead			X	
Sagittaria latifolia	Common arrowhead			X	
Salix amygdaloides	Peach-leaved willow	X	X	X	
Salix discolor	Pussy willow	X		X	
Salix eriocephala	Heart-leaved willow			X	
Salix glaucophylloides	Blue-leaved willow	X	X	X	
Salix humilis	Prairie willow	X	X	X	
Salix interior	Sandbar willow		X	X	
Salix nigra	Black willow	X	X	X	
Salix pedicellaris hypoglauca	Bog willow			X	
Salix petiolaris	Meadow willow			X	
Salix purpurea	Purple willow		X		A
Salix syrticola	Dune willow			X	
Salsola kali tenuifolia	Russian thistle		X	X	A
Sambucus canadnesis	Elderberry	X	X	X	
Sanguinaria canadensis	Bloodroot			X	
Sanicula marilandica	Black snakeroot			X	
Saponaria officinalis	Bouncing bet	X		X	
Sassafras albidum	Sassafras	X	X	X	A
Satureja arkansana	Dogmint			X	E
Saxifraga pensylvanica	Swamp saxifrage		X		
Schizachyrium scoparium	Little bluestem	X	X	X	
Scirpus acutus	Hard-stemmed bulrush		X	X	
Scirpus atrovirens	Dark green rush		X	X	
Scirpus cyperinus	Wool grass			X	
Scirpus pendulus	Red bulrush		X		
Scirpus pungens	Chairmaker's rush	X	X	X	
Scirpus validus creber	Great bulrush	X	X	X	
Scleria pauciflora caroliniana	Few-flowered nut rush		X		E
Scleria triglomerata	Tall nut rush			X	
Scleria verticillata	Low nut rush		X	X	
Scutellaria epilobiifolia	Marsh skullcap	X		X	
Scutellaria lateriflora	Mad-dog skullcap	X	X	X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Senecio pauperculus	Balsam ragwort		X	X	
Setaria faberii	Giant foxtail			X	A
Setaria glauca	Yellow foxtail			X	A
Setaria viridis	Green foxtail			X	A
Silene antirrhina	Sleepy catchfly	X		X	
Silene cserei	Glaucous campion			X	A
Silene cucubalus	Bladder campion			X	A
Siphium integrifolium	Rosin weed	X			
Sisymbrium altissimum	Tumble mustard			X	A
Sisyrinchium albidum	Common blue-eyed grass	X	X	X	
Sium suave	Tall water parsnip		X	X	
Smilacina racemosa	Feathery false Solomon's seal	X		X	
Smilacina stellata	Stary false Solomon's seal	X	X	X	
Similax lasioneura	Common carrion flower	X		X	
Smililax rotundifolia	Green briar			X	
Smilax tamnoides hispida	Bristly green briar	X	X		
Solanum americanum	Black nightshade			X	A
Solanum ducamara	Bittersweet nightshade	X	X	X	A
Soliago altissima	Tall goldenrod		X	X	
Solidago caesia	Blue-stem goldenrod	X	X	X	
Solidago gigantea	Late goldenrod		X	X	
Solidago gramminifolia	Smooth grass-leaved goldenrod		X	X	
Solidago gramminifolia nutallii	Hairy grass-leaved goldenrod	X	X	X	
Solidago gymnospermoides	Vicid grass-leaved goldenrod		X	X	
Solidago juncea	Early goldenrod			X	
Solidago missouriensis fasciculata	Missouri goldenrod		X	X	
Solidago nemoralis	Old-field goldenrod	X	X	X	
Solidago ohioensis	Ohio goldenrod		X	X	
Solidago ptarmicoides	Prairie goldenrod			X	R
Solidago racemosa gillmanii	Dune goldenrod			X	
Solidago riddellii	Riddell's goldenrod		X		
Solidago ridida	Stiff goldenrod			X	
Solidago rugosa	Rough goldenrod		X	X	
Solidago sempervirens	Seaside goldenrod		X		A
Solidago speciosa	Showy goldenrod	X	X	X	
Solidago tenuifolia	Slender-leaved goldenrod			X	
Solidago uliginosa	Bog goldenrod		X		
Sonchus asper	Spiny sow thistle			X	A
Sonchus oleraceus	Store-front sow thistle			X	A
Sonchus uliginosus	Common sow thistle			X	A
Sorghastrum nutans	Indian grass		X	X	
Sparganium americanum	American bur reed	X		X	
Sparganium chlorocarpum	Dwarf bur weed			X	
Sparganium eurycarpum	Common bur reed			X	
Spartina pectinata	Prairie cord grass	X	X	X	
Sphenopholis intermedia	Slender wedge grass			X	
Spirea alba	Meadowsweet	X	X	X	
Spirea tomentosa rosea	Steeple bush		X	X	
Spiranthus ceruna	Nodding ladys' tresses		X	X	
Sporobolus asper	Rough dropseed			X	A
Sporobolus cryptandrus	Sand dropseed			X	
Stachys palustris homotricha	Woundwort			X	
Stachys tenuifolia hispida	Marsh hedge nettle			X	
Stipa spartea	Porcupine grass	X	X	X	

Appendix.—Continued.

Scientific name	Common name	DT	CP	MW	Status
Strophostyles helvula	Trailing wild bean			X	
Symphoricarpos orbiculatus	Coral berry			X	A
Talinum rugospermum	Fame flower			X	E
Taraxacum officinale	Common dandelion	X		X	A
Tephrosia virginiana	Goat's rue	X		X	
Teucrium canadense	Germander			X	
Thalictrum dioicum	Early meadow rue			X	
Tilia ameriana	Basswood			X	
Tofieldia glutinosa	False asphodel				R
Tradescantia ohiensis	Spider wort	X	X	X	
Tragopogon dubius	Sand goat's beard	X		X	A
Tragopogon pratensis	Common goat's bear			X	A
Trifolium hybridum	Alsike clover			X	A
Trifolium pratense	Red clover			X	A
Trifolium repens	White clover			X	A
Triglochin maritima	Common bog arrow grass		X	X	
Tripasis purpurea	Sand grass			X	
Triticum aestivum	Wheat			X	A
Typha angustifolia	Narrow-leaved cattail	X	X	X	A
Typha latifolia	Broad-leaved cattail	X	X	X	
Ulmus pumila	Siberian elm			X	A
Utricularia cornuta	Horned bladderwort			X	T
Utricularia gibba	Humped bladderwort			X	
Utricularia minor	Small bladderwort			X	
Utricularia vularis	Great bladderwort			X	
Vaccinium angustifolium	Early low blueberry			X	
Vaccinium pallidum	Late low blueberry			X	
Vallisneria americana	Eel grass			X	
Verbascum thapsus	Common mullein	X	X	X	
Verbana hastata	Blue vervain	X	X	X	A
Verbena stricta	Hoary vervain	X		X	
Veronia missurica	Missouri ironweed			X	
Veronicastrum virginicum	Culver's root		X		
Viburnum acerifolium	Maple-leaved arrow-wood			X	
Viburnum lentago	Nannyberry			X	
Viburnum prunifolium	Black haw	X			
Viburnum rafinesquianum	Downy arrow-wood			X	
Vicia americana	American vetch	X			
Viola conspersa	Dog violet		X		
Viola fimbriatula	Sand violet			X	
Viola lanceolata	Lance-leaved violet	X			
Viola pedata lineariloba	Bird's foot violet			X	
Viola pubescens	Yellow violet			X	
Viola sagittata	Arrow-leaved violet	X			
Viola sororia	Common blue violet		X		
Viola tricolor	Pansy violet			X	
Vitis aestivalis	Summer grape	X			A
Vitis labrusca	Fox grape	X			
Vitis riparia	Riverbank grape		X	X	
Vitis vulpina	Froot grape	X			
Xanthium strumarium	Cocklebur			X	A
Zizaia aquatica	Wild rice	X		X	
Zizia aurea	Golden Alexander	X		X	

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