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CRANDON PROJECT

WETLANDS ASSESSMENT APPENDI

Prepared for

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APPENDIX A

SURFICIAL GEOLOGIC HISTORY

SURFICIAL GEOLOGIC HISTORY

Wetlands in glaciated areas, such as the study area and the region, occur primarily due to the glacial processes which created the surficial geologic deposits, topography, and hydrogeology. To understand the function of a wetland, the geologic framework of the wetland must first be determined. This appendix was written to acquaint the reader with an understanding of the geologic events which created the study area wetlands.

Within the study area, and in nearby areas, previous investigators (Simpkins et al., 1981; Mickelson et al., 1974; Dames and Moore, 1981; Golder Associates, 1980) have found that the Precambrian bedrock surface is covered with from 25 feet (8 m) to more than 300 feet (91 m) of unconsolidated surficial geologic deposits. According to these investigators, deposits were formed primarily during the Woodfordian glaciation, 22,000 to 13,000 C-14 years before the present.

The front of the advancing Woodfordian ice age sheet was divided into lobes of ice advancing (Figure A-1) somewhat independently (Mickelson et al., 1974; Hadley, 1976; Hole, 1943; Thwaites, 1943; Weidman, 1907). The study areas is located in an area glaciated by both the Green Bay lobe and the Langlade lobe.

Where the two lobes either came in contact with each other or deposited sediments over the same area, but at different times, these different deposits are found to be stratigraphically truncated and interfingered each other (Dames and Moore, 1981). An understanding of the stratigraphy within this area of interaction between the two lobes is determined by understanding the history of deposition by each lobe. Mickelson et al. (1974) and Simpkins et al. (1981) believe that ice of

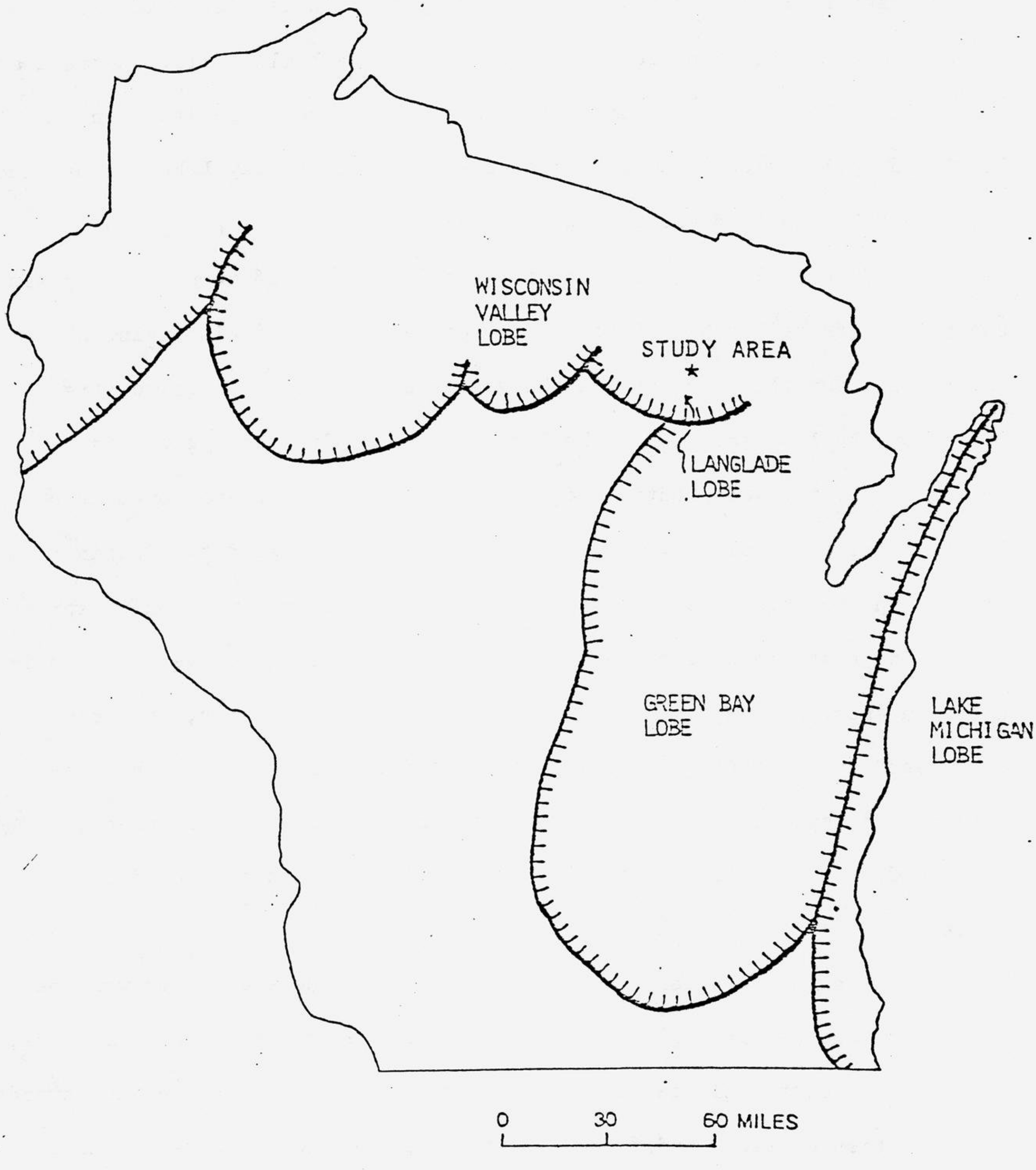

Figure A-1. Woodfordian glacial lobes at maximum glaciation in Wisconsin.

the Green Bay Lobe first deposited both till (Mapleview Till) and outwash in southeastern Forest County. Subsequently the Langlade Lobe ice displaced the Green Bay Lobe ice and deposited the Nashville Till. Retreat of the Langlade Lobe deposited stratified sand and gravel deposits. An idealized stratigraphic column for an area where Green Bay Lobe ice preceeded Langlade Lobe ice is presented in Table A-1.

Black (1970) offers a hypothetical sequence of events to explain the origin of the Northern Kettle Interlobate Moraine of Wisconsin, which may account for the shape of the study area's topography prior to streamlining by the last advance of the Langlade Lobe. In this hypothesis (Figure A-2), two lobes butted together, resulting in upward movement of debris along shear planes. The subsequent wasting created two distinct hills. The topography of the study area has a similar topographic expression. The east and west ridges of the study area nearly converge at their northern ends, forming a triangle. The complex stratigraphy, topographic cross-section and triangular shape of the ridges, suggest that the prestreamlined topography may have formed in an interlobate environment, as suggested by its similarity to that of interlobate moraines found elsewhere.

The last glacial event that occurred in the study area was the wasting of the Langlade glacier ice. Glacier ice wastes in three manners, from the top of the glacier downward, from the front of the glacier towards the direction of flow, and from the bottom of the glacier upward. As the glacier wastes, it continues to flow until it becomes thin enough at its snout for stagnation to occur. The combination of wasting and continued flow accumulates debris on the ice surface, at the snout and beneath the

Table A-1. Idealized stratigraphic column for area glaciated by first the Green Bay Lobe and then by the Langlade Lobe related to wetlands study area.

UNIT	OCCURRENCE	OBSERVATION
Holocene alluvium and swamp deposits	Outcrops in study area	Observed by all investigators
Langlade Lobe stratified outwash lacustrine and ice-contact deposits and ablation till	Outcrops in study area	Observed by all investigators
Langlade Lobe lodgement till - Nashville Till Member	Outcrops in study area	Observed by all investigators
Langlade Lobe advance outwash Green Bay Lobe retreat outwash	May not have been deposited or was removed by advancing Langlade Lobe ice	Shown in Dames & Moore (1981) cross-sections A-A' and D-D': implied in Golder Associates (1980) cross-sections A-A, B-B, C-C, D-D: Suggested by Simpkins et al., 1981.
Green Bay Lobe lodgement till - Mapleview Till member	May have been removed by advancing Langlade Lobe ice	Implied in Golder Associates, 1980. Lumped as Green Bay "Drift" by Dames & Moore, 1981. Observed by Mickelson et al., 1974. Observed by Simpkins et al., 1981.
Green Bay Lobe advance outwash stratified sand and gravel	May have been removed by advancing Green Bay Lobe ice or not deposited	Lumped as Green Bay "Drift" by Dames & Moore (1981). Observed by Mickelson et al., 1974. Observed by Simpkins et al., 1981.
Pre-Woodfordian glacial deposits Merrill Till?	May have been removed by advancing Woodfordian ice	Suggested by Dames & Moore, 1981.
Bedrock	Outcrops out of study area	Observed by Golder Associates, 1980, Dames & Moore, 1981.

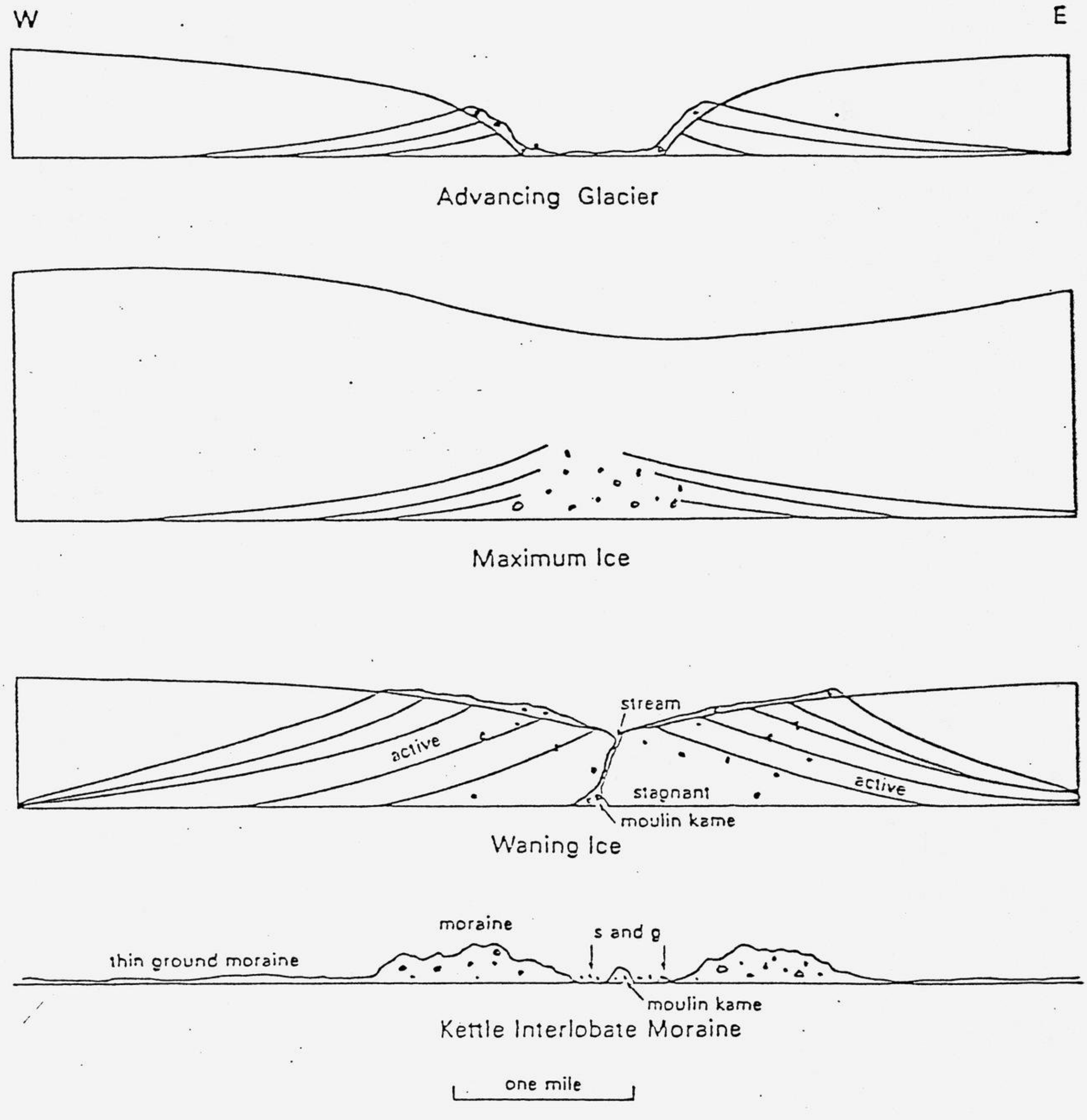

Figure A-2. Hypothetical sequence of events postulated to explain the origin of some glacial features of the Northern Kettle Interlobate Moraine. From Black, 1970.

ice (Koteff, 1974). This accumulation was most pronounced at the terminus of the glacier. As the ice wasted, vast amounts of melt water came in contact with the debris wasting from the ice, the water transported, sorted and deposited it as various types of stratified deposits of gravel, sand, silt and clay. Some of these stratified deposits formed directly in contact with the wasting ice and are called ice-contact stratified drift. Other deposits were carried away from the ice and deposited as non-ice contact stratifed drift deposits (Koteff, 1974), either in stream environments (glaciofluvial) or lake environments (glaciolacustrine). In some cases melt water had very little interaction with the debris wasted from the ice. This debris was deposited as ablation till and flow till. Both of these tills generally contain fewer fines (silt and clay) and are less dense than the lodgement till produced by flowing glacier ice. They produced topography which contains numerous ice-contact features such as kettles and ice-channel filling. The difference between poorly sorted ice-contact glacio-fluvial deposits and ablation till deposits is slight and the two deposits commonly interfinger and grade into each other.

As glacier ice thinned by wasting in the study area, the higher hills first emerged through the glacier (Simpkins et al., 1981). Figure A-3 illustrates the various phases of deglaciation which created the topography of the study area wetlands. Phase 1 (Figure A-3) shows the hills of the study area emerging as the ice down waste.

The ice between the two hills continued to be part of the actively flowing glacier until, through continued wasting, became separated from the remainder of the ice of the Langlade Lobe. When this occurred (Phase 2, Figure A-3), the ice trapped between the two hills stagnated and

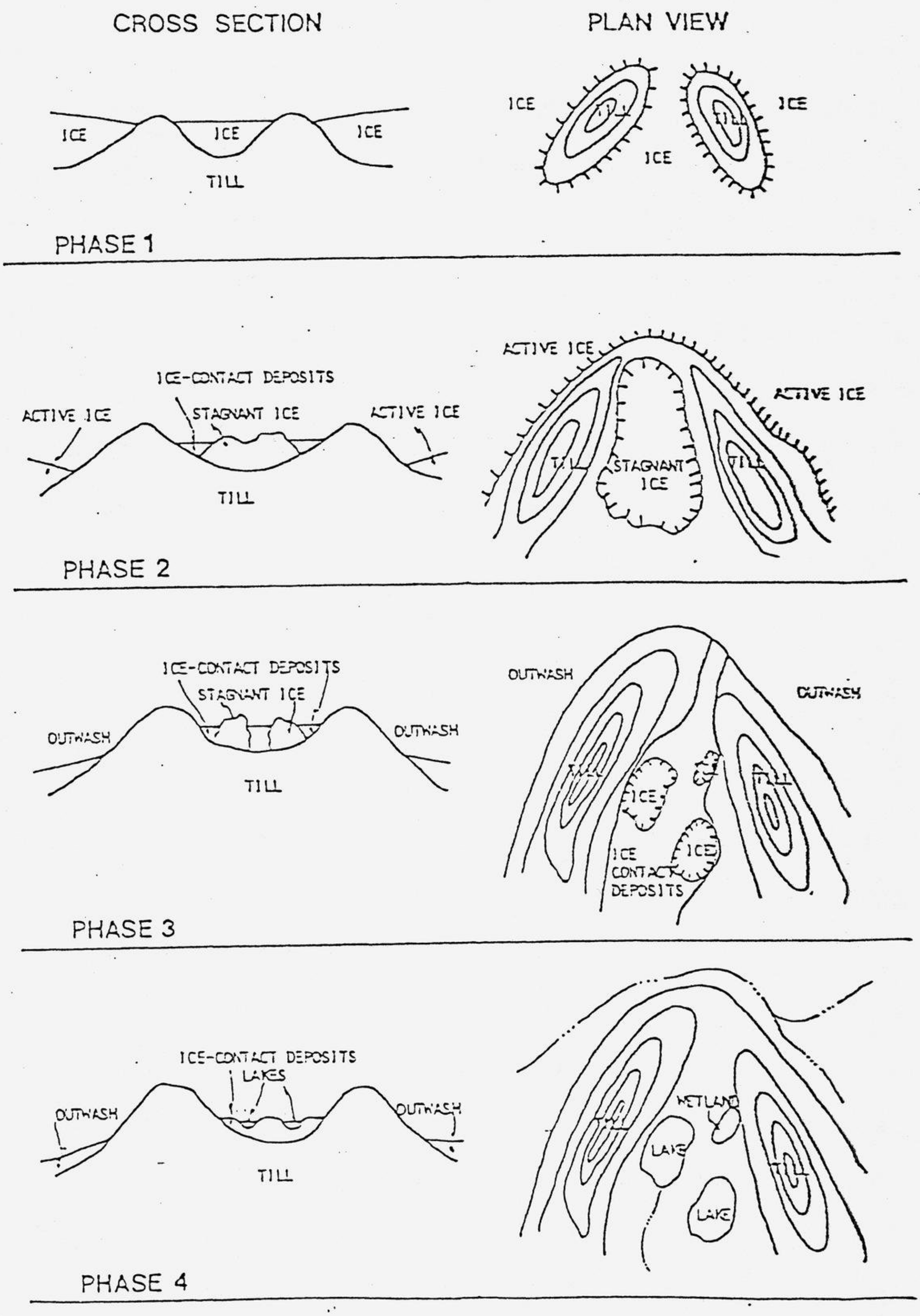

Figure A-3. Phases of deglaciation of the wetland study area.

continued to waste becoming debris covered. As the stagnant ice continued to melt between the two hills, melt water from the Langlade Lobe ice to the north was predominantly prevented from flowing between the two hills by the convergence of the two hills at their northern ends and blocks of wasting ice (Phase 2, Figure A-3). Large blocks of ice were trapped between the two ridges and slowly wasted (Phase 3, Figure A-3). Debris melted from these blocks of ice was deposited predominantly as ablation till between the wasting ice blocks and adjacent lodgement till slopes. Where larger amounts of melt water was present, glaciofluvial sand and gravel was deposited, adjacent to or over wasting ice. When the ice blocks completely melted (Phase 4, Figure A-3), they created topographic lows (kettles), many of which either intersected the water table or collected perched water, forming lakes and ponds. Melt water released from the melting of the glacier ice incised melt-water channels into the till or ice-contact deposits, also creating topographic low areas where water could collect. As a result of these processes of glacier and melt-water deposition and erosion, many large and small basins of various shapes were created in the till and ice-contact deposits. Immediately following deglaciation, strong glacial winds blew fine sand and silt particles across the landscape. Much of this material was deposited into the basins, either dry or water filled. At the same time, surface water runoff also transported and deposited fine sand, silt and clay particles into the basins. In the basins occupied by water this material settled out as lacustrine (lake bottom) deposits. In dry basins eolian (wind) deposits predominate. These eolian and lacustrine deposits generally are more impermeable than the till or ice-contact deposits they overlay. As a result they act as "liners" and aid in trapping (perching) water. Once water occurs at or near the land surface for a significant portion of the year, a wetland vegetative community will grow. As the vegetative community generates organic debris, it is deposited into anaerobic conditions resulting in the accumulation of organic rich soils. The thickness of these organic soils is controlled by the elevation of the basin's outlet or the water table in basins having no outlet. Once organic soils accumulate they, in turn, act as a "liner" for the basin. They also can store large amounts of water and aid in maintaining the water table, anaerobic conditions and wetland vegetative community.

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APPENDIX B

GENERAL ECOLOGY OF WETLAND TYPES

PREFACE

This appendix contains descriptions of the general ecology of those wetland communities found in the study area. Descriptions of the geologic and hydrologic conditions which give rise to each of the wetland types is included along with descriptions of the plant and wildlife communities. The information contained in these descriptions provides a basis for relating the characteristics of wetland types in the study area to what would be "typical" characteristics for these types in the region.

GENERAL ECOLOGY OF WETLAND TYPES

1.0 BOGS

Bogs in the eastern and central United States are isolated ponds in hydrologic locations where the water budgets and annual nutrient input are low, and sphagnum moss (*Sphagnum* sp.) is dominant. The typical vegetation association in Wisconsin bogs includes Pitcher plants (*Sarracenia purpurea*), black spruce (*Picea mariana*), tamarack (*Larix laricina*), round leaved sundew (*Drosera rotundifolia*), and heaths, such as cranberries and blueberry (*Vaccinium* spp.), leatherleaf (*Chamaedaphne calyculata*), bog laurel (*Kalmia polifolia*), bog rosemary (*Andromeda glaucophylla*), and Laborador tea (*Ledum groenlandicum*). The herbaceous layer is dominated by the sedge family, and the shrub layer by the heath species (Curtis, 1959). Although water in the bogs remains cold in the spring, most of the plants flower in early spring. Many of the shrub layer plants are also berry producing, making the bog an important food source for wildlife species.

Although production of primary food materials is low in bog communities because nutrient input is low, the open water in the central portion is slowly taken over by the floating mat of vegetation. The acidic water, maintained by the sphagnum and its related community, results in a very slow rate of decomposition. This leads to the build-up of organic deposits which slowly fill the original depression, eventually succeeding to a coniferous swamp.

The typical hydrogeologic locations where bogs occur in the region are isolated kettles and semi-closed basins. These are believed to be local aquifer connected (perched) where there is little inflow or outflow of surface water and no inflow of ground water from the main aquifer. Seepage of bog water may occur slowly to the underlying local and main aquifers. Thick peat soils are normally found in bogs.

Bogs are of minimal value to most wildlife including birds because of their relatively low primary production (Golet and Larson, 1974). The presence of a floating peat mat additionally restricts the availability of open water for wildlife. The available open water frequently is too deep for dabbling ducks such as mallards and black ducks. The ring-necked duck (Aythya collaris) is one of the few waterfowl species which regularly inhabits bogs (Golet and Larson, 1974). This diving duck feeds on submerged plants too deep for dabblers. Bogs with large expanses of open water (such as F28 at Duck Lake) provide important staging and resting areas for waterfowl during autumn migration.

Although bogs are considered to have a minimal value for wetland birds, they do attract a variety of more upland bird species (usually coniferous forest species) which nest along the edge of bog and upland cover types. These include warblers, flycatchers, nuthatches, and kinglets (Landin, 1979). Anderson (1979) listed the following birds as "indicator species" for bogs in the north-central United States: Eastern kingbird (Tyrannus tyrannus), tree swallow (Iridoprocne bicolor), common yellowthroat (Geothlypis trichas), red-winged blackbird (Agelaius phoeniceus), Lincoln's sparrow (Melospiza lincolnii), swamp sparrow (Melospiza georgiana), and song sparrow (Melospiza melodia). Wooded bogs containing spruce and tamarack also provide both food and cover for ruffed grouse (Bonasa umbellus) during the winter (Golet and Larson, 1974). With the exception of the bog lemming (Synaptomys cooperi), few small mammal species regularly utilize bogs.

The distribution of amphibians in the four major vegetational "successional" zones surrounding a bog in northwestern Minnesota during late summer has been reported by Marshall and Buell (1955). Mink frogs (*Rana septentrionalis*) were common in the open water, with leopard frogs (*Rana pipiens*) most abundant in the adjacent sedge mat and tamarack zone. Wood frogs (*Rana sylvatica*) and spring peepers (*Hyla crucifer*) increased in abundance outward from the center of the bog through the tamarack, black spruce, and fir-black ash (*Fraxinus nigra*) zones. The "swamp tree frog" (boreal chorus frog, *Pseudacris triseriata*) was found in the two zones farthest from the center, black spruce and fir-black ash. Gray tree frogs (*Hyla versicolor*) were scarce in all zones. The American toad (*Bufo americana*) was found only in the peripheral zone.

Other herpetofauna that may occur in bogs include the four-toed salamander (*Hemidactylium scutatum*), pickerel frog (*Rana palustris*), Blanding's turtle (*Emyboidea blandingi*), water snake (*Natrix sipedon*), brown snake (*Storeria dekayi*) and red-bellied snake (*Storeria occipito-maculata*) (Conant, 1975).

2.0 SHRUB SWAMP

Shrub swamps are commonly found in open surface water drainages characterized by a muck soil type and some ground-water discharge. Deciduous vegetation is most characteristic of shrub swamps and frequently the predominant species in Wisconsin shrub swamps is alder (*Alnus rugosa*), with their nitrogen-fixing capability (Curtis, 1959). Other species include hardhack (*Spiraea tomentosa*), sensitive fern (*Onoclea sensibilis*) and the grasses and sedges of seasonally-flooded stream banks such as blue-joint grass (*Calamagrostis canadensis*) and sedge (*Carex rostrata*). Many of these species are also found in deciduous swamps and marshes. They also include herbs such as asters (*Aster* spp.), and the Joe-pye weed (*Eupatorium maculatum*). Shrub swamp communities are generally high in production, with soils rich in nutrients and high in oxygen levels, contrasting sharply with the peat soils of bogs.

The value of shrub swamps to wildlife depends primarily on their subtype classification and surrounding habitats. Sapling shrub swamps (typically red maple dominated) are characterized by little cover in the shrub layer (.61 to 1.5 m [2 to 5 foot] zone) and hence are of minimal wildlife value except for songbirds such as yellowthroats which nest in heavy ground cover and birds such as vireos which nest at greater heights (Golet and Larson, 1974). Shrub swamps without nearby open water provide suitable habitat only for such upland species as woodcock (*Philohela minor*), snipe (*Capella gallinago*) and ruffed grouse. When near open water, the value of shrub swamps increases if dead standing trees large enough to provide nesting cavities are present.

The "bushy swamp" subtype (Golet and Larson, 1974) has minimal value to waterfowl but is of great value to songbirds for nesting and as winter cover for pheasants (Schitoskey and Linder, 1979). "Compact shrub swamps" with a high stem density of such species as sweet gale are normally too dense for waterfowl or marsh birds, but when not too wet, do provide good foraging for song sparrows and swamp sparrows (Golet and Larson, 1974). Red-winged blackbirds also will nest here if more desirable areas are not available. Shrub swamps containing "aquatic" shrub species such as buttonbush (Cephalanthus occidentalis) often have a higher waterfowl value because they frequently are in close proximity to deep marsh areas. Wood duck (Aix sponsa) broods will frequently seek refuge in aquatic shrub areas (Golet and Larson, 1974).

Shrub swamps provide habitat for many amphibians and reptiles depending largely on the amount of standing water (Conant, 1975). Salamanders and toads utilize temporary pools that are formed in shrub swamps after snow melt for egg laying. In addition, the gray treefrog, spring peeper, and wood frog also utilize these wetlands during both the breeding and non-breeding season. Typical reptile species found in shrub swamps include the wood turtle (Clemmys insculpta), water snake and brown snake (Conant, 1975).

Among the small mammals associated with shrub swamps are the masked shrew (Sorex cinereus), southern red-backed vole (Clethrionomys gapperi), white-footed mouse (Peromyscus leucopus), deer mouse (Peromyscus maniculatus) and woodland jumping mouse (Napaeozapus insignis). Larger mammals using these areas include the Virginia opossum (Didelphis virginiana), raccoon (Procyon lotor) and striped skunk (Mephitis mephitis) (Jackson, 1961).

3.0 DECIDUOUS SWAMPS

Deciduous swamps are commonly found in areas which are seasonally flooded. Generally they occur in shallow drainage basins with thin organic soils and are commonly connected with local aquifers. Deciduous swamp wetlands include wet mesic northern lowland forest as described by Curtis (1959), and some woodlands with muck soils having species not characteristic of the plant communities identified by Curtis in Wisconsin (Curtis, 1959). Examples of this latter deciduous swamp type include wet forests of bur oak (Quercus macrocarpa) and swamps of mature red maple (Acer rubrum) (Braun, 1972). Species composition of deciduous swamps depends on the flow of water and nutrients through these wetlands, and the sediment load. Deciduous swamps also may vary greatly in the extent of the shrub and ground layers.

When located near open water such as streams, ponds, or lakes, deciduous swamps provide valuable habitat for wood ducks, black ducks, and mallards. Their value to waterfowl is directly related to the persistence of surface water during the critical nesting period. They also are important to many upland bird species because of the high structural diversity which is frequently characteristic of deciduous swamps (Golet and Larson, 1974). Typical bird species include hawks, owls, woodpeckers, flycatchers, nuthatches, vireos, warblers, thrushes, grackles, and many other passerines. Woodland swamps adjacent to upland stands of mast producing trees are utilized by gray squirrels (Sciurus carolinensis) and flying squirrels (Glaucomys sabrinus). The moist forest floor also provides ideal habitat for insectivores such as the masked, pygmy (Microsorex hoyi) and short-tailed shrew (Blarina brevicauda and star-nosed mole (Condylura cristata).

The southern red-backed vole is a common inhabitant of wooded swamps with an abundance of fallen logs, stumps, and exposed roots (Merritt, 1981). The spotted salamander (Ambystoma maculatum), gray tree frog, western chorus frog (Pseudacris triseriata), spring peeper and wood frog are also common in deciduous swamps (Bishop, 1947; Wright and Wright, 1949).

4.0 CONIFEROUS SWAMP

In northern Wisconsin, coniferous swamps are found in melt-water channels and large kettle holes, and they may be either recharge areas for the main aquifer or discharge areas for the local aquifer. Silt and nutrients accumulate at a slow rate in these depressions. Coniferous swamps are synonymous with Curtis' (1959) wet northern lowland forest classification in which black spruce and tamarack are dominant. In swamps where yellow birch (Betula lutea) and white cedar (Thuja occidentalis) dominate, the community is classified as wet-mesic northern forest (Curtis, 1959). In the drier regions of such stands and around the moist edges, hemlocks (Tsuga canadensis) indicate the more mesic portions. The ground layer of coniferous swamps may also include many of the ericaceous shrubs typical of bogs. Organic soils of variable thickness are typical of coniferous swamps.

The succession from bog to coniferous swamp in Wisconsin is often in concentric circles, advancing to fill the open water at about 30 cm (1.2 inches) per year (Curtis, 1959). Drier, firmer soils allow the more shade-tolerant white cedars to invade. Many of the trees in bogs are sensitive to fires, especially the tamarack, and a fire or a drop in the water table can cause oxidation of the peaty soils which hastens the conversion process to an alder thicket or a white cedar swamp.

Coniferous swamps attract bird species associated with boreal forests such as the golden-crowned kinglet (Regulus satrapa), magnolia warbler (Dendroica magnolia), red-breasted nuthatch (Sitta canadensis) and yellow-bellied flycatcher (Empidonax flaviventris) (Golet and Larson, 1974; Peterson, 1980). They also provide excellent habitat for sawwhet (Aegolius acadicus) and great-gray (Strix nebulosa) owls. Red squirrels (Tamiasciurus hudsonicus), snowshoe hares (Lepus americanus) and red-backed voles are characteristic mammalian species in coniferous swamps (Burt, 1957). Dames and Moore (1981) reported the following species in order of abundance from coniferous swamps in the site area: red-backed vole, deer mouse, masked shrew, unidentified juvenile Peromyscus, snowshoe hare, and least chipmunk (Eutamias minimus).

Coniferous swamps are also valuable as winter yarding areas for white-tailed deer (Odocoileus virginianus). DNR has identified five such yards within an 8 km (5 mile) radius of the Crandon ore body (Dames and Moore, 1981): (1) the large Swamp Creek Yard on the northern boundary of the site area, (2) Rolling Stone Deeryard in the southwest corner of the site areas, (3) a portion of the K Tower Deeryard, west of the site area, (4) Maloney Deeryard, southwest of the site area, and (5) a portion of Deeryard No. 27, southeast of the site area. Although most coniferous species (with the exception of white cedar) provide excellent cover, they are considered poor deer foods. Red maple, although not a prevalent species in coniferous swamps, and alder are excellent hardwood foods for deer and are heavily browsed when occurring in or adjacent to yards.

Amphibians commonly associated with coniferous swamps include the tree frog, western chorus frog, spring peeper, four-toed salamander, and blue-spotted salamander (Ambystoma laterale) (Bishop, 1947; Wright and Wright, 1949).

5.0 MARSH

Marshes in Wisconsin are characteristic of shallow, nearly level areas dominated by grasses or sedges that are wet for most of the year. Wet conditions are maintained in marshes by discharge from local or main groundwater aquifers. Generally, the drainage basin in which marshes occur are shallow and contain thin organic soils. These are equivalent, in some cases, to the sedge meadow community described by Curtis (1959). The dominant herbs in marshes are sedges (Carex spp.) and blue-joint grass (Calamagrostis canadensis). A marsh with this composition conforms more nearly with the southern sedge meadow or to the wet prairie communities described by Curtis (1959). Northern sedge meadows are more commonly dominated by Cyperus spp.

Marshes provide valuable feeding, resting, and nesting habitat for waterfowl (Golet and Larson, 1974; Landin, 1979). They are also important nesting and feeding areas for red-winged blackbirds, swamp sparrows, and other passerines. Other birds such as common gallinules (Gallinula chloropus), soras (Porzana carolina), Virginia rails (Rallus limicola), American coots (Fulica americana), common snipes (Capella gallinago), spotted sandpipers (Actitis macularia), and all herons and bittern species also utilize marshes (Landin, 1979). Marsh wetlands constitute valuable muskrat (Ondatra zibethicus) habitat (Golet and Larson, 1974). Raccoons (Procyon lotor) also frequently forage in marshes for both large invertebrates and amphibians. Amphibians and reptiles frequently found in shallow marshes include the snapping turtle (Chelydra serpentina), painted turtle (Chrysemys picta), water snake, chorus frog, spring peeper, leopard frog, and bullfrog (Rana catesbeiana).

6.0 AQUATIC BED

Aquatic beds are contiguous to deep water (>0.5 m [1.6 feet]) and are characterized by a periphery of emergent plants with a floating plant community in the deeper portions. They are located in both kettle holes and melt-water channels where ground-water discharge keeps the area very wet. This type of wetland is classified as an emergent and submerged aquatic community by Curtis (1959). Aquatic beds are dominated by water lilies (*Nymphaea* sp.) and burreeds (*Sparganium* sp.).

Deep marshes represent the most valuable all-purpose habitat for waterfowl (Golet and Larson, 1974). They provide habitat for both dabbling and diving ducks as well as geese. They are utilized for mating, nesting, feeding, brood-rearing, and for staging-resting areas during migration (Golet and Larson, 1974). The shallower areas near their margins provide valuable feeding habitats for wading birds such as the great blue heron (*Ardea herodias*), green heron (*Butorides striatus*), black-crowned night heron (*Nycticorax nycticorax*) and American bittern (*Botaurus lentiginosus*). Aerial feeders, like tree swallows, often feed over aquatic beds. Stands of emergents such as cattail and wild rice (*Zizania aquatica*) support muskrats. Amphibians associated with aquatic beds include the spring peeper, green frog (*Rana clamitans*), leopard frog, mink frog, and bullfrog. The reptiles are represented by the snapping turtle, painted turtle, and water snake.

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APPENDIX C

DESCRIPTION OF WETLAND INVENTORY ELEMENTS

PREFACE

In this appendix all of the elements on the wetland inventory sheet are described and the methods used in measuring each element are discussed. This information is presented to develop an understanding of the process used to inventory wetlands using the inventory sheets and to provide the background necessary to understand the role of each element in the models as discussed in Appendix D.

DESCRIPTION OF WETLAND INVENTORY ELEMENTS

1.0 ECOLOGICAL ELEMENTS

1.1 DOMINANT WETLAND CLASS

Wetland classes are synonymous with the wetland types described in Section 4.2 and are distinguished on the basis of vegetative life form (e.g. tree, shrub, emergent), water depth during the growing season, and water level fluctuation. A given class is seldom found as a pure type, but commonly contains life forms typical of other classes, in which case the class is characterized based on the life form which occupies the greatest area. Wetland classes can be readily delineated on large scale (e.g. 1" = 500') aerial photographs, although frequent ground checks are necessary to correct interpretation errors and note changes occurring since the photographs were taken.

1.2 NUMBER OF WETLAND CLASSES (RICHNESS)

Wetland class richness refers to the number of different classes in a wetland. Class richness can be assessed by delineating the boundary of each distinct class within a given wetland on aerial photographs and totalling the number of different classes.

1.3 NUMBER OF WETLAND SUBCLASSES (RICHNESS)

Wetland areas within a class are divided into subclasses that differ from one another by vegetative life form and species composition. For example, a shrub swamp dominated by bushy shrubs, such as blueberry or dogwood, would constitute a different subclass from a shrub swamp in which red maple saplings were predominant. Subclasses are difficult to distinguish on aerial photographs because of similarities in appearance between certain life forms; therefore, intensive ground truthing is generally required to correct improper designations or errors in boundary placement. After the boundaries have been corrected, the subclasses are totalled in the same manner as the classes.

1.4 VEGETATIVE INTERSPERSION

Vegetative interspersion is a measure of vegetative life form diversity and the length of edge, or line of contact between two or more different wetland classes or subclasses. Edge increases with the degree of interspersion, which improves as the size of individual stands of vegetation decreases and the variety of such stands increases. Golet and Larson (1974) distinguished three different interspersion conditions.

1. Low interspersion where length and types of edge are minimum, and the various life forms occur in concentric rings,
2. moderate interspersion, in which length and types of edge are moderate, and the different life forms occur in broken, irregular rings, and,
3. high interspersion where the length and diversity of edge are high and the various life forms are small and scattered.

These three conditions are illustrated in Figure C-1. The interspersion condition of a wetland should be assessed by observing the wetland on aerial photographs and in the field, comparing the actual condition to the three shown in Figure C-1.

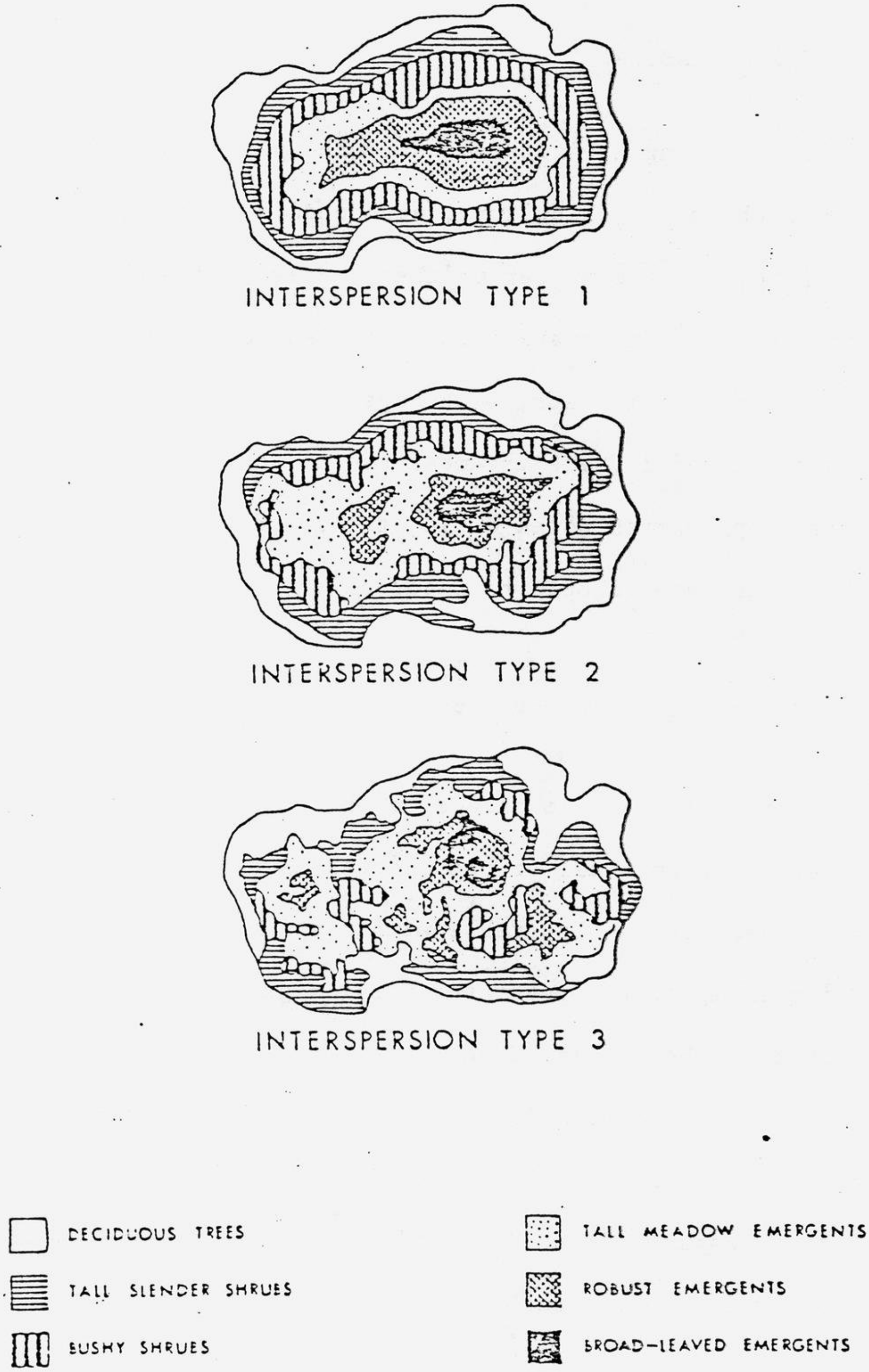

Figure C-1. Examples of the three wetland vegetative interspersion types (Golet and Larson, 1974).

1.5 SURROUNDING HABITAT

Surrounding habitat refers to the percentage of the surrounding landscape which is in agriculture, abandoned open land, forest land, and/or developed land, and the number of these categories present. Although a certain amount of information regarding surrounding habitat can be obtained from topographic maps, such maps are often outdated. Recent aerial photographs, therefore, are the most useful tool for assessing surrounding conditions; any changes noted during the field visit that have occurred since the photography should be recorded.

1.6 WATER/COVER RATIO (COVER TYPE)

Water/cover ratio refers to the proportions of open water and plant cover throughout all of the classes in a vegetated wetland. Certain wetland classes are fairly stable with respect to this ratio; in deciduous swamps, for example, the vegetated portion generally occupies 90-95 percent. This element can be estimated on aerial photographs; although field checking each wetland is advisable, particularly in problem areas. Water/cover ratio can change throughout the year due to the growth of wetland plants, therefore the estimate should be made when the growing season is well underway, using leaf-on photographs.

1.7 PERCENT OPEN WATER

Percent open water refers to the condition in which cover is restricted to vegetation on the periphery of a contiguous body of open water. This element differs from water/cover ratio in that the cover occurs either on the periphery or in diffused open stands or dense scattered patches in open stands. In water/cover ratio the arrangement of cover and water in a wetland is assessed, whereas, in percent open water, only the amount of water existing as a contiguous body is assessed. Percent open water can be readily assessed on aerial photographs but, as with water/cover ratio, the assessment should be made when seasonal development of the plant cover is well underway.

1.8 PERCENT OF WETLAND EDGE BORDERING OPEN WATER

The segment of edge between an open water body, such as a stream, river or lake, and a wetland along the periphery is estimated as a percentage of the total wetland border. Although this information can be obtained from topographic maps, the wetland boundary can be more accurately defined on aerial photographs, which improves the accuracy with which percent edge can be assessed. Moreover, the kind of edge can also be more accurately determined from the photographs.

1.9 VEGETATIVE SPECIES RICHNESS

Vegetative species richness is the number of different plant species per unit area, and is assessed by inventorying plants within random nested sample plots; plot sizes are 10 m x 10 m (32.8 x 32.8 feet) for trees, 3 m x 3 m (9.8 x 9.8 feet) for shrubs and 2 m x .5 m (6.5 x 1.6 feet) for herbs. The inventory is continued within a given wetland until the number of new species added per set of nested plots is one or zero. The slightly increased accuracy gained by continuing to sample beyond this point does not justify further sampling effort. Assessment of species richness in a given wetland is based on comparisons with other wetlands in the study area.

1.10 PROPORTION OF WILDLIFE FOOD PLANTS

The wildlife food value of wetland plants varies widely with such factors as palatability, nutritional value and quantity produced. The overall food values of a large number of plant species are given in Martin et al. (1961); species of wetland plants on the list derived from the field survey can be rated based on these values. The relative abundance of the various plant species, together with the value ratings, indicates the proportion of food plants in a wetland.

1.11 VEGETATIVE DENSITY

Vegetative density is the number of plants per unit area. Although this can be assessed by actually counting stems, the most efficient technique is to estimate the percentage of an object obscured by vegetation at a fixed distance from an observer. These techniques are described in Schemnitz (1980). Estimates are made in various locations in a wetland and an overall assessment of high, medium or low density is recorded. As with species richness, the assessment of vegetative density is judgemental.

1.12 WETLAND JUXTAPOSITION

Wetland juxtaposition refers to the location of a wetland with respect to other wetlands. This is assessed on the basis of whether the wetland is totally isolated, at a considerable distance from other wetlands, or whether other wetlands are nearby but not connected, or interconnected by streams. Proximity to other wetlands and surface connections can be determined from leaf-off aerial photographs. Wetlands that are isolated are considered to be unfavorable. Wetlands connected to wetlands both above and below are highly unfavorable, while wetlands connected to only one other wetland, above or below are moderately unfavorable.

2.0 SPECIAL ELEMENTS

There are six special elements in the wetland inventory report: (1) Aquatic Study Area, (2) Sanctuary or Refuge, (3) Wildlife Management Area, (4) Fisheries Management Area, (5) Educational Study Area, and (6) Historical Area. These special elements were not used in any of the functional values models, but represent concerns that must be addressed wherever they apply. They have been included to identify those wetlands requiring additional consideration. Wetlands having status for one or more of these elements are identified primarily with the assistance of state agencies and academic institutions.

3.0 TOPOGRAPHICAL ELEMENTS

3.1 TOPOGRAPHIC CONFIGURATION

Wetlands are found in four possible topographic features; closed basins, semi-closed basins, valleys and hillsides. This finding is based upon the work of Hollands and Mulica (1978), Novitzki (1978), IEP (1979), Motts and O'Brien (1980), plus extensive field observations.

A closed basin is a topographic feature, commonly called a depression, which can be identified on a topographic map by one or more perimeter contour lines which have closure and decrease in elevation creating a depression. A wetland occupying a closed basin has no outlet and occurs at an elevation lower than the lowest point of the rim of the depression. The width to length ratio is generally 1 to 1, or 1 to 2, as shown in Figure C-2.

A semi-closed basin is a topographic feature having the same general shape as a closed basin but with a distinct outlet, either ephemeral or perennial, through the rim of the basin. An example is shown in Figure C-3.

A valley is a landform containing a stream channel with a distinct gradient, and is indicated on a topographic map by the upstream "V" of the contour lines. An example of a wetland in a valley is shown in Figure C-4.

A hillside wetland is a topographic feature which is neither a basin nor valley and which has a distinct contour gradient. An example is presented in Figure C-5.

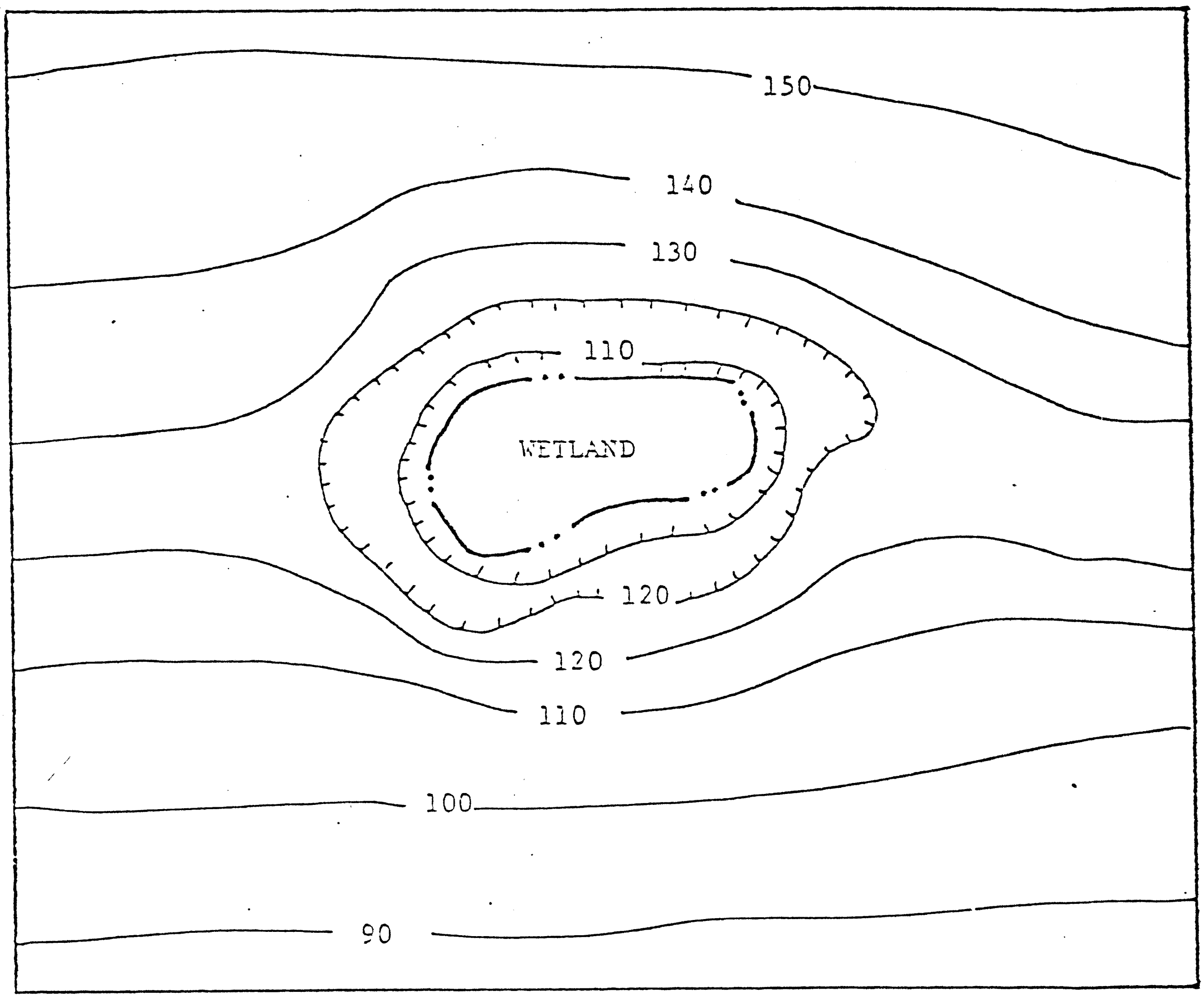

Figure C-2. An example of a wetland in a depression. (values are meters above MSL).

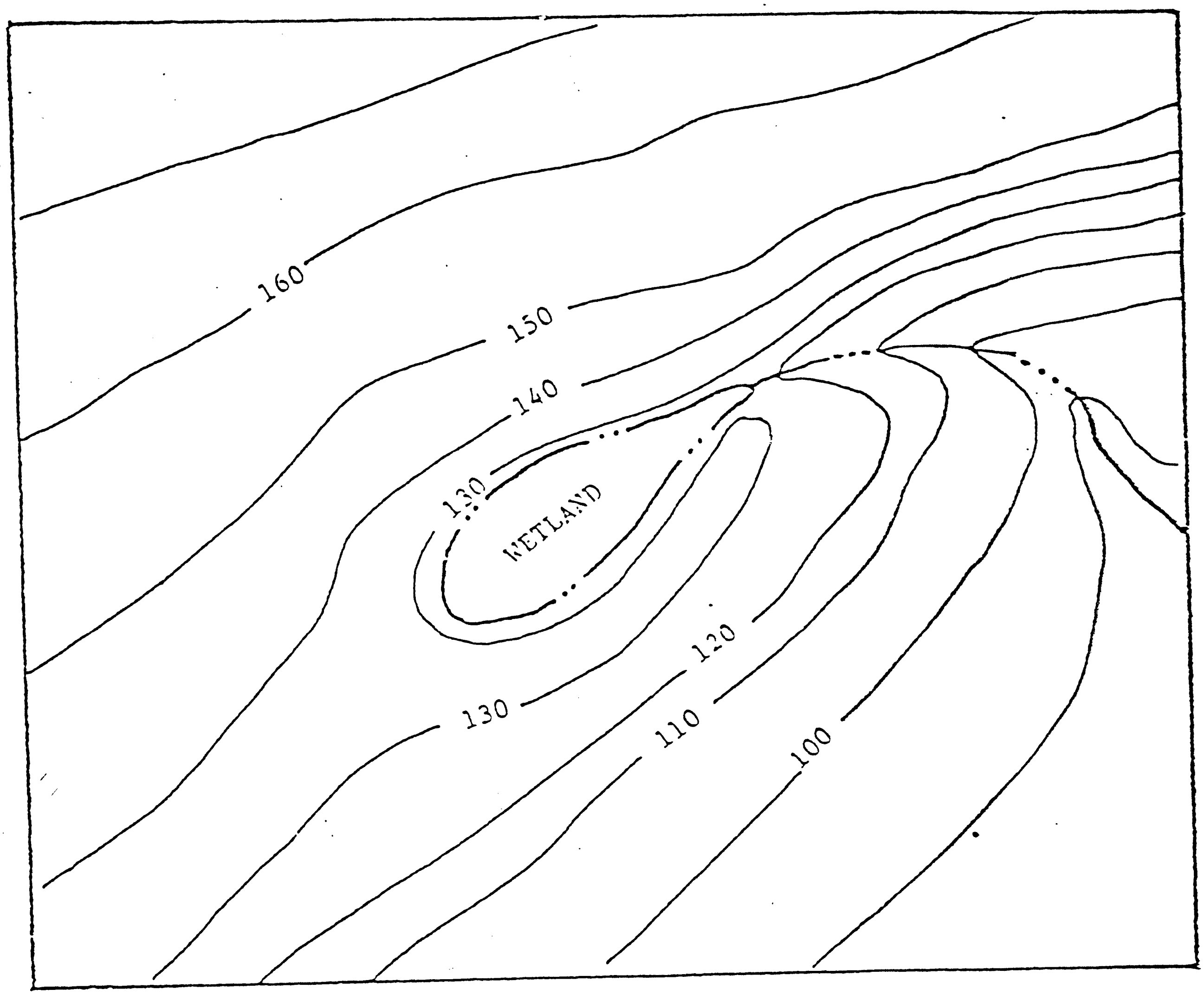

Figure C-3. An example of a wetland in a semi-closed basin (values are meters above MSL).

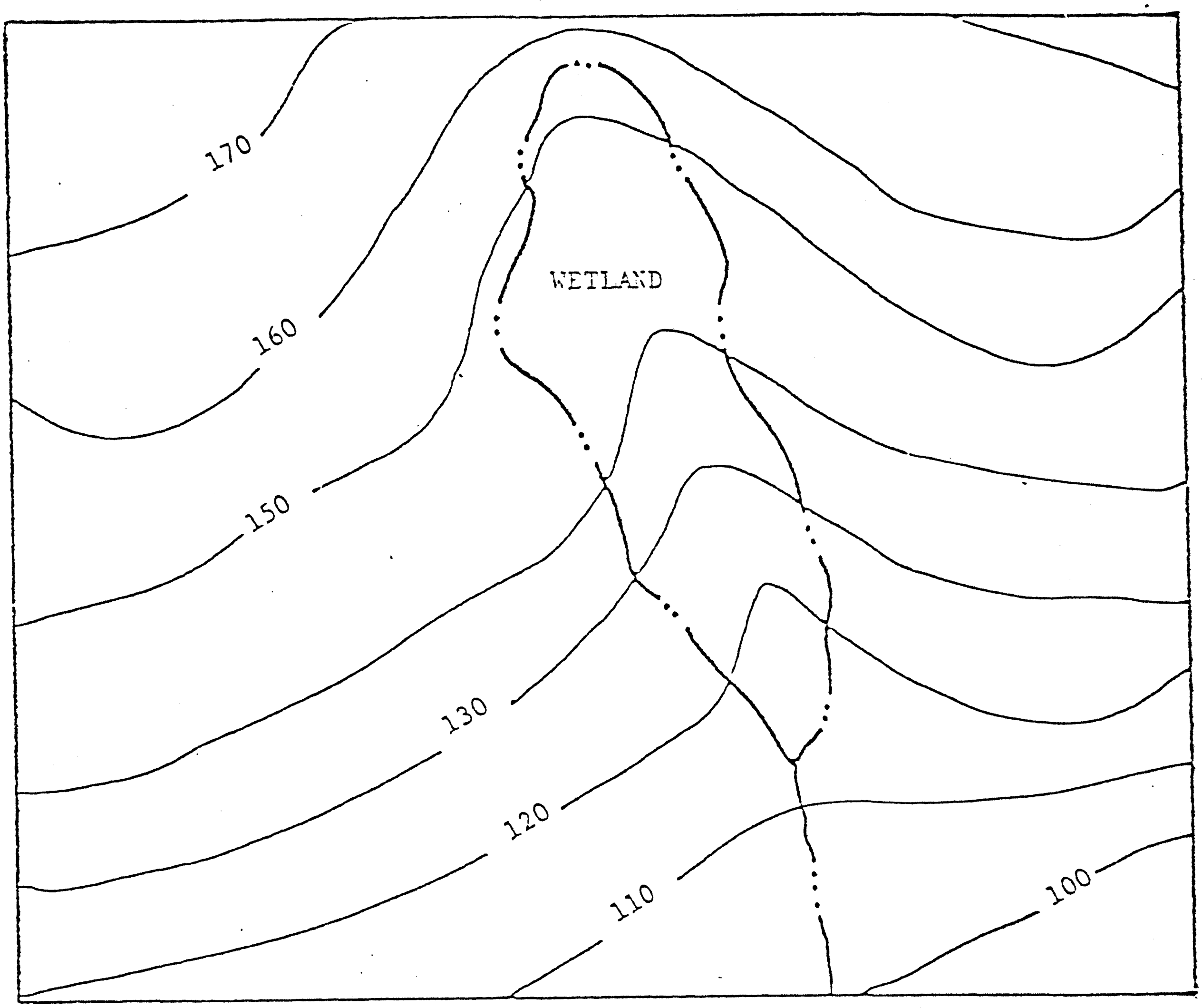

Figure C-4. An example of a wetland in a valley (values are meters above MSL).

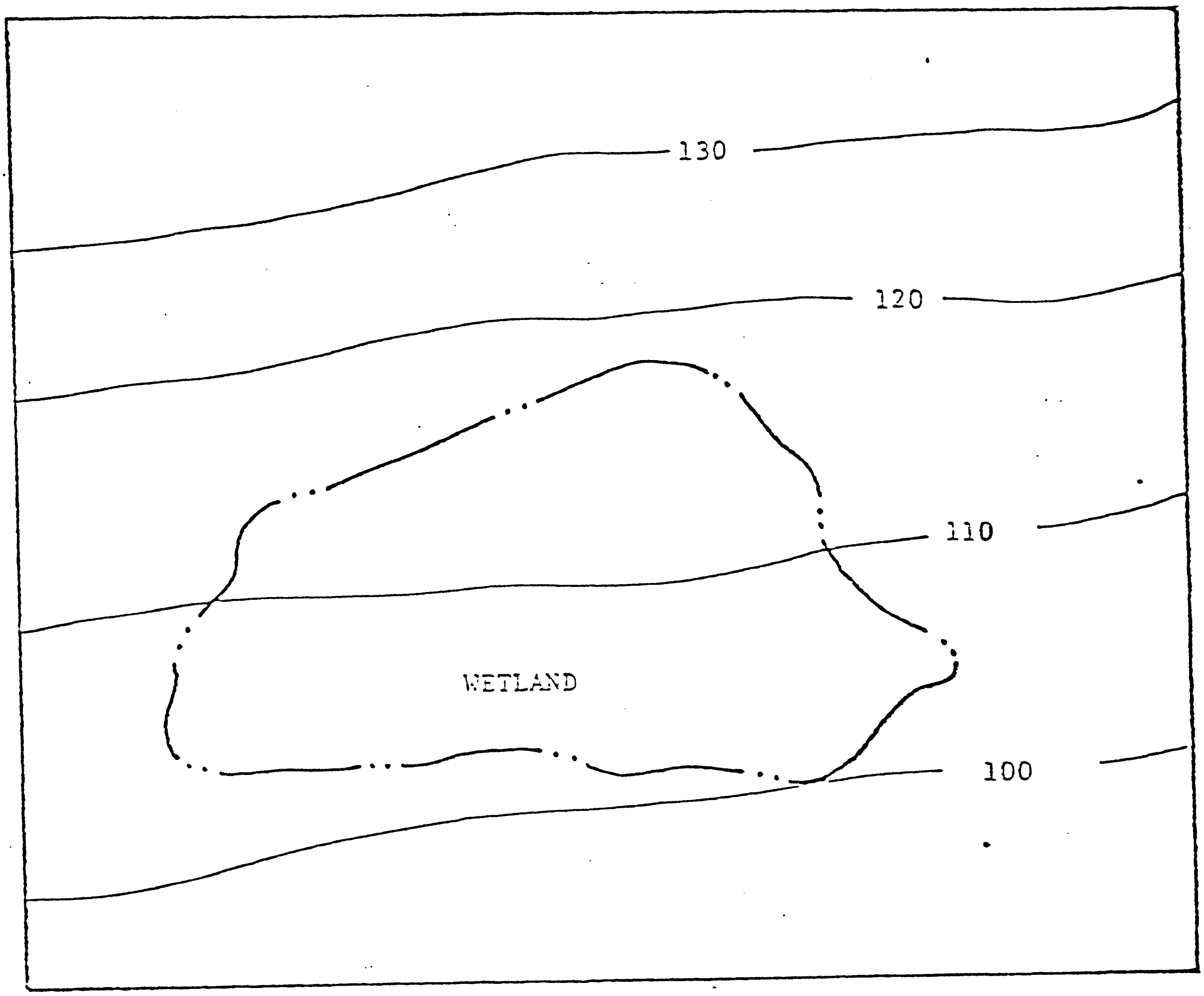

Figure C-5. An example of a wetland on a hillside (values are meters above MSL).

3.2 WETLAND GRADIENT

The gradient of a wetland is its slope along its length (vertical elevation decline divided by length). The gradient of a wetland is expressed as a percent slope. The definition from 0 to 3 percent slope is considered a slight slope and greater than 3 percent is considered steep, based upon definitions used in estimating erosional soil loss. Slope was measured in the field using an inclinometer, such as is found on a Brunton Compass, or was determined from a topographic map.

3.3 SURROUNDING SLOPES

The steepness of surrounding slopes was measured using the same techniques and definitions as for the wetland gradient.

3.4 TOPOGRAPHIC POSITION IN WATERSHED

Wetlands which have an outlet but no inlet were defined as occurring in the upper portion of the watershed. Wetlands having both an inlet and an outlet, and which occur in the upper 66 percent of the length of the watershed, were defined as intermediate. Wetlands having both an inlet and outlet, and which occur in the lower 33 percent of the watershed, were defined as lower wetlands.

3.5 SIZE

The size categories of large, medium and small describe the surface area of the wetland. The area of each numbered wetland was measured using a digital planimeter to the nearest .040 ha (.10 acre). Wetlands .40 ha (1.0 acre) or less are considered small; wetlands .40 to 1.8 ha (1.1 to 4.5 acres) medium, and 1.8 ha (4.5 acres) and greater are large.

4.0 GEOLOGICAL ELEMENTS

4.1 SURFICIAL MATERIALS

Till is an unsorted, unstratified mixture of all grain sizes deposited by flowing or wasting glacier ice (Flint, 1971). It generally has a low permeability.

Stratified sand and gravel formations consist of sorted and stratified material ranging from 1/4 mm to 2 mm (.001 to .08 inches) in diameter (sand) and from 2 mm to 64 mm (.08 to 2.56 inches) (gravel) deposited by meltwater in predominantly glaciofluvial (glacial stream) environments. These deposits have high permeabilities.

Stratified fine sand and silt formations consist of sorted and stratified material ranging in diameter from 1/4 mm to 1/256 mm (.001 to .0001 inches) or smaller. These are deposited predominantly in glacio-lacustrine (glacial lake) sedimentary environments, and usually have low permeabilities.

Alluvium is gravel, sand, silt and clay deposited in recent fluvial (river) sedimentary environments. Definitions of these elements are found in Flint (1971). Alluvium has variable permeabilities but is generally permeable.

4.2 BEDROCK

Igneous rocks are formed from molten magma and occur either as intrusive or extrusive rocks. Sedimentary rocks are formed directly from sediments. Metamorphic rocks were once either igneous or sedimentary rocks which then were subjected to sufficient heat and pressure to substantially change their mineralogy. Igneous and metamorphic rocks generally have low primary porosity while sedimentary rocks may have moderate to high primary porosity. The classification of wetland bedrock types used is from Motts and O'Brien (1980). Rock types are defined in Bowen (1956); Pettijohn (1957) and Deer et al. (1966).

4.3 ORGANIC MATERIAL

The organic soils of a wetland may be classified as having either high or low permeability. Highly permeable organic soil, such as peat, is defined by the Soil Conservation Service (1980) as Fibric soils. These soils are the least decomposed of all organic soil materials. They contain large amounts of fibers that are well preserved and are readily identifiable as to botanical origin. They commonly have very low bulk density and high water content when saturated. The colors of these materials range from light yellowish-brown, dark brown, to reddish brown.

Wetland soils with low permeability are commonly called muck. The Soil Conservation Service (1980) defines these soils as Sapric soils. They are the most highly decomposed of the organic materials, and normally have the smallest amount of plant fiber, the highest bulk density and the lowest water content at saturation. Color is commonly very dark grey to black.

5.0 HYDROLOGICAL ELEMENTS

5.1 HYDROLOGIC POSITION

5.1.1 Local Aquifer Wetland

The hydrologic position of wetlands is defined by Motts and O'Brien (1980). Perched (local aquifer) wetlands occur when the water table which forms the wetland is distinctly separated by a zone of unsaturated or semisaturated soil between the wetland and the underlying regional (main aquifer) water table (Figure C-6).

5.1.2 Main Aquifer Wetlands

A water table (main aquifer) wetland is one where the regional water table intersects the land surface creating the wetland. A well, screened below the organic soils of the wetland will have a water table equal to or slightly below the land surface of the wetland (Figure C-7).

5.1.3 Main Aquifer/Artesian Wetlands

A water table/artesian wetland (Figure C-8) is one where the regional water table (main aquifer) intersects the land surface. A well, screened below the organic soils of the wetland, will have a water table higher than the wetland surface. Also, the water in the wetland is directly connected to the regional water table which slopes towards the wetland.

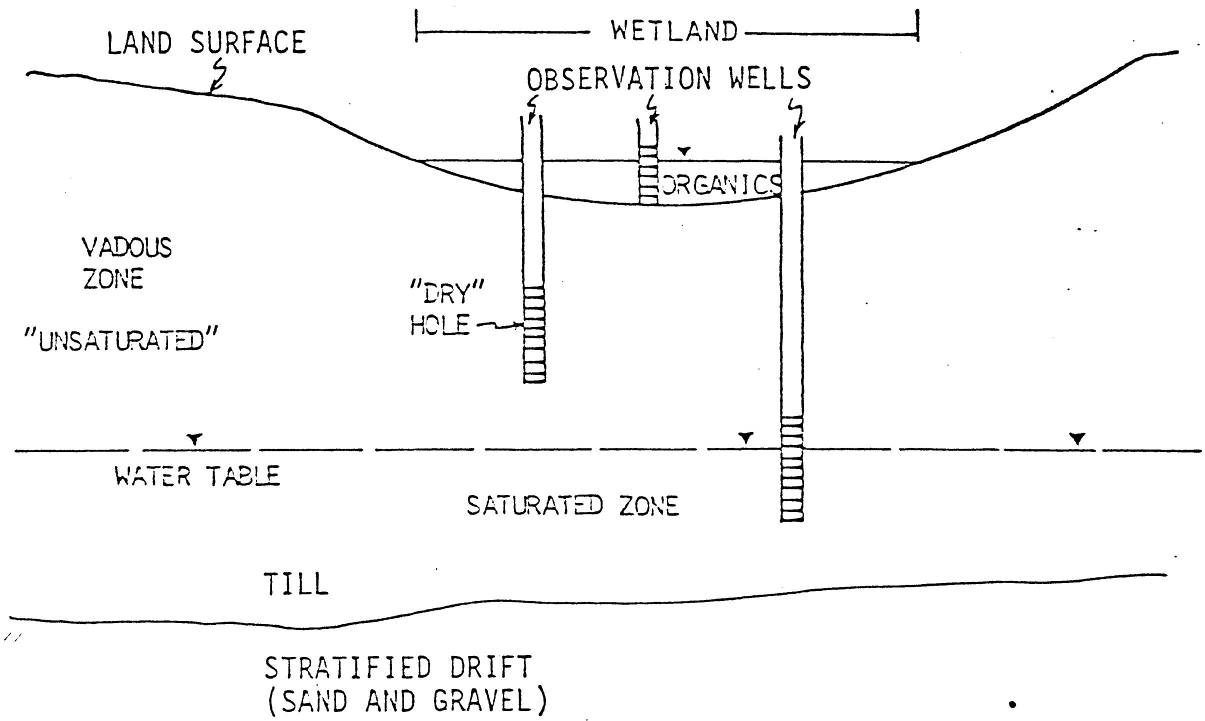

Figure C-6. Cross-section illustrating "perched" water table (local aquifer) conditions.

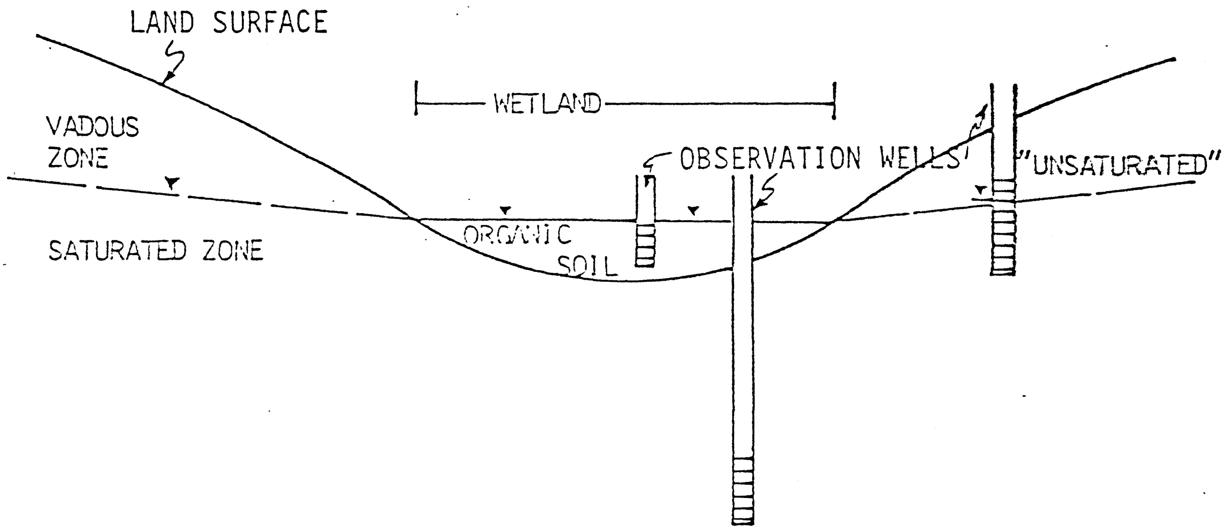

Figure C-7. Cross-section illustrating a water table wetland.

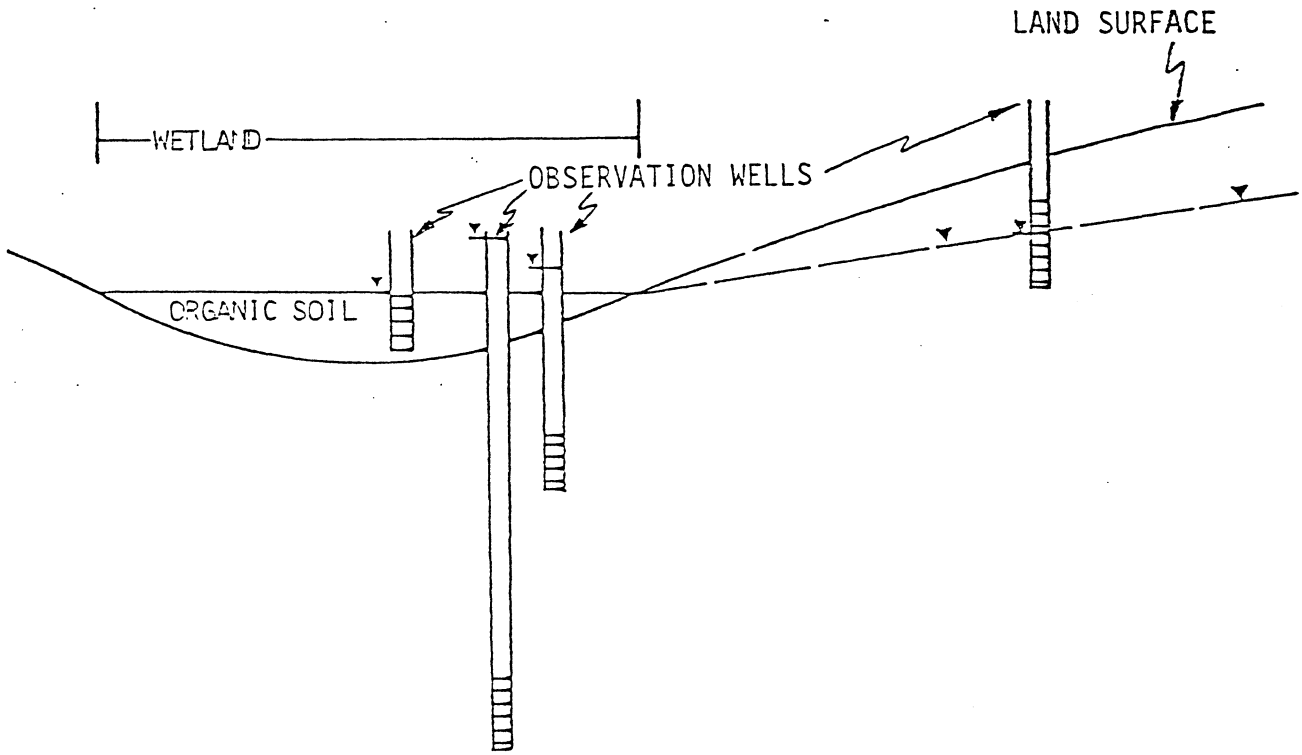

Figure C-8. Cross-section showing a water table/artesian wetland.

5.1.4 Artesian Wetland

An artesian wetland is one where a confining layer exists between the wetland organic soils and an underlying aquifer (Figure C-9). A fault, joints, fractures, or other high permeability zone occurs below the wetland and through the confining layer, whereby water under hydraulic head passes up through the confining layer to the land surface creating a wetland. A well, screened in the aquifer, will have a water elevation above the land surface of the wetland. A well, screened in the confining layer, will either have a water elevation below the land surface or will be dry.

5.2 TRANSMISSIVITY OF AQUIFER

Transmissivity is the rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of an aquifer under a unit hydraulic gradient. It is a measurement of the ease with which water passes through an aquifer. The divisions of transmissivity into high, moderate, and low are those developed by Motts and O'Brien, 1980.

5.3 DOMINANT HYDROLOGIC TYPE

The following hydrologic types refer to the hydrodynamic characteristics of a wetland. Generally, data concerning the hydrodynamics of a wetland are difficult to obtain. Additionally, the relationship between hydrology, biota and wetland values is difficult to define.

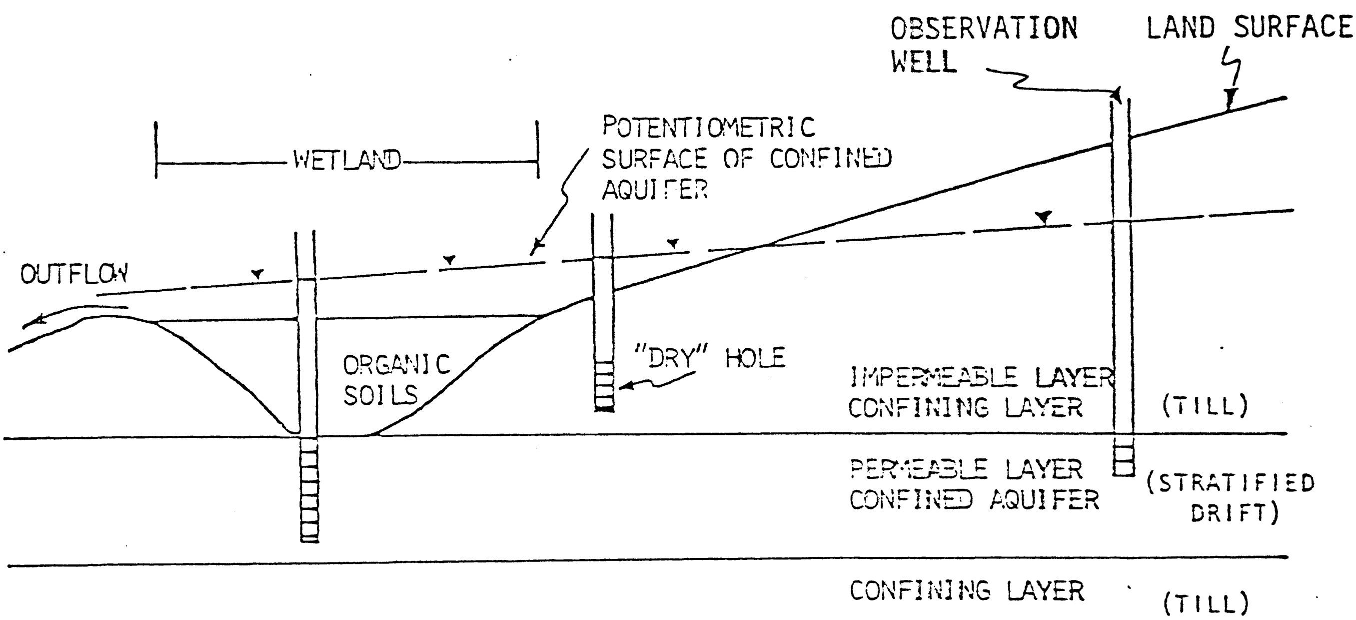

Figure C-9. Cross-section illustrating an artesian wetland.

Gosselink and Turner (1978) presents the best conceptual discussion of the relationship between hydrodynamics and wetland ecosystem characteristics (Figure C-10). The following conceptual model illustrates the role of hydrology in wetland ecosystems. Hydrology determines the chemical and physical properties that in turn allow a specific wetland vegetative community to develop. The organic matter generated by the vegetation modifies the hydrology and the cycle is continuous.

The six hydrologic conditions (IEP, 1976) used on the wetland inventory sheet relate hydrology to the surface water flow velocity, renewal rate, and seasonal timing of water passing through the wetland ecosystem. Many wetland values are assumed to be related to the length of time a molecule of water spends within the wetland ecosystem.

5.3.1 Hydrologic Condition 1

A Condition 1 wetland has a steep gradient, a narrow channel, no floodplain, a gravel to boulder substrate with no organic soils, and little or no vegetation within the channel (Figure C-11). For this type of wetland, surface water flows quickly through this ecosystem. The wetland has little opportunity to store flood waters. Nutrient uptake by plants, and interaction with wetland soils is also limited. A steep gradient rushing mountain brook is typical of this type.

5.3.2 Hydrologic Condition 2

A Condition 2 wetland is a stream with a moderate to low gradient and a floodplain that is relatively narrow and does not flood (stream leaves

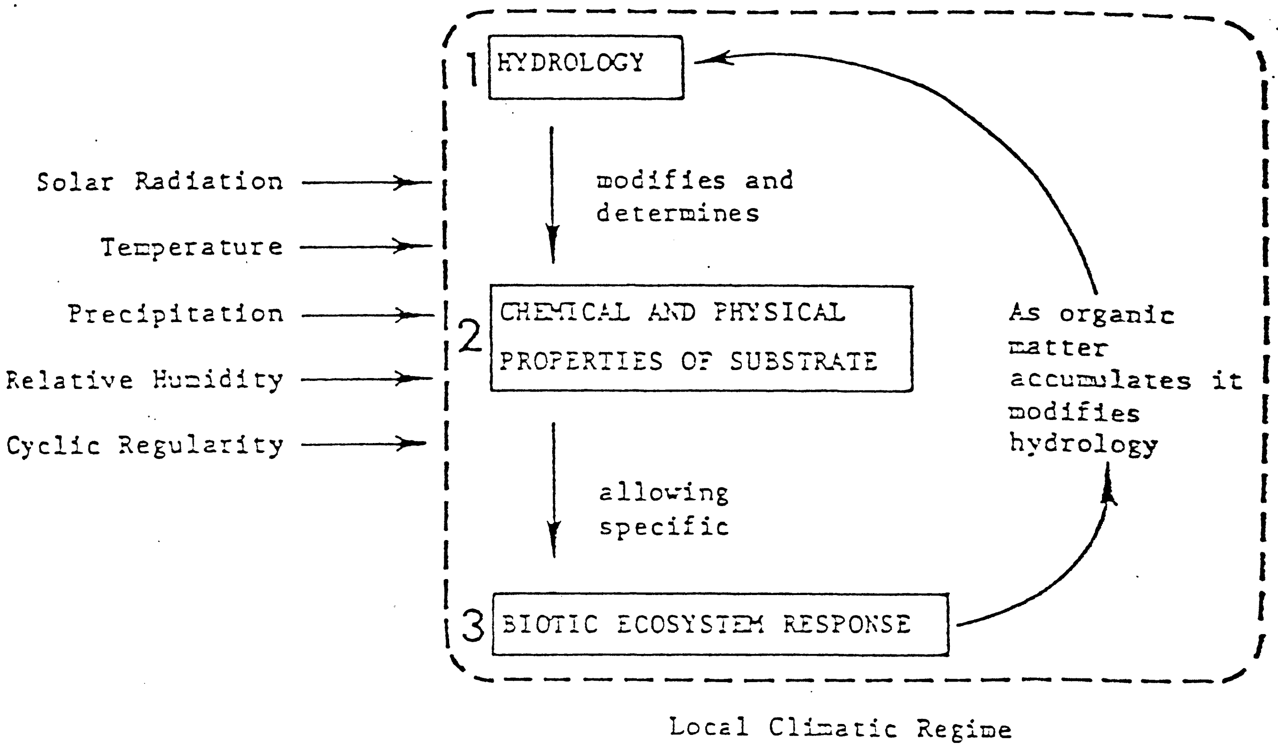

Figure C-10. Conceptual model of the role of hydrology in wetland ecosystems (from Gosselink and Turner, 1978).

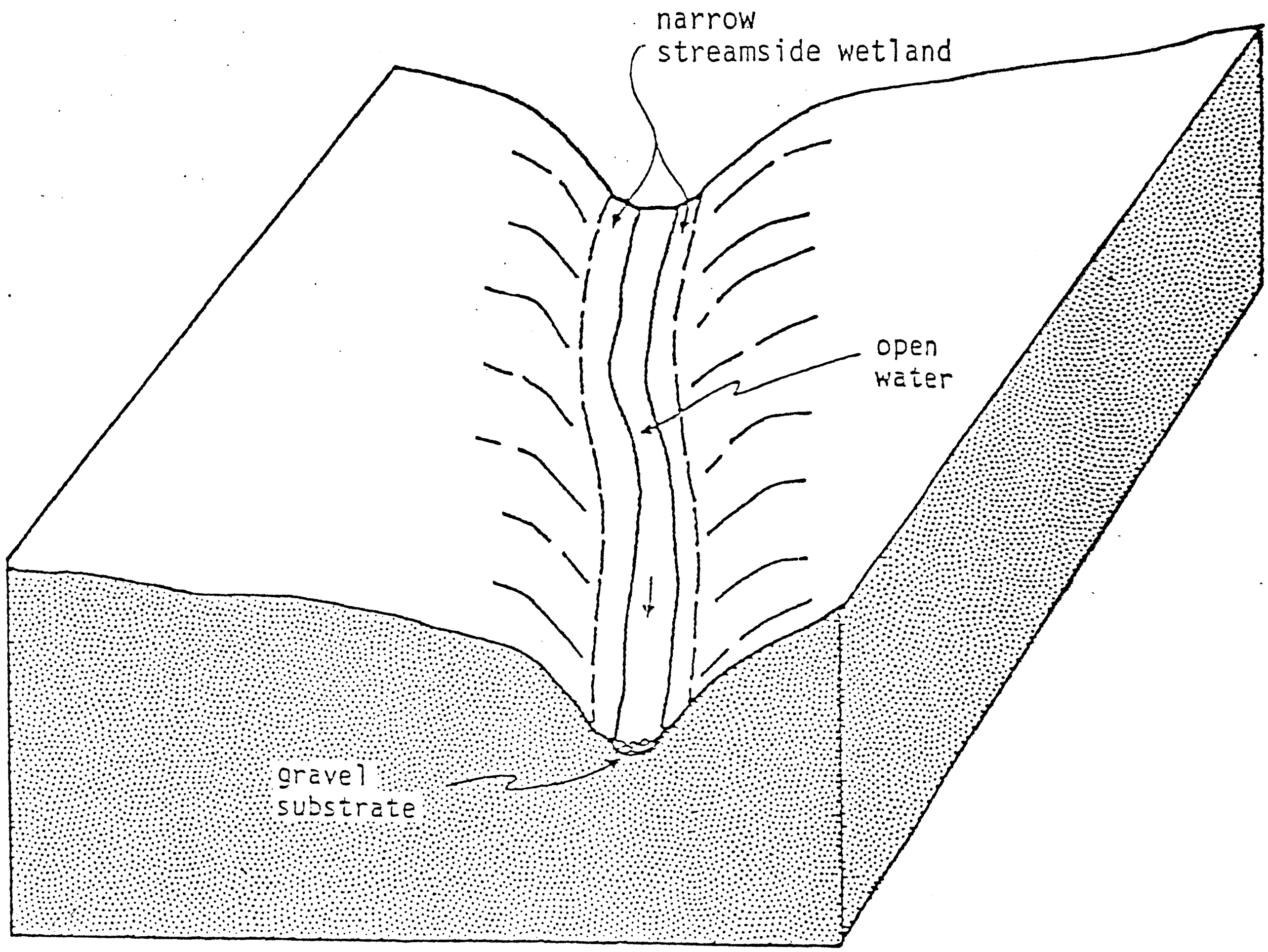

Figure C-11. A block diagram illustrating a hydrologic Condition 1 wetland.

its bank) every year (Figure C-12). The floodplain contains upland vegetation and upland soils.

5.3.3 Hydrologic Condition 3

A Condition 3 wetland is a stream with a low gradient and a wide floodplain which floods annually (Figure C-13). The vegetation of the floodplain consists of wetland plant species and the soil is organic.

5.3.4 Hydrologic Condition 4

A Condition 4 wetland consists of wooded swamp, shrub swamp, or shallow fresh marsh, through which surface water flows in a defined channel or channels (Figure C-14). Organic wetland soils are present. Generally the inflowing stream has a higher gradient than the stream in the wetland which has a very low gradient. The wetland floods at least once a year. Surface water may flow through the vegetated wetland in a braided pattern.

5.3.5 Hydrologic Condition 5

A Condition 5 wetland consists of a wooded swamp, shrub swamp, shallow fresh marsh, wet meadow or bog with a flat profile (Figure C-15). This type of wetland has an inflow stream or streams, a perennial (year long flow) or ephemeral (seasonal flow) outlet stream, and organic soils. Surface water enters and leaves the wetland in a defined channel or flows diffusely through the wetland (through the vegetation, organic debris and soils) with no well defined continuous channel.

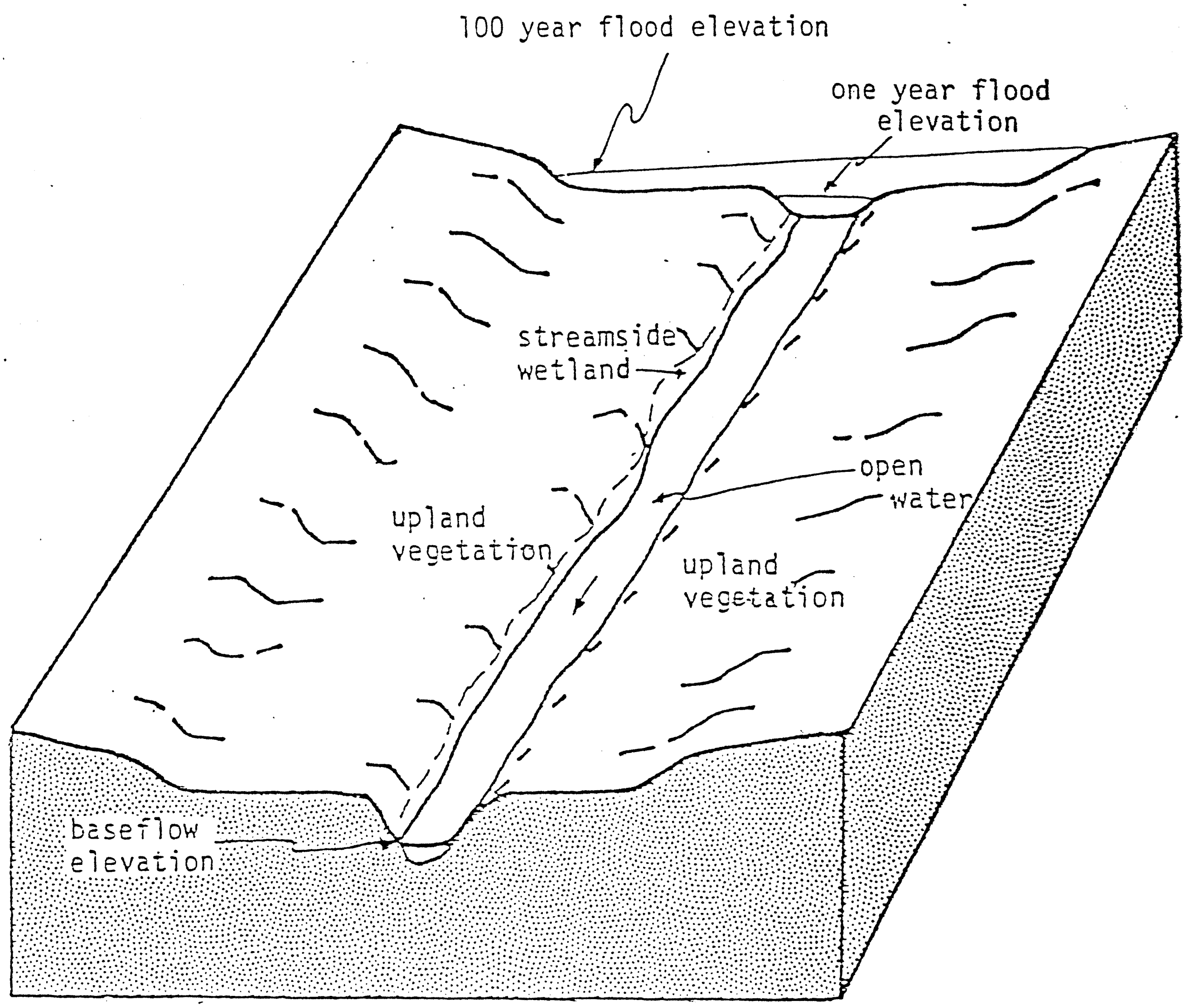

Figure C-12. A block diagram illustrating a hydrologic Condition 2 wetland.

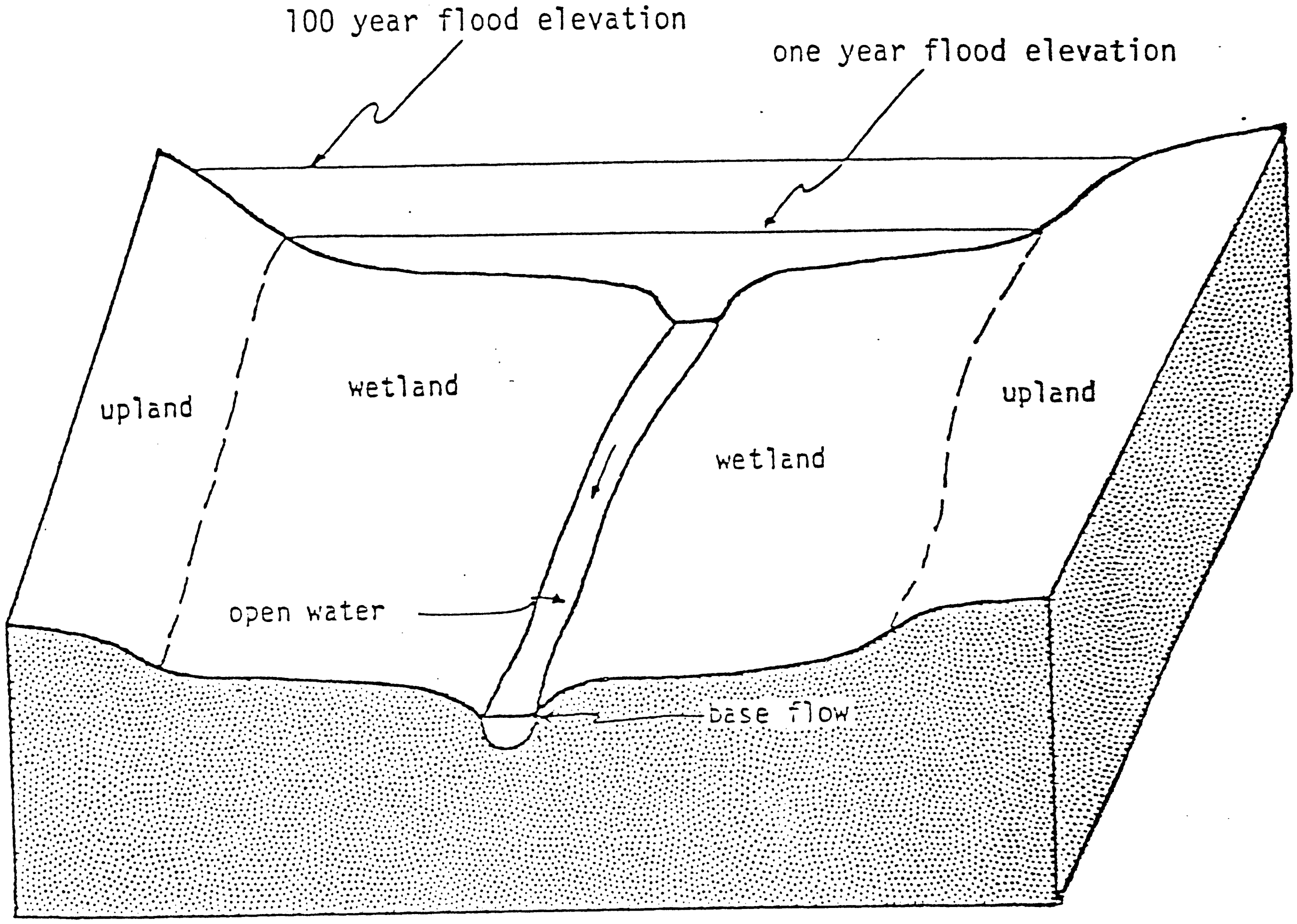

Figure C-13. A block diagram illustrating a hydrologic Condition 3 wetland.

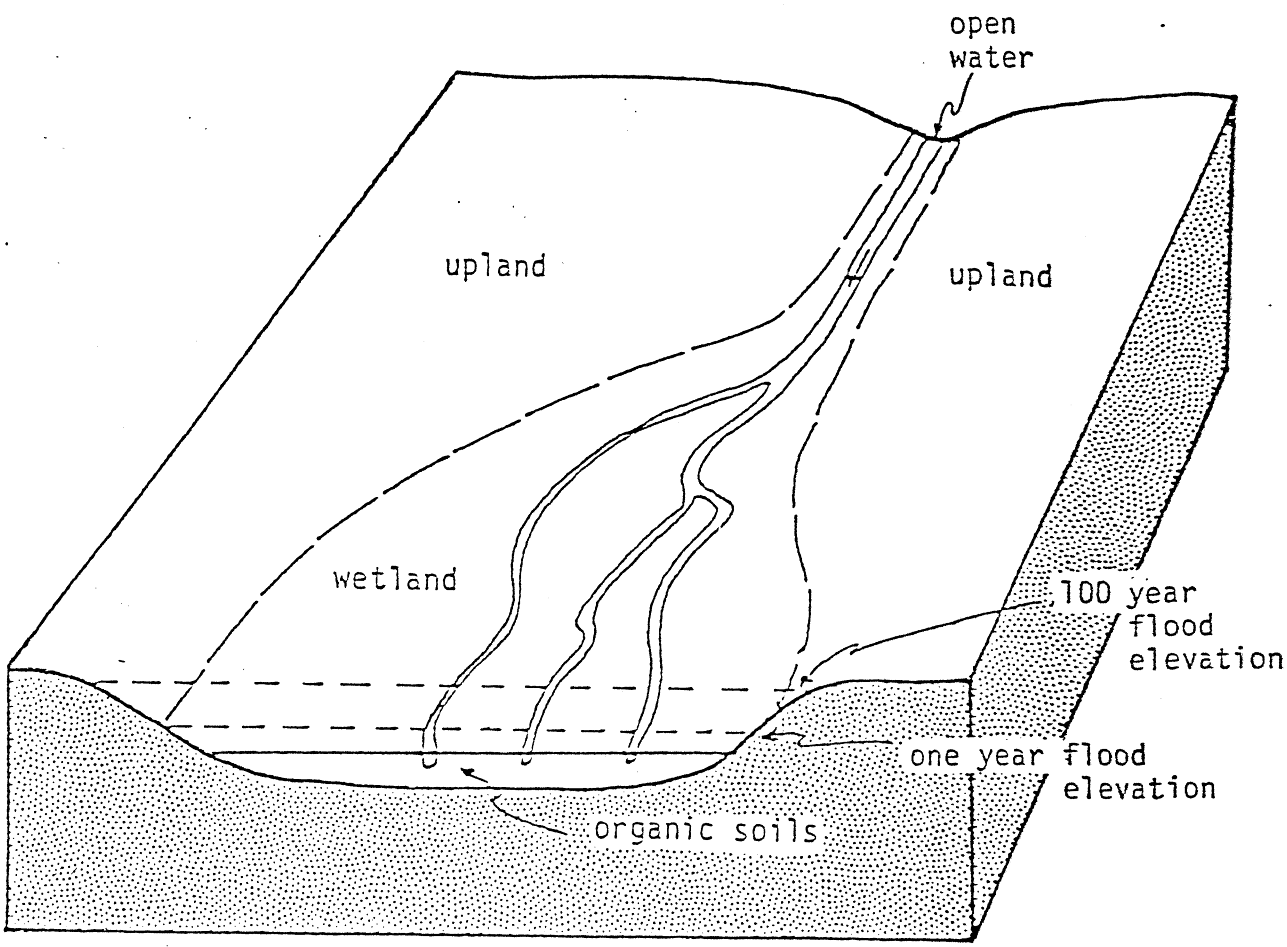

Figure C-14. A block diagram illustrating a hydrologic Condition 4 wetland.

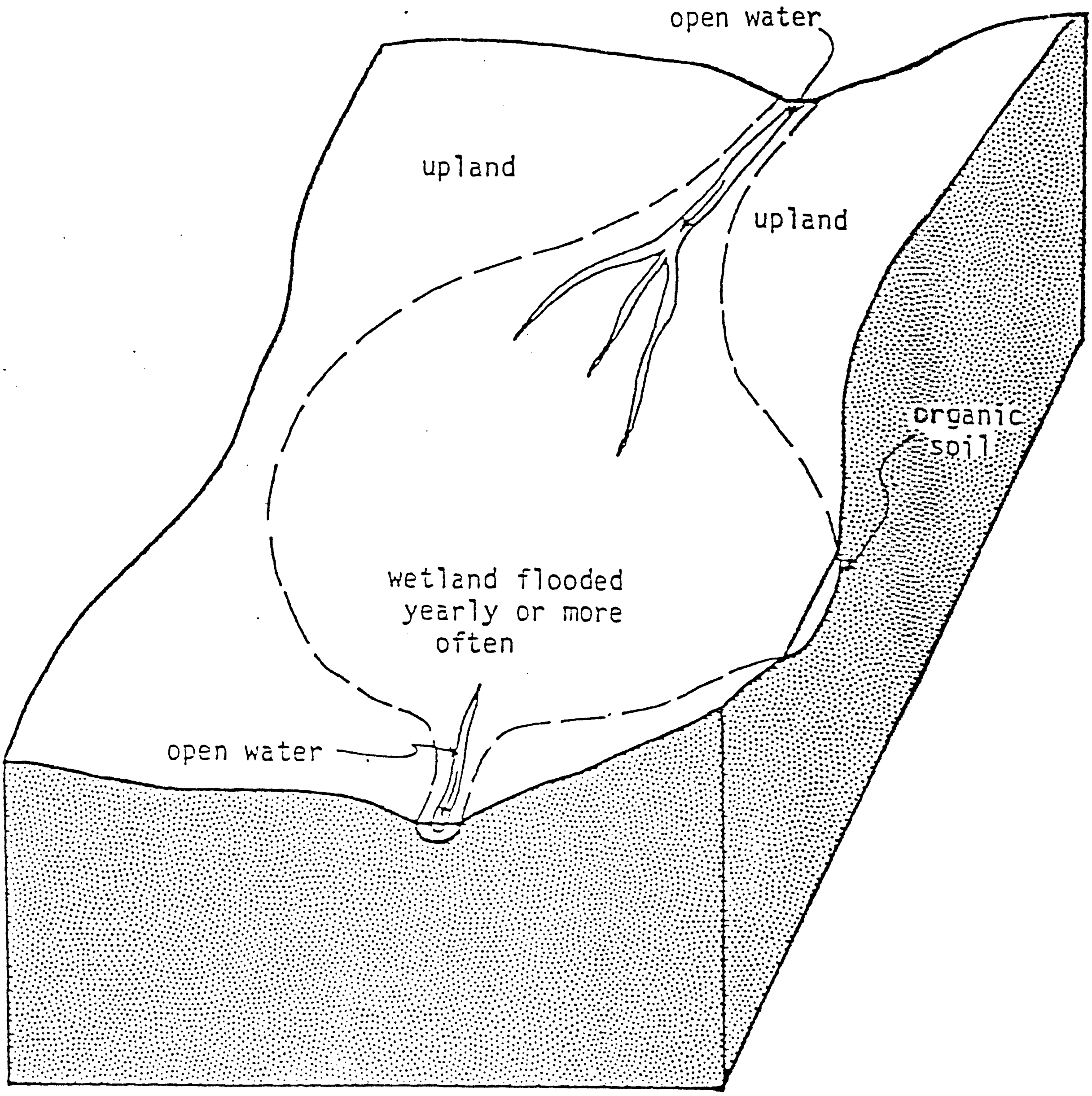

Figure C-15. A block diagram illustrating a hydrologic Condition 5 wetland.

5.3.6 Hydrologic Condition 6

A Condition 6 wetland has no outlet but lies in a closed basin such as a kettle hole (Figure C-16). Inflowing surface water does not leave the wetland other than by evapotranspiration and groundwater recharge.

5.4 HYDROLOGIC CONNECTION

Many wetlands are part of stream (riparian) systems, that is, surface water flows into and/or out of the wetland. A wetland was considered to be part of a riparian system when: 1) a definable stream channel existed with ephemeral or perennial surface water flows, and 2) a valley had no definable stream channel but observable shallow confined interflow or soil water (shallow ground water) flow was observed.

5.5 WATER LEVEL FLUCTUATION

Water level fluctuation is a measure of the seasonal rise and fall of the surface water elevation within a wetland. High water level fluctuations were defined as greater than .60 m (2 feet) per year, and low as less than .60 m. In a vernal pool, the water table is below the land surface of the wetland for the majority of the year, but during the spring rises to slightly above the land surface. The water table in a vernal pool is primarily the result of groundwater fluctuations, rather than surface water flooding.

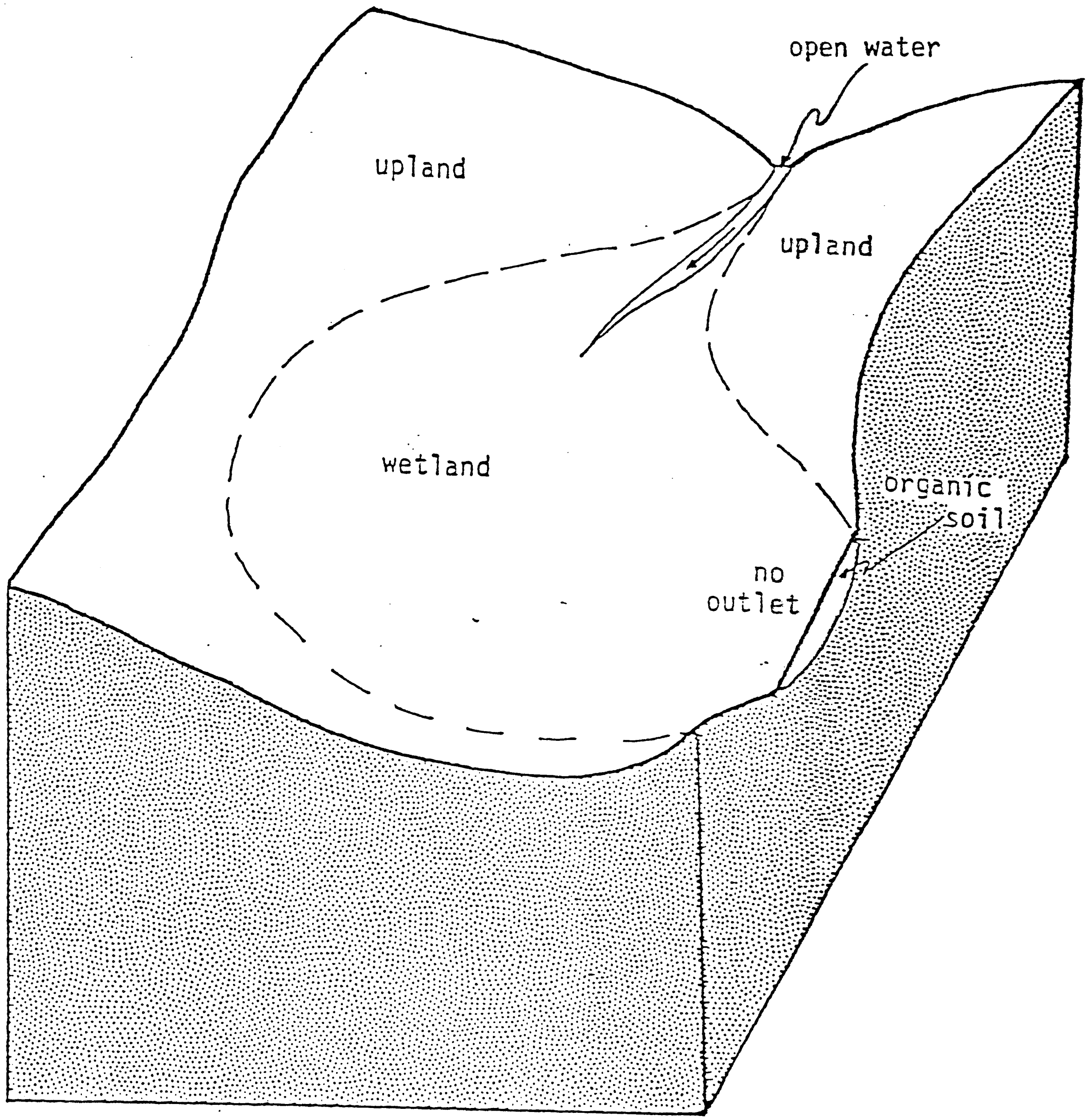

Figure C-16. A block diagram illustrating a hydrologic Condition 6 wetland.

5.6 GROUNDWATER OUTFLOW

Groundwater outflow is the amount of groundwater discharged into the wetland from the underlying aquifer and that exits the wetland through its outlet. Perched (local aquifer) wetlands do not discharge main aquifer groundwater outflow, while wetlands in other hydrologic positions may. Groundwater outflow occurs if the amount of surface water outflow exceeds the amount of surface water inflow. Groundwater outflow may also occur when water is released from storage by wetland organic soils. Water may leave these wetland organic soils primarily by interflow or subsurface streamflow.

5.7 INLET

An inlet is any definable surface water channel which transmits either ephemeral or perennial stream flow, subsurface stormflow or interflow into a wetland.

5.8 OUTLET

An outlet is any definable surface water channel which transmits either ephemeral or perennial stream flow, subsurface stormflow, or interflow out of a wetland to another wetland.

6.0 SOCIAL-ECONOMICAL ELEMENTS

Many of the elements in the preceeding sections are also used in the social-economical models because of their important role in these functions. The following elements are unique to the social-economical models and have not been described in the above sections.

6.1 SURFACE WATER CONNECTION

Surface water connection refers to a condition in which a wetland borders a lake, stream or river, or is part of a riparian system. In a riparian system, surface water flows in a defined channel, or shallow ground-water flows as confined interflow into and out of a wetland. Wetland connection to a lake or a surface riparian system can be readily determined from topographic maps; however, to identify connection to a subsurface riparian system aerial photographs and field observation may be required in addition to topographic maps.

6.2 PUBLIC ACCESS

Public access, as used here, means either a gravel or surfaced roadway of sufficient size, and in a state of repair adequate to permit automobile traffic to within 30.4 m (100 feet) of a wetland. One hundred feet was chosen as the maximum distance that the majority of potential users would be likely to walk. Access also refers to that attained by a waterway such as a lake, river or stream of sufficient size to permit motor boat travel. An isolated wetland is one which is not sufficiently close to either a passable waterway or an adequate roadway to permit access by the majority of the public. Access can be readily determined from recent topographic maps or aerial photographs. This information was updated where necessary, by noting any changes observed while in the field.

6.3 LOCAL SCARCITY

Local scarcity refers to the uniqueness of a particular wetland class within the study area, which was defined as the distance to the nearest similar class or type. This can be assessed from a wetland map having the boundaries of all the wetlands clearly delineated by scaling off the distance between each wetland and the nearest similar type.

6.4 REGIONAL SCARCITY

The regional scarcity of a wetland is not used in any of the functional values models and is assessed separately. For a discussion of methods see Section 4.8.

6.5 PREEMPTIVE ELEMENTS

A wetland which harbors populations of threatened or endangered species, or which provides habitat for such species was immediately accorded special consideration and assessed separately from the functional value model. The protection accorded such species by state and federal statutes further necessitates this special consideration. Other preemptive categories such as "Aquatic Study Area" and "Sanctuary or Refuge" are presented in Section 4.7.

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APPENDIX D

WETLAND INVENTORY REPORT EXAMPLE

WETLAND INVENTORY REPORT EXAMPLE

Wetland F60 is used as an example of how the inventory report was completed in the field and the office. A copy of the inventory report is presented in pages D-5 to D-7.

The cover page of the report identifies the investigator's project number (which is 448), and the wetland number (F60), which identifies the wetland as occurring in watershed F and being number 60 within that watershed. The wetland has been delineated on aerial photo flightline five, photo number 37 of the April 28, 1976, 15275-147613 panchromatic aerial photography, primarily used for wetland delineations. No number was assigned to the wetland map. The area of the wetland was measured on the map with a digital planimeter and found to be 9.4 ha (23.2 acres). This total acreage has been divided into its various subtypes and found to consist of .93 ha (2.3 acres) of shrub swamp and 8.4 ha (20.8 acres) of wooded swamp.

A botanist visited the wetland at a number of locations and penetrated to the center of the wetland. The plant species found were listed under "vegetation" on the second sheet. Both the common and scientific names are listed. The appropriate box was also marked if the plant occurred as an occasional, common or dominant member of the wetland's vegetative community.

The botanist also checked the appropriate boxes under Ecological Elements. These checks were based upon viewing the wetland in the field during the plant species inventory, viewing the aerial photos stereoscopically, and using the orthophoto map, all done in the field at the wetland. The wetland was found to be predominantly an evergreen wooded swamp of 6.2 ha (15.2 acres) and partly a deciduous wood swamp of 2.26 ha (5.6 acres). A shrub swamp .93 ha (2.3 acres) in extent was also found. The appropriate boxes under Wetland Subclasses and Dominant Wetland Class were checked. Since there were only two wetland classes found, the "2" box under Wetland Class Richness was checked. Subclass richness was found to be three so the "2-3" box was checked. Field inspection of the vegetative community found vegetative interspersion to be high and that component was so checked. The botanist inspected the surrounding habitat and checked the appropriate boxes on the sheet. One hundred percent of the wetland consisted of a vegetative cover so the 100 percent box was checked. The juxtaposition of wetland was moderately favorable with wetlands above and below F60. The status of wetland F60 with respect to "Special Elements" designations such as "Aquatic Study Area" and "Sanctuary or Refuge" was determined by researching the land ownership of the wetland and consulting knowledgeable sources. No special elements applied.

The geologist viewed the aerial photos and the orthophoto map and walked the perimeter of the wetland to determine which of the topographic elements applied. The type of topographic configuration was a semiclosed basin. The wetland had a flat gradient (0-3 percent) and slight (0-3 percent) surrounding slopes. Review of the topographic map indicated that wetland F60 was positioned intermediate in watershed F, with respect to other wetlands.

Wetland F60 was located in glacial till as shown on the surficial geologic map of Simpkins et al. (1981). The geologist examined the surficial geologic deposits surrounding the wetland in the field to substantiate this finding. The bedrock which underlies the wetlands' surficial geologic strata consisted of igneous and metamorphic rocks as determined by borings performed at nearby locations by Dames and Moore (1981a) and Golder Associates

(1980). The geologist examined the organic soils exposed at the surface and probed them with a peat probe to determine that high permeability peat is the dominant organic material.

The hydrological elements were assessed both by the surficial geologist and the hydrogeologist. Review of the hydrogeologic data of Dames and Moore (1981b) and Golder Associates (1980), the surficial geologic data of Simpkins et al. (1981), and the field examinations by the geologist and hydrologist indicated that the wetland was a perched (local aquifer) water table overlying dense glacial till having a low transmissivity. The dominant hydrologic type was determined by field inspection to be a Condition 5. Since the wetland had water flowing into and out of it, it was part of a riparian system. Field inspection found no evidence of a high water level fluctuation, so "low" was checked under water level fluctuation. Only one inflowing ephemeral stream was found coming from wetland F68. The outlet of F60 was through a road culvert and was believed to be perennial. This flow was attributed to ground-water outflow from the perched water stored in the high permeability peat soils and the appropriate box was checked.

Under socio-economical elements, the hydrologic connection was found to be to a small stream. Since a road was adjacent to the wetland on two sides, "within 30.6 m (100 feet) of a road" was checked under access to public. No one lived near the wetland and it was in a nearly unpopulated area so the first box under surrounding population density was checked. Review of the orthophotomap and the aerial photos and the site visit found that the distance to a similar wetland type was greater than 304.80 m (1000 feet). No use of the wetland for crops was found and the box for none was checked under Known Crop Value or Potential category.

The size of the wetland was 4.5 acres or greater and the large box was checked. The dominant surficial geologic material of the wetland's watershed as shown by Simpkins et al. (1981) was glacial till and that box was checked. The wetland did not border on any open water. The land ownership of the wetland was private and there was no legal access to the wetland by the public. The boxes regarding fetch and depth of lake were not checked since the wetland did not border a lake.

WETLAND INVENTORY REPORT

PROJECT NUMBER 448

WETLAND NUMBER F60

FLIGHT, PHOTO NUMBER(S) 5-37

MAP NUMBER(S)

ACREAGE 23.16

ACREAGE	PERCENT	
		WET MEADOW
		SHALLOW MARSH
		DEEP MARSH
2.32	10.00	SHRUB SWAMP
20.84	90.00	WOODED SWAMP
		BOG
		OTHER
23.16	100.00	TOTAL

vegetation

	occ	com	dom
Thuja occidentalis		✓	
Arbor vitae			
Tsuga canadensis		✓	
Hemlock			
Acer rubrum	✓		
Red maple			
Populus tremuloides	✓		
Trembling aspen			
Alnus rugosa	✓		
Speckled alder			
Abies balsamea	✓		
Balsam fir			
Sphagnum sp.		✓	
Sphagnum moss			
Betula lutea	✓		
Yellow birch			
Ulmus americana		✓	
American elm			
Ribes sp.		✓	
Gooseberry			

inventory

number F60

date 5/2/81

field investigator(s)

D. Magee

G. Hollands

water quality

Wetland Subclasses

- Stream or Brookside Wetland
- Open Fresh Water
  - [ ] Vegetated Subclass
  - [ ] Non Vegetated Subclass
- Deep Fresh Marsh
  - [ ] Dead Woody
  - [ ] Shrub
  - [ ] Sub-Shrub
  - [ ] Robust
  - [ ] Narrow-Leaved
  - [ ] Broad-Leaved
- Shallow Fresh Marsh
  - [ ] Robust
  - [ ] Narrow-Leaved
  - [ ] Broad-Leaved
  - [ ] Floating-Leaved
- Flood Plain/Flats
  - [ ] Emergent
  - [ ] Shrubs and Trees
- Wet Meadow
  - [ ] Ungrazed
  - [ ] Grazed
- Shrub Swamp
  - [x] Sapling
  - [ ] Bushy
  - [ ] Compact
  - [ ] Aquatic
- Wooded Swamp
  - [x] Deciduous
  - Dominant→ [x] Evergreen
- Bog
  - [ ] Shrub
  - [ ] Wooded

Ecological Elements

Dominant Wetland Class
- [ ] Stream or Brookside Wetland
- [ ] Open Fresh Water
- [ ] Deep Fresh Marsh
- [ ] Shallow Fresh Marsh
- [ ] Yearly Flooded Flood Plain
- [ ] Wet Meadow
- [ ] Shrub Swamp
- [x] Wooded Swamp
- [ ] Bog
- [ ] Other

Wetland Class Richness
- [ ] >5
- [ ] 4
- [ ] 3
- [x] 2
- [ ] 1

Subclass Richness (Lateral Diversity)
- [ ] >10
- [ ] 6-9
- [ ] 4-5
- [x] 2-3
- [ ] 1

Vegetative Interspersion
- [x] High
- [ ] Moderate
- [ ] Low

Surrounding Habitat
- [ ] >90% of 2 or more of Listed Types
- [x] 50-90% of 1 or more; 90% of 1
- [ ] <50% of 1 or more of Listed Types

Cover Type
- [ ] 26-75% Scattered
- [ ] 26-75% Peripheral
- [ ] 75% or <25 Scattered
- [x] 100% Cover; >75% or <25% Peripheral

Percent Open Water
- [x] 0-30%
- [ ] 34-66%
- [ ] 67-95%
- [ ] 96-100%

Vegetative Species Richness
- [ ] Low
- [x] Medium
- [ ] High

Proportion of Wildlife Food Plants
- [ ] Low
- [x] Moderate
- [ ] High

Vegetative Density
- [x] High
- [ ] Moderate
- [ ] Low

Wetland Juxtaposition
- [ ] Highly Favorable
- [x] Moderately Favorable
- [ ] Unfavorable

Special Elements

- [ ] Aquatic Study Area
- [ ] Sanctuary or Refuge
- [ ] Wildlife Management Area
- [ ] Fisheries Management Area
- [ ] Educational Study Area
- [ ] Historical Area
- [ ] Other

Topographical Elements

Topographic Configuration
- [ ] Closed Basin
- [x] Semi-closed Basin
- [ ] Valley
- [ ] Hillside

unusual, rare, or endangered vegetation	unus	rare	end

unusual, rare, or endangered fauna	unus	rare	end

Wetland Gradient
- [x] Slight 0-3%
- [ ] Steep >3%

Surrounding Slopes
- [x] Slight 0-3%
- [ ] Steep >3%

Topographic Position in Watershed
- [ ] Upper
- [x] Intermediate
- [ ] Lower

Geological Elements

Surficial Material
- [x] Till
- [ ] Stratified Sand and Gravel
- [ ] Stratified Fine Sand and Silt
- [ ] Alluvium

Bedrock
- [x] Igneous and Metamorphic
- [ ] Sedimentary

Organic Material
- [ ] Absent
- [x] High Permeability
- [ ] Low Permeability

Hydrological Elements

Hydrologic Position
- [x] Perched Wetland
- [ ] Water Table Wetland
- [ ] Water Table/Artesian Wetland
- [ ] Artesian Wetland

Transmissivity of Aquifer
- [x] Low <10,000 gal/day/ft
- [ ] Moderate 10,000 - 40,000 gal/day/ft
- [ ] High >40,000 gal/day/ft

Dominant Hydrologic Type
- [ ] Condition 1
- [ ] Condition 2
- [ ] Condition 3
- [ ] Condition 4
- [x] Condition 5
- [ ] Condition 6

Hydrologic Connection
- [ ] Not Part of Riparian System
- [x] Part of Riparian System

Water Level Fluctuation
- [ ] High
- [x] Low
- [ ] Vernal Pool

Groundwater Outflow
- [x] Absent
- [ ] Present

Inlet
- [ ] Absent
- [x] Present, from wetland F68
- [ ] Perennial
- [x] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ____
- [ ] Perennial
- [ ] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ____
- [ ] Perennial
- [ ] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ____
- [ ] Perennial
- [ ] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ____
- [ ] Perennial
- [ ] Ephemeral

Outlet
- [ ] Absent
- [x] Present, to wetland ____
- [ ] Perennial
- [x] Ephemeral

Outlet
- [ ] Absent
- [ ] Present, to wetland ____
- [ ] Perennial
- [ ] Ephemeral

Size
- [x] Large >4.6 acres
- [ ] Medium 1.1-4.5
- [ ] Small <1 acres

Surficial Geologic Material of watershed
- [x] Till
- [ ] Stratified sand and gravel
- [ ] Stratified fine sand and silt
- [ ] Alluvium

Percent Wetland Bordering Open Water
- [ ] < 33%
- [ ] 34-66%
- [ ] 67-100%
- [x] Does not border

Legal Access
- [ ] Yes
- [x] No

Fetch
- [ ] Over 2000 ft.
- [ ] Under 2000 ft.

Depth of Lake
- [ ] Deep >6 ft.
- [ ] Shallow <6 ft.

Social-economical Elements

Hydrologic Connection
- [x] Connected to a Small Stream
- [ ] Connected to a River
- [ ] Connected to a Lake
- [ ] Connected to a Combination

Access to Public
- [x] Within 100 ft of Road
- [ ] Access by Passable Waterway
- [ ] Isolated

Surrounding Population Density
- [x] <1 person/acre (<320/mi²)
- [ ] 0.5 - 1.9 p/a (430-1220/mi²)
- [ ] >2 p/a (>1220/mi²)

Local Scarcity
- [ ] <200 ft to nearest similar type
- [ ] 201 to 1000 ft to nearest similar type
- [x] >1000 ft to nearest similar type

Known Crop Value or Potential
- [x] None
- [ ] Supports 1 family for part of year
- [ ] Completely supports 1 family
- [ ] Supports viable commercial interest

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APPENDIX E

DESCRIPTION OF WETLAND FUNCTIONAL MODELS

PREFACE

The information presented in this appendix addresses the specific assumptions that were used by the investigators to arrive at the various element weights and condition weights illustrated on Table E-1 through E-10. The precedence for assigning numerical wetland element values to assess wetland functions was established by Golet and Larson (1974) and expanded by Reppert et al. (1979). These authors followed established environmental planning principles such as those put forth by McHarg (1969). This approach has been used in numerous Environmental Impact Statements for state and Federal agencies.

The models apply to all wetlands, with only one exception. The Shoreline Protection function model (Table E-5) only applies to those wetlands which border on a lake or stream. Many wetlands in the study area do not border on a lake or stream and have no shoreline protection function.

DESCRIPTION OF WETLAND FUNCTIONAL MODELS

1.0 BIOLOGICAL FUNCTION MODEL

The Biological Function Model was based on the wildlife habitat models developed by Fried (1973) and Golet and Larson (1974) and has been modified to address the specific considerations presented under "Biological Functions" in NR 132.06 of the Wisconsin Administrative Code (Table E-1). The elements that comprise this model were selected to evaluate those wetland features known to determine "the kinds, numbers and relative abundance" of animal species, "wildlife production and use", "short- and long-term importance of the wetlands to both aquatic and terrestrial species" and "specialized wetland functions essential for an organism to complete its life cycle requirements such as cover, spawning, feeding and the like." In general, life form (growth form or habit) and arrangement of the vegetation were the most important considerations in this model. Classical works by MacArthur and MacArthur (1961) and Weller and Spatcher (1965) have demonstrated the key role of vegetation in determining wildlife production and variety. Porter (1981) recognized the key role that the wetland-upland transition zone played in wildlife habitat.

Vegetative density was used as an expression of biomass, which served as an indicator of "net primary production of plant communities." Pratt and Andrews (1981) indicated that wetlands are naturally very productive habitats often nutrient sinks, and that their biomass represents a large potential energy source. Other elements were less directly used; surface water connection, for example, was an indicator of the "kinds and amount of organic material transported to other aquatic systems as a potential energy

Table E-1. Biological Function Model.

Elements	Element Weight	Condition Weight	Conditions
Unique Fisheries[a]	NA[b]	NA	Present
		NA	Not Present
Presence of Endangered or Threatened Species[a]	NA	NA	Present
		NA	Not Present
Dominant Wetland Class	5	1	Stream or brookside wetland
		0	Open fresh water
		4	Deep fresh marsh (aquatic bed)
		5	Shallow fresh marsh
		5	Yearly flooded floodplain
		2	Wet meadow
		4	Shrub swamp
		2	Wooded swamp (deciduous)
		4	Wooded swamp (coniferous)
		3	Bog
Number of Wetland Classes (Richness)	4	5	>5
		4	4
		3	3
		2	2
		1	1
Number of Wetland Subclasses (Richness)	3	5	>10
		4	6-9
		3	4-5
		2	2-3
		1	1
Vegetative Interspersion	4	3	High
		2	Moderate
		1	Low

[a] = Preemptive Factors
[b] = Not applicable

Table E-1. (continued)

Elements	Element Weight	Condition Weight	Conditions
Surrounding Habitat	3	3	>90% of two or more of listed types
		2	50-90% of one or more: 90% of one
		1	<50% of one ore more of listed
Water/Cover Ratio (Cover Typed)	3	4	26-75% scattered
		2	26-75% peripheral
		3	75% or <25% scattered
		1	100% cover: >75% or <25% peripheral
Number of Plant Species (Vegetative Species Richness)	2	1	Low
		2	Medium
		3	High
Proportion of Wildlife Food Plants	1	1	Low
		2	Moderate
		3	High
Vegetative Density	2	3	High
		2	Moderate
		1	Low
Wetland Juxtaposition	3	3	Highly favorable
		2	Moderately favorable
		0	Unfavorable
Hydrological Position (Groundwater Connection)	2	1	Perched wetland
		4	Water table wetland
		3	Water table/artesian wetland
		3	Artesian wetland
Water Level Fluctuation	1	2	Low
		1	Vernal pool
		0	High

Table E-1. (continued)

Elements	Element Weight	Condition Weight	Conditions
Surface Water Connection	1	1	Connected to a small stream
		2	Connected to a river
		3	Connected to a lake
		4	Connected to a combination
		0	Not connected
Percent Wetland Bordering on Open Water	4	1	<33%
		2	34-66%
		3	67-100%
		0	Does not border
Size	5	3	Large $\geq$ 4.6 acres
		2	Medium 1.1-4.5 acres
		1	Small $\leq$ 1.0 acres
	Range 29-158		
	Mean 93		

source for consumer organisms in those systems." In aggregate, the elements of this model constituted an evaluation system designed to assess the maximum potential of a wetland for biological production and variety. Each of these elements is described in Table E-1.

1.1 PREEMPTIVE FACTORS

Wetlands bordering a water body that supports unique commercial or recreational fisheries, or which provide habitat for or are frequented by threatened or endangered species were immediately identified for more thorough analysis.

1.2 DOMINANT WETLAND CLASS

As a result of the important role vegetation life form plays in determining wildlife habitat value, Dominant Wetland Class was accorded a weighting of five. Some wetland classes have a higher value than others for wildlife species diversity and production rate because of the differences in vegetative life form and water depth and permanence. Shallow marsh, for example, was one of the most valuable classes because of the habitat provided for nesting birds and various mammals, particularly muskrats. This class was also assigned a value of five. Yearly flooded floodplain was also a very valuable class because of its importance as nesting habitat for many wetland animals, particularly waterfowl, and from its importance as a waterfowl feeding area during migration. This class was also assigned a value of five. A steep-sided stream or brookside wetland, on the other hand was one of the least valuable classes because of the poor development of wetland functions essential for an organism to complete its life cycle requirements; therefore, this class was assigned a value of one. The weights assigned to the remaining classes in this element are presented in Table E-1.

1.3 NUMBER OF WETLAND CLASSES (RICHNESS)

As the number of wetland classes increases so does the variety of plant life forms which, in turn, increases the potential for wildlife species diversity (Weller and Spatcher, 1965). This was one of the most important wetland features in determining kinds, numbers and relative abundances of wildlife species, and wildlife production and use; therefore, this element was assigned a weight of four. The weight assigned to the condition increased or decreased depending on the number of wetland classes comprising the wetland (Table E-1).

1.4 NUMBER OF WETLAND SUBCLASSES (RICHNESS)

This element was a refinement of "Number of Wetland Classes" in assessing the potential for wildlife species diversity. As the number of subclasses increases so do those features important in the life cycles of many wildlife species, such as cover and food, which increases the kinds and numbers of wildlife that can be supported in an area. Differences among subclasses are probably less important than differences among classes with respect to increases in wildlife habitat variety (Golet and Larson, 1974); therefore this element was assigned a weight of three. The weight assigned to the condition increased or decreased depending on the number of sub-classes present (Table E-1).

1.5 VEGETATIVE INTERSPERSION

As stated above, wildlife density and species diversity are primarily a function of vegetative life form variety and arrangement. Since most species of wildlife require more than one life form of vegetation, wildlife population density and species diversity were closely related to the length and number of different kinds of edge. As vegetative interspersion increases, wildlife production and use, and overall biological production improves. Because of its importance in the model, this element was accorded a weight of 4. The conditions were weighted on a descending scale from high to low (Table E-1).

1.6 SURROUNDING HABITAT

The habitat surrounding a wetland is an important factor affecting its wildlife production since the life cycle requirement of many species is satisfied partly in wetlands and partly in uplands. Many waterfowl and other wildlife depend upon surroundings such as hay fields, corn, and oak forests for food and nesting cover. The nature of the surrounding habitat also determines which upland wildlife are likely to utilize the wetland. Marshes, for example, provide cover for pheasants and cottontail rabbits. Uplands also provide a buffer against human disturbance, a frequent deterrent to successful breeding, and wetlands bordered by agriculture, forest land and abandoned open land have a higher wildlife support capacity than those surrounded by industry, housing or outdoor recreation. Based on its role in determining the importance of a wetland to both aquatic and terrestrial species this element was assigned a weight of 3. The listed types in the three conditions refer to agriculture, forest land and abandoned open land . (Table E-1).

1.7 WATER/COVER RATIO (COVER TYPE)

The relative proportion of vegetative cover and open water in a wetland is a very important factor affecting the kinds, numbers and relative abundance of wildlife species. Investigators have found that maximum numbers and species diversity of wetland wildlife occurred where a water/cover ratio of 50:50 was attained (Weller and Spatcher, 1965). Wetlands having nearly total cover or total open water were less valuable than wetlands with nearly equal proportions of each. The degree of water/cover interspersion was also an important factor affecting value. Scattered cover, or cover interspersed with water was a more valuable condition than peripheral cover or water because of the greater edge which results (Delacour, 1964). Based on its role in determining wildlife production and use, this element was assigned a weight of 3. The weight assigned to the condition was related to both the ratio of cover to open water and the degree of interspersion (Table E-1).

1.8 PLANT SPECIES VARIETY

As the number of different plant species in a wetland increases, so also does the species diversity of invertebrate fauna supported by the vegetation. This is directly related to the food available to certain wildlife species and life stages, and is therefore an indicator of wildlife production. Also, some wildlife, including certain waterfowl, tend to be plant species specific with regard to placement of nests (Delacour, 1964) or in selection of plant foods. Thus, although life form plays a more important role in wildlife production and use of a wetland, plant species variety is also a contributing factor. As plant species variety increases the potential of the wetland to provide specialized functions essential for some wildlife to complete their life cycle requirements also improves. Because of its secondary role in determining wildlife production and use, this element was assigned a weight of 2. The condition (high, medium, low) was chosen using best professional judgement, based on comparing the kinds of plant species inventoried in a unit area of a given wetland to those found in the same unit areas of other wetlands in the study area (Table E-1).

1.9 PROPORTION OF WILDLIFE FOOD PLANTS

This element is a direct indicator of wildlife production and use, and of the degree of expression of those wetland functions which are essential for wildlife to fulfill their feeding requirements. Some plant species provide food for only a short time, but this is often during critical periods in wildlife cycles such as during annual migrations or before the onset of winter. Other plant species produce structures that supply food over winter. Both kinds of food production along with other factors, such as quantity produced, were considered in the analysis of plant food availability. Since vegetative structure plays a greater role in wildlife production and use than do the edible parts of plants, this element was assigned a weight of 1. It was included, however, to distinguish wetlands in which plant food production was particularly high so that when it occurred the contribution of such a condition to the overall assessment could be added. The condition (high, medium, low) was chosen following the field inventory, and was based on the food value of each species listed on the wetland inventory report (Martin et al., 1961) and its relative abundance (Table E-1).

1.10 VEGETATIVE DENSITY

Vegetative density is an expression of biomass or standing crop, which can serve as an index of net primary production of plant communities depending upon age of the wetland. During early wetland stages, such as shallow marsh and shrub swamp, high density is much more directly related to high primary production than in a mature wetland stage, such as wooded swamp. In the latter type, a large quantity of biomass may be represented in the vegetative structure while net annual primary production is very low. Moreover, in the younger stages a higher proportion of the primary production is in the form of edible structures that can be utilized by wildlife for food. However, in all stages, high plant density provides more breeding, resting and escape cover so that higher wildlife densities per unit area can be accommodated. Vegetative density, therefore, can serve both as an index of primary production and an indicator of potential numbers and relative abundance of wildlife species (Smith, 1980). Based on its contribution to the overall wildlife support value of a wetland, this element was assigned a weight of 2 (Table E-1).

1.11 WETLAND JUXTAPOSITION

Wildlife production and use in a wetland is generally higher if it is located near other wetlands, particularly those of a different class or with different subclasses. This value improves if the wetlands are connected by streams which provide cover and travelways to permit wetland wildlife to move safely between wetlands. This element becomes less important in large, diversified wetlands in which life cycle requirements can be met without travelling to other wetlands. Based on its contribution to wildlife production and use, wetland juxtaposition was assigned a weighting of 3. The condition in which other wetlands were nearby and connected by streams was highly favorable and was accorded a weight of 3; if wetlands were nearby but not connected, the condition was moderately favorable and was given a weight of 2. Isolated wetlands received no value for wetland juxtaposition (Table E-1).

1.12 HYDROLOGIC POSITION (GROUND-WATER CONNECTION)

The position of a wetland with respect to ground water determines its longevity, water level fluctuation and nutrient level. Productivity rates of wetland plants are closely related to nutrient availability and abundance. Local aquifer (perched) wetlands have shorter longevity, lower nutrient levels, less diverse vegetation and greater water level fluctuation when compared with those connected to the main aquifer (Bay 1967). In wetlands connected to the main aquifer, water level is relatively constant and the abundance and availability of nutrients is higher because of ground water movement through the wetland soils. As a result, plant productivity rates are higher and wildlife production and use is greater. In general, main aquifer wetlands potentially have a greater short- and long-term importance to wildlife than local aquifer wetlands. In comparison with the contributions of other elements in the model, hydrologic position was assigned a weight of 2. The level of discrimination between water table/artesian wetlands and artesian wetlands was not important with respect to those wetland functions relevant to wildlife cycles, and both were assigned a weight of 3 (Table E-1).

1.13 WATER LEVEL FLUCTUATION

The magnitude of water level fluctuation in a wetland has a direct effect on wildlife production and use. Wide fluctuations adversely affect a large variety of wildlife species. High water may destroy nests and young, and low water may expose the nests to predators. Although the contribution of this element to the model was considerably less than that of other elements (an assigned weight of 1), water level fluctuation was a consideration that affected the ability of a wetland to fulfill wildlife requirements and was part of the overall evaluation. Since low water fluctuation was the preferred condition it was assigned a weight of 2. Wetlands with a high water level fluctuation receive no rating for this element (Table E-1).

1.14 PERCENT OF WETLAND BORDERING OPEN WATER

The value of a wetland with respect to wildlife support is greater if associated with a stream, river or lake than if isolated. Open water provides habitat for waterfowl during migration and during the breeding season, as well as for other wildlife, such as otter and raccoons. The greater the percentage of wetland edge bordering open water, the higher the numbers and kinds of wildlife that will utilize the wetland. Because of the importance of this element in determining wildlife production and use, it was accorded a weight of 4. The weights assigned the conditions varied with the percent of wetland bordering open water (Table E-1).

1.15 SURFACE WATER CONNECTION

The kind of open water connected to a wetland influences wildlife production and use as well as the transport of organic material to other aquatic systems. Although some small streams, particularly those bordering marshes, may provide some habitat for waterfowl broods and other wildlife, the spectrum of aquatic and terrestrial wildlife which are able to fulfill certain life cycle requirements is greater in wetlands bordered by rivers and lakes. Thus, rivers, lakes and particularly combinations of riparian and lake habitats greatly improve wildlife production in the wetlands they border. In general, rivers are more important than small streams with respect to the transport of organic material because of the higher predictability of surface water flow during summer months. Overall however, the kind of surface water connection was less important than the percentage of bordering wetland edge; therefore, this element was assigned a weight of 1. The weight assigned to the conditions varied with the kind of water body and with combinations receiving the heaviest weighting (Table E-1).

1.16 SIZE

In general, as wetland size increases so does its value for wildlife production and use. Greater size results in greater insulation from human disturbance on the periphery. Also, habitat variety tends to improve with increased size, so that a large wetland would be more likely to fulfill all of a species life cycle requirements than a small wetland. Large wetlands are valuable as waterfowl feeding and resting areas during migration. Moreover, the factors which determine longevity such as permanence of the water table and watershed size were correlated with large wetland size. As a result of the important role of this element in determining the kinds and numbers of wildlife supported by the wetland, it was accorded a weight of 5. The weight assigned to the condition was directly related to size (Table E-1).

2.0 WATERSHED FUNCTION MODELS

Watershed functions, as defined in proposed Wisconsin NR 132 consist of five separate functions; hydrologic support, ground-water, storm and floodwater storage, shoreline protection, and water quality maintenance functions. The following text describes the models for these functions.

2.1 HYDROLOGIC SUPPORT FUNCTION MODEL

Water resides in wetlands for a limited time; that is, some water is always passing through a wetland. Water leaves wetlands by evaporation-transpiration, recharge to the ground-water system or as surface water outflow to downstream areas (Winter, 1981a). The ability of a vegetative wetland to discharge surface water to downstream surface waterbodies, streams, lakes and other vegetated wetlands, is important in maintaining the chemical and physical integrity of downstream aquatic ecosystems.

The Hydrologic Support Function Model (Table E-2) is designed to assess the "Hydrologic Support Function" of a wetland defined in the Wisconsin Administrative Code, NR 132, by inventorying those physical elements which in combination allow a wetland to function so that it controls the quantity and quality of water that it discharges to downstream waterbodies. These physical elements defined in NR 132 include location, topographic position, areal extent (size), degree of connection, hydrologic regime, water chemistry, velocity, water depth, fluctuation patterns, water renewal rate and temporal pattern.

It is difficult to separate wetland functions into specific definitions. The functions ascribed to wetlands are highly interrelated. For

Table E-2. Hydrologic Support Function Model.

Elements	Element Weight	Condition Weight	Conditions
Size	4	3	Large $\geq$ 4.6 acres
		2	Moderate 1.1-4.5 acres
		1	Small $\leq$ 1.0 acres
Topographic Configuration	1	3	Semi-closed basin
		2	Valley
		1	Hillside
		0	Closed basin
Dominant Hydrologic Type	5	1	Condition 1
		2	Condition 2
		3	Condition 3
		4	Condition 4
		5	Condition 5
		0	Condition 6
Water Level Fluctuation	2	2	Low
		1	High
Outlet	4	2	Perennial Outlet
		1	Ephemeral Outlet
		1	Groundwater Outflow
		0	Absent
Inlet	1	2	Perennial
		1	Ephemeral
		0	Absent
Percent Wetland[a] Bordering on Open Water	4	1	<33%
		2	34-66%
		3	67-100%
		0	Does not border
		Range 6-66[b] Mean 36	

[a] Applies only to those wetlands with an outlet.

[b] Total value for one inlet and one outlet only.

example, the hydrologic support function is closely related to the prevention of pollution and stormwater storage functions. In other words, these two wetland functions, in part, control the quantity and quality of water passed down stream. Thus, when assessing the hydrologic support function of a wetland, one must assess, in part, the wetland's stormwater storage and prevention of pollution function. Reppert et al. (1979) define a method to determine the hydrologic support functions of wetlands, but emphasize flushing rates as opposed to frequency of flooding. No consideration is given for base water flow maintenance.

According to NR 132 (Wisconsin Administrative Code), there is a correlation between specific wetland physical elements such as "location" and "topographic position" and a physical condition such as hydrologic "degree of connection". The hydrologic support function model includes those physical elements which give rise to a particular wetland functioning "to maintain the hydrologic characteristics, and thereby the physical and chemical integrity of an entire aquatic ecosystem." These elements are listed in the model (Table E-2).

2.1.1 Size

The size of a wetland was considered to be a critical element in the hydrological support function and was given a weight of 4. The larger a wetland, the more potential it has to contribute to the "hydrologic regime" of downstream receiving hydrologic systems. If all other inventory elements were equal between two wetlands except size, the larger wetland should better support the hydrological regime (Table E-2).

2.1.2 Topographic Configuration

Particular topographic wetland configurations dictate the "temporal pattern" or the "frequency of inundation" potential of a wetland. They also, in turn, control "water velocity" and the "ability of the water to carry suspended particulate matter." "Water depth, fluctuation patterns" and water "renewal rates" are also controlled in part by the topographic configuration. The topographic configuration, which slows the flow of water (reduces water velocity), and controls temporal patterns was considered most beneficial to the hydrologic support function of a wetland. This situation was defined as a semi-closed basin and it was given a condition weight of 3. Valleys and hillsides, respectively, were considered to be less beneficial. The element weight given to topographic configuration was low (1) since it was considered not to be as important as other elements (Table E-2).

2.1.3 Dominant Hydrologic Type

Dominant hydrologic type is used to describe the residence time of water in a wetland, travel time for a drop of water moving through a wetland. The more time a drop of water spends in the wetland, the greater its chance to interact with the physical elements of the wetland. This is a measure of the "living filter" function of a wetland which controls water chemistry to include "ionic composition" and "oxygen saturation." Each hydrologic type predicts potential water "velocity", "fluctuation patterns", "flooding" and "renewal rates". These factors control the quantity, quality and "temporal pattern" of water leaving the wetland. The conditions representative of the highest residence times were assumed to be the most valuable. Those reflecting low residence times were assumed to have low values (Table E-2).

2.1.4 Water Level Fluctuation

Water level fluctuation is a measure of the rise and fall of water in a wetland, its "frequency of inundation and its regularity or predictability." Wetlands with low water level fluctuations were assumed to be indicative of a complex set of wetland elements that control and regulate (smooth out) surface water flows. Wetlands with high water level fluctuations were assumed to be indicative of more extreme "flashy" and uneven surface water flows. Wetlands which exhibit the most control of water movement generally have small water level fluctuations and better store and release water. This maintains downstream base water flows, which, in turn, supports aquatic ecosystems (Table E-2).

2.1.5 Outflow

The outflow element was assigned a weight of 4 since it was critical to insuring that a wetland contributes to and supports other aquatic ecosystems. The greater the outflow, the more the wetland supports "renewal rates", "water depth", water chemistry and fluctuation patterns. Another important factor is that the outlet establishes the "degree of connection with other wetlands and water bodies." Perennial wetlands were given the highest condition weight (2) while ephemeral and groundwater (soil interflow) outlets were each given a weight of 1 (Table E-2).

2.1.6 Inflow

The type of inflowing water, whether perennial or ephemeral, determines, in part, the amount of water available for hydrologic support.

This element was considered to be less important than the outlet and was given an element weight of 2. Perennial inlets were weighted higher (2) than ephemeral ones (1) (Table E-2).

2.1.7 Wetland Shoreline as a Percent of Total Lake Shoreline or Wetland Edge

The amount of contact or edge that a vegetative wetland has with a surface water body (pond, lake or stream) was assumed to be a critical element for the wetland to support the "hydrologic regime" of an aquatic ecosystem and was assigned an element weight of 4 (Table E-2). This percentage was determined by measuring the total length of lake or pond edge and then measuring the length of edge between the individual wetland and the lake or pond. For example, the length of the stream section passing through the wetland was compared with the total circumference of the wetland/upland boundary. Measurements were made using the orthophoto map (Scale: 1 inch = 400 feet) and the appropriate box was checked on the wetland inventory report.

2.2 GROUND-WATER FUNCTION MODEL

The ground-water function of a wetland may better be termed the "ground-water support function", since this function is directed towards a wetland's ability to recharge underlying aquifers. Wetlands in a recharge condition pass accumulated surface water and direct precipitation from the wetland soil downward into an aquifer. Many wetlands seasonally alternate between recharge and discharge. Even perched (local aquifer) wetlands may be partly recharging a deep underlying main aquifer by slow seepage. Winter (1981b) described the geohydrologic scientific uncertainties in estimating the water balance of lakes and wetlands. The potential for some ground-water recharge, however small, appears to be common to most wetlands. Thus, in developing the ground-water function model, it was assumed that all wetlands have some recharge potential and only those elements that enhance this potential were included in the model (Table E-3).

2.2.1 Surficial Geology

Surficial geology controls recharge and was assigned an element weight of 3. Those wetlands that occurred in till areas had the least potential for recharge since till was the most impermeable surficial geologic deposit in the study area. Stratified sand and gravel was the most permeable and thus offered the most recharge potential. Fine sand and gravel and alluvium had intermediate permeabilities and intermediate recharge potential. Condition weights were accordingly assigned (Table E-3).

Table E-3. Ground-water Function Model.

Elements	Element Weight	Condition Weight	Conditions
Surficial Geology	3	1	Till
		4	Stratified sand and gravel
		3	Stratified fine sand and silt
		2	Alluvium
Organic Material	2	3	Absent
		2	High permeability
		1	Low permeability
Hydrologic Position	5	2	Perched wetland
		4	Water table wetland
		2	Water table/artesian wetland
		1	Artesian wetland
Transmissivity Aquifer	4	1	Low <10,000 gal/day/ft
		2	Mod. 10,000-40,000 gal/day/ft
		3	High >40,000 gal/day/ft
Inlet	1	1	Absent
		3	Perennial
		2	Ephemeral
Outlet	2	3	Absent
		2	Perennial
		1	Ephemeral
Size	3	3	Large $\leq$ 4.6 acres
		2	Medium 1.1-4.5 acres
		1	Small $\geq$ 1.0 acres
		Range 20-68[a]	
		Mean 44	

[a]Total value for one inlet and one outlet only. Some wetlands may have more than one inlet or outlet but the range above is for wetlands with only one inlet and one outlet.

2.2.2 Organic Material

Organic material has a low vertical permeability and retards movement of surface water from a wetland to the underlying groundwater system. Some organic materials have higher permeabilities than others and allow greater recharge. Wetlands with little organic material would have the greatest recharge potential since the organic material "liner" is reduced. The organic material inventory elements were weighted using these assumptions (Table E-3).

2.2.3 Hydrologic Position

The hydrologic position element was considered the best measure of a wetland's recharge potential and was given the highest element weight (5). A water table (main aquifer) wetland was considered to be the best hydrogeologic situation for recharge and was assigned a condition weight of 4. Perched (local aquifer) hydrogeologic situations had the potential for slow recharge and were given a weight of 2. Water table/artesian wetlands have some recharge potential but are more commonly discharge areas. They were given a weight of 2 while artesian wetlands are almost always in a discharge condition and were given a weight of 1 (Table E-3).

2.2.4 Transmissivity of Aquifer

The aquifer is the receptor of recharge and transmissivity is a measure of the value of an aquifer for water withdrawal, ground-water movement, and possible discharge to down-gradient aquatic ecosystems. It is used to define the hydrologic characteristics of an associated aquifer. The larger the transmissivity of an aquifer the more valuable will be the recharge of overlying wetlands. Because of its importance to the aquifer this element was assigned a weight of 4 (Table E-3).

2.2.5 Inlet

The inlet characteristics define, in part, the amount of surface water flowing into a wetland which may recharge the underlying aquifer. Perennial inlet conditions were given a higher weight (3) than ephemeral (2) because of the continuous water flow into the wetland and the potential to recharge the aquifer. The inlet element was assigned a weight of 1 (Table E-3).

2.2.6 Outlet

The amount of water leaving a wetland could provide an estimate of the recharge function of a wetland. A wetland receiving inflowing surface water but having no outlet, forces water to leave the wetland by recharge or evapotranspiration. A wetland having a perennial outlet, is constantly losing potential recharge water and may also be indicative of a discharge wetland. Thus, the highest inventory condition weight (3) was assigned to wetlands with no outlet and the lowest (1) to wetlands having an ephemeral outlet (Table E-3).

2.2.7 Size

The size of a wetland can be used to measure its potential recharge value. When other conditions are held equal, the larger a wetland, the greater its recharge potential. Large wetlands were weighted 3, medium 2 and small 1 (Table E-3).

2.3 STORM AND FLOODWATER STORAGE FUNCTION MODEL

The value of wetlands for control of storm waters and prevention of downstream flooding has been recognized by numerous investigators (Coleman and Kline, 1977). Wetlands may contain many natural resources which intercept, retain, and detain inflowing storm waters so that the outflow hydrograph has less of a peak and a greater time of concentration than the inflow hydrograph. How wetlands function to control storm water is a complex topic (Novitzki, 1978; Larson, 1981; and Reppert, 1981). One concept is to treat a wetland simplistically as a designed flood control device and apply standard hydrologic engineering approaches to estimating the wetland's flood storage volume as has been practiced by the Department of Environmental Quality Engineering in Massachusetts. Another concept is to examine the wetland as a complex ecosystem and assess the various elements of that ecosystem as to their ability to store water and retard water flows during periods of flood or storm discharge (Coleman and Kline, 1977). To meet the criteria presented in NR 132 (Wisconsin Administrative Code) the latter concept was used and the following model (Table E-4) was developed.

2.3.1 Dominant Wetland Class

Wetland vegetation has the potential for reducing the energy of inflowing storm water and retaining water. Those wetland classes which have the highest potential for primary production were also assumed to have the highest stem density to reduce flood water energy and to remove water by evapotranspiration. The inventory conditions shallow fresh marsh, wooded swamp and shrub swamp were assumed to be high primary production

Table E-4. Storm and Flood Water Storage Function Model.

Elements	Element Weight	Condition Weight	Conditions
Dominant Wetland Class	2	1	Stream or brookside wetland
		1	Open fresh water
		2	Deep fresh marsh (aquatic bed)
		4	Shallow fresh marsh
		4	Yearly flooded floodplain
		3	Wet meadow
		5	Shrub swamp
		4	Wooded swamp
		3	Bog
Percent Open Water	2	3	0-33%
		2	34-66%
		1	67-95%
		0	96-100%
Vegetative Density	4	3	High
		2	Moderate
		1	Low
Topographic Configuration	2	4	Closed basin
		3	Semi-closed basin
		2	Valley
		1	Hillside
Topographic Position in Watershed	3	3	Upper
		2	Intermediate
		1	Lower
Surficial Material of Watershed	2	4	Till
		1	Stratified sand and gravel
		3	Stratified fine sand and silt
		2	Alluvium

Table E-4. (continued)

Elements	Element Weight	Condition Weight	Conditions
Surficial Geologic Materials of Wetland Banks	2	1	Till
		4	Stratified sand and gravel
		2	Stratified fine sand and silt
		3	Alluvium
Organic Material	1	2	High permeability
		1	Low permeability
		0	Absent
Dominant Hydrologic Type	5	1	Condition 1
		2	Condition 2
		3	Condition 3
		4	Condition 4
		5	Condition 5
		6	Condition 6
Hydrologic Connection	4	1	Not part of riparian system
		2	Part of riparian system
Water Level Fluctuation	3	2	High
		1	Low
Inlet	1	2	Perennial
		1	Ephemeral
		0	Absent
Outlet	1	1	Perennial
		2	Ephemeral
		0	Absent
Size	4	3	Large $\geq$ 4.6 acres
		2	Medium 1.1-4.5 acres
		1	Small $\leq$ 1.0 acres
		Range 29-123[a]	
		Mean 76	

[a]Total value for one inlet and one outlet only. Some wetlands may have more than one inlet or outlet but the range above is for wetlands with only one inlet and one outlet.

vegetative communities and were assigned high condition weights. This element was given a weight of 2. This element also was considered to be a measure of the substrates' texture (vegetative structure), the material over which flood water must flow (Table E-4).

2.3.2 Percent Open Water

The percent open water element addresses the considerations of "previous degree of saturation" and wetland vegetation. Wetlands with large amounts of open water (67-95 percent) are predominantly saturated and have high amounts of surface water discharge. Also, there is little stem density to slow down flood water. This inventory condition was assigned a weight of 1 in comparison to a wetland with little area (0-30 percent) of open water (3) (Table E-4).

2.3.3 Vegetative Density

Vegetative density is an important criterion since it retards inflowing storm water. Some wetlands of the same dominant class may have different densities and thus different abilities to control floods. It was also considered to be an estimate of substrate texture. Since stem density was considered to be one of the most important vegetative elements it was given a weight of 4. Condition weight reflects an increase in flood control value corresponding to an increase in stem density (Low = 1, High = 3) (Table E-4).

2.3.4 Topographic Configuration

The topographic configuration element is a measure of the "basin shape" (Bureau of Reclamation, 1977). Basins with shapes similar to flood control dams, such as closed basins and semi-closed basins were given high condition weights, 4 and 3, respectively. These topographic shapes have the highest potential for retardation near the outlet so that the basin can fill with water. Valleys and hillsides have little if any potential for holding water, but they have the potential for channel storage (valley) or water spreading (hillsides) (Table E-4).

2.3.5 Topographic Position in Watershed

The location of a wetland in a stream's watershed was considered to influence the ability or importance of the wetland in controlling flooding. Wetlands near the top of the watershed were considered to be important since they are the first to receive runoff (they have the shortest times of concentration). As a result they absorb the initial hydrologic shock generated by a runoff event. Without wetlands high in the watershed, lower sections of the stream would have higher flood peaks and a shorter time of concentration. As a result, the element weight assigned was moderate (3) and condition weights were correlated with watershed locations (upper 3, lower 1) (Table E-4).

2.3.6 Surficial Geological Materials

Impervious surficial geologic materials of the watershed permit greater surface water discharge which results in higher peak discharges.

Those wetlands occurring in high surface water runoff potential watersheds are more important in controlling floods than those in low surface water drainage potential watersheds. Till has a high surface water discharge potential, while permeable sand and gravel has a low potential and the condition weights reflect this relationship (Till - 4, stratified sand and gravel - 1) (Table E-4).

2.3.7 Surficial Geologic Materials of Wetland Embankments

As water rises in a wetland because of rapidly inflowing surface water, the water level in the wetland may become higher than the groundwater table in the surrounding embankments. If this condition continued for sufficient time, water would infiltrate from the wetland through the embankments and cause a rise in the water table. The more permeable the wetland embankments, the greater the potential for them to store flood waters (bank storage). Impermeable till has little storage potential whereas permeable sand and gravel has a high storage potential and the condition weights (1 to 4) reflect this relationship (Table E-4).

2.3.8 Organic Materials

Some flood water storage may occur in wetland organic soils that are not saturated. High permeability wetland soils have larger porosities and a greater potential for drying than do low permeability soils and were assigned a higher condition weight (2 versus 1). This element was not weighted high (1) because organic soils are anaerobic due to water saturation and are seldom "dry" or unsaturated (Table E-4).

2.3.9 Dominant Hydrologic Type

Dominant hydrologic type was considered to be the most important element and was given the highest weight (5). This element is a measure of the potential length of time (retention time) that a drop of water spends in a wetland. Hydrologic Condition 1 is a high gradient rushing stream passing water through the wetlands as rapidly as possible and has the least impact on reducing peak surface water discharges and the lowest floodwater storage potential since it is not a topographically flat area. Hydrologic Condition 6, a closed depression with no outlet, stores water which enters and has the highest flood control potential; therefore, it was given a condition weight of 6 (Table E-4).

2.3.10 Hydrologic Connection

This element received a high weighting (4) since it was believed that a wetland must be part of a riparian system in order to protect downstream areas from flooding. Isolated wetlands also serve a flood control function by retention of water and not passing it downstream; however, they were not believed to play as important a role in flood control as wetlands connected to a riparian system. Isolated wetlands have a similar flood control value to isolated upland closed basins. However, it is only when a vegetated wetland occurs as part of a riparian system that the role of the vegetation and soils play an important role in reducing flood flows and providing flood storage.

2.3.11 Water Level Fluctuation

A high water level fluctuation observed in a wetland indicates that the wetland is functioning to store floodwaters. This condition was assigned an element weight of 3 and condition weights of 2 and 1 (Table E-4).

2.3.12 Inlet

The amount and frequency of water flowing into a wetland are partly controlled by its inlet. The greater the volume of inflowing water the more important becomes the function of a wetland in controlling that water. A wetland could have all the components necessary to control storm water, but if it is seldom required to do so, it has less value than a wetland which frequently receives large amounts of water. Thus, a perennial inlet was assigned a weight of 2 and an ephemeral inlet 1 (Table E-4).

2.3.13 Outlet

The outlet of a wetland partially controls the amount of floodwater that can be stored in the wetland. An ephemeral outlet was assumed to have higher water storage capacity than a perennial outlet. In addition, a perennial outlet may indicate continuous saturation of wetland soils, while ephemeral outlets could indicate that the wetland soils may become dry during parts of the year. Thus, an ephemeral outlet was assigned a weight of 2 and a perennial outlet a weight of 1 (Table E-4).

2.3.14 Size

If all other elements were equal between two wetlands, it was assumed that the larger wetland would have a greater potential to control flooding than a smaller one. As a result, large wetlands (>1.8 ha [4.6 acres]) were assigned a weight of 3, medium 2, and small 1 (Table E-4).

2.4 SHORELINE PROTECTION FUNCTION MODEL

When wetlands are adjacent to a lake or a stream channel, they buffer the wave and current energy of these water bodies and protect upland ecosystems and valuable residential, commercial and industrial acreage. Such wetlands have preemptive value as shown in Table E-5 along with the other elements required for this model.

2.4.1 Vegetative Density

Vegetative density affords protection of shorelines by providing plant stems which reduce water flow rates and thus decrease erosive energy. Plant stems also prevent debris and ice from battering the shoreline. The higher the vegetation stem density, the greater the shoreline protection (Table E-5).

2.4.2 Dominant Wetland Class

The shoreline buffering capacity of a wetland is in part a reflection of the strength of the plant stems to resist water flow, floating debris and ice. Also, the type of vegetation present determines the strength of the root mat for erosion control. Wetland classes with poorly rooted floating communities and non-woody stems were assumed to offer little shoreline buffering capacity, such as a deep marsh which was assigned a condition weight of 1. On the other hand, a shrub swamp or wooded swamp containing strong plant stems and thick root mats securely attached to the soil were considered to have a high shoreline buffering capacity and were assigned a weight of 4. Other classes were intermediate in value (Table E-5).

Table E-5. Shoreline Protection Function Model.

Elements	Element Weight	Condition Weight	Conditions
Wetland Borders[a] Lake or Stream	NA[b]	NA	Yes
		NA	No
Vegetative Density	2	3	High
		2	Moderate
		1	Low
Dominant Wetland Class	3	0	Open fresh water
		0	Stream and brookside
		1	Deep fresh marsh (aquatic bed)
		2	Shallow fresh marsh
		4	Yearly floodplain
		1	Wet meadow
		4	Shrub swamp
		4	Wood swamp
		3	Bog
Surficial Material Underlying Wetland	1	2	Till
		1	Stratified sand and gravel
		4	Stratified fine sand and silt
		3	Alluvium
Fetch (Lakes only)	4	2	Over 2000 ft.
		1	Under 2000 ft.
Depth of Lake	1	2	Deep 6 ft.
		1	Shallow 6 ft.
		Range 3-32 Mean 17	

[a]preemptive

[b]= not applicable

2.4.3 Surficial Material Underlying a Wetland

Some wetlands overlie surficial geologic materials which are very difficult to erode. A wetland located upon easily erodable materials such as fine sand and silt have a greater protective function than wetlands located on more difficult materials to erode such as stratified sand and gravel. Condition weights were assigned accordingly (Table E-5).

2.4.4 Fetch

Fetch is a measure of the length of open lake water across which wind may blow to generate waves. In general, a long fetch will create a high wave. A fetch of >609.6 m (2000 feet) was considered large, <609.6 m was considered small. Large fetch was assigned a condition weight of 2 while small fetch was assigned a weight of 1. Fetch was considered the most important element and was weighted 4 (Table E-5).

2.4.5 Depth of Lake

Large waves are created in deep lakes with a long fetch. A shallow lake with a long fetch will not generate waves as high as will a deep lake with an equally long fetch. Wave energy is primarily a result of wave height. The depth of a lake is generally given an element weight equal to that of fetch. However, it was not since all the study area lakes are shallow and capable of generating only small waves. Fetch in this case is more important than depth in determining wave height (Table E-5).

2.5 WATER QUALITY MAINTENANCE FUNCTION MODEL

According to Wisconsin Administrative Code, NR 132, "wetlands may degrade, inactivate, or store materials such as heavy metals, sediments, nutrients, and organic compounds that would otherwise drain into waterways." This function is best defined as the ability of a wetland to abate inflowing pollutants and to discharge cleaner water. In the Massachusetts Wetlands Protection Act (Massachusetts General Laws 131-40) this function is defined as the prevention of pollution value of a wetland. It has also been referred to as the wetland's "living-filter" function.

Wetlands may act as "living-filters" removing floatable and sinkable debris, suspended solids, dissolved solids, nutrients and chemical compounds, both natural and manmade by a variety of methods including physical filtering, sedimentation, nutrient uptake, adsorption, and absorption (Burton, 1981; Davis et al., 1981; Kadlec, 1981; and Oberts, 1981).

The following model (Table E-6) has been developed to assess the pollution abatement function by using the nine criteria set forth in NR 132:

1) density and distribution of plants;
2) area, depth and basin shape;
3) hydrologic regime;
4) physical, chemical and biological properties of the water and soil;
5) relationship of wetland size to watershed size;
6) the number and size of other wetlands remaining in the watershed;
7) topography of the watershed;

Table E-6. Water Quality Maintenance Function Model.

Elements	Element Weight	Condition Weight	Conditions
Dominant Wetland Class	4	1	Stream or brookside wetland
		0	Open fresh water
		3	Deep fresh marsh (aquatic bed)
		4	Shallow fresh marsh
		4	Yearly floodplain
		3	Wet meadow
		4	Shrub swamp
		2	Wooded swamp
		2	Bog
Percent Open Water	1	3	0-33%
		2	34-66%
		1	67-95%
		0	96-100%
Vegetative Density	3	3	High
		2	Moderate
		1	Low
Topographic Configuration	3	4	Closed basin
		3	Semi-closed basin
		2	Valley
		1	Hillside
Topographic Position in Watershed	2	1	Upper
		2	Intermediate
		3	Lower
Organic Material	1	1	High permeability
		2	Low permeability
		0	Absent

Table E-6. (continued)

Elements	Element Weight	Condition Weight	Conditions
Dominant Hydrologic Type	4	1	Condition 1
		2	Condition 2
		3	Condition 3
		4	Condition 4
		5	Condition 5
		6	Condition 6
Hydrologic Connection	2	1	Not part of riparian system
		2	Part of riparian system
Inlet	2	2	Perennial
		1	Ephemeral
		0	Absent
Outlet	3	2	Perennial
		1	Ephemeral
		0	Absent
Size	4	3	Large ≥ 4.6 acres
		2	Moderate 1.1-4.5 acres
		1	Small ≤ 1.0 acres
		Range 18-98 [a]	
		Mean 58	

[a]Total value for one inlet and one outlet only. Some wetlands may have more than one inlet or outlet but the range above is only for wetlands with one inlet and one outlet.

8) position of the wetland relative to springs, lakes rivers and other waters; and

9) land use practices and trends within the watershed, or the likelihood of nutrient, sediment or toxin loads increasing.

2.5.1 Dominant Wetland Class

The dominant wetland class defines the type of vegetative community that may act as a "living-filter". This element was considered to be important and was weighted 4. Some types of wetlands are assumed to have better physical filtering and nutrient uptake than others. Shallow fresh marsh, shrub swamp and yearly floodplain were considered to be the best "living-filters" and were assigned a weight of 4. The stream or brookside wetland offered the least amount of potential for interaction of water with vegetation and was weighted the lowest (1). Other classes were weighted intermediate (Table E-6).

2.5.2 Percent Open Water

The lesser the amount of open water, the more the contact between water and the vegetative community. Those wetlands having little open water will function best since their water is in contact with the largest percentage of wetland plants. Those wetlands having 0-30 percent open water were considered the best and were given a weight of 3. Those having large amounts of open water, 67-95 percent, were weighted 1 (Table E-6).

2.5.3 Vegetative Density

Densely vegetated wetlands provide a high rate of physical filtering and nutrient uptake and were given a weight of 3. Wetlands with low vegetative density have the least potential for physical filtering and nutrient uptake and were weighted 1. This element was considered important in assessing the pollution abatement function and was assigned a weight of 3 (Table E-6).

2.5.4 Topographic Configuration

Topographic configuration is a description of the "basin shape" and the "topography of the watershed." The topographic configuration relates to the potential for the wetland to act as a trap for inflowing pollutants. The best pollutant trap is a closed basin which does not release any water to a downstream ecosystem, and was weighted the highest (4). A hillside offers the least ability to trap pollutants and was weighted the lowest (1) (Table E-6).

2.5.5 Topographic Position in Watershed

This element refers to the "relationship of wetland size to watershed size" and the "number and size of other wetlands remaining in the watershed." It was assumed that wetlands lower in the watershed will have larger watersheds than wetlands higher in the watershed. Thus, such wetlands will receive a larger volume of water for renovation. Also, wetlands low in the watershed will have fewer wetlands below them to further renovate polluted water. For these reasons, wetlands lower in the watershed were assigned a higher weight (3) and those higher in the watershed a low weight (1) (Table E-6).

2.5.6 Organic Material

Organic material has the potential to remove pollutants by adsorption and absorption. Organic soils also act as habitat for bacteria which are important in nutrient cycling. The lower the permeability of an organic material, the larger the number of molecular attachment sites available for absorption and adsorption. Also, water will pass more slowly through organic soil, offering a longer period of time for trapping and retaining pollutants before they pass downstream. Low permeability materials were assigned a condition weight of 2 and high permeability materials a weight of 1 (Table E-6).

2.5.7 Dominant Hydrologic Type

Dominant hydrologic type refers to the residence time of water in a wetland or the amount of time required for a drop of water to move through a wetland. The longer a drop of water spends in the wetland, the greater its chances to interact with the "living-filter" function of the wetland. Those conditions that have the highest residence times were considered to have the greatest function. Those with lowest residence times were considered to have the least function. Appendix C, Section 4.3 defines the various dominant hydrologic types in detail. Hydrologic Condition 6 was considered to be the best pollutant trap since it allows nothing to pass downstream. Hydrologic Conditions 4 and 5 have slightly different residence times, but are very similar and were assigned equal weights (4). Condition 1, a rushing stream, does little to remove pollutants and was given a weight of 1 (Table E-6).

2.5.8 Hydrologic Connection

The hydrologic connection defines the "position of the wetland within the watershed" relative to springs, lakes, rivers and other waters. Basically a wetland is either located above other aquatic ecosystems and protects them by pollution abatement function or it does not. If it is not part of a riparian system, it can not directly protect downstream ecosystems and was weighted the lowest (1). If it is part of a riparian system, it protects downstream ecosystems and was assigned a weight of 2 (Table E-6).

2.5.9 Inlet

Since perennial inlets have water flow continuously, they have the potential to continuously add polluted water to the wetland. Wetlands having perennial inlets could have the potential to renovate inflowing water continuously and were considered more valuable than wetlands having ephemeral inlets. Perennial inlets were assigned a weight of 2 and ephemeral inlets were weighted 1 (Table E-6).

2.5.10 Outlet

The outlet character of a wetland is an important element in the hydrologic regime. An important function of a wetlands' hydrologic regime is to maintain downstream ecosystems by maintaining base water flow, which decreases pollution by dilution, maintains water chemistry and temperature, and provides water volumes for aquatic habitats. Perennial outlets have more of a potential to provide clean downstream water than do ephemeral outlets and were weighted higher (2); ephemeral outlets were weighted lower (1) (Table E-6).

2.5.11 Size

When other elements are equal, the larger the wetland the greater will be its prevention of pollution function. This element was weighted high (4) since the potential quantity of pollutants entering a wetland either naturally or man-induced, is difficult to predict. Larger wetlands should be able to renovate a larger quantity of polluted water. Large wetlands (>1.8 ha [4.6 acres]) were assigned a weight of 3, moderate size wetlands 2 and small wetlands 1 (Table E-6).

In the study area, all wetlands were considered to have an equal "likelihood of nutrient, sediment or toxin loads increasing" so the pollution abatement function model would not be biased towards potential Crandon Project activities.

3.0 CULTURAL AND ECONOMIC FUNCTION MODEL

In attempting to model wetland cultural values, it became apparent that the cultural heritage of people in the vicinity of the proposed Crandon Project was not readily definable in terms of model elements and that such a model would not be an adequate evaluation of all possible relevant considerations. For this reason, it was decided that major cultural considerations would be identified by contacting appropriate information sources and making a qualitative assessment of wetland cultural values. The wetland functions that give rise to economic value, on the other hand, were much more readily identified in terms of model elements. The elements which were considered to be most important in determining economic function are presented in Table E-7.

3.1 DOMINANT WETLAND CLASS

Dominant wetland class has a direct bearing on whether commercial products are present such as wild rice, furbearers or game fish that have the potential to contribute to the economic base of the region. Because of its important role in the model, this element was assigned a weight of 4. The weighting was high for classes having high potential for producing cash crops such as wooded swamps, which very often contain some harvestable timber, or marshes which provide habitat for commercial crops and game species. Conversely, the weighting was low for classes that seldom produce economically viable crops, such as shrub swamps (Table E-7).

Table E-7. Cultural and Economic Function Model.

Elements	Element Weight	Condition Weight	Conditions
Dominant Wetland Class	4	0	Stream or brookside
		0	Open fresh water
		4	Deep fresh marsh
		4	Shallow fresh marsh
		0	Yearly flooded floodplain
		2	Wet meadow
		3	Shrub swamp
		5	Wooded swamp (deciduous)
		6	Wooded swamp (coniferous)
		3	Bog
Access	3	3	Within 100' of road
		2	Access by passable waterway
		1	Isolated
Size	8	3	Large ≥ 4.6 acres
		2	Medium 1.1-4.5 acres
		1	Small ≤ 1.0 acres
		Range 11-87 Mean 54	

3.2 ACCESS

Access to wetlands having a potential cash crop is a factor in the wetlands' economic value, but its importance as an element in the model was less than that of the other 2 elements, which determine the presence and extent of the resource. Moreover, if the cash crop has a major value, access will be developed when a decision has been made to harvest. Based on the above, this element was assigned a weight of 3; the weight assigned the condition increases with ease of access (Table E-7).

3.3 SIZE

Size of a wetland containing a potential cash crop is as important a factor in determining economic viability of the resource as actual presence of the crop. Size is directly related to total yield of the harvest, which has a direct bearing on both the decision to harvest and cash return. It was determined that this element should have the same maximum possible score as "Dominant Wetland Class" and it was assigned a weight of 8; the large size category was weighted 3 (Table E-7).

4.0 RECREATIONAL FUNCTION MODEL

The elements in this model are very similar to the criteria used by Bedford et al. (1974) to assess the recreational value of wetlands in Dane County, Wisconsin (Table E-8).

4.1 DOMINANT WETLAND CLASS

Dominant wetland class directly affects the potential for hunting, trapping, fishing and nature study. Wetland classes differ with respect to wildlife species diversity and net primary production; shallow marsh provides habitat for songbirds and certain mammals, coniferous swamps provide winter yards for deer, and aquatic beds provide habitat for warm water fish species. Based on its role in determining recreational value this element was assigned a weight of 3 and the weights assigned to each class varied with its importance as wildlife habitat (Table E-8).

4.2 PERCENT OPEN WATER

Percent open water is an important element, since it affects recreational potential in several ways. Open water provides opportunities for boating and fishing, as well as providing an added habitat element for both game and non-game wildlife. Based on its role in this model, this element was assigned a weight of 3. The weight assigned to the condition increased with percent open water, the optimum condition being between two-thirds and complete open water (Table E-8).

Table E-8. Recreational Function Model.

Elements	Element Weight	Condition Weight	Conditions
Dominant Wetland Class	3	0	Stream or brookside
		0	Open fresh water
		6	Deep fresh marsh
		5	Shallow fresh marsh
		0	Yearly flooded floodplain
		0	Wet meadow
		2	Shrub swamp
		2	Wooded swamp (deciduous)
		3	Wooded swamp (coniferous)
		2	Bog
Percent Open Water	3	1	0-33%
		2	34-66%
		3	67-95%
		0	96-100%
Surface Water Association	4	1	Connected to a small stream
		2	Connected to a river
		3	Connected to a lake
		4	Connected to a combination
		0	Not connected
Access to Public	2	3	Within 100' of road
		2	Access by passable waterway
		1	Isolated
Size	4	3	Large $\geq$ 4.6 acres
		2	Medium 1.1-4.5 acres
		1	Small $\leq$ 1.0 acres
Legal Access	2	2	Yes
		1	No

Table E-8. (continued)

Elements	Element Weight	Condition Weight	Conditions
Output From Biological Function Model	3	3	High
		2	Moderate
		1	Low
		Range 10-71 Mean 40	

4.3 SURFACE WATER CONNECTION

Connection of a wetland to a surface water body is the most important factor affecting recreational potential, since without a surface water connection the recreational benefits associated with open water discussed above are absent from the wetland. Surface water connection directly influences wildlife and finfish production, an important factor affecting recreational potential. Because of its importance in determining recreational potential of a wetland this element was assigned a weight of 4. The weight accorded to the condition is related to the type of connection and the recreational benefits associated with each, a combination of lake and riparian system being the most ideal (Table E-8).

4.4 PUBLIC ACCESS

Although access to a wetland is a factor in its recreational potential, this element was considered to be less important than others in the model. In fact, in a wetland affording good hunting and fishing opportunities isolation may be an enhancement to those sportsmen willing to make their own access. Based on the above, this element was assigned a weight of 2. The weight assigned to the condition increased with ease of access (Table E-8).

4.5 SIZE

Size is a very important element since it directly influences recreational carrying capacity of a wetland. Larger wetlands support a greater variety and density of wildlife, and afford more opportunities for recreational activities associated with wetlands such as canoeing, nature study and hunting. Because of its important role in this model, size was accorded a weight of 5, the weight assigned to the condition varying directly with size (Table E-8).

4.6 LEGAL ACCESS

Ownership status determines whether a wetland is legally accessible; the broad categories of ownership are public, private and Native American. As with Public Access, this element was much less important than those functional elements which actually determine recreational potential because ownership and legal access status can both change. Accordingly, "Legal Access" was assigned a weight of 2 (Table E-8).

4.7 OUTPUT FROM BIOLOGICAL FUNCTION MODEL

Since the potential of a wetland for biological production and variety determines whether it might provide habitat for or be productive of species of recreational, cultural or economic interest, this was an important consideration in determining recreational potential. The contribution of this element to the recreational model was included by assigning one of three conditions using the output from the biological function model. As a result of the importance of this output to the recreational model, it was assigned a weight of 3 (Table E-8).

5.0 AESTHETICS FUNCTION MODEL

5.1 DOMINANT WETLAND CLASS

Dominant wetland class was important in determining the aesthetic value of a wetland. Certain wetland classes have higher visual appeal than others. For example, floating mats of vegetation such as occur in a bog or an aquatic bed are highly attractive; shrub swamps and most deciduous swamps, on the other hand, provide very shallow vistas and little visual relief, therefore, their contributions to the aesthetics of a wetland were considered to be minimal. This element was assigned a weight of 4 and the weights assigned to the wetland classes varied with their visual appeal (Table E-9).

5.2 NUMBER OF WETLAND SUBCLASSES (RICHNESS)

Subclass richness is a measure of the variety of plant form and arrangement. Where this factor was rated high the wetland was also rated high in visual richness and aesthetic appeal. This element was assigned a weight of 3, and the weights assigned to the conditions varied with the number of different wetland subclasses (Table E-9).

5.3 PERCENT OPEN WATER

Open water is an important factor contributing to the aesthetic appeal of a wetland, and this element was assigned a weighting of 4. The aesthetic appeal improves as percent open water increases with an optimum occurring for most people at around 95 percent. Up to this point, sufficient

Table E-9. Aesthetic Function Model.

Elements	Element Weight	Condition Weight	Conditions
Dominant Wetland Class	4	0	Stream or brookside wetland
		0	Open fresh water
		5	Deep fresh marsh
		4	Shallow fresh marsh
		0	Yearly flooded floodplain
		0	Wet meadow
		2	Shrub swamp
		3	Wooded swamp (deciduous)
		3	Wooded swamp (coniferous)
		5	Bog
Number of Subclasses (Richness)	3	4	6-9
		3	4-5
		2	2-3
		1	1
Percent Open Water	4	1	0-33%
		3	34-66%
		4	67-95%
		0	96-100%
Access to Public	3	3	Within 100' of road
		2	Access by passable waterway
		1	Isolated
Local Scarcity	3	1	<200' to nearest similar type
		2	201-1000' to nearest similar type
		3	>1000' to nearest similar type
		Range 9-66 Mean 37	

vegetation is present to provide visual relief but as percent vegetation diminishes to zero, visual richness declines (Table E-9).

5.4 ACCESS

Access to a view of a wetland is certainly a factor contributing to its aesthetic value. If access was limited, appreciation of the wetland's aesthetic attributes was considered to be minimal. However, access may be created to provide visual access to a particularly appealing view, therefore, this factor was not as important as the functional components "Dominant Wetland Class" and "Percent Open Water" in determining the aesthetic value of a wetland. The weight assigned to this element was 3, and the weights assigned to the conditions varied with ease of access (Table E-9).

5.5 LOCAL SCARCITY

Visual relief is a factor in the aesthetic value of a wetland. Where a particular wetland type was commonly distributed over the landscape, visual relief was considered to be low; but where a type was quite rare, relief was given a heavy weighting. This element was assigned a weight of 3 and weights assigned to the conditions varied depending on the commonness of the wetland type as a landscape element (Table E-9).

6.0 EDUCATIONAL FUNCTION MODEL

There exists such a variety of elements to the processes of education that no system can be developed that foresees all future educational opportunities and directions. This model was designed to include present educational uses and trends at various age and professional levels of education.

6.1 NUMBER OF WETLAND SUBCLASSES (RICHNESS)

This element is a measure of the variety of vegetative life forms available for study in a wetland. As the number of subclasses increases the opportunity becomes greater to observe natural history phenomena compared to a similar sized wetland of lower plant form variability and therefore, having less edge, lower interspersion and fewer wildlife. Based on the above, this element was assigned a weight of 3; the weight assigned to the conditions varies with the number of subclasses as presented in Table E-10.

6.2 PUBLIC ACCESS

Wetlands affording public access permit larger numbers of people to study wetland processes and observe plant and animal life cycle interactions than do isolated wetlands. Because access was considered important in terms of the educational value of a wetland, this element was assigned a weight of 4, and the weights assigned to the conditions varied with ease of access (Table E-10).

Table E-10. Educational Function Model.

Elements	Element Weight	Condition Weight	Conditions
Subclass Richness (Lateral Diversity)	3	4	6-9
		3	4-5
		2	2-3
		1	1
Access to Public	4	3	Within 100 ft. of road
		2	Access by passable waterway
		1	Isolated
		Range 7-24 Mean 15	

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APPENDIX F

MODEL USE EXAMPLES

MODEL USE EXAMPLES

1.0 BIOLOGICAL FUNCTION MODEL

The triangular shaped bog (F16) was selected to illustrate the application of the biological function model. Its Wetland Inventory Report is included on pages F3 through F5.

In Wetland F16, the dominant wetland class was a bog which has limited wildlife value; when the element weight (5) was multiplied by the condition weight (3), the contribution of this element to the total values of the wetland was 15 points. Since this wetland contained two classes and three subclasses, the subscores for these two elements were 8 and 6, respectively. Vegetative interspersion was moderate and received a subscore of 8. The surrounding habitat consisted of more than 90 percent woodland, resulting in a subscore of 6. Water-cover ratio was less than 25 percent and peripheral, which was next to the least favorable condition that could occur (subscore 3). The bog mat was composed of a large number of a few dominant species, mainly black spruce, leatherleaf and sphagnum; therefore, species richness was low (subscore 2); the proportion of wildlife food plants was moderate (subscore 2); and vegetative density was moderate (subscore 4). Wetland juxtaposition was moderately favorable (subscore 6) since other wetlands of different classes were nearby, but none were connected to F16.

Hydrologically, the triangular bog was perched (subscore 2) and water level fluctuation was low (subscore 2). This wetland was not connected to any surface water, therefore there was no subscore contributed by "Surface Water Connection" and "Percent Wetland Bordering Open Water". Compared to all other wetlands in the study area, F16 was large, the most favorable condition from the standpoint of wildlife habitat value (subscore 15). By adding the subscores, the total value of the triangular bog for biological function was 79 points, with a model range of minimum 29 to maximum 158. Additional information on the procedures for calculating model scores may be found in Appendix E, "Descriptions of Wetland Functional Models."

WETLAND INVENTORY REPORT

PROJECT NUMBER 448

WETLAND NUMBER F16

FLIGHT, PHOTO NUMBER(S) ______

MAP NUMBER(S) ______

ACREAGE 6.27

ACREAGE	PERCENT	
		WET MEADOW
		SHALLOW MARSH
		DEEP MARSH
		SHRUB SWAMP
		WOODED SWAMP
6.27	100	BOG
		OTHER ______
6.27	100	TOTAL

vegetation

	occ	com	dom
Chamaedaphne calyculata			
Leatherleaf			✓
Andromeda glaucophylla			
Bog rosemary	✓		
Vaccinium macrocarpon			
American cranberry		✓	
Sarracenia purpurea			
Pitcher plant	✓		
Sphagnum spp.			
Sphagnum moss		✓	
Picea mariana			
Black spruce		✓	
Kalmia angustifolia			
Sheep laurel		✓	
Larix laricina			
Tamarack	✓		

inventory

number F16

date 5/1/81

field investigator(s)

D. Magee

G. Hollands

water quality

Wetland Subclasses
- Stream or Brookside Wetland
- Open Fresh Water
  - ☐ Vegetated Subclass
  - ☐ Non Vegetated Subclass
- Open Fresh Marsh
  - ☐ Dead Woody
  - ☐ Shrub
  - ☐ Sub-Shrub
  - ☐ Robust
  - ☐ Narrow-Leaved
  - ☐ Broad-Leaved
- Shallow Fresh Marsh
  - ☐ Robust
  - ☐ Narrow-Leaved
  - ☐ Broad-Leaved
  - ☐ Floating-Leaved
- Flood Plain/Flats
  - ☐ Emergent
  - ☐ Shrubs and Trees
- Wet Meadow
  - ☐ Ungrazed
  - ☐ Grazed
- Shrub Swamp
  - ☐ Sapling
  - ☐ Bushy
  - ☐ Compact
  - ☐ Aquatic
- Wooded Swamp
  - ☐ Deciduous
  - ☒ Evergreen
- Bog
  - ☒ Shrub
  - ☒ Wooded

Ecological Elements

Dominant Wetland Class
- ☐ Stream or Brookside Wetland
- ☐ Open Fresh Water
- ☐ Deep Fresh Marsh
- ☐ Shallow Fresh Marsh
- ☐ Yearly Flooded Flood Plain
- ☐ Wet Meadow
- ☐ Shrub Swamp
- ☐ Wooded Swamp
- ☒ Bog
- ☐ Other ____________

Wetland Class Richness
- ☐ 5
- ☐ 4
- ☐ 3
- ☒ 2
- ☐ 1

Subclass Richness (Lateral Diversity)
- ☐ 10
- ☐ 6-9
- ☐ 4-5
- ☒ 2-3
- ☐ 1

Vegetative Interspersion
- ☐ High
- ☒ Moderate
- ☐ Low

Surrounding Habitat
- ☐ 90% of 2 or more of Listed Types
- ☒ 50-90% of 1 or more; 90% of 1
- ☐ 50% of 1 or more of Listed Types

Cover Type
- ☐ 26-75% Scattered
- ☐ 26-75% Peripheral
- ☐ 75% or <25 Scattered
- ☒ 100% Cover; 75% or <25% Peripheral

Percent Open Water
- ☒ 0-30%
- ☐ 34-66%
- ☐ 67-95%
- ☐ 96-100%

Vegetative Species Richness
- ☒ Low
- ☐ Medium
- ☐ High

Proportion of Wildlife Food Plants
- ☐ Low
- ☒ Moderate
- ☐ High

Vegetative Density
- ☐ High
- ☒ Moderate
- ☐ Low

Wetland Juxtaposition
- ☐ Highly Favorable
- ☒ Moderately Favorable
- ☐ Unfavorable

Special Elements
- ☐ Aquatic Study Area
- ☐ Sanctuary or Refuge
- ☐ Wildlife Management Area
- ☐ Fisheries Management Area
- ☐ Educational Study Area
- ☐ Historical Area
- ☐ Other ____________

Topographical Elements

Topographic Configuration
- ☒ Closed Basin
- ☐ Semi-closed Basin
- ☐ Valley
- ☐ Hillside

unusual, rare, or endangered vegetation	unus	rare	end

unusual, rare, or endangered fauna	unus	rare	end

Social-economical Elements

Size
- ☒ Large >4.6 acres
- ☐ Medium 1.1-4.5
- ☐ Small <1 acres

Surficial Geologic Material of watershed
- ☒ Till
- ☐ Stratified sand and gravel
- ☐ Stratified fine sand and silt
- ☐ Alluvium

Percent Wetland Bordering Open Water
- ☐ < 33%
- ☐ 34-66%
- ☐ 67-100%
- ☒ Does not border

Legal Access
- ☒ Yes
- ☐ No

Fetch
- ☐ Over 2000 ft.
- ☐ Under 2000 ft.

Depth of Lake
- ☐ Deep >6 ft.
- ☐ Shallow <6 ft.

Hydrologic Connection
- ☐ Connected to a Small Stream
- ☐ Connected to a River
- ☐ Connected to a Lake
- ☐ Connected to a Combination

Access to Public
- ☒ Within 100 ft of Road
- ☐ Access by Passable Waterway
- ☐ Isolated

Surrounding Population Density
- ☒ <1 person/acre (<320/mi²)
- ☐ 0.5 - 1.9 p/a (430-1220/mi²)
- ☐ >2 p/a (>1220/mi²)

Local Scarcity
- ☐ <200 ft to nearest similar type
- ☐ 201 to 1000 ft to nearest similar type
- ☒ >1000 ft to nearest similar type

Known Crop Value or Potential
- ☒ None
- ☐ Supports 1 family for part of year
- ☐ Completely supports 1 family
- ☐ Supports viable commercial interest

Inlet
- ☐ Absent
- ☐ Present, from wetland ___
- ☐ Perennial
- ☐ Ephemeral

Inlet
- ☐ Absent
- ☐ Present, from wetland ___
- ☐ Perennial
- ☐ Ephemeral

Outlet
- ☒ Absent
- ☐ Present, to wetland ___
- ☐ Perennial
- ☐ Ephemeral

Outlet
- ☐ Absent
- ☐ Present, to wetland ___
- ☐ Perennial
- ☐ Ephemeral

Wetland Gradient
- ☒ Slight 0-3%
- ☐ Steep >3%

Surrounding Slopes
- ☒ Slight 0-3%
- ☐ Steep >3%

Topographic Position in Watershed
- ☒ Upper
- ☐ Intermediate
- ☐ Lower

Geological Elements

Surficial Material
- ☐ Till
- ☒ Stratified Sand and Gravel
- ☐ Stratified Fine Sand and Silt
- ☐ Alluvium

Bedrock
- ☒ Igneous and Metamorphic
- ☐ Sedimentary

Organic Material
- ☐ Absent
- ☒ High Permeability
- ☐ Low Permeability

Hydrological Elements

Hydrologic Position
- ☒ Perched Wetland
- ☐ Water Table Wetland
- ☐ Water Table/Artesian Wetland
- ☐ Artesian Wetland

Transmissivity of Aquifer
- ☒ Low <10,000 gal/day/ft
- ☐ Moderate 10,000 - 40,000 gal/day/ft
- ☐ High >40,000 gal/day/ft

Dominant Hydrologic Type
- ☐ Condition 1
- ☐ Condition 2
- ☐ Condition 3
- ☐ Condition 4
- ☐ Condition 5
- ☒ Condition 6

Hydrologic Connection
- ☒ Not Part of Riparian System
- ☐ Part of Riparian System

Water Level Fluctuation
- ☐ High
- ☒ Low
- ☐ Vernal Pool

Groundwater Outflow
- ☒ Absent
- ☐ Present

Inlet
- ☒ Absent
- ☐ Present, from wetland ___
- ☐ Perennial
- ☐ Ephemeral

Inlet
- ☐ Absent
- ☐ Present, from wetland ___
- ☐ Perennial
- ☐ Ephemeral

Inlet
- ☐ Absent
- ☐ Present, from wetland ___
- ☐ Perennial
- ☐ Ephemeral

2.0 HYDROLOGIC SUPPORT FUNCTION MODEL

Wetland F60 was selected to illustrate the application of the hydrologic support function model. Its Wetland Inventory Report is included on pages F7 through F-9.

Wetland F60 was 9.47 ha (23.16 acres) is size. This was a large wetland and it received a condition weight of 3 which was multiplied by the element weight of 4 to yield a subscore of 12. Wetland F60 was a semi-closed basin within the element of topographic configuration and received a subscore of 3. The dominant hydrologic type was a Condition 5, resulting in a subscore of 25. The wetland had a low water level fluctuation yielding an element value of 4. The wetland had an ephemeral outlet resulting in a subscore of 4. Wetland F60 had an inlet which was ephemeral (subscore 1). This wetland had no stream bank or lake shoreline associated with it and had an element value of 0 for percent shoreline. Adding these subscores, the total hydrologic support function value for this wetland was 49. The range for this model is from 6 to 66.

This procedure was also followed for each of the other eight functional models for each of the 127 wetlands inventoried in the study area.

WETLAND INVENTORY REPORT

PROJECT NUMBER 448

WETLAND NUMBER F60

FLIGHT, PHOTO NUMBER(S) 5-37

MAP NUMBER(S)

ACREAGE 23.16

ACREAGE	PERCENT	
		WET MEADOW
		SHALLOW MARSH
		DEEP MARSH
2.32	10.00	SHRUB SWAMP
20.84	90.00	WOODED SWAMP
		BOG
		OTHER
23.16	100.00	TOTAL

vegetation inventory

	occ	com	dom
Thuja occidentalis		✓	
Arbor vitae			
Tsuga canadensis		✓	
Hemlock			
Acer rubrum	✓		
Red maple			
Populus tremuloides	✓		
Trembling aspen			
Alnus rugosa	✓		
Speckled alder			
Abies balsamea	✓		
Balsam fir			
Sphagnum sp.		✓	
Sphagnum moss			
Betula lutea	✓		
Yellow birch			
Ulmus americana		✓	
American elm			
Ribes sp.		✓	
Gooseberry			

number F60

date 5/2/81

field investigator(s)

D. Magee

G. Hollands

water quality

Wetland Subclasses

Stream or Brookside Wetland

Open Fresh Water
- [ ] Vegetated Subclass
- [ ] Non Vegetated Subclass

Deep Fresh Marsh
- [ ] Dead Woody
- [ ] Shrub
- [ ] Sub-Shrub
- [ ] Robust
- [ ] Narrow-Leaved
- [ ] Broad-Leaved

Shallow Fresh Marsh
- [ ] Robust
- [ ] Narrow-Leaved
- [ ] Broad-Leaved
- [ ] Floating-Leaved

Flood Plain/Flats
- [ ] Emergent
- [ ] Shrubs and Trees

Wet Meadow
- [ ] Ungrazed
- [ ] Grazed

Shrub Swamp
- [x] Sapling
- [ ] Bushy
- [ ] Compact
- [ ] Aquatic

Wooded Swamp
- [x] Deciduous
- Dominant→ [x] Evergreen

Bog
- [ ] Shrub
- [ ] Wooded

Ecological Elements

Dominant Wetland Class
- [ ] Stream or Brookside Wetland
- [ ] Open Fresh Water
- [ ] Deep Fresh Marsh
- [ ] Shallow Fresh Marsh
- [ ] Yearly Flooded Flood Plain
- [ ] Wet Meadow
- [ ] Shrub Swamp
- [x] Wooded Swamp
- [ ] Bog
- [ ] Other ____

Wetland Class Richness
- [ ] 5
- [ ] 4
- [ ] 3
- [x] 2
- [ ] 1

Subclass Richness (Lateral Diversity)
- [ ] >10
- [ ] 6-9
- [ ] 4-5
- [x] 2-3
- [ ] 1

Vegetative Interspersion
- [x] High
- [ ] Moderate
- [ ] Low

Surrounding Habitat
- [ ] >90% of 2 or more of Listed Types
- [x] 50-90% of 1 or more; 90% of 1
- [ ] <50% of 1 or more of Listed Types

Cover Type
- [ ] 26-75% Scattered
- [ ] 26-75% Peripheral
- [ ] 75% or <25 Scattered
- [x] 100% Cover; >75% or <25% Peripheral

Percent Open Water
- [x] 0-30%
- [ ] 31-66%
- [ ] 67-95%
- [ ] 96-100%

Vegetative Species Richness
- [ ] Low
- [x] Medium
- [ ] High

Proportion of Wildlife Food Plants
- [ ] Low
- [x] Moderate
- [ ] High

Vegetative Density
- [x] High
- [ ] Moderate
- [ ] Low

Wetland Juxtaposition
- [ ] Highly Favorable
- [x] Moderately Favorable
- [ ] Unfavorable

Special Elements
- [ ] Aquatic Study Area
- [ ] Sanctuary or Refuge
- [ ] Wildlife Management Area
- [ ] Fisheries Management Area
- [ ] Educational Study Area
- [ ] Historical Area
- [ ] Other ____

Topographical Elements

Topographic Configuration
- [ ] Closed Basin
- [x] Semi-closed Basin
- [ ] Valley
- [ ] Hillside

unusual, rare, or endangered vegetation	unus	rare	end

unusual, rare, or endangered fauna	unus	rare	end

Size
- [x] Large >4.6 acres
- [ ] Medium 1.1-4.5
- [ ] Small <1 acres

Surficial Geologic Material of watershed
- [x] Till
- [ ] Stratified sand and gravel
- [ ] Stratified fine sand and silt
- [ ] Alluvium

Percent Wetland Bordering Open Water
- [ ] < 33%
- [ ] 34-66%
- [ ] 67-100%
- [x] Does not border

Legal Access
- [ ] Yes
- [x] No

Fetch
- [ ] Over 2000 ft.
- [ ] Under 2000 ft.

Depth of Lake
- [ ] Deep >6 ft.
- [ ] Shallow <6 ft.

Social-economical Elements

Hydrologic Connection
- [x] Connected to a Small Stream
- [ ] Connected to a River
- [ ] Connected to a Lake
- [ ] Connected to a Combination

Access to Public
- [x] Within 100 ft of Road
- [ ] Access by Passable Waterway
- [ ] Isolated

Surrounding Population Density
- [x] <1 person/acre (<320/mi²)
- [ ] 0.5 - 1.9 p/a (430-1220/mi²)
- [ ] >2 p/a (>1220/mi²)

Local Scarcity
- [ ] <200 ft to nearest similar type
- [ ] 201 to 1000 ft to nearest similar type
- [x] >1000 ft to nearest similar type

Known Crop Value or Potential
- [x] None
- [ ] Supports 1 family for part of year
- [ ] Completely supports 1 family
- [ ] Supports viable commercial interest

Inlet
- [ ] Absent
- [ ] Present, from wetland ___
- [ ] Perennial
- [ ] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ___
- [ ] Perennial
- [ ] Ephemeral

Outlet
- [ ] Absent
- [x] Present, to wetland ___
- [ ] Perennial
- [x] Ephemeral

Outlet
- [ ] Absent
- [ ] Present, to wetland ___
- [ ] Perennial
- [ ] Ephemeral

Wetland Gradient
- [x] Slight 0-3%
- [ ] Steep >3%

Surrounding Slopes
- [x] Slight 0-3%
- [ ] Steep >3%

Topographic Position in Watershed
- [ ] Upper
- [x] Intermediate
- [ ] Lower

Geological Elements

Surficial Material
- [x] Till
- [ ] Stratified Sand and Gravel
- [ ] Stratified Fine Sand and Silt
- [ ] Alluvium

Bedrock
- [x] Igneous and Metamorphic
- [ ] Sedimentary

Organic Material
- [ ] Absent
- [x] High Permeability
- [ ] Low Permeability

Hydrological Elements

Hydrologic Position
- [x] Perched Wetland
- [ ] Water Table Wetland
- [ ] Water Table/Artesian Wetland
- [ ] Artesian Wetland

Transmissivity of Aquifer
- [x] Low <10,000 gal/day/ft
- [ ] Moderate 10,000 - 40,000 gal/day/ft
- [ ] High >40,000 gal/day/ft

Dominant Hydrologic Type
- [ ] Condition 1
- [ ] Condition 2
- [ ] Condition 3
- [ ] Condition 4
- [x] Condition 5
- [ ] Condition 6

Hydrologic Connection
- [ ] Not Part of Riparian System
- [x] Part of Riparian System

Water Level Fluctuation
- [ ] High
- [x] Low
- [ ] Vernal Pool

Groundwater Outflow
- [x] Absent
- [ ] Present

Inlet
- [ ] Absent
- [x] Present, from wetland F68
- [ ] Perennial
- [x] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ___
- [ ] Perennial
- [ ] Ephemeral

Inlet
- [ ] Absent
- [ ] Present, from wetland ___
- [ ] Perennial
- [ ] Ephemeral

APPENDIX G

WETLAND AND WATERSHED AREA DATA

WETLAND AND WATERSHED AREA DATA

Data presented in the attached tables itemize and total the area of each subtype of each numbered wetland in the study area and in some locations adjacent to the study area. These data were used to determine the size of study area wetlands. The watershed area measurements were not used in the models; however these data were generated for use in determining development effects on wetlands. Wetland minor and major watershed areas are shown.

The wetland sub-type symbols as shown on each table are presented below.

S/SW-a	=	Bog
S/SW-b	=	Shrub swamp
FW-a	=	Coniferous swamp
FW-b	=	Deciduous swamp
EW-b	=	Marsh
AB	=	Aquatic bed
untyped	=	Sub-type not specified

The tables are ordered alphabetically by major watershed letter. Each table is headed by the major watershed letter and area.

The wetland numbers are listed in the left-hand column of each table. The wetland sub-types head the columns to the right. The column headed "TOTAL" provides the total area of each numbered wetland.

The two columns on the right-hand side of each table present data for the areas of minor watershed which drain to each wetland. The column headed "Direct" presents data for the minor watershed area from which overland flow is directly into the numbered wetland. The column headed "Cumulative" presents data for both the area of direct flow into the numbered wetland and areas of other minor watersheds which are tributary to the numbered wetland.

The total areas of each numbered wetland sub-type and areas of direct and cumulative minor watersheds are shown in the "TOTAL" row near the bottom of each table. The "Unnumbered or off-site" row presents data for areas of each sub-type of wetlands not designated by the numbering scheme and areas of minor watersheds which flow either into unnumbered wetlands or to off-site regions. The "GRAND TOTAL" row sums the areas of numbered and unnumbered wetland subtypes and the areas of minor watershed comprising each major watershed. Not all areas of the wetland study are tributary to either a minor or major watershed, because of the shape of the study area boundary and topography. Also, lakes are not considered wetlands and large portions of the study area are part of lake watersheds. These areas were not measured separately. All data are presented in acres; therefore, to convert acres to hectares multiply acres by 0.4047.

WATERSHED: A (within site)   AREA: 370.46 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
A1	-	-	-	-	0.62	-	-	0.62	4.50	4.50
A2	-	-	1.82	-	-	-	-	1.82	30.54	30.54
A3	-	-	-	1.04	-	-	-	1.04	185.64	185.64
TOTAL	-	-	1.82	1.04	0.62	-	-	3.48	220.68	
Unnumbered or off-site	-	-	-	-	0.21	-	-	0.21	149.78	
GRAND TOTAL	-	-	1.82	1.04	0.83	-	-	3.69	370.46	

WATERSHED: B AREA: 201.11 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
B1	-	-	-	-	-	-	0.05	0.05	3.49	173.05
B2	-	1.71	3.13	-	-	-	-	4.84	28.06	169.56
B3	-	-	-	1.65	-	-	-	1.65	25.03	163.60
B4	-	1.37	19.32	-	-	-	-	20.69	138.57	138.57
B5	-	-	0.55	-	-	-	-	0.55	3.44	3.44
B8	-	-	-	0.46	-	-	-	0.46	2.52	2.52
TOTAL	-	3.08	23.00	2.11	-	-	0.05	28.24	201.11	
Unnumbered or off-site	-	0.34	-	0.76	-	-	-	1.10	-	
GRAND TOTAL	-	3.42	23.00	2.87	-	-	0.05	29.34	201.11	

WATERSHED: C AREA: 18.64 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
(No Numbered Wetlands Present)										
TOTAL	-	-	-	-	-	-	-	-	-	-
Unnumbered or off-site	-	-	-	0.61	-	-	-	0.61	18.64	
GRAND TOTAL	-	-	-	0.61	-	-	-	0.61	18.64	

WATERSHED: D AREA: 234.77 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
D1	-	1.75	2.85	-	-	-	-	4.60	26.68	234.77
D2	-	-	-	-	-	-	0.05	0.05	2.89	208.09
D3	-	-	1.53	-	-	-	-	1.53	13.04	13.04
D4	-	-	13.58	3.41	-	-	-	16.99	142.85	196.80
D4A	-	-	-	1.87	-	-	-	1.87	30.34	30.34
D5	0.84	-	-	-	-	-	-	0.84	8.40	8.40
D8	-	-	0.74	-	-	-	-	0.74	6.22	6.22
D18	-	-	-	0.71	-	-	-	0.71	4.35	4.35
TOTAL	0.84	1.75	18.70	5.99	-	-	0.05	27.33	234.77	-
Unnumbered or off-site	-	-	-	1.20	-	-	-	1.20	-	-
GRAND TOTAL	0.84	1.75	18.70	7.19	-	-	0.05	28.53	234.77	-

WATERSHED: E AREA: 27.70 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
(No Numbered Wetlands Present)										
TOTAL	-	-	-	-	-	-	-	-	-	-
Unnumbered or off-site	-	-	-	-	-	-	-	-	27.70	-
GRAND TOTAL	-	-	-	-	-	-	-	-	27.70	-

WATERSHED: F AREA: 2943.90 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
F1	-	5.81	-	3.38	-	-	-	9.19	30.74	2832.16
F2	-	9.48	-	-	10.49	-	-	19.97	478.88	2645.50[a]
F4	-	1.00	3.50	-	-	-	-	4.50	8.31	17.19
F5	-	-	3.50	-	-	-	-	3.50	8.88	8.88
F6	-	-	-	-	-	-	0.05	0.05	11.91	143.90
F7	-	-	3.72	8.82	8.93	-	-	21.47	114.15	131.99
F8	-	-	-	0.85	-	-	-	0.85	17.84	17.84
F9	-	-	7.52	-	-	-	-	7.52	31.09	1434.55
F10	-	-	8.98	0.50	-	-	-	9.48	45.37	593.94
F11	-	-	17.99	-	-	-	-	17.99	122.65	516.36
F12	-	-	-	0.62	11.77	3.44	-	15.83	124.67	380.66
F13	-	-	1.15	-	-	-	-	1.15	6.49	8.59
Unnumbered or off-site	-	-	-	-	-	-	-	-	-	-
Subtotal	-	16.29	46.36	14.17	31.19	3.44	0.05	111.50	1000.98	-

[a]includes Little Sand Lake area and areas of direct drainage to Little Sand Lake.

WATERSHED: F (continued)

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
F15	-	-	-	22.92	11.17	-	-	34.09	162.68	247.40
F16	7.90	-	-	0.90	-	-	-	8.80	35.35	60.90
F17	-	-	-	1.87	-	-	-	1.87	25.55	25.55
F18	28.77	-	27.31	1.25	-	-	-	57.33	112.47	1399.21
F19	-	-	-	-	9.08	-	-	9.08	22.02	884.58
F21	-	-	-	0.05	1.36	-	-	1.41	7.84	17.48
F22	-	-	2.02	-	-	-	-	2.02	9.64	9.64
F23	4.69	-	-	-	-	-	-	4.69	38.35	176.04
F24	-	-	-	-	-	-	0.05	0.05	11.15	137.69
F25	-	-	3.53	-	-	-	-	3.53	73.11	126.54
F26	-	-	-	-	-	-	0.05	0.05	11.96	53.43
F27	-	2.12	-	2.06	-	-	-	4.18	41.47	41.47
Unnumbered or off-site	-	-	-	-	-	-	-	-	-	-
Subtotal	41.36	2.12	32.86	29.05	21.61	-	0.10	127.10	551.59	

WATERSHED: F (continued)

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
F28	54.06	-	9.59	1.51	-	-	-	65.16	251.50	402.16[b]
F29	-	3.43	-	-	-	-	-	3.43	31.70	136.17
F30	-	-	-	-	-	-	0.05	0.05	37.15	91.30
F31	-	-	4.62	1.38	-	-	-	6.00	54.15	54.15
F32	-	-	-	0.55	-	-	-	0.55	7.41	7.41
F33	-	-	-	1.60	-	-	-	1.60	23.82	23.82
F34	-	-	-	0.40	-	-	-	0.40	4.49	4.49
F35	-	-	2.50	-	-	-	-	2.50	4.25	4.25
F36	-	-	-	1.26	-	-	-	1.26	9.27	9.27
F37	-	1.26	-	1.51	13.48	-	-	16.25	150.69[c]	1009.50[c]
F38	-	-	-	-	-	-	0.05	0.05	15.62[c]	1025.12[c]
F39	-	5.80	-	-	-	-	-	5.80	25.71	1055.07
Unnumbered or off-site	-	-	-	-	-	-	-	-	-	-
Subtotal	54.06	10.49	16.71	8.21	13.48	-	0.10	103.05	625.76	-

[b] includes Duck Lake area and areas of direct drainage to Duck Lake

[c] includes off-site micro-watershed areas which are tributary to this wetland

WATERSHED: F (continued)

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
F40	-	5.90	2.47	-	0.25	-	-	8.62	47.50	1105.37
F42	-	0.80	-	-	-	-	-	0.80	2.80	2.80
F43	1.26	-	-	-	-	-	-	1.26	7.29	12.72
F45	0.50	-	-	-	-	-	-	0.50	5.43	5.43
F46	-	-	3.53	-	-	-	-	3.53	10.15	10.15
F48	-	-	0.50	-	-	-	-	0.50	1.87	1.87
F50	-	-	-	0.60	-	-	-	0.60	2.61	2.61
F51	-	-	0.70	-	-	-	-	0.70	1.43	34.57
F52	2.90	-	-	-	-	-	-	2.90	5.58	30.53
F53	-	-	14.30	-	-	-	-	14.30	24.95	24.95
F54	-	-	1.86	-	-	-	-	1.86	4.24	4.24
F55	-	-	-	0.75	-	-	-	0.75	3.75	3.75
Unnumbered or off-site	-	-	-	-	-	-	-	-	-	-
Subtotal	4.66	6.70	23.36	1.35	0.25	-	-	36.32	117.60	-

WATERSHED: F (continued)

Wetland Number	Sub-Type Areas (Acres) S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Minor Watershed Area (Acres) Direct	Cumulative
F57	-	2.37	-	4.04	-	-	-	6.41	74.46[c]	528.95[c]
F58	-	-	-	-	0.25	-	-	0.25	1.50	1.50
F60	-	2.32	15.24	5.60	-	-	-	23.16	135.38[c]	452.99[c]
F61	-	-	-	2.02	-	-	-	2.02	41.38	277.06
F62	-	-	5.04	2.27	-	-	-	7.31	48.92	187.86
F63	1.05	-	8.59	-	-	-	-	9.64	29.56	138.94
F64	4.54	-	-	-	-	-	-	4.54	16.48	109.38
F65	-	2.52	-	-	-	-	-	2.52	12.14	92.90
F66	-	3.13	13.07	-	-	-	-	16.20	80.76	80.76
F69	-	-	-	1.01	-	-	-	1.01	18.32	30.91
F70	-	-	-	1.70	-	-	-	1.70	12.59	12.59
F72	-	-	-	4.14	-	-	-	4.14	47.82	47.82
Unnumbered or off-site	-	-	-	-	-	-	-	-	-	-
Subtotal	5.59	10.34	41.94	20.78	0.25	-	-	78.90	519.31	-

[c] includes off-site micro-watershed areas which are tributary to this wetland

WATERSHED: F (continued)

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
F81	-	-	-	-	-	0.35	-	0.35	5.76	5.76
F86	-	-	-	0.25	-	-	-	0.25	10.33	10.33
F87	-	-	-	0.75	-	-	-	0.75	10.37	10.37
F90	-	-	-	-	-	0.27	-	0.27	2.24	2.24
F114	-	-	-	-	0.31	-	-	0.31	2.10	2.10
F116	-	-	0.59	-	-	-	-	0.59	13.05	13.05
F119	-	-	1.11	-	-	-	-	1.11	16.15	16.12
F121	-	-	-	0.25	-	-	-	0.25	8.79	8.79
F122	-	-	-	0.55	-	-	-	0.55	2.72	2.72
F122A	-	0.20	-	-	-	-	-	0.20	22.14	24.86
F125	-	0.50	0.50	-	-	-	-	1.00	10.13	10.13
F126	-	-	-	-	0.40	-	-	0.40	13.24	13.24
F127	-	-	-	1.00	-	-	-	1.00	9.64[c]	9.64
Subtotal	-	0.70	2.20	2.80	0.71	0.62	-	7.03	126.63	-
Unnumbered or off-site	-	1.05	-	1.68	-	-	6.09	8.82	2.03	-
GRAND TOTAL	105.75	47.44	163.93	77.18	67.49	4.06	6.34	472.19	2943.90	

[c]includes off-site micro-watersheds which are tributary to this wetland

WATERSHED: G AREA: 18.48 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
G1	-	-	-	0.31	-	-	-	0.31	2.21	2.21
TOTAL	-	-	-	0.31	-	-	-	0.31	2.21	-
Unnumbered or off-site	-	-	-	-	-	-	0.32	0.32	16.27	-
GRAND TOTAL	-	-	-	0.31	-	-	0.32	0.63	18.48	

WATERSHED: H AREA: 127.54 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
H1	1.26	-	16.40	-	0.60	-	-	18.26	116.91	116.91
TOTAL	1.26	-	16.40	-	0.60	-	-	18.26	116.91	-
Unnumbered or off-site	-	-	0.98	-	-	-	-	0.98	10.63	-
GRAND TOTAL	1.26	-	17.38	-	0.60	-	-	19.24	127.54	

WATERSHED: I AREA: 67.83 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
I1	-	-	-	0.48	-	-	-	0.48	4.27	4.27
TOTAL	-	-	-	0.48	-	-	-	0.48	4.27	-
Unnumbered or off-site	-	-	-	0.56	-	-	-	0.56	63.56	-
GRAND TOTAL	-	-	-	1.04	-	-	-	1.04	67.83	

WATERSHED: J AREA: 54.02 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
J1	-	-	-	0.50	-	-	-	0.50	17.83	17.83
TOTAL	-	-	-	0.50	-	-	-	0.50	17.83	-
Unnumbered or off-site	-	-	-	-	-	-	0.05	0.05	36.19	-
GRAND TOTAL	-	-	-	0.50	-	-	0.05	0.55	54.02	

WATERSHED: K AREA: 196.95 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
K1	-	-	-	-	-	-	0.05	0.05	10.01	196.95
K2	-	-	4.29	1.26	-	-	-	5.55	60.35	186.94
K3	-	-	13.62	-	-	-	-	13.62	92.07	92.07
K4	-	0.60	-	-	-	-	-	0.60	15.17	15.17
K5	1.00	-	-	-	-	-	-	1.00	19.35	19.35
TOTAL	1.00	0.60	17.91	1.26	-	-	0.05	20.82	196.95	-
Unnumbered or off-site	-	-	-	0.30	-	-	-	0.30	-	-
GRAND TOTAL	1.00	0.60	17.91	1.56	-	-	0.05	21.12	196.95	

WATERSHED: L AREA: 37.87 acres

Wetland Number	Sub-Type Areas (Acres) S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Minor Watershed Area (Acres) Direct	Cumulative
L1	-	-	-	0.60	-	-	-	0.60	5.42	5.42
TOTAL	-	-	-	0.60	-	-	-	0.60	5.42	-
Unnumbered or off-site	-	-	-	-	-	-	-	-	32.45	-
GRAND TOTAL	-	-	-	0.60	-	-	-	0.60	34.87	

WATERSHED: M AREA: 115.28 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
M1	-	1.00	-	-	-	-	-	1.00	11.59	115.28
M2	-	-	-	-	-	-	0.05	0.05	17.08	103.69
M3	-	-	2.01	2.17	-	-	-	4.18	44.48	62.29
M4	-	-	-	0.60	-	-	-	0.60	17.81	17.81
M5	-	-	1.76	-	-	-	-	1.76	11.27	11.27
M6	-	-	-	0.50	-	-	-	0.50	13.05	24.32
TOTAL	-	1.00	3.77	3.27	-	-	0.05	8.09	115.28	-
Unnumbered or off-site	-	-	0.06	0.31	-	-	-	0.37	0	-
GRAND TOTAL	-	1.00	3.83	3.58	-	-	0.05	8.46	115.28	

WATERSHED: N AREA: 90.96 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
N1	-	0.55	-	-	-	-	-	0.55	16.83	16.83
TOTAL	-	0.55	-	-	-	-	-	0.55	16.83	-
Unnumbered or off-site	-	-	-	0.25	-	-	-	0.25	74.13	-
GRAND TOTAL	-	0.55	-	0.25	-	-	-	0.80	90.96	

WATERSHED: 0 AREA: 458.27 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
01	-	-	115.54	-	-	-	-	115.54	411.96	458.27
03	-	-	-	1.77	-	-	-	1.77	46.31	46.31
TOTAL	-	-	115.54	1.77	-	-	-	117.31	458.27	-
Unnumbered or off-site	-	-	-	-	-	-	0.41	0.41	-	-
GRAND TOTAL	-	-	115.54	1.77	-	-	0.41	117.72	458.27	

WATERSHED: P AREA: 176.00 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
P1	-	-	-	2.12	-	-	-	2.12	20.40	176.00
P2	-	-	20.78	-	-	-	-	20.78	155.60	155.60
TOTAL	-	-	20.78	2.12	-	-	-	22.90	176.00	-
Unnumbered or off-site	-	-	-	-	-	-	-	-	-	-
GRAND TOTAL	-	-	20.78	2.12	-	-	-	22.90	176.00	

WATERSHED: Q AREA: 22.32 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
(No Numbered Wetlands Present)										
TOTAL	-	-	-	-	-	-	-	-	-	-
Unnumbered or off-site	-	-	-	-	-	-	-	-	22.32	-
GRAND TOTAL	-	-	-	-	-	-	-	-	22.32	

WATERSHED: R AREA: 581.43 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
R1	-	-	1.76	4.03	-	-	-	5.79	83.54	581.43
R1A	-	-	-	9.08	-	-	-	9.08	71.90	497.89
R3	-	5.55	-	1.26	14.63	-	-	21.44	220.72	425.99
R5	-	2.27	5.80	2.32	-	-	-	10.39	98.01	205.27
R7	-	-	-	1.26	-	-	-	1.26	24.85	107.26
R7A	-	3.78	-	-	-	-	-	3.78	68.41	82.41
R8	-	1.76	-	-	-	-	-	1.76	14.00	14.00
TOTAL	-	13.36	7.56	17.95	14.63	-	-	53.50	581.43	-
Unnumbered or off-site	-	-	0.35	-	-	-	0.34	0.69	-	-
GRAND TOTAL	-	13.36	7.91	17.95	14.63	-	0.34	54.19	581.43	

WATERSHED: T AREA: 148.94 acres

Wetland Number	Sub-Type Areas (Acres) S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Minor Watershed Area (Acres) Direct	Cumulative
T1	1.91	-	-	-	-	-	-	1.91	6.07	6.07
T2	0.65	1.00	-	-	-	-	-	1.65	5.79	5.79
T3	-	0.25	-	-	-	-	-	0.25	3.65	3.65
T4	-	8.62	36.16	-	-	-	-	44.78	127.28	127.38
T5	-	-	1.41	-	-	-	-	1.41	1.72	1.72
TOTAL	2.56	9.87	37.57	-	-	-	-	50.00	144.51	-
Unnumbered or off-site	-	0.75	-	-	-	-	0.20	0.95	4.43	-
GRAND TOTAL	2.56	10.62	37.57	-	-	-	0.20	50.95	148.94	

WATERSHED: U AREA: 172.8 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
(No Numbered Wetlands Present)										
TOTAL	-	-	-	-	-	-	-	-	-	-
Unnumbered or off-site	-	-	-	-	-	-	-	-	172.8	-
GRAND TOTAL	-	-	-	-	-	-	-	-	172.8	

WATERSHED: W AREA: 195.12 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
W1	-	-	15.19	-	-	-	-	15.19	23.04	23.04
W2	-	4.07	36.17	-	1.18	-	-	41.42	92.31	92.31
TOTAL	-	4.07	51.36	-	1.18	-	-	56.61	115.35	-
Unnumbered or off-site	-	0.65	-	-	-	-	-	0.65	79.77	-
GRAND TOTAL	-	4.72	51.36	-	1.18	-	-	57.26	195.12	

WATERSHED: X AREA: 228.52 acres

Wetland Number	Sub-Type Areas (Acres)								Minor Watershed Area (Acres)	
	S/SW-a	S/SW-b	FW-a	FW-b	EW-b	AB	Untyped	TOTAL	Direct	Cumulative
X2	-	-	-	0.65	-	-	-	0.65	1.38	1.38
X3	-	-	38.1	-	-	-	-	38.1	223.31	224.69
X4	-	-	-	-	0.75	-	-	0.75	3.83	3.83
TOTAL	-	-	38.1	0.65	0.75	-	-	39.50	228.52	-
Unnumbered or off-site	-	-	-	-	-	-	0.38	0.38	-	-
GRAND TOTAL	-	-	38.1	0.65	0.75	-	0.38	39.88	228.52	

APPENDIX H

REGIONAL SCARCITY MEASUREMENTS

REGIONAL SCARCITY MEASUREMENTS

The data presented in Tables H-1 through H-8 were generated as part of the regional analysis (Section 4.8). The tables contain data of measurements from interpretation of panchromatic stereoscopic aerial photographs dated July 1979, obtained from the Wisconsin DNR, and having an average image area of 5,346 acres. All measurements were made using a digital planimeter (Model H Dell Foster RSS-4MGT-2). These measurements were used to determine the regional scarcity of the study areas' wetlands. The actual photograph numbers and the area of coverage of each photograph are shown in Figure 4.8-1. Tables H-2 through H-8 are measurements of individual wetlands on the 7 stereoscopically interpreted photographs. Table H-1 summarizes these data. To convert acres to hectares multiply acres x .4047.

Table H-1. Wetland measurements from aerial photographs of the Wolf River Watershed above Langlade (Region).

WETLAND TYPE[a]	ACRES	SQUARE MILES
AB	154.2	.2
S/SW-a	800.9	1.3
S/SW-b	1164.6	1.8
FW-a	3220.7	5.0
FW-b	933.7	1.5
EW-b	609.0	1.0
TOTAL (all types)	6883.1	10.8

Total Region Area	=	301,900 acres = 471.6 square miles
Photo Coverage Area	=	37,242 acres = 58.46 square miles
Percent (%) Photo Coverage	=	37,424/301,900 = 12.4%
Percent (%) Wetland within photo coverage area	=	6883.1/37.424 = 18.4%

a = AB = Aquatic Bed; S/SW-a = Bog; S/SW-b = Shrub Swamp; FW-a = Coniferous Swamp; FW-b = Deciduous Swamp; EW-b = Shallow Marsh

Table H-2. Measurements of individual wetlands from aerial photograph 3712E27 (acres).

	WETLAND TYPES[a]						
	AB	S/SW-a	S/SW-b	FW-a		FW-b	EW-b
	10.1	2.8	6.3	226.0	22.8	25.7	0.6
			3.9	1.7	34.8	35.3	2.0
			3.6	3.7	25.6	3.3	5.0
			294.0	1.7	0.8	46.6	
				9.6	2.3		
				23.6	2.1		
				29.1	4.5		
				30.4	1.7		
				457.3	7.0		
				6.6			
				3.0			
				19.5			
				2.4			
				87.4			
				41.9			
				3.7			
				2.1			
				72.1			
				13.7			
				4.2			
				8.7			
				67.2			
				26.8			
				69.6			
				56.0			
				211.7			
Totals:	10.1	2.8	307.8	1581.3	101.6	110.9	7.6
hectares:	4.0	1.1	124.3	638.8	41.0	44.8	3.0

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

Table H-3. Measurements of individual wetlands from aerial photograph 3411E03 (acres).

	WETLAND TYPES[a]					
	AB	S/SW-a	S/SW-b	FW-a	FW-b	EW-b
	72.0	2.2	12.4	5.4	7.5	17.8
	2.4	30.5	3.4	2.6	25.3	18.8
		8.6	9.4	2.7	3.0	1.9
		24.8	0.9	1.0	5.4	10.8
		8.7	2.4	17.8	13.9	15.9
		2.3	3.2	2.5	12.9	3.5
		3.1	33.7	8.7	2.3	9.3
		1.1	5.8	2.0	4.6	29.8
		175.5	18.0	2.0	27.7	15.1
			19.6	12.7	14.2	44.7
			5.4	3.4	3.7	2.1
			5.1	7.0	22.7	
			149.7	6.9	1.9	
				13.9		
			1.0	1.9	59.4	
			0.8	40.2	8.0	
			11.9	8.0	1.3	
				5.3	1.4	
				14.8		
				4.2		
				2.0		
				5.1		
				22.7		
				4.8		
				16.8		
				0.6		
				0.9		
Totals:	74.4	256.8	282.7	215.9	217.2	169.7
hectares:	30.0	103.7	114.2	87.2	87.7	68.5

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

Table H-4. Measurements of individual wetlands from aerial photograph 3612E28 (acres).

	WETLAND TYPES[a]					
	AB	S/SW-a	S/SW-b	FW-a	FW-b	EW-b
	5.8	2.1	47.8	4.7	2.1	13.7
		0.6	21.9	21.5	2.9	
		0.2	40.7	12.8	2.3	
		0.5		16.8	11.9	
		0.3		6.5	9.9	
		0.5		17.7		
		0.6		7.1		
		47.0		11.0		
		3.5		21.0		
		78.0		29.6		
		25.0		13.5		
		63.3				
		12.8				
		26.7				
		11.3				
		4.1				
Totals:	5.8	276.5	110.4	162.2	29.1	13.7
hectares:	2.3	110.7	44.6	65.5	11.7	5.5

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

Table H-5. Measurements of individual wetlands from aerial photograph 3411E29 (acres).

	WETLAND TYPES[a]						
	AB	S/SW-a	S/SW-b	FW-a		FW-b	EW-b
	2.6	28.9	2.3	6.5	30.7	16.0	29.0
		1.9	4.1	46.7	0.7	9.2	224.1
		1.9	10.2	32.6	42.5	1.3	5.4
		7.6	4.1	12.5	17.1	8.1	
		7.7	5.6	1.4	32.4	11.5	
		1.3	17.5	29.3	11.2	3.5	
		4.3	1.1	0.5		3.5	
		10.5	37.8	0.4		1.4	
		3.5	8.1	1.6		2.6	
		2.9	1.1	8.1		3.3	
		0.9	3.6	4.5		1.8	
		9.2	1.1	7.7		30.4	
		2.4	3.9	9.8		3.1	
		1.4	19.0	12.4		12.1	
				4.4			
				3.3			
				1.9			
				3.7			
				5.6			
				4.6			
				6.3			
				5.4			
				5.8			
				3.9			
				4.7			
				5.7			
				2.4			
				2.0			
Totals:	2.6	84.4	119.5	368.3	134.6	107.8	258.5
hectares:	1.0	34.0	48.2	148.7	54.3	43.5	104.4

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

Table H-6. Measurements of individual wetlands from aerial photograph 3312E13 (acres).

	WETLAND TYPES[a]					
	AB	S/SW-a	S/SW-b	FW-a	FW-b	EW-b
	28.7	2.4	0.4	9.6	2.1	15.9
	1.3	0.4	13.7	9.8	6.6	0.8
	7.4	7.9	1.8	25.7	22.8	6.3
		5.5	0.7	2.9	3.4	0.7
		1.1	36.3	0.6	9.9	2.3
		6.5	34.9	5.3	7.6	23.0
		0.6	27.0	26.0	127.1	7.4
			4.8	11.7	7.2	2.8
			3.5	42.7	49.3	12.1
				5.1	3.0	32.2
				0.9	3.1	1.6
				122.3	9.1	2.1
				4.5	41.7	
				47.5	4.6	
				109.5	21.3	
				9.1	35.2	
				147.9	9.1	
				84.1	48.9	
				8.9	30.7	
				0.7	4.0	
				17.4		
Totals:	37.4	24.4	123.1	692.2	446.7	107.2
hectares:	15.1	9.8	49.7	279.6	180.4	43.3

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

Table H-7. Measurements of individual wetlands from aerial photograph 3313E27 (acres).

	WETLAND TYPES[a]					
	AB	S/SW-a	S/SW-b	FW-a	FW-b	EW-b
	6.1	79.4	6.3	4.6	1.7	1.1
	7.4	4.8	0.2	0.6	1.5	5.8
		1.3	1.0	8.4	3.2	2.2
		0.1	8.7	6.9	2.5	
		2.7	53.6	8.4	1.3	
		1.8	13.1	1.9	2.7	
		1.0	6.9	8.7		
		1.9	1.5	0.6		
		2.7	2.5	2.5		
		1.5	7.5	1.5		
			0.3			
Totals:	13.5	97.2	101.6	44.1	12.9	9.1
hectares:	5.4	39.2	41.0	17.8	5.2	3.6

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

Table H-8. Measurements of individual wetlands from aerial photograph 3214E16 (acres).

	WETLAND TYPES[a]					
	AB	S/SW-a	S/SW-b	FW-a	FW-b	EW-b
	4.4	0.3	88.2	17.2	6.0	38.6
	6.0	3.9	3.5	5.3	1.5	4.6
		3.6	10.5	11.5	0.8	
		7.7	1.7	16.0	0.4	
		0.6	14.3	78.3	0.4	
		33.2	1.3	8.9		
		1.2		6.3		
		1.5		1.7		
		4.2		4.9		
		2.6		0.5		
				2.1		
				0.7		
				3.3		
Totals:	10.4	58.8	119.5	156.7	9.1	43.2
hectares:	4.2	27.7	48.2	63.3	3.6	17.4

a= AB = Aquatic Bed
S/SW-a = Bog
S/SW-b = Shrub Swamp
FW-a = Coniferous Swamp
FW-b = Deciduous Swamp
EW-b = Shallow Marsh

APPENDIX I

WETLAND INVENTORY REPORTS

WETLAND INVENTORY REPORTS

A set of the wetland inventory reports for 127 study area wetlands is presented in a separate document. The 46 wetlands of special interest are included among the 127 wetland inventory reports. The element condition designations in these reports were the basis for rating and ranking the wetlands in each of the functional models.

The wetland inventory report was first developed by the investigators in 1975 and has been used regularly to conduct wetland assessments throughout New England. The original inventory reports used in New England were modified specifically for use in northern Wisconsin in 1981.

APPENDIX J

VEGETATION AND WILDLIFE DATA

VEGETATION AND WILDLIFE DATA

In this appendix individual transect data for vegetation are shown in Tables J-1 through J-16 and actual numbers of birds observed on each transect are presented in Table J-17 and J-18. A summary of all miscellaneous observations for mammals is presented in Table J-19.

TABLE J-1. Phytosociological characteristics of a deciduous swamp community in the study area; Transect 1.

TRANSECT: 1 WETLAND NO: F57 TYPE: Deciduous Swamp PLOTS: 5 DATE: 5/18/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a] D	CD	SD	S		PERCENT COVER	PERCENT RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	PERCENT RELATIVE FREQUENCY	PERCENT IMPORTANCE VALUE
TREE LAYER												
Populus tremuloides	3	9	2	5	1	1		-[b]	.525	.450	.333	1.309
Tsuga canadensis	1	1	0	0	1	0		-	.059	.050	.111	.220
Acer rubrum	3	7	1	5	1	0		-	.303	.350	.333	.987
Abies balsamea	1	2	0	2	0	0		-	.086	.100	.111	.297
Fraxinus pennsylvanica var. *subintegerrima*	1	1	0	1	0	0		-	.026	.050	.111	.187
TOTALS	9	20										
			SOCIABILITY[c] A	B	C	D	E					
SHRUB LAYER												
Alnus rugosa	5	46	1	4	0	0	0	26.4	-	.613	.385	.998
Acer rubrum	3	5	2	1	0	0	0	0.6	-	.067	.231	.297
Nemopanthus mucronata	2	18	0	2	0	0	0	6.0	-	.240	.154	.394
Sorbus americana	1	2	1	0	0	0	0	0.4	-	.027	.077	.104
Rubus occidentalis	2	4	2	0	0	0	0	0.6	-	.053	.154	.207
TOTALS	13	75										
HERB LAYER												
Maianthemum canadense	4	-	2	2	0	0	0	1.6	-	-	.174	.174
Carex sp.	4	-	0	4	0	0	0	2.0	-	-	.174	.174
Sphagnum sp.	5	-	0	0	2	3	0	35.0	-	-	.217	.217
Lycopus sp.	3	-	1	2	0	0	0	2.1	-	-	.130	.130
Clintonia borealis	2	-	1	1	0	0	0	0.5	-	-	.087	.087
Coptis groenlandica	3	-	3	0	0	0	0	0.3	-	-	.130	.130
Cornus canadensis	1	-	1	0	0	0	0	0.1	-	-	.043	.043
Poaceae	1	-	0	1	0	0	0	0.1	-	-	.043	.043
TOTALS	23											

a = Canopy classes are: D = dominant
CD = codominant
SD = subdominant
S = surpressed

b = Not applicable

c = Sociability categories are:
A. solitary, growing singly
B. growing in small groups of a few individuals
C. large group of many individuals; small scattered patches
D. patches or a broken mat
E. extensive mat almost completely covering entire plot

TABLE J-2. Phytosociological characteristics of a coniferous swamp community in the study area; Transect 2.

TRANSECT: 2	WETLAND NO: F60	TYPE: Coniferous Swamp	PLOTS: 4	DATE: 5/18/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a]					PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
			D	CD	SD	S						
TREE LAYER												
Picea mariana	5	4	0	1	2	2		-[b]	.098	.333	.500	.931
Tsuga canadensis	1	1	0	0	1	0		-	.044	.067	.125	.236
Larix laricina	9	3	4	3	2	0		-	.858	.600	.375	1.833
TOTALS	15	8										
			SOCIABILITY[c]									
			A	B	C	D	E					
SHRUB LAYER												
Nemopanthus mucronata	2	16	2	0	0	0	0	7.5	-	.027	.077	.104
Ledum groenlandicum	4	232	0	2	2	0	0	37.5	-	.399	.154	.552
Kalmia polifolia	3	9	2	1	0	0	0	0.4	-	.015	.115	.130
Vaccinum corymbosum	3	38	1	2	0	0	0	3.5	-	.065	.115	.181
Picea mariana	2	11	1	1	0	0	0	13.8	-	.019	.077	.096
Abies balsamea	1	1	1	0	0	0	0	1.3	-	.002	.038	.040
Ilex verticillata	3	10	3	0	0	0	0	0.4	-	.017	.115	.132
Chamaedaphne calyculata	4	126	2	1	1	0	0	15.3	-	.216	.154	.370
Vaccinium macrocarpon	3	138	0	2	1	0	0	3.9	-	.237	.115	.352
Larix laricina	1	1	1	0	0	0	0	0.1	-	.002	.038	.040
TOTALS	26	582										
HERB LAYER												
Carex sp.	2	-	0	1	1	0	0	7.6	-	-	.222	.222
Sphagnum sp.	4	-	0	0	1	1	2	71.3	-	-	.444	.444
Cornus canadensis	2	-	2	0	0	0	0	0.6	-	-	.222	.222
Coptis groenlandica	1	-	1	0	0	0	0	0.1	-	-	.111	.111
TOTALS	9											

a = For canopy classes see Table J-1.
b = Not applicable
c = For sociability classes see Table J-1.

TABLE J-3. Phytosociological characteristics of a shrub swamp community in the study area; Transect 3.

TRANSECT: 3	WETLAND NO: F39	TYPE: Shrub Swamp	PLOTS: 4	DATE: 5/18/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE DENSITY	PERCENT RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER											
Alnus rugosa	4	111	0	4	0	0	0	63.8	.965	.667	1.632
Salix sp.	1	3	1	0	0	0	0	0.1	.026	.167	.193
Sorbus americana	1	1	1	0	0	0	0	0.1	.009	.167	.176
TOTALS	6	115									
HERB LAYER											
Maianthemum canadense	3	-[b]	2	1	0	0	0	2.1	-	.200	.200
Sphagnum sp.	4	-	0	0	0	2	2	61.3	-	.267	.267
Dryopteris sp.	1	-	1	0	0	0	0	0.1	-	.067	.067
Impatiens capensis	1	-	1	0	0	0	0	0.1	-	.067	.067
Lycopus sp.	2	-	2	0	0	0	0	0.2	-	.133	.133
Poaceae	1	-	1	0	0	0	0	0.1	-	.067	.067
Calamagrostis canadensis	2	-	0	1	1	0	0	12.5	-	.133	.133
Pontederia cordata	1	-	1	0	0	0	0	0.8	-	.067	.067
TOTAL	15										

a = For sociability classes see Table J-1.
b = Not applicable

TABLE J-4. Phytosociological characteristics of a bog community in the study area; Transect 4.

TRANSECT: 4	WETLAND NO: F16	TYPE: Bog	PLOTS: 5	DATE: 5/18/81								
SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER											
Chamaedaphne calyculata	5	500	0	0	5	0	0	35.0	.660	.263	.923
Vaccinium macrocarpon	5	148	1	4	0	0	0	5.3	.195	.263	.458
Kalmia polifolia	4	40	4	0	0	0	0	1.8	.053	.211	.263
Andromeda glaucophylla	3	65	2	0	1	0	0	4.2	.086	.158	.244
Larix laricina	1	4	1	0	0	0	0	0.8	.005	.053	.058
Betula papyrifera	1	1	1	0	0	0	0	1.0	.001	.053	.054
TOTALS	19	758									
HERB LAYER											
Sphagnum sp.	5	-[b]	0	0	0	0	5	96.0	-	.417	.417
Carex sp.	5	-	0	4	1	0	0	9.1	-	.417	.417
Sarracenia purpurea	2	-	2	0	0	0	0	0.2	-	.167	.167
TOTAL	12										

a = For sociability classes see Table J-1.
b = Not applicable.

TABLE J-5. Phytosociological characteristics of a deciduous swamp community in the study area; Transect 5.

TRANSECT: 5 WETLAND NO: F15 TYPE: Deciduous Swamp PLOTS: 5 DATE: 5/21/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a] D	CD	SD	S	PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
TREE LAYER											
Acer rubrum	3	2	0	1	2	0	-[b]	.068	.150	.154	.371
Ulmus americana	4	3	1	1	1	1	-	.263	.200	.231	.693
Populus tremuloides	2	2	0	1	0	1	-	.143	.100	.154	.397
Quercus macrocarpa	3	6	0	5	1	0	-	.299	.300	.231	.830
Fraxinus pennsylvanica var. *subintegerrima*	2	4	0	4	0	0	-	.192	.200	.154	.546
Betula papyrifera	1	1	0	1	0	0	-	.036	.050	.077	.163
TOTALS	15	18									

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[c] A	B	C	D	E	PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER												
Populus tremuloides	3	11	3	0	0	0	0	1.2	-	.139	.188	.327
Fraxinus pennsylvanica var. *subintegerrima*	3	11	3	0	0	0	0	1.3	-	.139	.188	.327
Prunus serotina	2	3	1	1	0	0	0	0.7	-	.038	.125	.163
Acer rubrum	1	6	0	1	0	0	0	0.8	-	.076	.063	.138
Corylus cornuta	2	8	2	0	0	0	0	2.1	-	.101	.125	.226
Diervilla lonicera	1	2	0	1	0	0	0	0.1	-	.025	.063	.088
Rubus sp.	1	7	1	0	0	0	0	1.0	-	.089	.063	.151
Ilex verticillata	1	18	1	0	0	0	0	10.0	-	.228	.063	.290
Rubus idaeus	1	5	1	0	0	0	0	0.1	-	.063	.063	.126
Ulmus americana	1	8	1	0	0	0	0	2.0	-	.101	.063	.164
TOTALS	16	79										
HERB LAYER												
Maianthemum canadense	2	-	2	0	0	0	0	5.6	-	-	.087	.087
Cornus canadensis	1	-	1	0	0	0	0	1.0	-	-	.043	.043
Poaceae	1	-	0	1	0	0	0	0.6	-	-	.043	.043
Lycopodium lucidulum	1	-	0	1	0	0	0	1.0	-	-	.043	.043
Viola sp.	2	-	1	1	0	0	0	0.7	-	-	.087	.087
Dryopteris spinulosa	2	-	2	0	0	0	0	0.2	-	-	.087	.087
Carex sp.	4	-	0	3	1	0	0	8.6	-	-	.174	.174
Trientalis borealis	1	-	1	0	0	0	0	0.1	-	-	.043	.043
Luzula campestris	1	-	0	0	1	0	0	0.1	-	-	.043	.043
Pteridium aquilinum	1	-	1	0	0	0	0	0.1	-	-	.043	.043
Clintonia borealis	1	-	1	0	0	0	0	0.1	-	-	.043	.043
Calamagrostis canadensis	2	-	1	0	1	0	0	12.1	-	-	.087	.087
Impatiens capensis	1	-	1	0	0	0	0	0.1	-	-	.043	.043
Iris sp.	2	-	2	0	0	0	0	0.7	-	-	.087	.087
Lycopus sp.	1	-	1	0	0	0	0	0.6	-	-	.043	.043
TOTAL	23											

a = For canopy classes see Table J-1.
b = Not applicable
c = For sociability classes see Table J-1.

TABLE J-6. Phytosociological characteristics of a marsh community in the study area; Transect 6.

TRANSECT: 6	WETLAND NO: F15	TYPE: Marsh					PLOTS: 5		DATE: 5/21/81
SPECIES	PLOTS PRESENT	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE FREQUENCY	IMPORTANCE VALUE
HERB LAYER									
Carex sp.	4	0	0	4	0	0	80.0	.667	.667
Calamagrostis canadensis	1	0	0	1	0	0	20.0	.167	.167
Fragaria virginiana	1	0	1	0	0	0	0.1	.167	.167
TOTAL	6								

a = For sociability classes see Table J-1.

TABLE J-7. Phytosociological characteristics of a marsh community in the study area; Transect 7.

TRANSECT: 7	WETLAND NO: F11	TYPE: Marsh					PLOTS: 5		DATE: 5/21/81
		SOCIABILITY[a]						PERCENT	
SPECIES	PLOTS PRESENT	A	B	C	D	E	PERCENT COVER	RELATIVE FREQUENCY	IMPORTANCE VALUE
HERB LAYER									
Calamagrostis canadensis	2	0	0	2	0	0	35.0	.222	.222
Carex sp.	5	0	0	5	0	0	63.0	.556	.556
Sphagnum sp.	1	0	0	0	1	0	10.0	.111	.111
Solidago sp.	1	1	0	0	0	0	0.1	.111	.111
TOTAL	9								

a = For sociability classes see Table J-1.

TABLE J-8. Phytosociological characteristics of a bog community in the study area; Transect 10.

TRANSECT: 10 WETLAND NO: F28 TYPE: Bog PLOTS: 4 DATE: 5/19/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER											
Picea mariana	4	13	4	0	0	0	0	20.0	.024	.148	.173
Larix laricina	4	18	4	0	0	0	0	18.8	.034	.148	.182
Ledum groenlandicum	3	300	0	0	3	0	0	45.0	.565	.111	.676
Andromeda glaucophylla	2	8	2	0	0	0	0	0.9	.015	.074	.089
Kalmia polifolia	4	41	4	0	0	0	0	6.0	.077	.148	.225
Vaccinium corymbosum	4	26	2	2	0	0	0	5.9	.049	.148	.197
Chamaedaphne calyculata	4	109	3	0	1	0	0	8.2	.205	.148	.353
Vaccinium macrocarpon	2	16	0	2	0	0	0	0.9	.030	.074	.104
TOTALS	27	531									
HERB LAYER											
Sphagnum sp.	4	-[b]	0	0	0	0	4	98.0	-	.571	.571
Eriophorum spissum	2	-	2	0	0	0	0	0.3	-	.286	.286
Clintonia borealis	1	-	1	0	0	0	0	0.1	-	.143	.143
TOTAL	7										

a = For sociability classes see Table J-1.
b = Not applicable.

TABLE J-9. Phytosociological characteristics of a shrub swamp community in the study area; Transect 11.

TRANSECT: 11 WETLAND NO: M1 TYPE: Shrub Swamp PLOTS: 4 DATE: 5/20/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER											
Alnus rugosa	4	27	1	3	0	0	0	26.3	.711	.500	1.211
Fraxinus pennsylvanica var. *subintegerrima*	2	7	2	0	0	0	0	7.3	.184	.250	.434
Rubus sp.	2	4	2	0	0	0	0	1.4	.105	.250	.355
TOTALS	8	38									
HERB LAYER											
Chrysosplenium americanum	1	-[b]	0	0	1	0	0	7.5	-	.048	.048
Galium palustre	4	-	4	0	0	0	0	1.1	-	.190	.190
Equisetum fluviatile	1	-	1	0	0	0	0	0.1	-	.048	.048
Carex sp.	4	-	0	1	3	0	0	21.3	-	.190	.190
Viola sp.	4	-	1	3	0	0	0	10.1	-	.190	.190
Impatiens capensis	2	-	2	0	0	0	0	0.9	-	.095	.095
Cirsium sp.	1	-	1	0	0	0	0	0.8	-	.048	.048
Caltha palustris	1	-	0	1	0	0	0	1.3	-	.048	.048
Sphagnum sp.	2	-	0	1	0	1	0	12.5	-	.095	.095
Onoclea sensibilis	1	-	1	0	0	0	0	0.1	-	.048	.048
TOTAL	21										

a = For sociability classes see Table J-1.
b = Not applicable.

TABLE J-10. Phytosociological characteristics of a deciduous swamp community in the study area; Transect 12.

TRANSECT: 12 WETLAND NO: M3 TYPE: Deciduous Swamp PLOTS: 5 DATE: 5/20/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a] D	CD	SD	S		PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
TREE LAYER												
Fraxinus pennsylvanica var. *subintegerrima*	11	5	0	6	5	0		-[b]	.468	.550	.385	1.403
Acer saccharum	1	1	0	0	1	0		-	.040	.050	.077	.167
Acer rubrum	2	2	0	1	1	0		-	.061	.100	.154	.315
Ulmus americana	5	4	1	3	1	0		-	.342	.250	.308	.899
Betula lutea	1	1	0	1	0	0		-	.089	.050	.077	.216
TOTALS	20	13										
			SOCIABILITY[c] A	B	C	D	E					
SHRUB LAYER												
Populus tremuloides	1	2	1	0	0	0	0	0.1	-	.061	.067	.127
Acer saccharum	1	5	1	0	0	0	0	0.1	-	.152	.067	.218
Fraxinus pennsylvanica var. *subintegerrima*	3	8	3	0	0	0	0	2.2	-	.242	.200	.442
Rubus idaeus var. *strigosus*	3	4	3	0	0	0	0	0.6	-	.121	.200	.321
Ribes sp.	2	3	1	1	0	0	0	0.2	-	.091	.133	.224
Ulmus americana	1	3	1	0	0	0	0	0.1	-	.091	.067	.158
Acer rubrum	2	6	2	0	0	0	0	5.0	-	.182	.133	.315
Tilia americana	1	1	1	0	0	0	0	0.6	-	.030	.067	.097
Fraxinus americana	1	1	1	0	0	0	0	0.6	-	.030	.067	.097
TOTALS	15	33										
HERB LAYER												
Dicentra cucullaria	1	-	0	1	0	0	0	0.8	-	-	.036	.036
Claytonia virginica	1	-	0	1	0	0	0	0.4	-	-	.036	.036
Carex sp.	5	-	0	3	2	0	0	13.1	-	-	.179	.179
Impatiens capensis	2	-	2	0	0	0	0	0.5	-	-	.071	.071
Sphagnum sp.	4	-	0	0	4	0	0	15.0	-	-	.143	.143
Cirsium sp.	1	-	1	0	0	0	0	0.1	-	-	.036	.036
Maianthemum canadense	3	-	2	1	0	0	0	3.1	-	-	.107	.107
Iris sp.	1	-	0	1	0	0	0	1.0	-	-	.036	.036
Trientalis borealis	2	-	2	0	0	0	0	0.2	-	-	.071	.071
Equisetum fluviatile	2	-	2	0	0	0	0	1.1	-	-	.071	.071
Lycopus sp.	1	-	1	0	0	0	0	0.1	-	-	.036	.036
Galium palustre	1	-	1	0	0	0	0	0.1	-	-	.036	.036
Viola sp.	2	-	1	1	0	0	0	0.2	-	-	.071	.071
Poaceae	2	-	0	2	0	0	0	2.1	-	-	.071	.071
TOTAL	28											

a = For canopy classes see Table J-1.
b = Not applicable
c = For sociability classes see Table J-1.

TABLE J-11. Phytosociological characteristics of a shrub swamp community in the study area; Transect 13.

TRANSECT: 13 WETLAND NO: F66 TYPE: Shrub Swamp PLOTS: 5 DATE: 5/20/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER											
Salix sp.	2	4	1	1	0	0	0	1.3	.030	.071	.102
Salix bebbiana	1	6	0	1	0	0	0	1.6	.045	.036	.081
Acer rubrum	6	29	4	2	0	0	0	11.3	.220	.214	.434
Betula lutea	5	11	2	3	0	0	0	5.5	.083	.179	.262
Ribes sp.	1	3	0	1	0	0	0	0.3	.023	.036	.058
Rubus idaeus var. *strigodus*	1	2	1	0	0	0	0	0.3	.015	.036	.051
Abies balsamea	2	3	2	0	0	0	0	2.5	.023	.071	.094
Acer spicatum	1	1	1	0	0	0	0	0.1	.008	.036	.043
Populus balsamifera	1	2	1	0	0	0	0	0.8	.015	.036	.051
Nemopanthus mucronata	2	48	0	2	0	0	0	7.8	.364	.071	.435
Corylus cornuta	1	1	1	0	0	0	0	0.5	.008	.036	.043
Vaccinium corymbosum	1	12	0	1	0	0	0	0.8	.091	.036	.127
Vaccinium macrocarpon	1	6	0	1	0	0	0	0.1	.045	.036	.081
Fraxinus pennsylvanica var. *subintegerrima*	1	2	1	0	0	0	0	0.7	.015	.036	.051
Ilex verticillata	1	1	1	0	0	0	0	0.3	.008	.036	.043
Picea mariana	1	1	1	0	0	0	0	0.5	.008	.036	.043
TOTALS	28	132									
HERB LAYER											
Sphagnum sp.	6	-[b]	0	0	0	4	2	57.5	-	.231	.231
Calamagrostis canadensis	3	-	1	1	1	0	0	5.9	-	.115	.115
Equisetum sp.	2	-	2	0	0	0	0	0.2	-	.077	.077
Carex sp.	4	-	0	3	1	0	0	10.1	-	.154	.154
Solidago sp.	1	-	1	0	0	0	0	0.1	-	.038	.038
Coptis groenlandica	1	-	1	0	0	0	0	0.1	-	.038	.038
Clintonia borealis	2	-	1	1	0	0	0	0.9	-	.077	.077
Maianthemum canadense	1	-	1	0	0	0	0	0.8	-	.038	.038
Equisteum fluviatile	1	-	1	0	0	0	0	0.1	-	.038	.038
Linnaea borealis	1	-	1	0	0	0	0	0.1	-	.038	.038
Cornus canadensis	1	-	1	0	0	0	0	0.1	-	.038	.038
Iris sp.	1	-	1	0	0	0	0	0.1	-	.038	.038
Trientalis borealis	2	-	2	0	0	0	0	0.2	-	.077	.077
TOTAL	26										

a = For sociability classes see Table J-1.
b = Not applicable.

TABLE J-12. Phytosociological characteristics of a bog community in the study area; Transect 14.

TRANSECT: 14 WETLAND NO: F64 TYPE: Bog PLOTS: 5 DATE: 5/20/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER											
Chamaedaphne calyculata	5	406	0	1	4	0	0	45.0	.858	.357	1.215
Salix sp.	2	6	2	0	0	0	0	0.2	.013	.143	.156
Vaccinium macrocarpon	4	45	0	4	0	0	0	2.1	.095	.286	.381
Picea mariana	1	2	1	0	0	0	0	1.0	.004	.071	.076
Larix laricina	1	2	0	1	0	0	0	2.0	.004	.071	.076
Kalmia polifolia	1	12	1	0	0	0	0	0.6	.025	.071	.097
TOTALS	14	473									
HERB LAYER											
Carex sp.	5	-[b]	0	0	5	0	0	43.0	-	.500	.500
Sphagnum sp.	5	-	0	0	0	5	0	88.0	-	.500	.500
TOTAL	10										

a = For sociability classes see Table J-1.
b = Not applicable.

TABLE J-13. Phytosociological characteristics of a marsh community in the study area; Transect 15.

TRANSECT: 15 WETLAND NO: F37 TYPE: Shallow Marsh PLOTS: 5 DATE: 5/18/81

SPECIES	PLOTS PRESENT	SOCIABILITY[a] A	B	C	D	E	PERCENT COVER	PERCENT RELATIVE FREQUENCY	IMPORTANCE VALUE
HERB LAYER									
Calamagrostis canadensis	4	0	2	2	0	0	28.0	.267	.267
Sphagnum sp.	5	0	0	0	3	2	70.0	.333	.333
Scirpus cyperinus	1	1	0	0	0	0	0.1	.067	.067
Glyceria canadensis	1	1	0	0	0	0	0.1	.067	.067
Spiraea tomentosa	1	0	1	0	0	0	1.0	.067	.067
Carex sp.	3	0	0	3	0	0	34.0	.200	.200
TOTAL	15								

a = For sociability classes see Table J-1.

TABLE J-14. Phytosociological characteristics of a coniferous swamp community in the study area; Transect 16.

TRANSECT: 16 WETLAND NO: D4 TYPE: Coniferous Swamp PLOTS: 5 DATE: 5/19/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a] D	CD	SD	S		PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
TREE LAYER												
Betula lutea	1	1	0	0	0	1		-[b]	.071	.055	.083	.204
Abies balsamea	2	2	0	0	2	0		-	.025	.100	.167	.292
Tsuga canadensis	2	2	0	1	0	1		-	.132	.100	.167	.399
Acer rubrum	2	2	1	1	0	0		-	.128	.100	.167	.394
Picea mariana	12	4	1	7	4	0		-	.477	.600	.333	1.410
Thuja occidentalis	1	1	0	1	0	0		-	.167	.050	.083	.300
TOTALS	20	12										
			SOCIABILITY[c] A	B	C	D	E					
SHRUB LAYER												
Picea mariana	3	3	3	0	0	0	0	4.0	-	.029	.200	.229
Alnus rugosa	3	40	0	3	0	0	0	19.0	-	.388	.200	.588
Nemopanthus mucronata	4	28	2	2	0	0	0	9.0	-	.272	.267	.539
Ledum groenlandicum	1	8	1	0	0	0	0	1.0	-	.078	.067	.144
Vaccinium corymbosum	1	12	1	0	0	0	0	1.0	-	.117	.067	.183
V. macrocarpon	1	10	0	1	0	0	0	0.6	-	.097	.067	.164
Pyrus melanocarpa	1	1	1	0	0	0	0	0.1	-	.010	.067	.077
Abies balsamea	1	1	1	0	0	0	0	0.4	-	.010	.067	.077
TOTALS	15	103										
HERB LAYER												
Coptis groenlandica	3	-	1	2	0	0	0	0.6	-	-	.136	.136
Maianthemum canadense	4	-	3	1	0	0	0	1.3	-	-	.182	.182
Cornus canadensis	2	-	2	0	0	0	0	0.2	-	-	.091	.091
Trientalis borealis	2	-	2	0	0	0	0	0.2	-	-	.091	.091
Osmunda cinnamomea	2	-	0	2	0	0	0	1.6	-	-	.091	.091
Sphagnum sp.	5	-	0	0	0	2	3	69.0	-	-	.227	.227
Carex sp.	3	-	0	2	1	0	0	10.5	-	-	.136	.136
Iris sp.	1	-	1	0	0	0	0	0.1	-	-	.045	.045
TOTAL	22											

a = For canopy classes see Table J-1.
b = Not applicable
c = For sociability classes see Table J-1.

TABLE J-15. Phytosociological characteristics of a coniferous swamp community in the study area; Transect 17.

TRANSECT: 17 WETLAND NO: F66 TYPE: Coniferous Swamp PLOTS: 5 DATE: 5/22/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a] D	CD	SD	S	PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
TREE LAYER											
Picea mariana	3	3	1	2	0	0	-[b]	.208	.150	.273	.630
Abies balsamea	1	1	0	1	0	0	-	.031	.050	.091	.172
Larix laricina	13	5	1	7	3	2	-	.567	.650	.455	1.671
Tsuga canadensis	3	2	0	2	0	1	-	.195	.150	.182	.527
TOTALS	20	11									

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	SOCIABILITY[c] A	B	C	D	E	PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
SHRUB LAYER												
Acer rubrum	3	8	2	1	0	0	0	4.1	-	.036	.143	.179
Nemopanthus mucronata	2	19	0	2	0	0	0	10.0	-	.085	.095	.180
Alnus rugosa	1	3	1	0	0	0	0	2.0	-	.013	.048	.061
Picea mariana	3	6	2	1	0	0	0	6.0	-	.027	.143	.170
Ledum groenlandicum	2	115	0	0	1	0	0	14.0	-	.516	.095	.611
Kalmia polifolia	1	6	1	0	0	0	0	0.6	-	.027	.048	.075
Vaccinium corymbosum	3	32	3	0	0	0	0	6.1	-	.143	.143	.286
V. macrocarpon	1	8	0	1	0	0	0	0.4	-	.036	.048	.083
Gautheria procumbens	3	20	0	3	0	0	0	2.2	-	.090	.143	.233
Amelanchier laevis	1	3	0	1	0	0	0	0.8	-	.013	.048	.061
Chamaedaphne calyculata	1	3	0	1	0	0	0	0.1	-	.013	.048	.061
TOTALS	21	223										
HERB LAYER												
Sphagnum sp.	5	-	0	0	0	5	0	53.0	-	-	.294	.294
Maianthemum canadense	4	-	4	0	0	0	0	0.9	-	-	.235	.235
Carex sp.	1	-	0	1	0	0	0	1.0	-	-	.059	.059
Osmunda cinnamomea	4	-	2	2	0	0	0	1.1	-	-	.235	.235
Coptis groenlandica	2	-	2	0	0	0	0	0.2	-	-	.118	.118
Cornus canadensis	1	-	1	0	0	0	0	0.1	-	-	.059	.059
TOTAL	17											

a = For canopy classes see Table J-1.
b = Not applicable
c = For sociability classes see Table J-1.

TABLE J-16. Phytosociological characteristics of a coniferous swamp community in the study area; Transect 18.

TRANSECT: 18 WETLAND NO: F63 TYPE: Coniferous Swamp PLOTS: 5 DATE: 5/20/81

SPECIES	PLOTS PRESENT	NUMBER OF STEMS	CANOPY CLASS[a] D	CD	SD	S		PERCENT COVER	RELATIVE DOMINANCE	PERCENT RELATIVE DENSITY	RELATIVE FREQUENCY	IMPORTANCE VALUE
TREE LAYER												
Larix laricina	8	4	0	4	4	0		-[b]	.519	.400	.444	1.363
Picea mariana	12	5	0	5	7	0		-	.481	.600	.556	1.637
TOTALS	20	9										
			SOCIABILITY[c] A	B	C	D	E					
SHRUB LAYER												
Ledum groenlandicum	1	3	0	1	0	0	0	1.0	-	.097	.083	.180
Ribes sp.	1	8	1	0	0	0	0	1.4	-	.258	.083	.341
Betula lutea	1	1	1	0	0	0	0	0.4	-	.032	.083	.116
Salix sp.	1	1	1	0	0	0	0	1.0	-	.032	.083	.116
Picea mariana	4	7	4	0	0	0	0	4.0	-	.226	.333	.559
Vaccinium corymbosum	1	1	1	0	0	0	0	0.1	-	.032	.083	.116
Nemopanthus mucronata	2	8	1	1	0	0	0	1.8	-	.258	.167	.425
Larix laricina	1	2	1	0	0	0	0	0.1	-	.065	.083	.148
TOTALS	12	31										
HERB LAYER												
Sphagnum sp.	5	-	0	0	0	5	0	69.0	-	-	.313	.313
Carex sp.	2	-	0	2	0	0	0	2.0	-	-	.125	.125
Maianthemum canadense	2	-	2	0	0	0	0	0.2	-	-	.125	.125
Solidago sp.	1	-	1	0	0	0	0	0.1	-	-	.063	.063
Dryopteris cristata	1	-	1	0	0	0	0	0.1	-	-	.063	.063
Coptis groenlandica	1	-	0	1	0	0	0	0.1	-	-	.063	.063
Osmunda cinnamomea	3	-	3	0	0	0	0	0.3	-	-	.188	.188
Oxalis montana	1	-	1	0	0	0	0	0.1	-	-	.063	.063
TOTAL	16											

a - For canopy classes see Table J-1.
b - Not applicable
c - For sociability classes see Table J-1.

TABLE J-17. Number of birds observed during four surveys along transects and at listening posts in five wetland communities in May, 1981.

SPECIES TRANSECT NO:	(DS)[a] 1	(CS)[b] 2	(SS)[c] 3	(B)[d] 4	(DS) 5	(M)[e] 6	(CS) 7	(M) 8*	(M) 9†	(B) 10	(SS) 11
	TRANSECTS AND LISTENING POSTS										
Common loon	1	-[f]	-	-	-	-	-	-	-	-	-
American bittern	-	-	-	-	-	-	-	-	-	-	2
Mallard	-	-	-	2	-	-	-	4	-	27	-
Black duck	-	-	-	-	-	-	-	-	-	9	-
Wood duck	-	-	-	-	-	-	-	2	1	-	-
Cooper's hawk	-	2	-	-	-	-	-	-	-	-	-
Red-tailed hawk	-	-	-	-	-	-	-	1	-	-	-
Osprey	-	-	-	-	1	-	-	-	-	-	-
Ruffed grouse	-	1	1	-	-	-	2	1	-	-	-
Solitary sandpiper	-	-	-	1	2	-	-	-	-	-	-
Belted kingfisher	-	-	1	-	-	-	-	-	-	-	2
Common flicker	-	-	-	-	-	-	-	-	-	1	-
Pileated woodpecker	-	-	-	-	-	-	-	-	-	1	-
Yellow-bellied sapsucker	-	-	-	2	-	-	-	1	1	-	4
Hairy woodpecker	-	1	-	2	2	-	1	-	-	-	2
Downy woodpecker	1	-	1	1	-	-	1	2	1	1	-
Great crested flycatcher	-	-	-	-	-	-	1	1	1	1	-
Least flycatcher	1	-	1	1	18	11	-	-	-	-	-
Tree swallow	-	-	-	-	-	-	1	3	3	-	-
Blue jay	1	1	4	4	-	2	3	1	3	1	2
Northern raven	-	-	-	1	-	-	-	-	-	-	-
American crow	-	-	-	1	-	-	-	-	1	-	-
Black-capped chickadee	5	7	2	2	3	-	5	-	1	2	7
White-breasted nuthatch	-	1	-	1	-	2	-	-	-	-	-
Red-breasted nuthatch	-	-	-	-	-	-	1	-	-	-	2
American robin	6	-	2	3	2	6	-	1	-	-	-
Hermit thrush	-	-	-	1	-	-	1	-	-	-	-
Veery	1	1	2	-	1	-	-	-	-	-	-
Ruby-crowned kinglet	-	-	-	-	-	-	-	1	1	-	1
Black and white warbler	4	2	1	1	-	-	1	2	-	4	1
Golden-winged warbler	-	1	-	-	-	-	-	-	-	3	-
Nashville warbler	7	8	10	3	-	-	14	3	3	2	2
Black-throated blue warbler	-	-	-	-	-	-	-	-	-	-	1
Yellow rump warbler	-	2	-	1	-	-	-	2	-	2	-
Black-throated green warbler	1	-	-	1	-	-	-	-	-	1	-
Chestnut-sided warbler	1	-	-	-	-	-	-	-	-	1	1
Ovenbird	2	1	7	6	1	1	-	-	1	2	1
Northern waterthrush	-	2	-	-	-	-	-	-	-	-	-
Red-winged blackbird	-	-	1	2	2	-	-	10	10	4	2
Common grackle	-	-	-	-	-	-	-	-	-	-	2
Brown-headed cowbird	-	1	-	-	-	-	1	1	-	-	-
Scarlet tanager	-	-	1	-	-	-	-	-	-	1	-
Rose-breasted grosbeak	-	1	2	1	-	-	-	2	4	1	-
Evening grosbeak	4	1	-	3	-	-	2	-	-	-	1
Purple finch	-	1	-	1	-	-	-	3	1	1	1
American goldfinch	-	-	-	1	-	-	-	-	-	1	-
Chipping sparrow	-	-	-	-	-	-	-	2	2	-	-
White-throated sparrow	3	-	-	1	-	2	2	1	1	2	-
Song sparrow	1	-	-	10	1	3	-	2	3	-	2

[a]Deciduous Swamp; [b]Coniferous Swamp; [c]Shrub Swamp; [d]Bog; [e]Marsh; [f]Dashes indicate no data.
*Listening Posts.
†Listening Posts surveyed three times.

TABLE J-18. Number of birds observed during three surveys along transects and at listening posts in five wetland communities in June 1981.

SPECIES TRANSECT NO:	TRANSECTS AND LISTENING POSTS										
	(DS)[a] 1	(CS)[b] 2	(SS)[c] 3	(B)[c] 4	(DS) 5	(M)[e] 6	(CS) 7	(M) 8*	(M) 9*	(B) 10	(SS) 11
Common loon	2	1	-[f]	-	-	-	-	1	-	1	-
Great blue heron	-	-	-	-	-	-	-	-	1	-	-
Black duck	-	-	-	-	-	2	-	-	1	-	-
Wood duck	-	-	-	-	-	-	-	1	1	-	-
Broad-winged hawk	-	-	-	-	1	-	-	-	-	-	-
Ruffed grouse	1	1	-	-	-	-	-	-	-	-	-
Yellow-billed cuckoo	-	-	-	-	-	1	-	-	1	-	-
Barred owl	-	-	-	-	1	-	-	-	-	-	-
Chimney swift	-	-	1	-	2	3	-	1	2	2	-
Common flicker	-	1	-	-	-	-	-	-	-	1	1
Pileated woodpecker	-	-	1	-	-	-	-	-	-	-	-
Yellow-bellied sapsucker	-	-	-	1	-	-	2	-	1	-	-
Hairy woodpecker	1	1	-	-	-	-	1	1	-	1	4
Downy woodpecker	-	-	-	-	-	-	-	-	-	1	1
Eastern kingbird	-	-	-	-	-	-	-	-	-	1	5
Great crested flycatcher	-	2	-	-	1	1	2	4	1	-	1
Yellow-bellied flycatcher	-	3	-	-	-	-	-	-	-	-	-
Least flycatcher	-	-	-	-	6	3	-	-	-	-	-
Olive-sided flycatcher	-	-	-	-	-	-	1	-	-	-	-
Tree swallow	-	-	-	-	-	-	-	2	3	-	-
Blue jay	1	2	2	-	1	-	5	1	4	1	4
Northern raven	-	-	-	-	-	-	-	1	1	-	-
American crow	-	1	-	-	-	-	1	3	2	2	2
Black-capped chickadee	1	-	1	-	-	-	5	1	4	2	4
Red-breasted nuthatch	-	-	-	-	-	-	-	1	-	-	1
Gray catbird	-	1	-	-	-	-	-	-	-	-	-
American robin	-	-	-	-	-	-	1	2	1	-	4
Hermit thrush	-	3	3	1	-	1	2	2	-	1	-
Veery	3	-	3	2	2	-	-	-	-	-	-
Cedar waxwing	-	-	-	-	-	-	5	-	8	-	-
Red-eyed vireo	3	3	3	5	4	2	4	1	2	4	2
Black and white warbler	2	2	-	-	-	-	3	1	-	4	2
Golden-winged warbler	-	-	2	-	-	-	-	-	-	1	-
Tennessee warbler	-	1	-	-	-	-	-	-	-	-	-
Nashville warbler	2	7	-	-	-	-	5	-	-	4	-
Yellow rump warbler	1	2	-	-	-	-	3	-	4	2	1
Black-throated green warbler	-	-	-	1	1	-	-	-	-	-	1
Chestnut-sided warbler	-	1	-	1	-	-	-	1	-	-	3
Ovenbird	1	1	3	7	4	-	1	3	2	1	2
Northern waterthrush	-	2	-	-	-	-	-	-	-	-	-
Mourning warbler	-	-	-	1	-	-	1	-	2	-	2
Common yellowthroat	-	2	-	-	-	3	2	2	2	1	4
Canada warbler	-	1	-	-	-	-	-	-	1	2	-
Red-winged blackbird	1	-	-	-	-	-	-	7	10	1	-
Northern oriole	1	-	-	-	-	-	-	-	1	-	1
Common grackle	1	-	1	-	-	-	-	-	-	-	-
Brown-headed cowbird	1	2	1	-	-	-	-	-	1	-	-
Scarlet tanager	-	-	-	-	-	-	-	-	-	2	-
Rose-breasted grosbeak	2	1	1	1	-	1	1	1	1	1	-
Indigo bunting	1	-	-	-	-	-	1	-	5	-	-
Purple finch	-	-	-	-	-	-	1	2	1	1	2
American goldfinch	-	-	-	1	-	1	-	2	-	-	-
Chipping sparrow	-	1	-	-	-	-	1	1	-	1	-
White-throated sparrow	-	3	-	-	-	-	7	1	1	5	-
Song sparrow	-	-	-	6	1	9	2	2	6	3	-

[a]Deciduous Swamp; [b]Coniferous Swamp; [c]Shrub Swamp; [d]Bog; [e]Marsh; [f]Dashes indicate no data.

*Listening Posts

Table J-19. Summary of all miscellaneous observations of mammals utilizing wetland habitats in the study area.

	WETLAND TYPE					
SPECIES	DECIDUOUS SWAMP	CONIFER SWAMP	SHRUB SWAMP	BOG	MARSH/ AQUATIC BED	LAKE/ CREEK
Snowshoe hare	-	+	-	+	-	-
Gray squirrel	+	-	-	-	-	-
Red squirrel	-	-	+	+	-	-
Beaver	-	-	-	-	-	+
Muskrat	-	-	-	-	+	+
Porcupine	+	-	-	+	-	-
Coyote	+	-	+	-	-	-
Black bear	-	-	+	-	-	-
White-tailed deer	+	+	+	+	-	-

+ = individuals or sign observed

- = no available evidence

APPENDIX K

THREATENED AND ENDANGERED SPECIES

1.0 THREATENED AND ENDANGERED SPECIES

Plants and wildlife on the Wisconsin Endangered and Threatened Species List, which includes Federal species listed for the state, are presented in Table K-1.

1.1 PLANTS

There are 33 species of plants listed as endangered by the Wisconsin Department of Natural Resources (DNR) and 23 as threatened; the only species also listed as federally threatened is the Northern Monkshood (*Aconitum noveboracense*).

1.2 AMPHIBIANS AND REPTILES

No amphibian species which occur in Wisconsin are listed as endangered by either the state or the federal government. However, four species are listed as threatened by the DNR: spotted salamander, Tremblay's salamander, Burn's leopard frog, and pickerel frog. All but the Burn's leopard frog have ranges which overlap the study area.

Dames and Moore (1980) has provided evidence that the spotted salamander is actually "more common" in northern Wisconsin than its special status would suggest. Several authorities also list this species as common throughout its range (Bishop, 1947; Smith, 1961). However, they are generally difficult to locate because of their fossorial and nocturnal habits. During the breeding season, which occurs immediately after snow melts in late April or early May, they can be observed migrating to shallow, woodland ponds (Dames and Moore, 1980). Spotted salamanders or their eggs were

TABLE K-1. Plants and wildlife on Wisconsin lists of endangered and threatened species[a] including Federal species listed for the state.

PLANTS

ENDANGERED

(no common name)	*Anemone multifida*
(no common name)	*Arenaria macrophylla*
Lake Cress	*Armoracia aquatica*
Green Spleenwort	*Asplenium viride*
Alpine Milk Vetch	*Astragalus alpinus*
a Marsh Marigold	*Caltha natans*
(no common name)	*Carex lupuliformis*
(no common name)	*Carex media*
Stoneroot	*Collinsonia canadensis*
Hemlock-parsley	*Conioselinum chinense*
(no common name)	*Draba lanceolata*
a Spike-rush	*Eleocharis quadrangulata*
a Spike-rush	*Eleocharis wolfii*
Harbinger-of-spring	*Erigenia bulbosa*
(no common name)	*Fimbristylis puberula*
Northern Comandra	*Geocaulon lividum*
Large-leaved Avens	*Geum macrophyllum*
Auricled Twayblade	*Listera auriculata*
a Grass-of-Parnassus	*Parnassia parviflora*
Heart-leaved Plantain	*Plantago cordata*
Pink Milkwort	*Polygala incarnata*
Great White Lettuce	*Prenanthes crepidinea*
Pine-drops	*Pterospora andromedea*
Small Shinleaf	*Pyrola minor*
Lapland Rosebay	*Rhododendron lapponicum*
Wild Petunia	*Ruellia humilis*
Sand Dune Willow	*Salix cordata*
Lake Huron Tansy	*Tanacetum huronense*
Hairy Meadow Parsnip	*Thaspium barbinode*
Dwarf Bilberry	*Vaccinium cespitosum*
Mountain Cranberry	*Vaccinium vitis-idaea*
Squashberry	*Viburnum edule*
a Violet	*Viola fimbriatula*

PLANTS

THREATENED

Northern Monkshood[b]	*Aconitum noveboracense*
(no common name)	*Carex concinna*
Lenticular Sedge	*Carex lenticularis*
Dune Thistle	*Cirsium pitcheri*
Ram's-head Lady's-slipper	*Cypripedium arietinum*
White Lady's-slipper	*Cypripedium candidum*

TABLE K-1. (Continued)

a Sundew	*Drosera anglica*
a Sundew	*Drosera linearis*
Western Fescue	*Festuca occidentalis*
Blue Ash	*Fraxinus quadrangulata*
Tubercled Orchid	*Habenaria flava var. herbiola*
Prairie White-fringed Orchid	*Habenaria leucophaea*
Dwarf Lake Iris	*Iris lacustris*
Prairie Bush-clover	*Lespedeza leptostachya*
Brittle Prickly Pear	*Opuntia fragilis*
Small Round-leaved Orchis	*Orchis rotundifolia*
(no common name)	*Oxytropis campestris var. chartacea*
a Grass-of-Parnassus	*Parnassia palustris*
(no common name)	*Potamogeton confervoides*
Prairie-parsley	*Polytaenia nuttallii*
Dune Goldenrod	*Solidago spathulata var. gillmani*
Snow Trillium	*Trillium nivale*
a Violet	*Viola novae-angliae*

MOLLUSCS

ENDANGERED

Higgins Eye Pearly Mussel[c]	*Lampsilis higginsi*

THREATENED

None

FISHES

ENDANGERED

Gravel Chub	*Hybopsis x-punctata*
Striped Shiner	*Notropis chrysocephalus*
Slender Madtom	*Noturus exilis*
Starhead Topminnow	*Fundulus notti*
Crystal Darter	*Ammocrypta asprella*
Gilt Darter	*Percina evides*
Bluntnose Darter	*Etheostoma chlorosomum*

FISHES

THREATENED

Goldeye	*Hiodon alosoides*
Speckled Chub	*Hybopsis aestivalis*
Palid Shiner	*Notropis amnis*
Blue Sucker	*Cycleptus elongatus*
Black Buffalo	*Ictiobus niger*
River Redhorse	*Moxostoma carinatum*

TABLE K-1. (Continued)

Longear Sunfish	*Lepomis megalotis*
Mud Darter	*Etheostoma asprigene*
Pugnose Shiner	*Notropis anogenus*
Ozark Minnow	*Dionada nubila*
AMPHIBIANS	
ENDANGERED	
None	
THREATENED	
Spotted Salamander[d]	*Ambystoma maculatum*
Tremblay's Salamander	*Ambystoma tremblayi*
Burns' Leopard Frog	*Rana pipiens burnsii*
Pickerel Frog	*Rana palustris*
REPTILES	
ENDANGERED	
Wood Turtle	*Clemmys insculpta*
Ornate Box Turtle	*Terrapene ornata*
Queen Snake	*Regina septemvittata*
Western Ribbon Snake	*Thamnophis proximus*
Northern Ribbon Snake	*Thamnophis sauritus*
Massasauga	*Sistrurus catenatus*
THREATENED	
Glass Lizard	*Ophisaurus attenuatus*
Blanding's Turtle	*Emydoidea blandingi*
BIRDS	
ENDANGERED	
Double-crested Cormorant	*Phalacrocorax auritus*
Bald Eagle[b]	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Peregrine Falcon[c]	*Falco peregrinus*
Piping Plover	*Charadrius melodus*
Forster's Tern	*Sterna forsteri*
Common Tern	*Sterna hirundo*
Barn Owl	*Tyto alba*

TABLE K-1. (Continued)

THREATENED	
Great Egret	*Casmerodius albus*
Greater Prairie Chicken	*Tympanuchus cupido pinnatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Loggerhead Shrike	*Lanius ludovicianus*
MAMMALS	
ENDANGERED	
Pine Marten	*Martes americana*
Canada Lynx	*Lynx canadensis*
Timber Wolf[c]	*Canis lupus*
THREATENED	
None	

a=Endangered and Threatened Species WDNR List
b=Threatened Species Federal List
c=Endangered Species Federal List
d=Proposed for removal from the Threatened Amphibian List by WDNR

found in 11 ponds in the study area during the surveys conducted by Dames and Moore (1980).

The Tremblay's salamander is a hybrid "species" between the Jefferson's (Ambystoma jeffersonianum) and blue-spotted salamander and is recognized histologically by its triploid complement of chromosomes. All are hybrid females and presumably mate with only blue-spotted males (Smith, 1978). There are no records of Tremblay's salamander in Forest County, although it has been reported in Oneida County (Pendecost and Vogt, 1976, cited by Dames and Moore, 1981).

Pickerel frogs prefer the cool water of sphagnum bogs, rocky ravines, and meadow streams (Conant, 1975). There are only a few records of this species in northern Wisconsin and none have been observed in the study area (Dames and Moore, 1981).

The DNR lists six reptile species as endangered, none of them federally listed: wood turtle (Clemmys insculpta), ornate box turtle (Terrapene ornata), queen snake (Regina septemvittata), western ribbon snake (Thamnophis proximus), northern ribbon snake (T. sauritus), and massasauga (Sistrurus catenatus). Two additional species are listed as threatened: glass lizard (Ophisaurus attenuatus) and Blandings turtle (Emydoidea blandingi). Only the wood turtle, northern ribbon snake, and Blandings turtle have ranges which extend into northeastern Wisconsin (Conant, 1975).

Wood turtles are one of the few really terrestrial turtle species. This species has not been observed in the study area but records do exist for Forest County (Dames and Moore, 1981). Although this species hibernates in wetland areas, it spends most of the year in more upland habitats (Carr, 1952).

The Blandings turtle is also a "land turtle" and is generally considered common throughout its range in northeastern United States (Carr, 1952). They have been reported in most counties of northeastern Wisconsin including Forest County (Pendecost and Vogt, 1976, cited by Dames and Moore, 1981). However, none have been observed in the study area (Dames and Moore, 1981).

The range of the northern ribbon snake is predominantly restricted to the northeastern United States with only one record in Wisconsin in Sheboygan County (Pendecost and Vogt, 1976, cited by Dames and Moore, 1981).

1.3 AVIFAUNA

Of the eight bird species listed as endangered by either the state or federal government, only two, the bald eagle (Haliaeetus leucocephalus) and osprey (Pandion haliaetus), can be found in the study area. Both are on the federal as well as the state list. Double-crested cormorant (Phalacrocorax auritus), piping plover (Charadrius melodus), Forster's tern (Sterna forsteri), and common tern (Sterna hirundo) breed in scattered locations throughout Wisconsin but none have been reported in the study area. The range of the barn owl (Tyto alba) is restricted to the southern half of the state. Peregrine falcons (Falco peregrinus) occur in Wisconsin only during their migration from breeding grounds in the Arctic Circle.

The DNR has identified four bald eagle nests within an 8.8 km (5.5 mile) radius of the study area (Table K-2). Only two of these are in the site area including a nest north of Rolling Stone Lake and another near

TABLE K-2. Current status and location of bald eagle and osprey nests in the study area.

NEST LOCATION	DISTANCE* (km)	DISTANCE* (MILES)	STATUS 1980	STATUS 1981
Bald Eagle				
1. North of Rolling Stone Lake NW 1/4 NW 1/4, sec. 12, T34N, R12E	4.0	2.5	Active	Inactive
2. Northside of Rice Lake SE 1/4 NE 1/4, sec. 22, T35N, R12E	4.1	2.6	Active	Active
3. South of Bishop Lake SW 1/4 SW 1/4, sec. 32, T35N, R12E	8.3	5.2	Blewdown	--
- build new nest along highway at NW 1/4 SW 1/4, sec. 29, T35N, R12E	8.1	5.1	Active	Active
4. Near Junction of Swamp Creek & Hemlock Creek SW 1/4 SW 1/4, sec. 21, T35N, R13E	8.4	2.3	Inactive	Inactive
Osprey				
1. Ground Hemlock Lake (2 nests but only one pair) NE 1/4 SW 1/4, sec. 33, T35N, R13E	4.1	2.6	Active	Active
2. Along Swamp Creek NE 1/4 NE 1/4, sec. 30, T35N, R13E	1.9	1.2	Active	Active
3. Mole Lake SW 1/4 SW 1/4, sec. 33, T35N, R12 E	6.5	4.1	Active	Active
4. Pickerel Lake SW 1/4 SW 1/4, sec. 24, T34N, R13E	8.1	5.1	Active	Active

*Distance from center of ore body.

the junction of Hemlock Creek and Swamp Creek. Both of these nests were inactive in 1981 although future nesting is possible. Current guidelines of the DNR recommend no activity within 5 chains (101 m [330 feet]) of any eagle nest and only seasonal activity (that is, during the autumn and early winter non-breeding period) within .40 km (0.25 mile [1380 ft.]) (Eckstein, 1981, DNR, pers. comm.).

Of the five osprey nests in the area, only three are actually on or immediately adjacent to the site area (Table K2). One is along Swamp Creek and two are near Ground Hemlock Lake. The latter two nests are occupied by the same pair, with one of the nests active in 1981. The DNR guidelines governing human activities in the vicinity of osprey nests are the same as those presented above for eagles. Like the eagle, osprey nests may be abandoned and then reused at a later date.

Five species of birds are listed as threatened by the DNR: great egret (Casmerodius albus), greater prairie chicken (Tympanuchus cupido pinnatus), Cooper's hawk (Accipiter cooperii), red-shouldered hawk (Buteo lineatus) and loggerhead shrike (Lanius ludovicianus). The range of both the great egret and greater prairie chicken does not include northeastern Wisconsin. Additionally, the range of the loggerhead shrike has been retracting southward (Peterson, 1980) and none is expected in the study area.

The mixture of habitats in the vicinity of the study area makes this area suitable for both the Cooper's and red-shouldered hawk. Cooper's hawks were observed in the study area by Dames and Moore (1981) in 1977 and 1978. No red-shouldered hawks were observed by Dames and Moore, although nest records do exist from other parts of Forest County (Erdman, 1978, pers. comm. cited by Dames and Moore, 1981).

1.4 MAMMALS

Three mammalian species are listed as endangered by the DNR: pine marten (Martes americana), Canada lynx (Lynx canadensis), and timber wolf (Canis lupus). The timber wolf is the only species also listed federally as endangered. There are no species listed as threatened.

After reintroduction of pine martens in northern Wisconsin (including the Nicolet National Forest in northern Forest County), the species still remains very scarce (Vanderschaegan, 1981, DNR, pers. comm.). There is no documentation of their presence in the study area. Martens are primarily arboreal and prefer large, dense coniferous forests especially cedar swamps.

Sightings of wolves (or their tracks) which have occurred throughout the northern counties of Wisconsin may be of individuals which have wandered in from neighboring Minnesota and Michigan. Reports of tracks have occurred approximately 20 km (12.5 miles) west of the study area near Monico (Eckstein, 1981, DNR, pers. comm.).

Historically, the range of the lynx extended over the entire state of Wisconsin. Today, sightings are extremely rare and only from the northern part of the state. The lynx is a truly wilderness species, preferring extensive tracts of boreal forest and feeding primarily on snowshoe hares (Burt, 1957).

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APPENDIX L

WETLAND RANKING NORMALIZATION PROCEDURE

WETLAND RANKING NORMALIZATION PROCEDURE

Each of the wetlands received a rating value for each of the 10 functional models. The range, mean and standard deviation of each functional model was different from those of the others, so that the presentation, for example, of a value of 57 for biological function and of 16 for shoreline protection could be misleading unless the means of those models (76 and 15) were also presented. In this example, the wetland was very low in biological value and yet above average in shoreline protection function.

To simplify the presentation of these ratings, a normalization was performed on the raw scores. Initially the data were converted to the statistic "Z" form, which is simply the sample deviation from the mean, divided by the standard deviation, as:

$$(1) \quad Z_1 = \frac{X_1 - \bar{x}}{S}$$

However, a table of Z, filled with decimals and plus and minus signs, would be cumbersome to read, especially to readers unfamiliar with the statistics. To simplify the presentation further, this system was converted to one with a mean of 50 and a deviation of 20. That is, the Z_1 value was multiplied by 20 and added to 50. However, it was found that some rating populations were sufficiently skewed or had such a high kurtosis, that they either exceeded 100 or fell below zero in value. The skewness (SK) and the kurtosis (K) for each model were then incorporated into the normalization, to bring all values within the zero to one hundred range, yet provide sufficient breadth to the values so that the output of one functional model could be visually compared with that of another, to give a good mental estimate of the relative rating of each. The final normalization equation was:

$$(2)\quad Y_i = \frac{(65)}{K+1}\,\frac{(X_i - \bar{x})}{S} + 50 - 10\ SK$$

Although the equation may look complex, it is linear and produces numbers conveniently between 0 and 100 for each functional model.

The rationale behind this formulation is as follows: the skewness (SK) is used to correct the mean of the distribution. The kurtosis (K) is used to correct the deviation. The coefficients for the correction factors were empirically determined so that the resulting transformed values fell within 0 to 100 range for all 10 model ratings. These results allow each model to be compared on an equal basis, and facilitated the formulation of an overall ranking. In practice, each model produced a set of rating values, on which were performed the usual statistics, high value, low value, range, moments one through four, standard deviation, skewness, and kurtosis. These figures were then input into a program for calculating Y values for each X value, based on Equation 2 above.

The wetlands were given an overall rating by combining the 10 normalized values. Since all the models ratings now occupied approximately the same range and contributed the same variance, they were averaged, using an importance weight for each model output. The biological function was weighted 0.40 or 40% due to its overriding importance as a ranking function. The five hydrological functions were given a total of 0.40 or 40% in combination, with each of the five being given equal weight, or 8% of the total. The four remaining socio-cultural functional models were each weighted equally at .05 or 5% of the overall value. To prepare the final table in Section 6.2.2, each wetland raw score was normalized with the population estimates appropriate for each model, using Equation 2, and the overall score was summed from the weighted, normalized components.

It is important to note that these normalized figures are not related to percentiles, as a glance through the values will confirm. Although the range of numbers is similar, the normalized values seldom reach 0 or 100. They simply vary about 50 in a manner similar to each other, and thus provide a simpler visual means of comparing ratings between models.