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WETLAND CONSERVATION STRATEGY MODEL DEVELOPMENT ABSTRACT OUTLINE

Grant Number: FW 0104

Date Report Submitted:

Project Title: Wetland Conservation Strategy Model Development

Project Goal: The major goal of this project was to gather available information on wetland resources within the Chicago Wilderness region in GIS format and use this information to develop GIS models to identify and map critical wetland habitats.

Funding Amount: $32,197

Institutional Match: ask Barb for final match number

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Products and Product Availability:

Chicago Wilderness members can access the products of this project by contacting Mike Hoather, GIS Analyst, Northeastern Illinois Planning Commission, 222 S. Riverside Plaza, Suite 1800, Chicago, IL 60606, telephone: 312-454-0400, Fax: 312-454-0411. Metadata for this project can also be accessed on-line at the One Stop Metadata Clearinghouse at (add URL). If report will be up on NIPC's website, add URL

Products available include:

Final Project Report: Wetland Conservation Strategy Model Development
GIS models and maps in both GIS (including Arc Grid and shapefile formats) and PDF (or JPG) format: Basin Marsh Model, Reptile and Amphibian Wetland Associate Model, Reptile and Amphibian Stream Associate Model, Restoration Model, and Heritage Wetland Plant Community maps and maps of Biodiversity Recovery Plan Aquatic Community Status and Goals. Products also include a model that combines the Reptile and Amphibian Stream Associate Model and the Basin Marsh model and a map of this combined model with the restoration model overlaid.

Project Abstract:

The major goal of the wetland conservation strategy model development project was to gather available information on wetland resources within the Chicago Wilderness region in GIS format and use this information to develop GIS models to identify and map critical wetland habitats. This modeling and mapping includes much of what is currently considered the "Chicago Wilderness region" including Cook, DuPage, Kane, Lake, McHenry and Will Counties in Illinois, Lake, Porter and LaPorte Counties in Indiana and Racine, Kenosha and Walworth Counties in Wisconsin. This project was undertaken to assist in the prioritization of wetlands for a regional wetland protection effort. This project built on a preliminary GIS model that identified and mapped important basin marsh resources in northeastern Illinois and northwestern Indiana with an emphasis on wetland bird habitat. We evaluated the appropriateness of the different criteria that went into the basin marsh model and then extended the basin marsh model into the Wisconsin Counties of Kenosha, Racine and Walworth. Additional models designed to identify wetland areas important to reptiles and amphibians were then created. This was followed by the creation of a model intended to highlight areas with a high potential for restoration. These models were supplemented by the creation of maps showing the locations of natural heritage wetland communities from the natural heritage databases of the Departments of Natural Resources of the states of Wisconsin, Illinois and Indiana as well as priority lakes, streams and rivers identified in *The Chicago Wilderness Biodiversity Recovery Plan.*

Key Words: wetland habitat, basin marsh habitat, reptile and amphibian habitat, wetland restoration

WETLAND CONSERVATION STRATEGY MODEL DEVELOPMENT

Northeastern Illinois Planning Commission, Grant #FW 0104

Study Purpose and Goals

The major goal of this project was to gather available information on wetland resources within the Chicago Wilderness region in GIS format and use this information to develop GIS models to identify and map critical wetland habitats.

The modeling and mapping of wetland resources done under this grant agreement includes much of what is currently considered the "Chicago Wilderness region" including Cook, DuPage, Kane, Lake, McHenry and Will Counties in Illinois, Lake, Porter and LaPorte Counties in Indiana and Racine, Kenosha and Walworth Counties in Wisconsin. This project was undertaken to assist in the prioritization of wetlands for a regional wetland protection effort.

The identification of critical wetland resources for protection and acquisition is important in the Chicago Wilderness region. Many high quality and restorable wetlands still exist, especially in the "collar" counties of the Chicago area which are experiencing intense development pressure, and, as a result, valuable wetland resources need to be identified so that protection can be extended before they are developed. Identification of critical wetland resources is also important to assist citizen groups and governments in extending protection to valuable isolated wetlands left unprotected by the Supreme Court decision which ruled that isolated wetlands are not under the regulatory jurisdiction of the federal government.

This project used existing GIS data to do an unprecedented region-wide assessment of wetlands, using indicators of wetland habitat quality for non-game species of concern such as threatened and endangered wetland birds and reptiles and amphibians to identify critical wetland resources. Although countywide assessments of wetland resources, completed under the U.S. Environmental Protection Agency's Advanced Identification of Aquatic Resources (ADID) program, exist for some parts of the region, namely Kane, McHenry and Lake Counties in Illinois and the northern portions of Lake, Porter and LaPorte Counties in Indiana, a region-wide assessment of wetlands has not previously been done. A consistent method applied to the entire region was needed in order to prioritize wetlands for conservation across the region. Important wetland resources may cross county and state lines (such as the Wolf Lake area on the Illinois/Indiana border) and a region-wide model allows these areas to be assessed using the same methods across political boundaries.

Ideally, the models developed under this grant agreement will leverage future accomplishments by providing information to support the writing of a Wetland Conservation Strategy Report which would discuss general protection strategies and present specific case studies based on priority areas identified by the modeling process.

Overview of the Models Created

This project built on a preliminary GIS model that identified and mapped important basin marsh resources in northeastern Illinois and northwestern Indiana with an emphasis on wetland bird habitat. This preliminary model was created by the Wetlands Initiative in conjunction with the Chicago Wilderness Wetlands Task Force of the Conservation Design Working Group in 2000 under a Chicago Wilderness grant agreement entitled Regional Wetland GIS Data Inventory, A Pilot Project (FW97.28).

The Wetland Conservation Strategy Model Development project (the current project) began with an evaluation of the appropriateness of the different criteria that went into the basin marsh model, and a comparison of the critical wetland areas identified by that model with other ecological databases to see if the results appeared to agree. Then the basin marsh model was extended into the Wisconsin Counties of Kenosha, Racine and Walworth.

Additional models designed to identify wetland areas important to reptiles and amphibians were then created. This was followed by the creation of a model intended to highlight areas with a high potential for restoration. These models were supplemented by the creation of a map showing the locations of natural heritage wetland communities from the natural heritage databases of the Departments of Natural Resources of the states of Wisconsin, Illinois and Indiana as well as priority lakes, streams and rivers identified in *The Chicago Wilderness Biodiversity Recovery Plan.*

Finally, the basin marsh model was combined with the reptile and amphibian models in order to highlight areas that appear to provide high quality wetland habitat for reptiles, amphibians and wetland bird species. This combined model was then overlaid with the restorable wetland model to draw attention to restorable areas nearby or adjacent to existing important wetland resources. Restoration of such sites has the potential to increase and enhance habitat for these species.

The combined model was also compared to a map of projected change in population density between 2000 and 2030 by subwatershed in order to identify areas that score well in the combined models and that fall within watersheds projected to undergo rapid growth over the next thirty years. Wetlands in these areas that do not already have protected status may be quickly developed if steps are not taken to protect them.

Overview of Model Methodology

For each model, a GIS map layer was generated that imposes a grid on the Chicago Wilderness region. Each cell in the grid represents an area of 30 meters by 30 meters (0.09 hectares) on the ground and each cell has a score assigned to it, based on the sum of the values assigned to the model inputs corresponding to the location of that cell.

This modeling effort relied heavily on wetland data from the National Wetlands Inventory (NWI) dataset along with the Wisconsin Wetlands Inventory (WWI) dataset (since National Wetlands Inventory mapping was not done in the state of Wisconsin) in order to create inputs for the models. Other important input datasets include state land cover datasets and Natural Resource Conservation Service (NRCS) soils datasets.

Model inputs to the basin marsh model and the reptile and amphibian models are designed to emphasize wetland areas that are surrounded by other wetland areas, forming "wetland complexes" thought to be important for the long term survival of wetland species. The proximity of wetlands to other wetlands provides alternative sites should one wetland site be disturbed or become unsuitable for some other reason. Proximity also results in a landscape that may allow individuals to move from one wetland to another thus providing a mechanism of recolonization of a wetland should a local event result in the disappearance of the previous population. It can also help populations remain viable over the long term by allowing new individuals to enter the area thus preventing inbreeding.

The model inputs as described below were assigned to each cell in the grid imposed over the region and then all inputs for each cell were added up to create a final score for the cell. Areas scoring highest when all model input scores are added represent areas of critical wetland resources as defined by each model.

Basin Marsh Model Inputs

1. National Wetlands Inventory Class: Grid cells corresponding to locations of wetlands (derived from the National Wetlands Inventory and Wisconsin Wetlands Inventory) were given a score ranging from 0 for upland areas to 10 for palustrine aquatic bed and palustrine emergent areas. These scores reflect the importance of these wetland types to basin marsh habitat and to wetland bird species that depend upon this habitat.

2. Basin Score: The number of basins (the count of all wetlands from the National Wetlands Inventory layer) which are completely or partially within a 2.5 km radius of each cell. Scores of 0-15 were assigned to each cell, with 0 indicating no wetlands within a 2.5 km radius, and 15 indicating a range of 234-250 wetlands.

3. Palustrine Hectare Score: The values of this layer reflect the acreage of palustrine wetlands within a 2.5 km radius of each grid cell. Each cell received a score ranging from 0-15, with 0 indicating no hectares of palustrine wetland are present within a 2.5 km radius, and 15 indicating that 753-806 hectares of palustrine wetlands are present.

4. Land Cover Value: This layer contributes to the model by analyzing various non-wetland landcover types, and giving higher scores to those types considered more desirable as habitat for wetland bird species when in close proximity to a wetland. The score (with a maximum value of 10) for each cell represents the desirability of the surrounding land cover within a 2.5 km radius. Rural grassland was considered most desirable and urban grassland least desirable.

The Reptile and Amphibian Models

Two models were created for reptiles and amphibians. One model was designed to highlight habitat for reptiles and amphibians that rely on wetland habitat (the wetland associate model), but that are not usually associated with stream corridors. The other was designed to highlight habitat for reptiles and amphibians that tend to be associated with stream corridors (the stream associate model).

Reptile and Amphibian Wetland Associate Model Inputs

1. National Wetlands Inventory Class: Grid cells corresponding to locations of wetlands (derived from the National Wetlands Inventory and Wisconsin Wetlands Inventory) were given a score ranging from 0 for upland areas to 10 for palustrine aquatic bed, palustrine emergent, palustrine forested and palustrine scrub/shrub areas. These scores reflect the importance of these wetland types to reptile and amphibian habitat.

2. Wetland Diversity: This layer expresses the number of different wetland types within 1000 meters of each cell. For this layer "wetland type" is defined by the system, class and water regime of that wetland. For example, a palustrine forested "very wet" wetland is counted as a different type than a palustrine forested "wet soil" wetland because the water regimes are different. Scores of 1-10 were assigned to each cell, with 1 indicating only one type of wetland occurred within a 1000 meter radius, and 10 indicating that the maximum number (which was 18) of wetland types occurred within a 1000 meter radius.

3. Number of Basins: The number of basins (the count of all wetlands from the National Wetlands inventory layer) which are completely or partially within a 1000 meter radius of each cell were counted. Scores from 1 to10 were assigned to each cell, with 1 indicating that 1-6 wetlands occurred within a 1000 meter radius and 10 indicating that 56-64 wetlands occurred within a 1000 meter radius.

4. Land Cover Type: This layer contributes to the model by analyzing various non-wetland landcover types, and giving higher scores to those types considered more desirable as habitat for reptile and amphibian species when in close proximity to a wetland. The score (with a maximum value of 10) for each cell represents the desirability of the surrounding land cover within a 1000 meter radius. Rural grassland and Forest were considered most desirable and urban grassland least desirable.

Reptile and Amphibian Stream Associate Model Inputs

Inputs 1-4 were identical to inputs 1-4 of the wetland associates model. However the stream associate model also includes layer 5 described below:

5. Streams and Major Rivers: This layer contributes to the model by expressing the locations of streams and rivers. Major Rivers thought to be critical to riverine turtles such as softshells, map turtles and sliders were scored 10 at their center with decreasing scores extending through a 120 meter buffer to stress the importance of river banks, and smaller stream systems were scored 3 at their center with decreasing scores extending through a 120 meter stream buffer.

Restorable Wetland Model

This model highlights areas of hydric soil that are not currently wetland, focusing on hydric soil outside of wetlands in agricultural areas and in "vacant" areas. Agricultural and vacant areas were chosen because both these land use types have a relatively high likelihood of being available in the future as potential open space and may constitute areas where opportunity exists for wetland restoration. In addition land currently used for agriculture tends to be available in large parcels offering opportunities for restoration of large wetlands or for restoring additional wetlands nearby in the future.

Because the restoration model was dependent on the availability of detailed hydric soils data in digital format, the restoration model only covers those counties for which these data were available as of August 2004. This includes the entire study area with the exception of Cook County, Illinois and Lake County, Indiana. Thus these two counties are excluded from this model.

Restorable Wetland Model Inputs

1. Hydric Soil: Hydric soils occurring outside of NWI wetlands were scored with a 10, hydric soils within NWI wetlands were scored as 0.

2. Agricultural Land: Agricultural land from land cover datasets from Wisconsin, Illinois and Indiana was scored as 10, all other land cover types were scored as 0.

3: Vacant Land: Vacant land from land use datasets from Wisconsin, Illinois, and Indiana was scored as 10, all other land use types were scored as 0.

Overview of Results

Comparing the Basin Marsh and Reptile and Amphibian Models

The Basin Marsh Model and the Reptile and Amphibian Models are similar in that they both confer high scores to areas with the following characteristics: a large number of wetlands occurring within a radius thought represent the size of the area that members of the taxa in question might reasonably be expected to use, and the kind of non-wetland land cover within that radius. They differ in some of their inputs. For example, the reptile and amphibian model stresses the number of different *kinds* of wetland within a 1000 meter radius with the water regime of a wetland included in the determination of wetland kind in order to insure that adequate breeding areas for amphibians would be available even in very wet or very dry years. The basin marsh model stresses both number of wetlands and number of hectares of wetlands because desirable wetland habitat for threatened and endangered wetland bird species would include both areas with a lot of wetlands and areas that have large wetlands. Both the Basin Marsh and Reptile and Amphibian Models stress palustrine wetlands over riverine and lacustrine, with palustrine emergent and palustrine aquatic bed wetlands receiving the highest possible score in both models and palustrine forested and palustrine scrub/shrub also receiving the highest possible scores in the reptile and amphibian model. Scores given to non-wetland land cover within the radius were also similar with urban grassland scoring low in both models, agricultural areas scoring in the intermediate range and rural grassland scoring highest. In the reptile and amphibian models, forested land cover also receives the highest score.

Figures 1, 2, and 3 show the Reptile and Amphibian Wetland Associates Model, the Reptile and Amphibian Stream Associates Model, and the Basin Marsh Model respectively. Although all three models show the highest scoring areas in roughly the same positions, the high scoring cells in the Basin Marsh Model cover larger areas because the inputs to this model (including the basin score, palustrine wetland score, and land cover value) were based on a 2.5 km radius (2500 meters) while the inputs to the reptile and amphibian models were based on a 1 km (1000 meter) radius. Other differences between the models include the fact that some areas that score highly in the Reptile and Amphibian Models do not score particularly highly in the Basin Marsh Model. A good example of this is the Indiana Dunes National Lakeshore. Since much of this area is covered with forest and both forested palustine wetland and forested non-wetland land cover received the highest possible scores in the Reptile and Amphibian Models, this area scores highly across most of the park in the Reptile and Amphibian Models while it does not score as highly in the Basin Marsh Model which does not emphasize forested wetland and upland.

Figure 1: the Reptile and Amphibian Wetland Associates Model

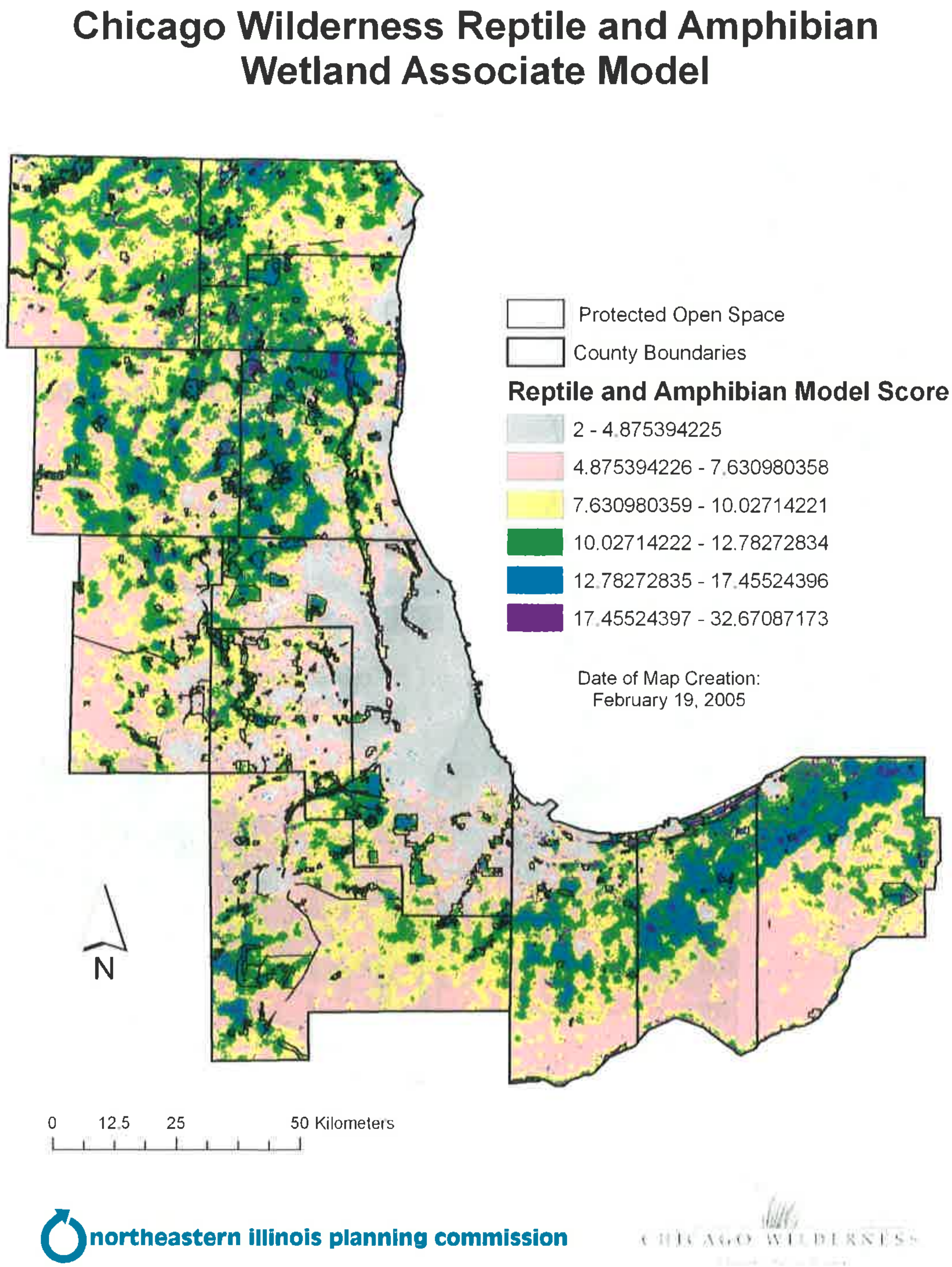


Figure 2: the Reptile and Amphibian Stream Associates Model

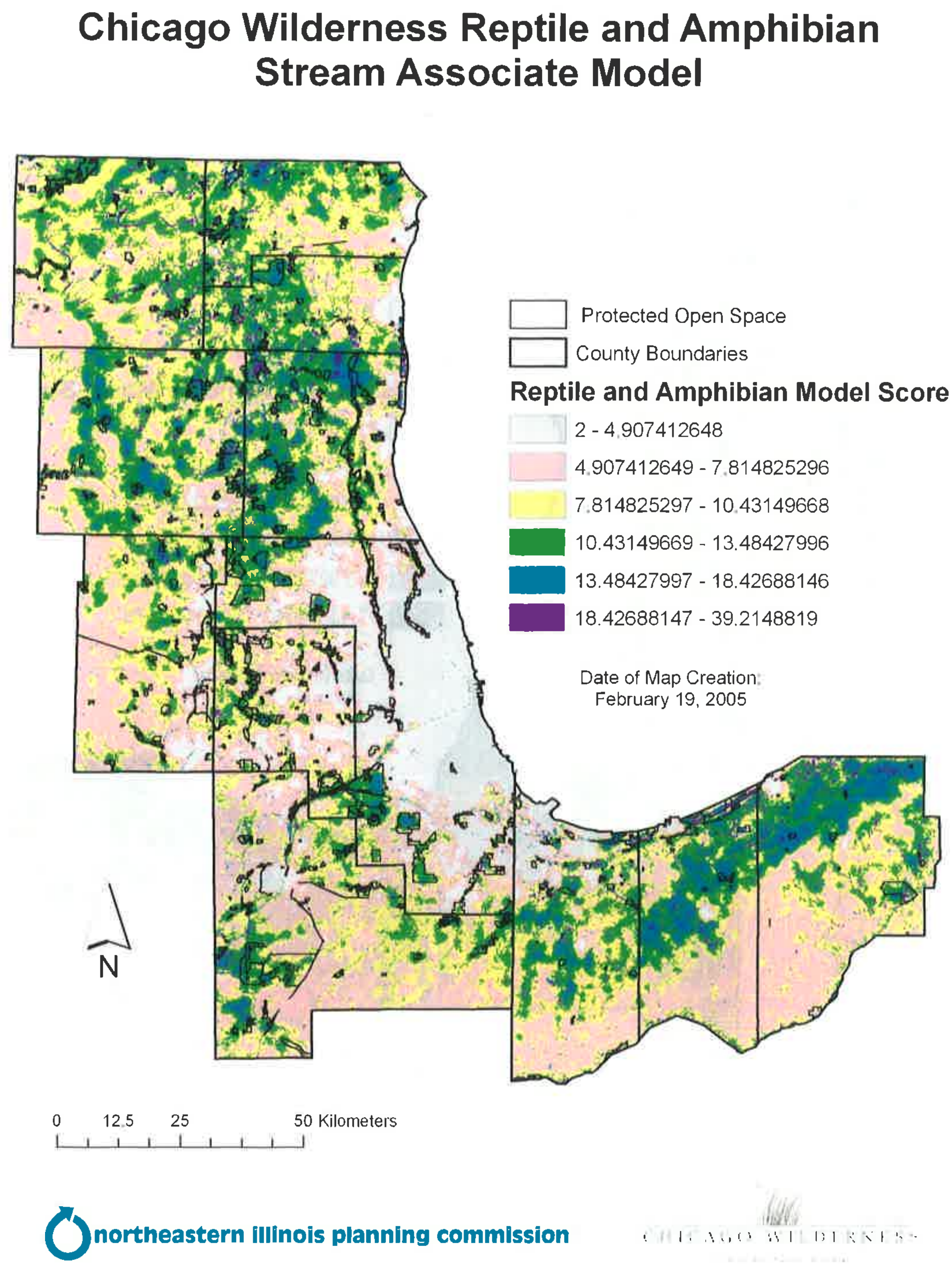
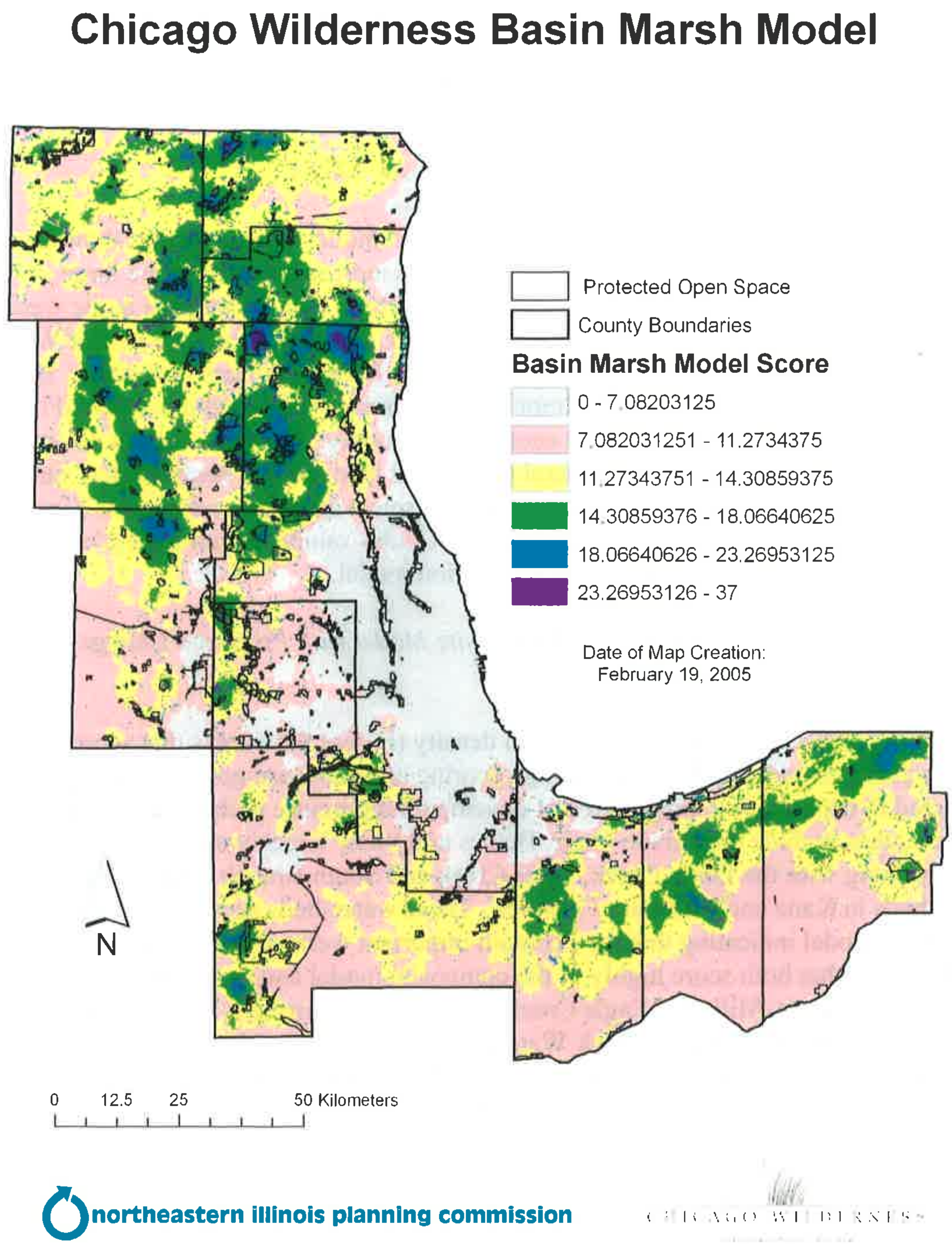


Figure 3: The Basin Marsh Model



Adding the Models Together

Creating a model that is a combination of the Reptile and Amphibian Wetland Associates Model and the Basin Marsh Model by adding the cell scores of the two models together resulted in a composite model. The reason for adding the models together was to try to create a model that would highlight wetland areas that appear to be of particular value to reptiles, amphibians and threatened and endangered bird species that rely on basin marsh habitat.

Overlaying the Restoration Model with the Composite Model

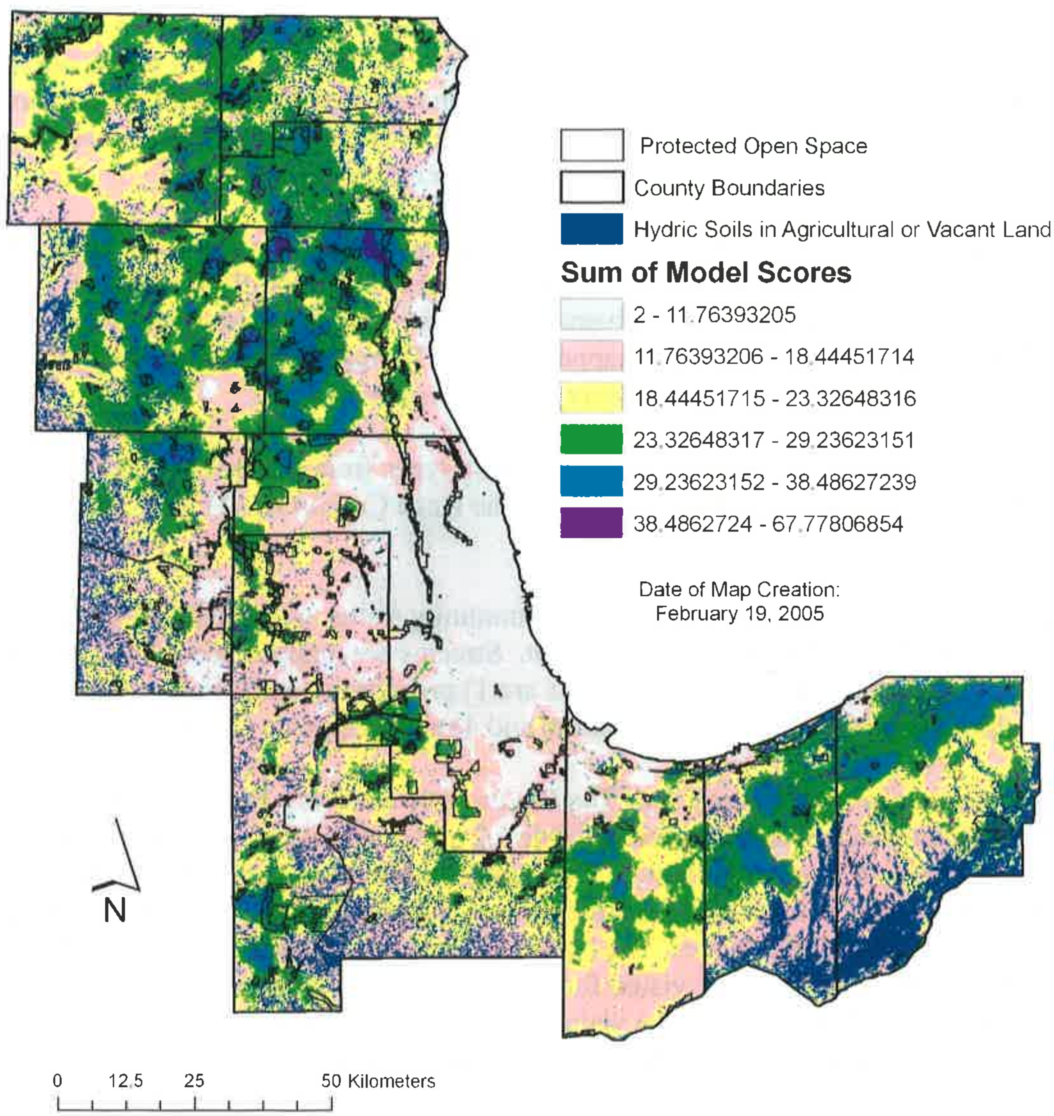
Overlaying the composite model with the restoration model (Figure 4) that shows non-wetland hydric soils in agricultural and vacant areas indicates that there are large concentrations of non-wetland hydric soils in agricultural and vacant land in the western half of Kane County, the western edge of McHenry County, the southern half of Will County and along the southern edges of LaPorte and Porter Counties in Indiana. Bands of non-wetland hydric soils in agricultural and vacant land also extend northward in Porter County, reaching almost to the center of the county. In other counties covered by the model, the hydric soils in agricultural and vacant land are less concentrated, but the model could still be used in these counties to help select areas for restoration. Since there were no detailed digital soils maps available for Cook County, IL and Lake County, IN these counties were not included in the restoration model.

Comparing the Illinois Portion of the Composite Model with Projected Change in Population Density between 2000 and 2030

Comparing projected change in population density (Figure 8) to areas that score highly in the composite model highlights some high scoring areas that are growing rapidly or are predicted to experience a high degree of development pressure in the near future. Some of these areas include the Ferson-Otter, Bowes and Stony Creek watersheds in Kane County along with the Eakin Creek, Tyler Creek and South Branch Kishwaukee River watersheds in Kane and McHenry Counties. These watersheds score highly in the composite model indicating that they contain important wetland resources. Some other notable areas that both score highly in the composite model and that are growing rapidly include the Sequoit, Mill, and Eagle Creek Watersheds in northern Lake County and the Squaw, Lily Lake and Mutton Creek Watersheds in west central Lake County along with the Lily Lake and Boone Creek Watersheds in McHenry County.

Figure 4: The Sum of the Reptile and Amphibian Wetland Associates Model and the Basin Marsh Model with the Restoration Model Overlaid

Sum of the Wetland Associate Reptile and Amphibian Model and the Basin Marsh Model Displayed With Areas of High Restoration Potential (Hydric Soils in Agricultural or Vacant Areas)



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Natural Heritage Plant Community Mapping and Mapping of Aquatic Community Status and Goals

The Biodiversity Recovery Plan defines status, needs, and goals for terrestrial communities, including wetlands, in Chapter 5. It outlines the status and recovery goals for wetland communities which are defined as marshes, bogs, fens, sedge meadows, pannes, seeps, and springs. *The Biodiversity Recovery Plan* prioritizes community types for conservation by placing them into tiers.

Wetland types discussed in the biodiversity recovery plan but not included in this tiering system include bogs, seeps and springs. *The Biodiversity Recovery Plan* points out that most remaining bogs are protected and that seeps and springs are so small they do not generally harbor many species. Wetland types present in the Chicago Wilderness region but not discussed in *The Biodiversity Recovery Plan* include swamps.

For the purposes of the Wetland Conservation Strategy Model Development, wetland community types from the Natural Heritage Databases of Illinois, Wisconsin and Indiana were mapped according to their Biodiversity Recovery Plan tier. Community types not tiered by Chicago Wilderness were mapped as "Not Tiered" as were community types not discussed in *The Biodiversity Recovery Plan* (swamps).

In addition to natural heritage wetland community types from Natural Heritage Databases of Illinois, Wisconsin, and Indiana, fens from the Kane County ADID were also included. (Figure 5)

Also included in the mapping was aquatic community status, needs and goals from Chapter 6 of *The Biodiversity Recovery Plan*. Streams are mapped according to the goal defined for them in Chapter 6. These goals are 1) protection—very high priority, 2) restoration—high priority, 3) rehabilitation, and 4) enhancement. (Figure 6)

Lake communities from Chapter 6 of *The Biodiversity Recovery Plan* were also mapped for this project if they were included in Table 6.2 as "exceptional" or if they were included in Table 6.3 as "important." The ratings displayed in these tables were based on assessments that utilized data from the Illinois Natural Heritage Database, the Illinois Department of Natural Resources, The Nature Conservancy, the McHenry County ADID Study, and expert opinion. The vision for exceptional lakes is to manage them for maximum aquatic biodiversity. The vision for important lakes is to improve their condition so that they can qualify as exceptional lakes. (Figure 7)

Figure 5: Wetland Community Types by Chicago Wilderness Biodiversity Recovery Plan Conservation Priority

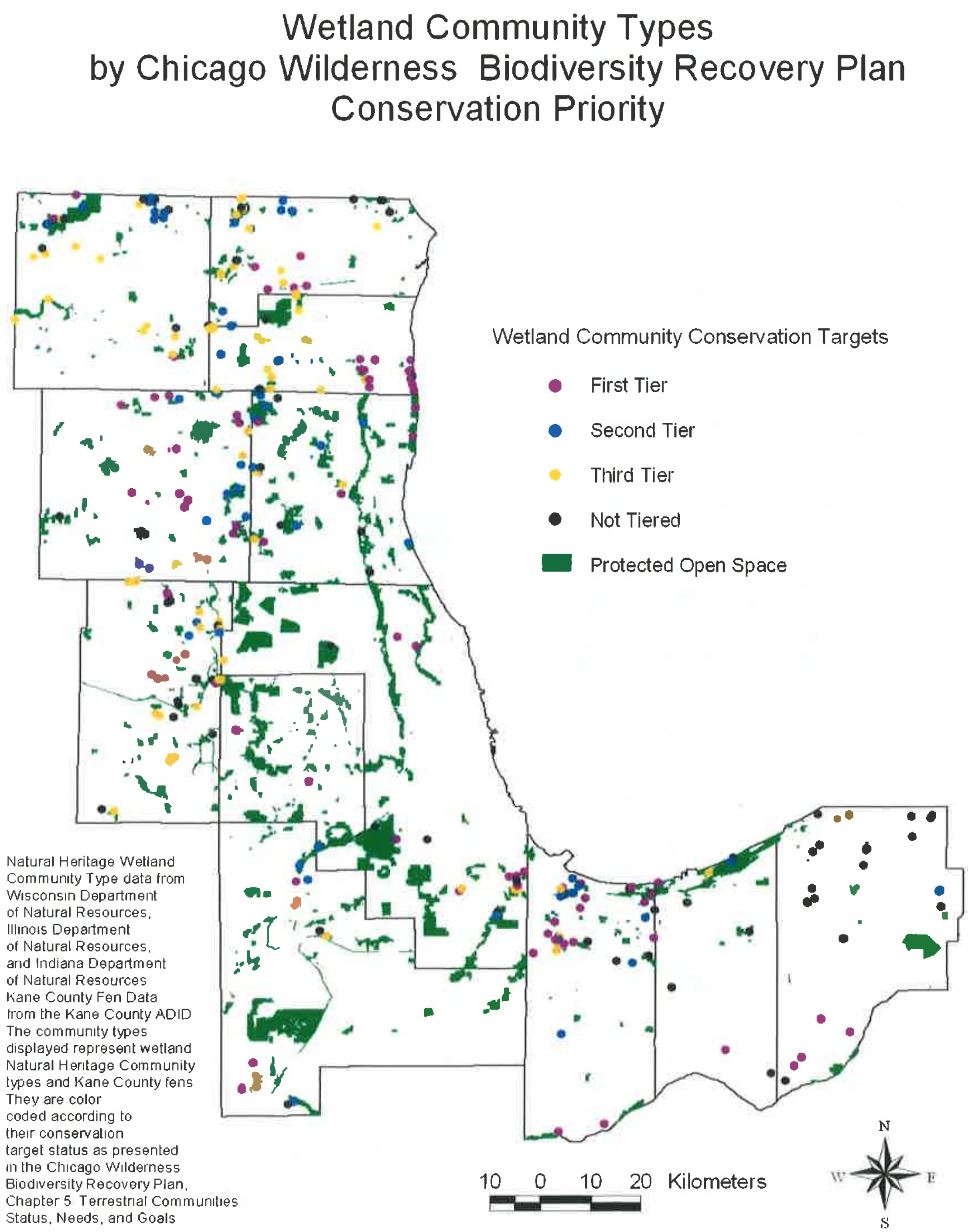


Figure 6: River and Stream Status from the Biodiversity Recovery Plan

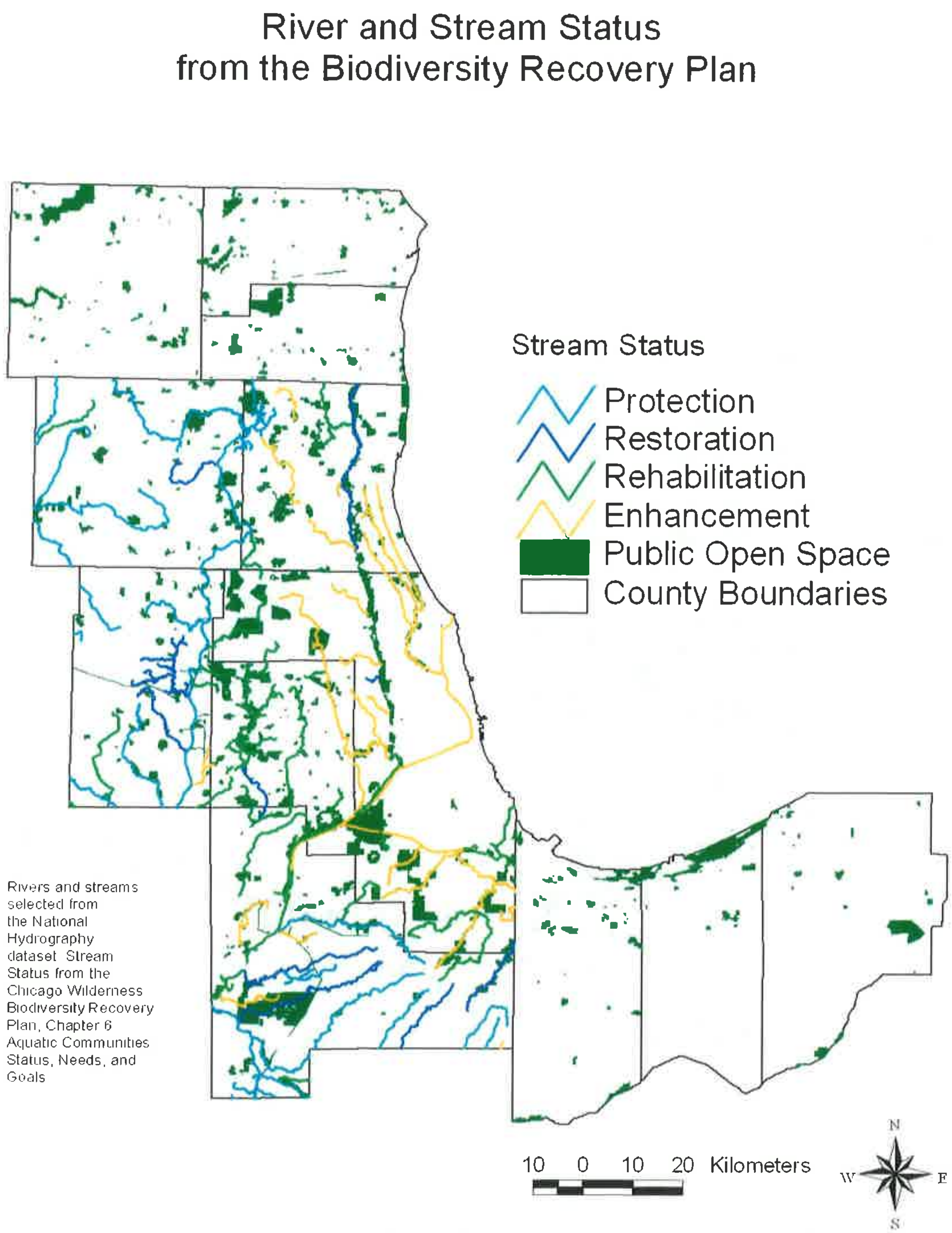


Figure 7: Exceptional and Important Lake Communities from the Biodiversity Recovery Plan

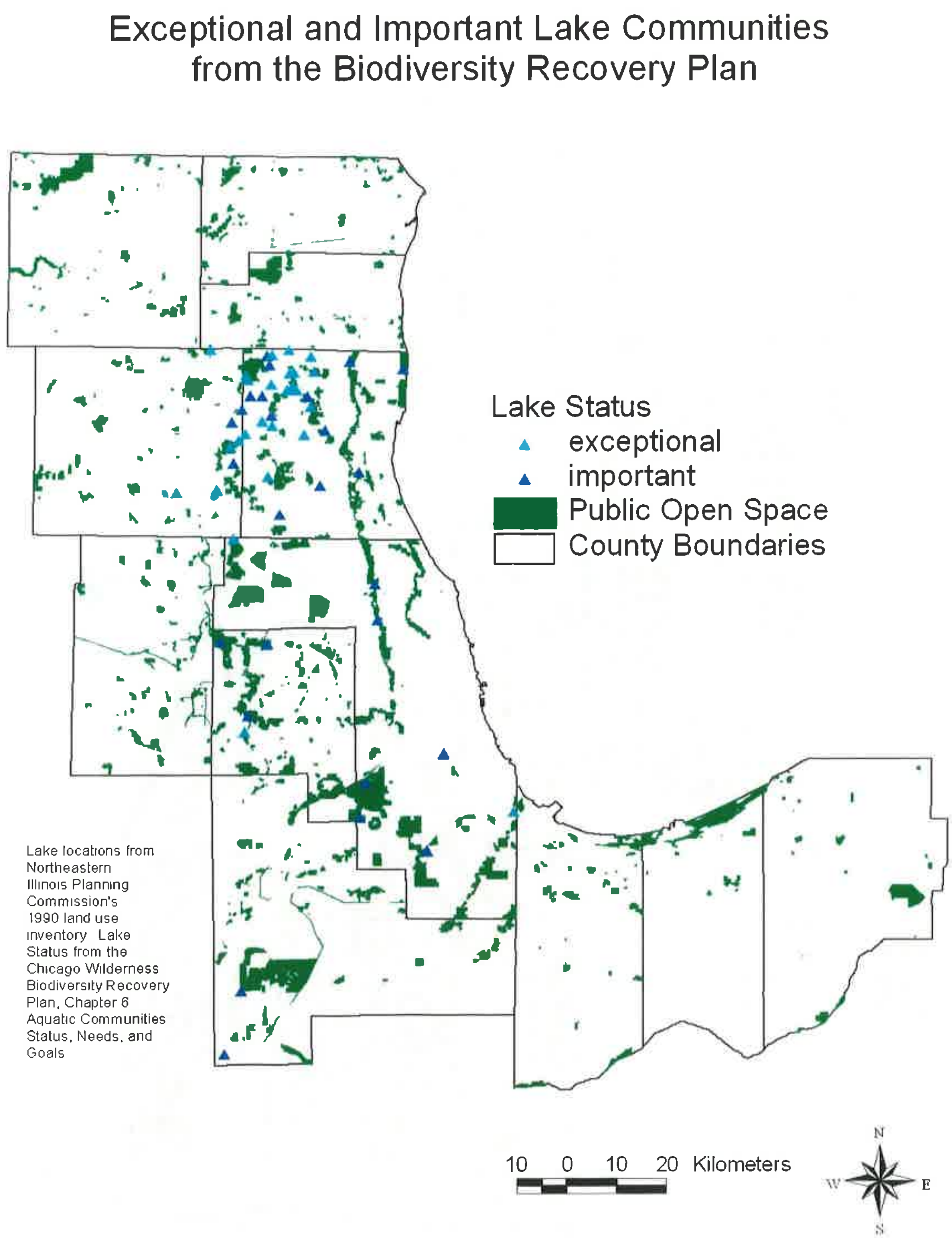
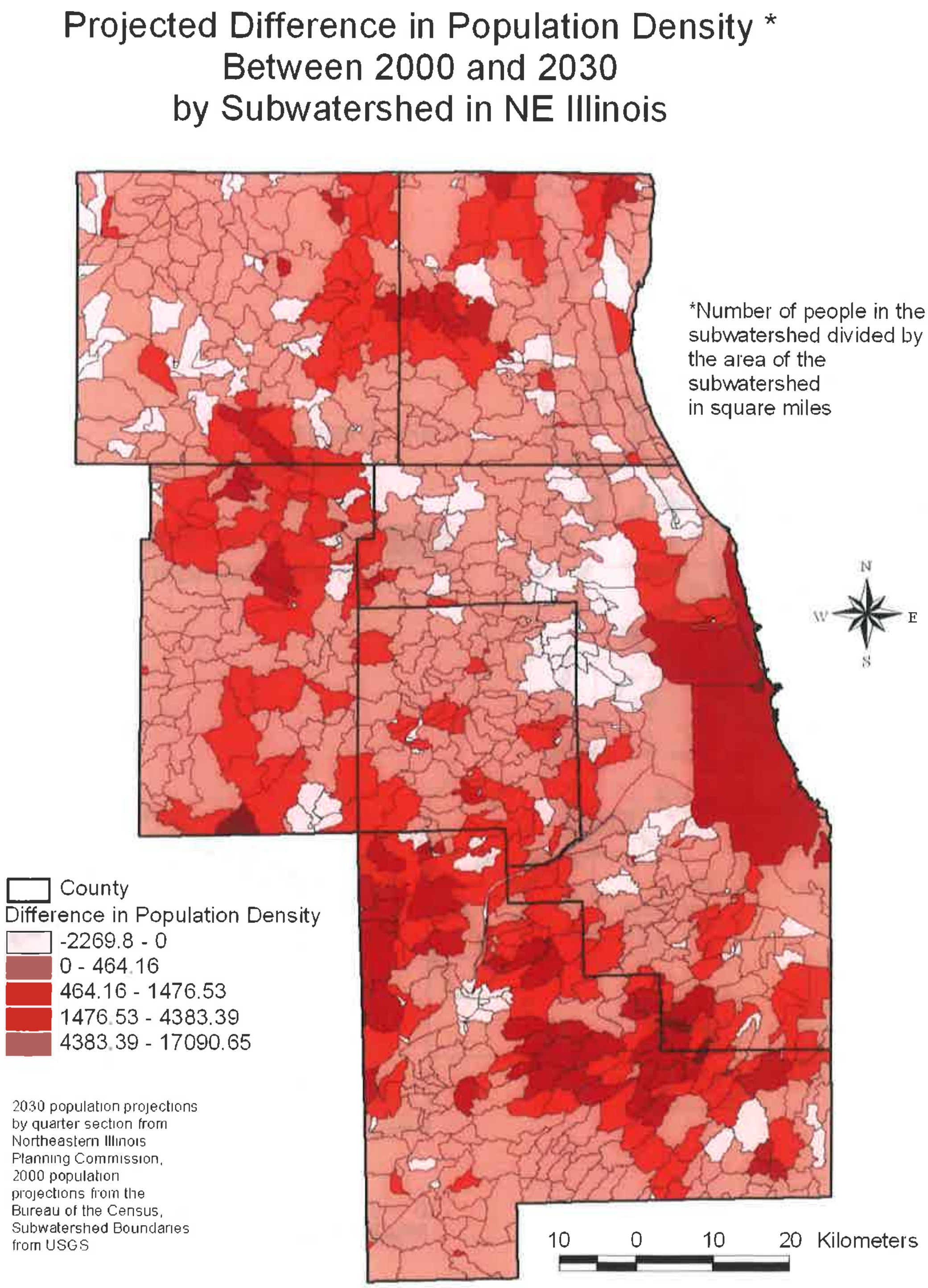


Figure 8: Difference in Population Density between 2000 and 2030 for the Northeastern Illinois Model Counties



Appendix A: The Basin Marsh Model

The Preliminary Basin Marsh Model

This preliminary model was created by the Wetlands Initiative in conjunction with the Chicago Wilderness Wetlands Task Force of the Conservation Design Working Group in 2000 under a Chicago Wilderness grant agreement entitled Regional Wetland GIS Data Inventory, A Pilot Project (FW97.28). The following explanation of how the preliminary model was created was written by David Clark of the Wetlands Initiative as part of his reporting for the preliminary model.

The preliminary model was worked out in collaboration with David Clark (The Wetlands Initiative), Charlie Paine (Max McGraw Wildlife Foundation), Tim Sullivan (Brookfield Zoo), Jim Anderson (Lake County Forest Preserve District), and Steve Byers (Illinois Nature Preserves Commission). An initial model was run on a subset of the region (McHenry County), with the results reviewed by Charlie Paine to determine whether the output satisfactorily reflected current conditions in the county (concerning the location of areas considered to be valuable as wetland resources).

Below is a brief description of all of the model inputs; this is followed by an explanation of the data sources that informed them and the procedures necessary to incorporate them into the model.

LAYERS USED FOR THE PRELIMINARY BASIN MARSH MODEL:

Layer 1—Wetlands by General Classification (NWI_CLASS)

Wetland inventory polygons (National Wetland Inventory and Wisconsin Wetland Inventory) were merged into general categories and converted to a grid layer with the following scores:

Wetland General Category	Score
All upland (U)	0
All riverine (R)	3
All lacustrine (L)	3
Palustrine open water (POW)	5
Palustrine aquatic bed (PAB)	10
Palustrine emergent (PEM)	10
Palustrine forested (PFO)	3
Palustrine scrub/shrub (PSS)	3
Palustrine unconsolidated bottom (PUB)	3
Palustrine unconsolidated shore (PUS)	3

Layer 2—Heritage Wetland Communities (HER_COMM)

Locations of wetland natural communities identified by state Natural Heritage inventories. All occurrences were given a score of ten points at the presumed center of the community, with scores for adjacent grid cells diminishing as distance from the center increases, to a distance of 2.5 kilometers.

IMPORTANT NOTE: Original data requests from Heritage Data Centers were limited to the analysis area (Cook, DuPage, Kane, Lake, McHenry and Will counties for Illinois; Lake, Porter and LaPorte counties for Indiana), no data was provided by the Centers for any locations outside of these counties. Therefore, any element occurrences just outside of the analysis area which may have had an effect on the fringes of the analysis area (due to the 2.5 km buffer) are not included in the model. Wisconsin data for communities within 2.5 km of the state line were included; however, since the points depicting those communities are the centers of generalized polygons, their locational accuracy is suspect.

Layer 3—Heritage Wetland T/E Bird Species (WET_BIRD)

Locations of occurrences of one or more threatened and endangered wetland bird species, based on Natural Heritage inventory data. A value of two points was assigned for each species recorded at each location, with a maximum contribution of 10 points at the (presumed) actual location, with scores for adjacent grid cells diminishing as distance from the center increases, to a distance of 2.5 kilometers.

IMPORTANT NOTE: Original data requests from Heritage Data Centers were limited to the analysis area (Cook, DuPage, Kane, Lake, McHenry and Will counties for Illinois; Lake, Porter and LaPorte counties for Indiana), no data was provided by the Centers for any locations outside of these counties. Therefore, any element occurrences just outside of the analysis area which may have had an effect on the fringes of the analysis area (due to the 2.5 km buffer) are not included in the model. Wisconsin Heritage data included no polygon centroids which were within 2.5km of the state line; therefore those data were not incorporated in the model since it would have no effect on the actual analysis area.

Layer 4—Number of Basins Within 2,500 Meter Radius From Each Cell (BASINSCOR)

This is the count of all wetlands which are completely or partially within a 2.5 kilometer radius of each grid cell. The "wetlands" used for this analysis is the same general category coverage which was used to create Layer 1 (NWI_CLASS). The output grid WETCOUNT contains values of 0-250; although this layer needed to be reclassified for the scoring system, the WETCOUNT layer has been saved on a CD entitled "REFGRIDS" in case future users wish to alter the scoring system for further modeling. The final layer, BASINSCOR, is a reclassification of the WETCOUNT layer, based on these values:

# Wetlands	Score
0	0
1 – 16	1
17 – 33	2
34 – 50	3
51 – 66	4
67 – 83	5
84 – 100	6
101 – 116	7
117 – 133	8
134 – 150	9
151 – 166	10
167 – 183	11
184 – 200	12
201 – 216	13
217 – 233	14
234 – 250	15

IMPORTANT NOTE: The WETCLASS coverage which was used to create this layer was edited and finalized prior to the development of the model, and did not incorporate wetlands from neighboring counties outside of the study area. Therefore, grid cells in the final model layer that are within 2.5 kilometers of the edges of the analysis area should be considered to be scored artificially low. The area along the Illinois Wisconsin border is not subject to this limitation since Wisconsin wetland data was included in the original NWI_CLASS layer.

Layer 5—Area of Palustrine Wetlands Within 2,500 Meter Radius From Each Cell PAL_HA_SCOR)

The values in this layer reflect the acreage of palustrine wetlands (specifically, Palustrine Emergent [PEM], Palustrine Open Water [POW], and Palustrine Aquatic Bed [PAB]) within a 2.5 kilometer radius of each grid cell. As in Layer 4, the wetlands were selected using the edited NWI_CLASS coverage. The output grid PAL_HA is a calculation of the number of hectares of palustrine wetlands within each cell's radius, and contains values ranging from 0-806; although this layer needed to be reclassified for the scoring system, the PAL_HA layer has been saved on the REFGRIDS CD incase future users wish to modify the scoring system for further modeling. The final layer, PAL_HA_SCOR, is a reclassification of the PAL_HA layer, based on these values:

Hectares	Score
0	0
1 – 54	1
55 – 107	2
108 – 161	3
162 – 215	4
216 – 268	5
269 – 322	6
323 – 376	7
377 – 430	8
431 – 483	9
484 – 537	10
538 – 591	11
592 – 644	12
645 – 698	13
699 – 752	14
753 – 806	15

IMPORTANT NOTE: The WETCLASS coverage which was used to create this layer was edited and finalized prior to the development of the model, and did not incorporate wetlands from neighboring counties outside of the study area. Therefore, grid cells in the final model layer that are within 2.5 kilometers of the edges of the analysis area should be considered to be scored artificially low.

Layer 6—Surrounding Landuse/Habitat (LANDCOV_VAL)

This layer contributes to the model by analyzing various non-wetland landcover types, and giving higher scores to those cover types considered to be more desirable as habitat when in close proximity to a wetland. The score for each cell represents the desirability of the surrounding landcover within a 2.5 kilometer radius, based on the proportion of four major landcover types:

Landcover Type	Value
Rural Grassland	1.0
Forest	0.8
Agriculture	0.8
Urban Grassland	0.3

After proportions were combined for the landcover types, all scores were multiplied by 10, which is the maximum contribution of this layer to the model. In an effort to provide flexibility to the model, four grid cell layers (one each for the four landcover types) were saved to the REFGRIDS CD; the cell values for each layer represent the proportion of that cover type in the surrounding 2.5 kilometer radius, expressed as decimals (example, if the area surrounding a grid cell is 24% forested, the value for that grid cell in the FOR_PROP layer would be 0.24).

IMPORTANT NOTE: For this model, landcover data surrounding the analysis extent was obtained for Wisconsin and Illinois, but not for Indiana outside of the three counties, nor the portion of Michigan bordering Indiana. Therefore, cell values for the outer 2.5 kilometers of the Indiana portion of the study area (except where it borders Will and Cook counties) will be under-valued. The area along the Illinois Wisconsin border is not subject to this limitation since Wisconsin wetland data was included in the original NWI_CLASS layer.

Layer 7—Hydric Soils (HYD_SOIL)

This layer depicts poorly-drained and very poorly-drained (hydric) soils. The spatial extent of this layer is restricted by the fact that such detailed data does not yet exist for every county in the study area. Data are from the NRCS SSURGO Soils Database (DuPage, Kane, and McHenry counties) and from the Lake County (IL) Department of Management Services (Lake).

Soil Type	**Score**
Very Poorly Drained	10
Poorly Drained	5
Other (inc. water)	0

HOW THE LAYERS FOR THE PRELIMINARY BASIN MARSH MODEL WERE DERIVED:

Layer 1—Wetlands by General Classification (NWI_CLASS)

Grid cell values were obtained from a polygon layer consisting of National Wetland Inventory (NWI) wetland polygons for Illinois and Indiana, along with Wisconsin Wetland Inventory (WWI) and southeast Wisconsin Landuse (SEWRPC). A copy of this coverage exists on the Data CD as WTLDPOLY.SHP.

Illinois Wetland Polygons: NWI polygons for Illinois wetlands were obtained from the CD *Illinois Geographic Information System, Vol. 1* (IDNR 1996). There is a separate ARC/INFO polygon coverage for each county (Cook, DuPage, Kane, Lake, McHenry, and Will). These polygon coverages were merged in ARC/INFO using the MAPJOIN function, and projected from the native map projection (Lambert) to the working projection (UTM Zone 16N, NAD83).

Indiana Wetland Polygons: NWI polygons for Indiana were downloaded from the Indiana Lake Rim GIS website (http://129.79.145.25/indmaps/ims/lakerimmo/lakerim_front.html#), maintained by the Indiana Geological Survey. One coverage contained the data for all three counties (Lake, Porter, and LaPorte). This coverage was in the UTM projection, but needed conversion from NAD27 to NAD83.

Wisconsin Wetland Polygons: The Digital Wisconsin Wetland Inventory (WWI) was created by the Wisconsin DNR, and is sold to interested parties on a township-by-township basis in ArcView shapefile format. Wetland data for all townships in Walworth, Racine and Kenosha counties were purchased. The shapefiles arrived in the UTM16 NAD83 projection, and were merged into one continuous polygon shapefile using ArcView. The WWI classification system differs from the NWI system; the most significant difference is the exclusion of open-water bodies (lakes and large rivers) from the inventory. This shapefile was converted to an ARC/INFO coverage using the SHAPEARC command.

In an attempt to make the Wisconsin data more consistent with that from the NWI, this project made use of the 1995 Land Use Inventory purchased from the Southeast Wisconsin Regional Planning Commission (SEWRPC). This inventory was delivered as numerous ArcView shapefiles (one per township). All polygons representing open water (code 950, "Open Lands, Surface Water") were selected and saved as a separate shapefile, which was then converted to an ARC/INFO coverage using the SHAPEARC command. The WWI and SEWRPC coverages were then combined using the UNION function, which retains all attributes of both input coverages. The resulting polygons, when represented as wetlands in the WWI, were given their original WWI codes. Polygons which were not wetlands in the WWI but were depicted as open water in the SEWRPC coverage were classed as lacustrine or riverine (based on visual inspections of each polygon).

Creating a Single Polygon Layer: Wetland polygons for the three states were combined into one coverage in ARC/INFO using the APPEND command, followed by the CLEAN function. The resulting coverage contained several sliver polygons and gaps where bordering coverages did not match up. A lengthy ARCEDIT session was necessary to clean up all incongruities of this new coverage.

Reclassifying Wetlands: Because a wetland analysis would be cumbersome if wetlands were considered by their exact classification (i.e. including modifiers representing water regime), all polygons were reclassified into the more general categories represented in the above table. The DISSOLVE command in ARC/INFO created a new coverage where all lines separating polygons with the same general category are removed. This coverage, WETCLAS1, is the source of the data used in this analysis layer.

Scoring Wetlands: This required creating a new data field in the database for WETCLAS1 to hold the wetland data value (0, 3, 5 or 10). All wetlands were selected based on general classification, and the appropriate value was given to all wetland polygons.

Creating the Grid: The polygon layer was converted to a 30-meter grid cell layer with the wetland data value as the cell value.

Layer 2—Heritage Wetland Communities (HER_COMM)
While the Heritage community classification scheme is consistent across the three states, the methodology for representing them in a GIS varies greatly:

Illinois Heritage Data: A point shapefile of Heritage natural community occurrences for the six northeast Illinois counties was obtained from Robert Gottfried of the Illinois DNR. This shapefile was projected from the native projection (Lambert) to UTM. A new shapefile depicting only wetland communities was created from these data; Jim Anderson of the Forest Preserve District of Lake County assisted in the identification of wetland communities.

Indiana Heritage Data: A polygon shapefile of Heritage natural communities for Lake, Porter, and LaPorte counties was sent by Ronald Hellmich of the Indiana DNR. A new shapefile depicting only wetland communities was created from these data, with assistance from Jim Anderson. Although the delineations of these communities appeared to be quite accurate, the necessity of creating a uniform model surface (i.e. consistent with data from other states) meant creating a point shapefile from the wetland polygons, with one point located in the center of each wetland polygon.

Wisconsin Heritage Data: A polygon shapefile of Heritage natural communities for Racine, Kenosha and Walworth counties was obtained after a request was sent to Betty Les, Section Chief for the Wisconsin Natural Heritage Inventory. The community data arrived as a polygon shapefile; however, the polygons do not conform to boundaries of natural communities, but rather to generalized locations based on legal description of property (i.e. section, township, range). A new shapefile depicting only wetland communities was created from these data, with assistance from Jim Anderson. Since there was no way to refine these locations spatially, points were generated at the centroids of each polygon.

Creating the Grid Layer: The three point shapefiles were merged in ArcView. All points were then buffered in ArcView to a radius of 1,250 meters. The data table for these polygon buffers was given a "score" field, with the value of 10 assigned to all areas within these buffers. This shapefile was then converted to a 30-meter grid cell layer, with all cells within the 1,250 meter circles being assigned the "10" score, while all outside cells were assigned a score of zero.

To create a grid layer with diminishing values from the center of these circles, a Neighborhood Analysis procedure was run in ArcView Spatial Analyst; in this procedure, each new cell represents the mean value of all grid cells within a 1,250 meter radius of that cell. This creates a layer where scores are highest (mean value 10) in the exact center of the original polygon buffer, with lower scores for grid cells further away from the center as their means contain fewer "10" cells and more "0" cells, with values of 0.01 occurring 2,500 meters away from the cells at the center of the polygons. This layer was then reclassified so that cell values were integers (rather than real numbers); all cells with scores of 0.01 to 1 were reclassified "1," 1.01 to 2 were reclassified "2," and so on. This reclassified grid cell layer is that which was used in the model.

Layer 3—Heritage Wetland T/E Bird Species (WET_BIRD)
While the Heritage community classification scheme is consistent across the three states, the methodology for representing them in a GIS varies as it does with the natural community data.

Wisconsin Heritage Data: Species data from the Wisconsin Heritage database was delivered in the same shapefile as the natural community data, with the same spatial generalization. After determining that no occurrences of wetland bird species were within 2.5 kilometers of the border of Illinois and Wisconsin (or, more accurately, no polygon centroids were within that distance), no Wisconsin data was used for this model layer.

Indiana Heritage Data: Occurrences of threatened/endangered species arrived as a point shapefile in the same delivery as the Indiana natural community data. Multiple records for species could occur at individual points. From this shapefile, all records of wetland birds were selected and saved into a new point shapefile. Bird selections were made by Jim Anderson.

Illinois Heritage Data: Occurrences of threatened/endangered species arrived as a point shapefile in the same delivery as the Illinois natural community data. Multiple records for species could occur at individual points. From this shapefile, all records of wetland birds were selected and saved into a new point shapefile. Bird selections were made by Jim Anderson.

Creating a New Point Shapefile with Species Counts: Illinois and Indiana shapefiles were merged into a single shapefile. Since multiple records existed at several (single) points, a multi-step process was necessary to count the number of species at each point:

1. Create a very small (10 meter) buffer around point records—buffers must be small at this to prevent overlapping. Where there are two records (points) at one location, two identical polygons were created.
2. This layer was then converted into an ARC/INFO coverage using the SHAPEARC command. By doing this with a reasonable fuzzy tolerance value (1 meter), overlying polygons will be turned into single polygons. This coverage has several label errors, due to the fact that there are now multiple labels within individual polygons. Converting this back to a shapefile results in single polygons, with only one of the multiple label points associated with it.
3. With ArcView Geoprocessing Wizard, perform a spatial join, joining the point (wetland bird occurrence layer) shapefile to the new polygon shapefile. The result is having all records in the original point table, with the polygon ID number joined to each point record. One can then count the number of species within each polygon by running a SUM on the polygon ID field. The SUM will include the number of times each individual polygon ID appears in the data table. This is the same as the number of species that appear at that point. By including the latitude and longitude fields in the sum, one can generate a new point coverage

(first in decimal degrees, then projected to UTM) that includes the species count for each point. The new, projected shapefile is BIRDCOUNT.shp, and contains only species counts (no records of individual species).

4. Add a score field to the data table; the value for that field is 2X the species count (since the model required two points for each T/E bird species at each point). Since no more than ten points are allowed for this layer, any records with a score above 10 (more than 5 T/E species at that location) is selected and reassigned a score of 10.

Creating the Grid Layer: The analysis procedure is similar to the Heritage community layer above. The BIRDCOUNT point shapefile was converted to a grid theme using the Neighborhood Statistics function. Cell values should be the Maximum Value from the score field, using a circle of 1,250 meters (one-half the buffer distance). The result is a series of circles with the highest-occurring score overriding any overlapping, lower scores. This layer was then reclassified, turning the No Data cells into "0" scores.

On this new grid, another Neighborhood Statistics procedure was run, this time choosing the mean statistic for a circle of 1,250 meters. What this does is compute the mean for each grid cell in a 1,250 meter radius; cells in the exact center of the1,250 meter circles from the earlier grid will have the maximum value of that circle, while cells away from the center will have diminishing values due to the influence of "0" score cells outside of the circles. The act of doing a 1,250-meter analysis on 1,250-meter circles means that no scored cell will contribute to any cells greater than 2,500 meters, in effect creating the 2,500-meter buffer with diminishing contribution. These values were then reclassified to integer values, and the resulting grid cell layer became the model input WET_BIRD.

Layer 4—Number of Basins Within 2,500 Meter Radius From Each Cell (BASINSCOR)

This is to count the number of individual wetlands that fall inside a 2,500 meter radius. "Wetlands" in this instance are those from the NWI_CLASS layer, so individual wetland polygons of one class but with different water regimes (say, seasonal versus semipermanent) are considered part of the same polygon.

Initial Grid Layer: The NWI_CLASS coverage was converted to a grid layer; so that each wetland would have a unique identity in this layer, the values for the grid cells were equal to the polygon ID number in the NWI_CLASS coverage. However, since polygons exist in this coverage for "uplands" as well, all ID numbers had to first be calculated into a new field WET_ID; then all "upland" polygons were selected and assigned a value of zero in that field. This was necessary so that upland areas would be counted consistently (once).

Wetland Count Grid Layer: To count all of the wetlands which are wholly or partially within a 2,500 meter radius of each grid cell, the Spatial Analyst--Neighborhood Statistics procedure needed to be run on the initial grid layer, choosing "Variety" as the statistic to be assigned to each grid cell. The Variety function counts the number of individual values it encounters while evaluating all grid cells within the 2,500 meter radius. Therefore, a wetland in the initial grid layer that includes 25 grid cells with a value of, say, "7557849," is counted once, while a neighboring wetland with 79 grid cells with a value of "94769243" is counted once as well. Since all upland cells have a common value ("0"), the output grid is the number of individual wetlands plus one. Using Map Calculator, a new layer was created where 1 is subtracted from all cell values. The total number of wetlands is now represented in the grid cell layer WETCOUNT. The range of values was from 0 to 250. While this is not the final layer for use in the model, a copy of it has been saved to the REFGRIDS CD so that future models can be run with different scoring systems.

Final Grid Layer (BASINSCOR): The final layer was reclassified in Spatial Analyst:

# Wetlands	Score
0	0
1 – 16	1
17 – 33	2
34 – 50	3
51 – 66	4
67 – 83	5
84 – 100	6
101 – 116	7
117 – 133	8
134 – 150	9
151 – 166	10
167 – 183	11
184 – 200	12
201 – 216	13
217 – 233	14
234 – 250	15

Layer 5—Area of Palustrine Wetlands Within 2,500 Meter Radius From Each Cell (PAL_HA_SCOR)

The purpose of this layer is to quantify (in hectares) the amount of the following wetlands within a 2,500-meter radius of each grid cell: Palustrine Open Water, Palustrine Emergent, and Palustrine Aquatic Bed.

Initial Grid Layer: A new data field was created in the NWI_CLASS coverage called PAL_SCORE; all wetland polygons classed POW, PEM, and PAB were assigned a value of "1" in this field, and all other polygons (wetland and upland) were given a value of "0." The coverage was then converted to a grid layer, with the value in the PAL_SCORE field as the grid cell value.

Palustrine Area Grid Layer: Using the Spatial Analyst Neighborhood Analysis function, the SUM routine was run to total the value of all grid cells within the 2,500 meter radius of each cell. Since each cell representing a palustrine wetland has a value of "1," and each cell represents an area of 900 square meters (0.09 hectares), the SUM output multiplied by 0.09 will yield the number of hectares of palustrine wetlands within the radius. This grid, named PAL_HA, has been saved on the REFGRIDS CD so that future users may vary the values which go into the model.

Final Grid Layer (PAL_HA_SCOR): The PAL_HA layer contained values from 0 to 806 hectares. This layer was reclassified in Spatial Analyst to a range of scores from 0 to 15:

Hectares	Score
0	0
1 – 54	1
55 – 107	2
108 – 161	3
162 – 215	4
216 – 268	5
269 – 322	6
323 – 376	7
377 – 430	8
431 – 483	9
484 – 537	10
538 – 591	11
592 – 644	12
645 – 698	13
699 – 752	14
753 – 806	15

Layer 6—Surrounding Landuse/Habitat (LANDCOV_VAL)
This layer contributes nearby non-wetland landcover types to the model. The formula involves multiplying the proportion of land use types within a 2.5Km radius times that type's assigned value times the maximum contribution (10 points).

Reclassifying Landcover Data: Because of differing landcover classification schemes, there are differences among the Wisconsin, Illinois, and Indiana sources. Additionally, there is an inordinate amount of land in the Wisconsin landcover grid classified as "barren." In checking those areas against digital orthophotos for McHenry County (which cross over the state line), it would appear that in most instances these were in fact agricultural fields, which may not have had any vegetation on them when the satellite image was taken. Therefore, I classed Wisconsin "barren" with the agriculture category. The more rigorous Illinois landcover data restricts "barren land" to quarries, rock outcrops, and beaches. The table below depicts how the values from each of the different landcover grids were reclassified.

Creation of Rural Grassland Layer: The landcover layers for all three states each needed to be reclassified into two categories: Rural Grassland (with a value of "1") and all other cover types (with a value of "0"). Because the Indiana and Wisconsin landcover data lumped both rural grassland and certain urban grassland types (such as cemeteries) in their respective "grassland" categories, only those cells classified as grassland that were outside of municipal areas were considered Rural Grassland. Limited spot-checking against digital orthophotos was done to verify that some grassland cells were indeed parks and cemeteries; however, due to the large area, an exhaustive comparison/reclassification could not be performed. To create the layer, then, required overlaying municipal boundaries over the landcover data, and selecting only those "grassland" cells which were outside of municipal areas. A new grid was created, with those selected cells given a value of "1" and all other cells (grassland in municipal areas and all non-grassland cells) a value of "0". Both the Wisconsin and Indiana landcover data required this, while it was not necessary for Illinois since there is a differentiation between rural grassland and urban grassland in that data set. A new, region-wide grid-cell layer for rural grasslands was then created by adding the three (Wisconsin, Illinois and Indiana) rural grassland layers together using Spatial Analyst Map Calculator (due to some areas of overlap, certain cells ended up with a value of "2"--these were reclassified to "1").

General Landcover Type	WI Classes	IL Classes	IN Classes	Value
Rural Grassland	150: Grassland (outside of municipal areas) 124: Agriculture, Forage Crops	12: Rural Grassland	7: Pasture/Grassland (outside of municipal areas)	1.0
Forest	163: Coniferous Forest, Red Pine 173: Coniferous Forest, Mixed/Other 177: Deciduous Forest, Oak 187: Deciduous Forest, Mixed/Other	13: Wooded/Forested, Deciduous Closed Canopy 14: Wooded/Forested, Deciduous Open Canopy 15: Coniferous	8: Deciduous Successional Shrubland 9: Deciduous Woodland 10: Deciduous Forest 11: Evergreen Forest	0.8
Agriculture	112: Agriculture, Row Crop 113: Agriculture, Corn 118: Agriculture, Other Row Crop 240: Barren Land	8: Cropland, Row Crops 9: Cropland, Small Grains 10: Cropland, Orchards and Nurseries	6: Row Crop Agriculture	0.8
Urban Grassland	105: Urban/ Developed, Golf Course 150: Grassland (inside municipal areas)	11: Urban Grassland	7: Pasture/Grassland (inside municipal areas)	0.3

Creation of the Urban Grassland Layer: This layer was created in the same manner as the Rural Grassland layer, except that for Wisconsin and Indiana all "grassland" cells within municipal areas were given a score of "1."

Creation of the Agriculture and Forest/Woodland Layers: These layers did not require any special selection or manipulation to be created; the table above states which classifications were used as inputs for the two layers.

Calculating the Proportion of Each Landcover Type: Each of these layers then needed to have the count of the number of grid cells of that landcover type within the radius converted to the proportion of land of that cover type as a part of the entire area within that radius. A circle with a 2.5 km radius has a total area of 19,625,000 square meters (Π * $2500m^2$); since each grid contains 900 square meters (30m * 30m), there is a total of 21,806 grid cells resident within each 2.5 km circle. To calculate the proportion of each landcover type against the total is a matter of dividing the number of grid cells by landcover type by 21,806. This calculation was performed on each of the landcover types, with the resulting grids: RU_GR_PROP, FOR_PROP, AG_PROP, and UR_GR_PROP. These grids have been saved on the REFGRIDS CD so that future users may vary the values which go into the model.

Calculating the Surrounding Landcover Contribution: Up to this point, all of the layers have been kept separate to make it easier to make modifications to the model. To calculate landcover contribution, each of the proportions needs to be multiplied by a factor of the landcover value times the maximum contribution of any grid cell to the output. For example, the forest contribution would be (proportion of forest land within the radius) * (0.8 [which is the value for forest land in the model]) * (10 [the maximum contribution of any cell]). The output grids from these calculations are: RU_GR_VAL, FOR_VAL, AG_VAL, and UR_GR_VAL. Finally, these four layers are summed together for a final layer, LANDCOV_VAL, which contains the scores which go into the model.

Layer 7—Hydric Soils

The final input layer for this model consists of poorly- and very poorly-drained soils. Such data are produced on a county-by-county basis, and is not yet available for a large part of the Chicago Wilderness region. To date, SSURGO soils (the large-scale GIS database created by the NRCS) are only available for McHenry, Kane, DuPage, and LaPorte Counties. Lake County (IL) has produced its own digital soils layer, and supplied this project with a "hydric soils" version of that layer. For the purposes of this analysis, LaPorte County was not included in this layer since it is geographically isolated from the other counties that have digital soils.

For each of the soils coverages, a new data field was created to contain the eventual score of the analysis layer. In the SSURGO coverages (McHenry, DuPage, and Kane), all polygons with DRAINAGE=VP ("very poorly-drained") were given a value of 10; all polygons with DRAINAGE=P ("poorly-drained") were given a value of 5; all remaining polygons were scored 0. The Lake County coverage did not contain non-hydric soil polygons, but did have polygons identified as "water" classed as a "very poorly-drained" soil. Water polygons were given a score of 0, and the remaining P and VP soils polygons were scored in conformance with the SSURGO coverages.

The four county coverages were then converted to separate grid layers, and then merged into a single grid layer using the Spatial Analyst Map Calculator.

Comparing the Basin Marsh Model in Kane County to the Kane County ADID

The Wetland Conservation Strategy Model Development Project began with a comparison of the preliminary basin marsh model and a draft of the Kane County ADID in order to assess the level of agreement between the two. Low scoring cells (cells scoring 15 or less) from the preminary Basin Marsh model that intersected with wetland polygons from the Kane County ADID that scored in the range of suspected high habitat quality wetlands were inspected in attempt to understand why they did not score well in the Basin Marsh model.

Lack of a National Wetlands Inventory Wetland

One major factor appeared to be instances where a high scoring ADID wetland polygon did not correspond with a National Wetlands Inventory polygon and was therefore "missed" by the Basin Marsh model, which uses the National Wetlands Inventory as a base. The version of the preliminary Basin Marsh model with hydric soils does a better job of picking up some of these areas "missed" by the National Wetlands Inventory.

Correspondence with a small, isolated National Wetlands Inventory Wetland

Another factor appeared to be instances where a high scoring ADID wetland polygon corresponded with a National Wetlands Inventory polygon that was small and isolated from other wetlands. Since the basin marsh model puts large emphasis on the count and acreage of wetlands within a 2.5 kilometer radius, if there are not many wetlands in this radius, the model score is likely to be lower.

High Scores in The Basin Marsh Model Where No ADID Wetland Exists

In some cases the Basin Marsh model had a high score where the ADID did not show a wetland. In these cases, the high score came from non-wetland land cover types and from the proximity of other wetlands to the high scoring cell.

Generally when comparing the Preliminary Basin Marsh Model to the Kane County ADID, the correspondence was much better if the 30 meter Grid was used as opposed to the 25 hectare shapefile. Overall, the agreement between the preliminary basin marsh model and the Kane County ADID was quite good, with some exceptions as noted above.

Modifications Made to the Preliminary Basin Marsh Model

The Chicago Wilderness Wetlands Task Force decided to remove the natural heritage wetland community location data and the threatened and endangered wetland bird species location data from the basin marsh model. This decision was made because these data represent only areas where natural heritage wetland communities and threatened and endangered wetland bird species are known to be. Since heritage quality wetland communities and threatened and endangered wetland bird species undoubtedly also exist in other areas where their presence has not been recorded, the task force was concerned that including known locations in the model would give too much weight to known resources, resulting in a de-emphasizing of potentially high quality resources in other areas. In practice, removing these layers from the basin marsh model did not result in dramatic changes in the model. Areas that scored highly in the preliminary basin marsh model tended to also score highly in the model once these layers were removed. There were a few exceptions, most notably three small areas in southern LaPorte County in Indiana which no longer scored highly in the basin marsh model once the heritage communities were excluded from the model.

In order to provide information on heritage communities in the mapping work done for this project, maps of natural heritage wetland community types were created to be used in conjunction with the models when prioritizing areas for a wetland conservation strategy.

Preparing a Wetland Layer Including the Wisconsin Counties in Order to Extend the Basin Marsh Model into Wisconsin and to Preparing to Include Wisconsin in the Reptile and Amphibian Modeling

The decision was made to include Walworth, Racine, and Kenosha counties in Wisconsin so that the project would better reflect what is considered to be the "Chicago Wilderness" area. For this reason, the basin marsh model was extended into Wisconsin by Northeastern Illinois Planning Commission and all subsequent models created for this project also included these Wisconsin counties.

Because Wisconsin does not have a National Wetlands Inventory, but instead has a Wisconsin Wetlands Inventory with different wetland categories, it was necessary to begin by merging the Wisconsin Wetlands Inventory and the National Wetlands Inventory into a single layer for SE Wisconsin, NE Illinois and NW Indiana. It was also necessary to determine equivalent wetland categories between the National Wetland Inventory and the Wisconsin Wetland Inventory. The Wisconsin Department of Natural Resources furnished a "crosswalk" showing how categories in the two inventories related. This was used to reclassify wetlands from the Wisconsin Wetlands Inventory according to National Wetlands inventory nomenclature for this project. The following table shows how system and class from the National Wetlands Inventory and Wisconsin Wetlands Inventory category codes were matched in the composite layer created for this project:

Wetland Category	**NWI**	**WWI**
All upland	U	U
All riverine	R	R
All lacustrine	L	L
Palustrine open water	POW	WO
Palustrine aquatic bed	PAB	A
Palustrine emergent	PEM	E
Palustrine forested	PFO	T

Palustrine scrub/shrub	PSS	S
Palustrine unconsolidated bottom	PUB	W1-4
Palustrine unconsolidated shore	PUS	F

In addition, the water regime modifiers differed between the National Wetland Inventory and the Wisconsin Wetland Inventory. Because the National Wetlands Inventory has seven different water regime categories in the NE Illinois and NW Indiana region, and the Wisconsin Wetlands Inventory has only 4 different water regime categories (including only 2 for palustrine wetlands), for this project all the water regimes were assigned to one of two categories: very wet and wet soil. The data were collapsed as follows:

Original Category	**Source of Category**	**Collapsed Category**
Permanently Flooded	National Wetlands Inventory	Very wet
Intermittently Exposed	National Wetlands Inventory	Very wet
Semipermanently Flooded	National Wetlands Inventory	Very wet
Saturated	National Wetlands Inventory	Wet soil
Temporarily Flooded	National Wetlands Inventory	Wet soil
Intermittently Flooded	National Wetlands Inventory	Wet soil
Artifically Flooded	National Wetlands Inventory	Very wet
Standing Water, Lake	Wisconsin Wetlands Inventory	Very wet
Flowing Water, River	Wisconsin Wetlands Inventory	Very wet
Standing Water, Palustrine	Wisconsin Wetlands Inventory	Very wet
Wet Soil Palustrine	Wisconsin Wetlands Inventory	Wet soil

The preliminary Basin Marsh Model did not include the Wisconsin counties. Although the lower part of Walworth and Kenosha counties were included in a wetland layer created for the preliminary basin marsh model that was used to create the layers PAL_HA_SCORE and BASINSCORE, a new layer merging the WWI and NWI needed to be created for the modeling done for the current project in order to include the entire areas of Walworth, Kenosha and Racine Counties and in order to maintain more detailed information about wetland type, including information about water regime, than was retained in the wetland layer created for the preliminary model.

The Digital Wisconsin Wetland Inventory (WWI) does not include lakes and large rivers. In an attempt to make the Wisconsin data more consistent with that from the NWI, which does include these deep water habitats, this project made use of the 1995 Land Use Inventory purchased from the Southeast Wisconsin Regional Planning Commission (SEWRPC). All polygons representing open water (code 950) were selected and saved as a separate shapefile, which was then merged with the WWI shapefile. Polygons which were not wetlands in the WWI but were depicted as open water in the SEWRPC coverage were classed as lacustrine or riverine (based on visual inspections of each polygon).

Wetland polygons for the three states were combined into one shapefile in ArcView using the Union command. The resulting coverage contained several sliver polygons and gaps where bordering coverages did not match up. These incongruities were corrected by editing the shapefile in ArcView.

Because detailed information on the wetland system, class and water regime were needed for the reptile and amphibian model and because wetlands from the Wisconsin Wetland Inventory needed to be in the same classification system as were wetlands in the National Wetlands Inventory, all wetlands were reclassified to one of the following categories (the number of wetlands in the final layer with this classification is also indicated as the "number of records"):

Wisconsin Lake/River --very wet, 2053 records
Riverine Lower Perennial Open Water—very wet, 124 records
Riverine Lower Perennial Aquatic Bed –very wet, 5 records
Riverine Lower Perennial Emergent—very wet, 1 record
Riverine Lower Perennial Unconsolidated Shore—wet soil, 8 records
Riverine Lower Perennial Unconsolidated Shore—very wet, 6 records
Riverine Lower Perennial Unconsolidated Bottom/Aquatic Bed—very wet, 1 record
Riverine Lower Perennial Unconsolidated Bottom—very wet, 127 records
Riverine Lower Perennial Emergent Unconsolidated Shore—very wet, 1 record
Riverine Intermittent Stream Bed—very wet, 3 records
Palustrine Unconsolidated Shore—wet soil, 38 records
Palustrine Unconsolidated Shore—very wet, 71 records
Palustrine Unconsolidated Bottom—very wet, 6905 records
Palustrine Scrub/Shrub/Open Water—very wet, 5 records
Palustrine Scrub/Shrub—wet soil, 914 records
Palustrine Scrub/Shrub—very wet, 1032 records
Palustrine Scrub/Shrub/Unconsolidated Bottom—very wet, 16 records
Palustrine Scrub/Shrub/Forested—wet soil, 236 records
Palustrine Scrub/Shrub/Forested—very wet, 284 records
Palustrine Scrub/Shrub/Emergent—wet soil, 444 records
Palustrine Scrub/Shrub/Emergent—very wet, 912 records
Palustrine Scrub/Shrub/Aquatic Bed—very wet, 58 records
Palustrine Open Water/Aquatic Bed—very wet, 230 records
Palustrine Open Water—very wet, 7719 records
Palustrine Forested/Unconsolidated Bottom,--very wet, 27 records
Palustrine Forested/Open Water—very wet, 14 records

Palustrine Forested/Emergent—wet soil, 228 records
Palustrine Forested/Emergent—very wet, 577 records
Palustrine Forested/Aquatic Bed—very wet, 25 records
Palustrine Forested—wet soil, 3687 records
Palustrine Forested—very wet, 4183 records
Palustrine Emergent/Unconsolidated Bottom,--wet soil, 2 records
Palustrine Emergent/Unconsolidated Shore—very wet, 10 records
Palustrine Emergent/Unconsolidated Bottom—very wet, 178 records
Palustrine Emergent/Aquatic Bed—very wet, 110 records
Palustrine Emergent/Open Water—very wet, 262 records
Palustrine Emergent—wet soil, 8318 records
Palustrine Emergent—very wet, 16617 records
Palustrine Aquatic Bed—very wet, 1009 records
Palustrine Aquatic Bed/Unconsolidated Bottom—very wet, 170 records
Lacustrine Littoral Unconsolidated Shore—very wet, 3 records
Lacustrine Littoral Unconsolidated Shore—wet soil, 66 records
Lacustrine Littoral Unconsolidated Bottom/Emergent—very wet, 2 records
Lacustrine Littoral Unconsolidated Bottom—very wet, 29 records
Lacustrine Littoral Open Water—very wet, 33 records
Lacustrine Littoral Emergent/Scrub/Shrub—very wet, 2 records
Lacustrine Littoral Emergent/Aquatic Bed—very wet, 21 records
Lacustrine Littoral Emergent—very wet, 53 records
Lacustrine Littoral Aquatic Bed/Scrub/Shrub—very wet, 1 record
Lacustrine Littoral Aquatic Bed/Open Water—very wet, 1 record
Lacustrine Littoral Aquatic Bed—very wet, 33 records
Lacustrine Littoral Unconsolidated Bottom/Aquatic Bed—very wet, 9 records
Lacustrine Limnetic Unconsolidated Bottom—very wet, 255 records
Lacustrine Limnetic Unconsolidated Bottom/Aquatic Bed—very wet, 1 record
Lacustrine Limnetic Open Water—very wet, 218 records
Lacustrine Limnetic Aquatic Bed—very wet, 19 records
Lacustrine Limnetic Surrounded by wetlands—very wet, 8 records

This created a wetland layer versatile enough to extend the Basin Marsh Model into Wisconsin and to include Wisconsin in the Reptile and Amphibian Modeling process.

Extending the Basin Marsh Model To Wisconsin

In order to produce a final version of the Basin Marsh Model and extend the model into Wisconsin, the following layers from the original Basin Marsh Model were used:

NWI_CLASS
BASINSCOR
PAL_HA_SCOR
LANDCOV_VAL

Then the same methodology that was used to create these layers was used to create layers for Walworth, Kenosha, and Racine Counties in Wisconsin. Each layer created for

Wisconsin was merged with the corresponding layer created for the Illinois and Indiana counties for the preliminary model and then these layers were added together using ArcView Spatial Analysts cell statistics, SUM function to create the final model layer that included the three Wisconsin counties. The model layers for the final Basin Marsh Model are shown in Figures 9, 10, 11, and 12.

Creating a Summary Shapefile

A summary of the model was created in shapefile format (Bmarsh.shp) in order to show average model scores for 25 hectare areas as well as the percent contribution of each model layer to the average score. This was done by using Spatial Analyst's map calculator to divide each input layer by the final model and multiply by 100 to create a layer for each input where each 30 meter cell had a number representing the percentage contribution of that cell to the final model score.

A 25 hectare grid was created by generalizing the final model layer to cells 25 hectares in size where each cell had the average score of the cells in that 25 hectare area. This was done using Spatial Analyst's cell statistics, choosing average and specifying that the output layer should have a cell size of 25 hectares. The resulting Arc Grid layer was then converted from a raster Arc Grid layer to a vector layer. Adjacent cells with final model scores less that 0.1 different were generalized to larger areas. Each 25 hectare (or larger) polygon was given a unique number.

This vector polygon layer was then overlaid on the final model Arc Grid layer (with the 30 meter cell size) and spatial analysts' neighborhood statistics was used to create a table where the mean, maximum, range, sum, and standard deviation of the scores of all 30 meter cells in each 25 hectare (or larger) polygon was listed for each unique polygon number from the vector 25 hectare polygon layer.

Then the vector layer was overlaid on each 30 meter percentage contribution layer and spatial analysts' neighborhood statistics was used to create a table where the mean percent contribution of all 30 meter cells in each 25 hectare (or larger) polygon was listed for each unique polygon number from the vector 25 hectare polygon layer.

The unique id was then used to join this tables to the 25 hectare polygon shapefile, resulting in a shapefile with a table containing the following fields:

Min: the minimum final model score of the 30 meter cells falling within each 25 ha (or larger) polygon

Max: the maximum final model score of the 30 meter cells falling within each 25 ha (or larger) polygon

Range: the range in final model scores of the 30 meter cells falling within each 25 ha (or larger polygon)

Mean: the mean final model score of the 30 meter cells falling within each 25 ha (or larger polygon)

Std: the standard deviation of final model scores of the 30 meter cells falling within each 25 ha (or larger polygon)

Sum: the sum of the final model scores of the 30 meter cells falling within each 25 ha (or larger) polygon

Basin_per: the average percent contribution of the of layer "Basinscor" to the average final model score of each 25 ha (or larger) polygon

Lc_per: the average percent contribution of the of layer "Landcov_val" to the average final model score of each 25 ha (or larger) polygon

Palha_per: the average percent contribution of the of layer "Pal_ha_scor" to the average final model score of each 25 ha (or larger) polygon

Wetcl_per: the average percent contribution of the of layer "Nwi_class" to the average final model score of each 25 ha (or larger) polygon

This shapefile can be used to display the average final model scores for each polygon and to examine what model inputs contributed most heavily to the determination of that score.

Figure 9: Basin Marsh Wetland Class Layer

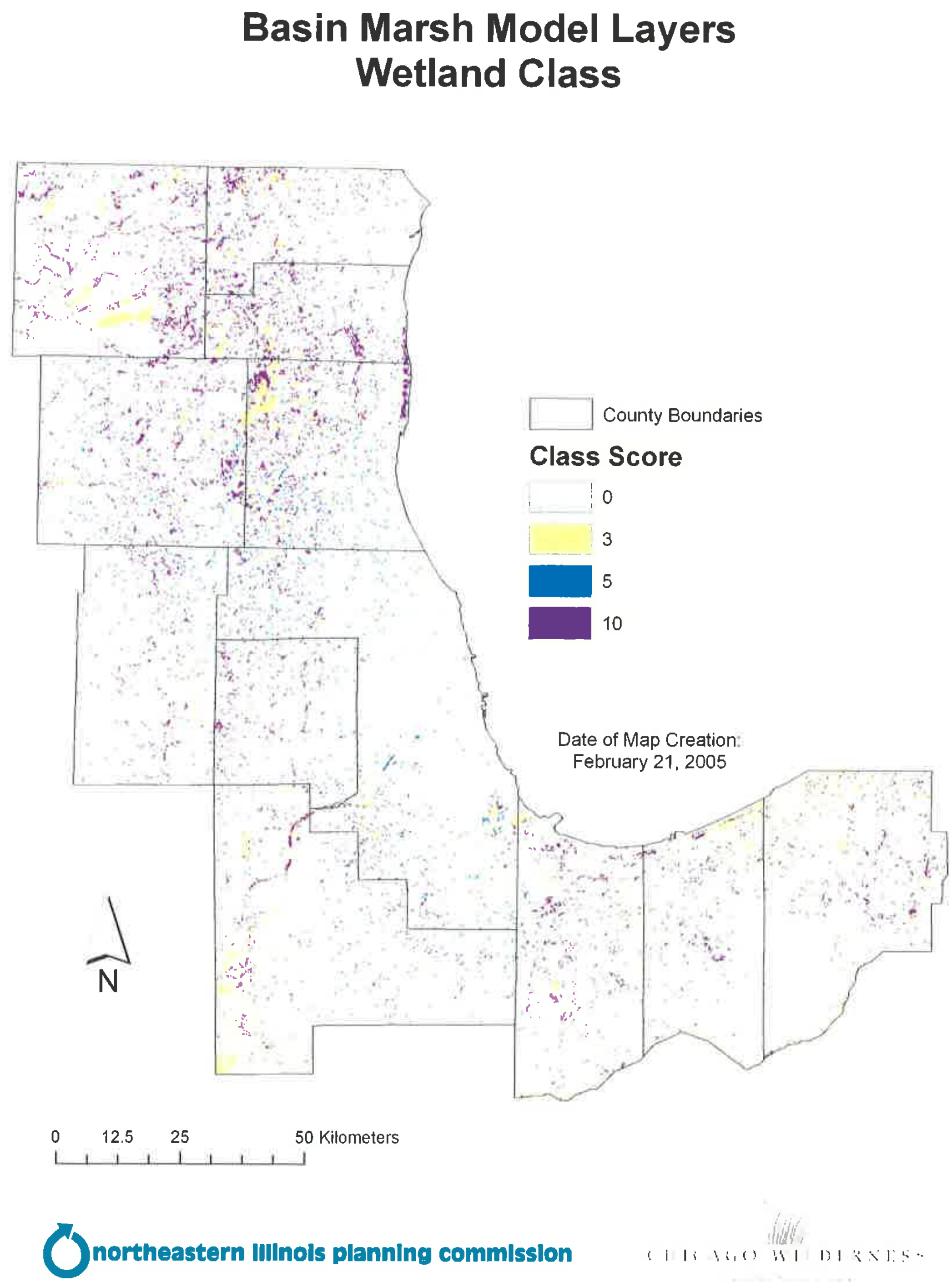


Figure 10: Basin Marsh Number of Basins within 2.5 Kilometers

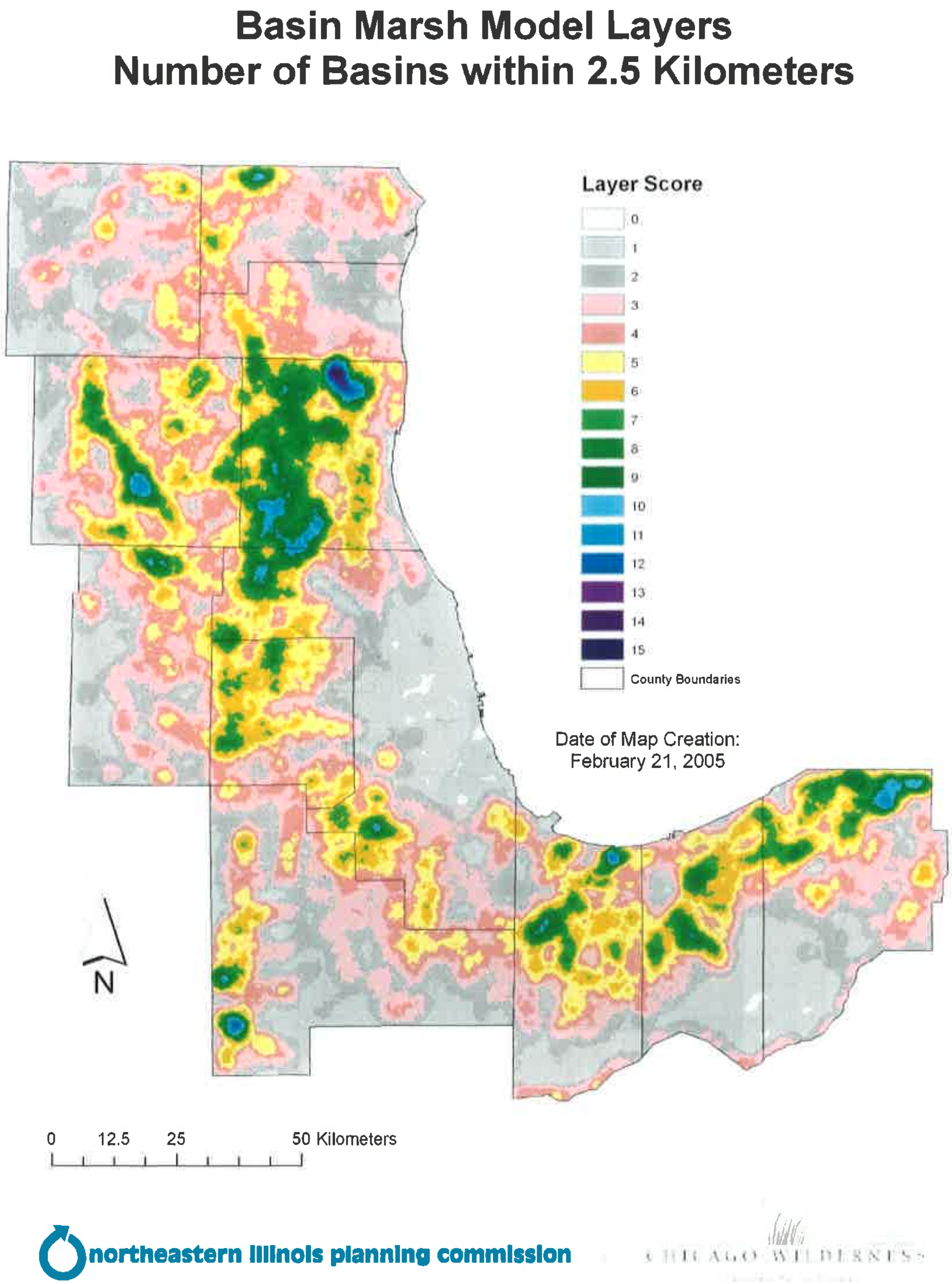


Figure 11: Basin Marsh Hectares of Palustrine Wetlands within 2.5 Kilometers

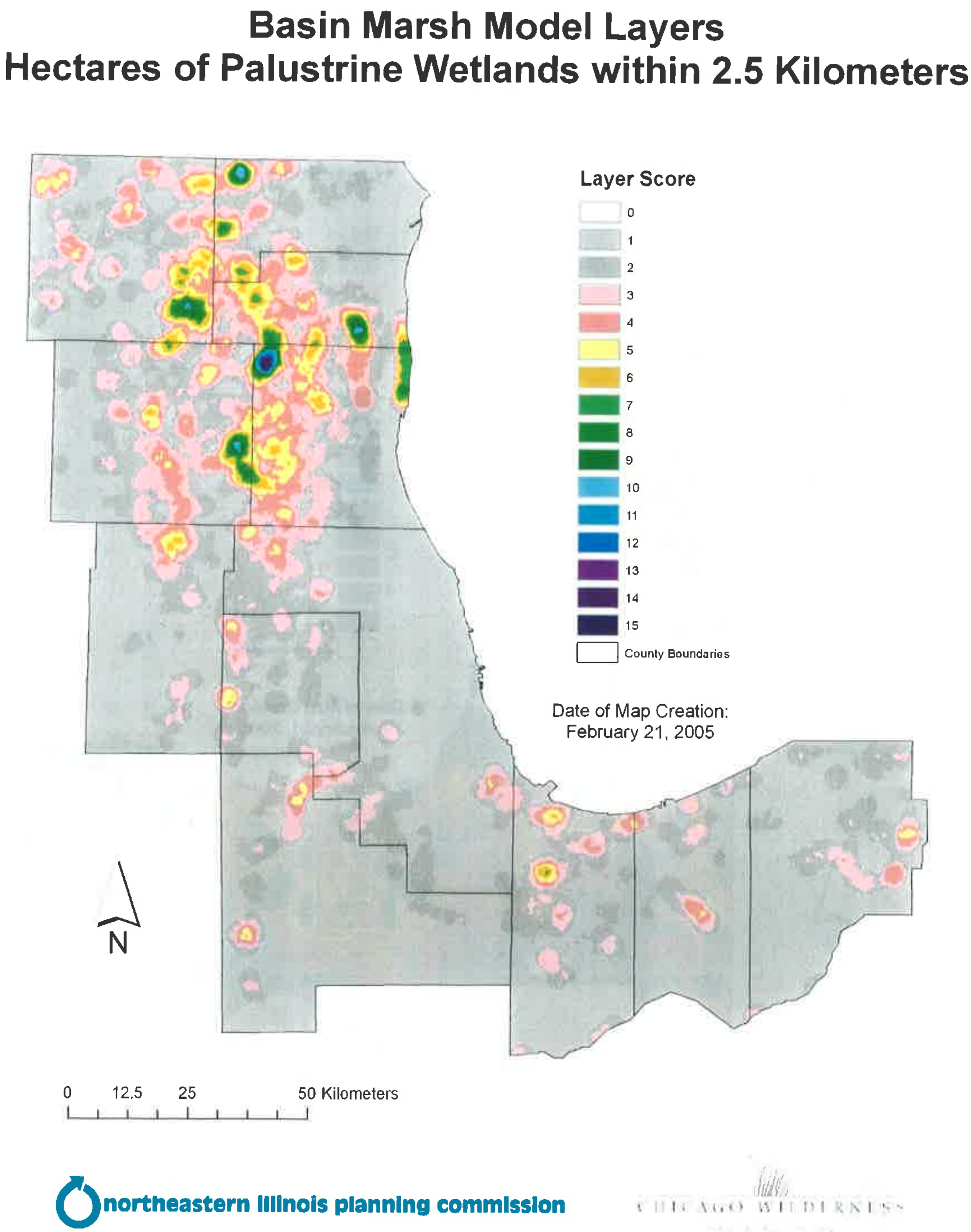
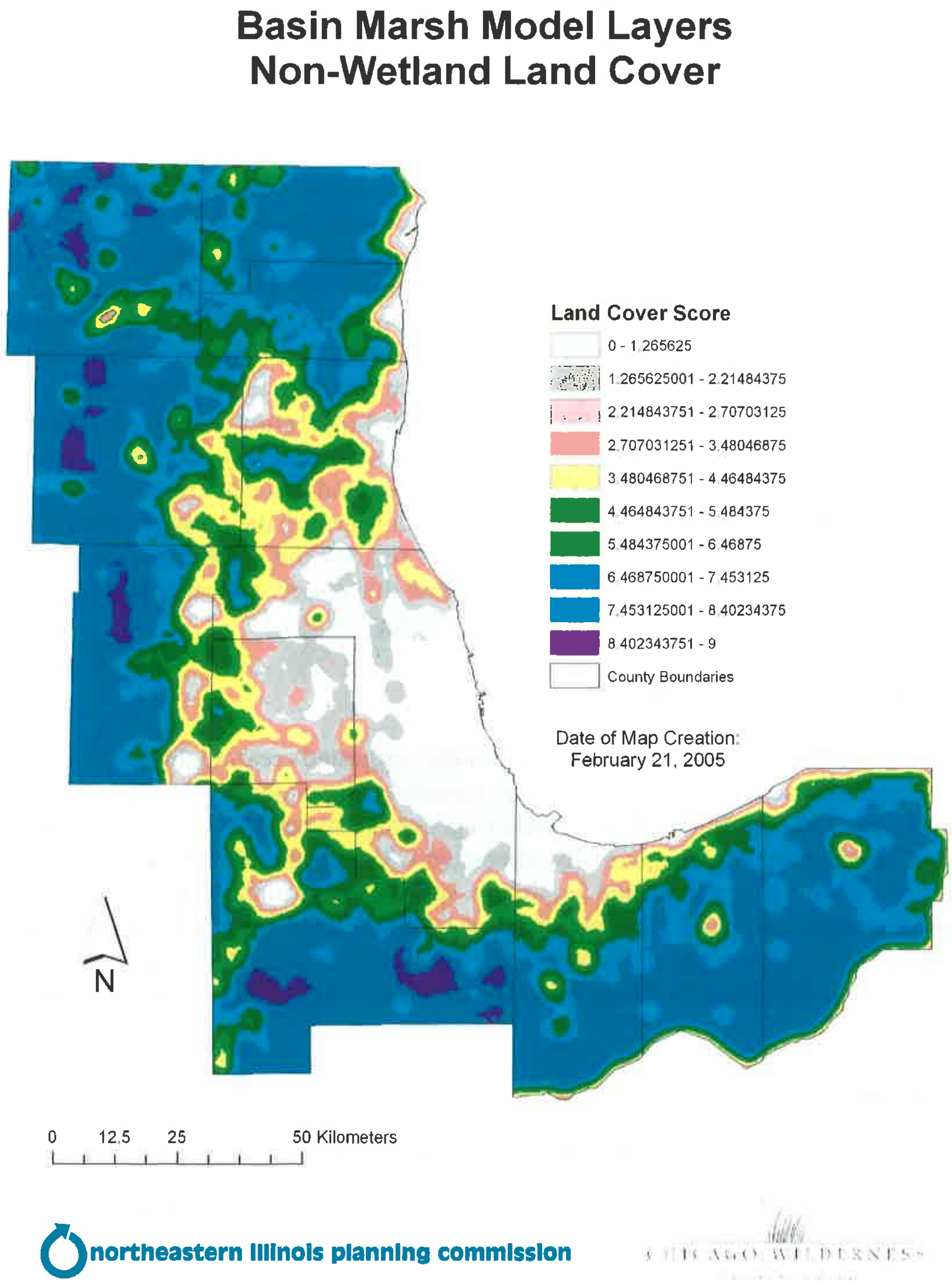


Figure 12: Basin Marsh Land Cover Value



Appendix B: The Reptile and Amphibian Models

Creating the Reptile and Amphibian Models:

The Reptile and Amphibian Models were created by Northeastern Illinois Planning Commission in conjunction with the Chicago Wilderness Wetlands Task Force of the Conservation Design Working Group in 2002-2004.

These models were worked out in a series of meetings and communications that included the following individuals: Laura Barghusen (Northeastern Illinois Planning Commission), Charlie Paine (Max McGraw Wildlife Foundation), Jim Anderson (Lake County Forest Preserve District), Mike Redmer (U.S. Fish and Wildlife Service), Tom Anton (The Field Museum), Karen Glennemeier (National Audubon Society, Chicago Region), Jennifer Filipiak (Lake County Forest Preserve District), Chris Phillips (Illinois Natural History Survey), Dave Mauger (Will County Forest Preserve District), Gary Casper (Milwaukee Public Museum), Ralph Grundel (USGS), Sue Hayden (McHenry County Conservation District), Brad Woodson (McHenry County Conservation District), and Dan Thompson (Forest Preserve District of DuPage County). The wetland associate reptile and amphibian model was reviewed by Mike Redmer (concerning the location of areas considered to be valuable as wetland resources for reptiles and amphibians) for preserves in DuPage County and the conclusions drawn from this review appear below in the section entitled "Assessment of the Wetland Associate Model."

The Concept of Specialty Models

The Reptile and Amphibian model group initially suggested creating three different models, one representing habitat for species generally associated with palustrine wetlands, one representing habitat for species generally associated with stream habitats, and one representing species generally associated with ephemeral wetlands. For this reason, the group broke reptile and amphibian species found in the region down into three groups or guilds, with guild 1 representing species associated with isolated ephemeral or frequently anoxic ponds, guild 2 representing species associated with streams and guild 3 representing species identified as general wetland associates. This break down was as follows:

Species Guilds

Guild I: Species associated with isolated ephemeral or frequently anoxic ponds, ranked as to associative strength

		Associative Strength
Blue-spotted salamander	*Ambystoma laterale*	high
Spotted salamander	*Ambystoma maculatum*	high
Tiger salamander	*Ambystoma tigrinum*	medium
Polyploid mole salamanders	*Ambystoma platineum* complex	
Smallmouth salamander	*Ambystoma texanum*	
Four-toed salamander	*Hemidactylium scutatum*	high
Central newt	*Notophthalmus viridescens*	medium
American toad	*Bufo americanus*	medium

Cope's gray treefrog	*Hyla chrysoscelis*	medium
Eastern gray treefrog	*Hyla versicolor*	medium
Spring peeper	*Pseudacris crucifer*	high
Western chorus frog	*Pseuacris tiseriata*	high
Wood frog	*Rana sylvatica*	high

Guild II: Stream associates.

Pickerel frog	*Rana palustris (in Walworth County this is a stream associate)*
Spiny softshell turtle	*Apalone spinifera*
Common map turtle	*Graptemys geographica*
Red-eared slider	*Trachemys scripta*
Northern watersnake	*Nerodia sipedon*
Queen snake	*Regina septemvittata*
Mudpuppy	*Necturus maculosus*

Guild IIB (Possible Subset): This is a very restricted species that inhabits ravines and high-order perennial or ephemeral streams in the Kankakee River Drainage.

Southern two-lined salamander	*Eurycea cirrigera*

Group III: Remaining species identified as general wetland associates

Tiger salamander	*Ambystoma tigrinum*
American toad	*Bufo americanus*
Fowler's toad	*Bufo fowleri*
Cricket frog	*Acris crepitans*
Cope's gray treefrog	*Hyla chrysoscelis*
Eastern gray treefrog	*Hyla versicolor*
Plains leopard frog	*Rana blairi*
Bullfrog	*Rana catesbeiana*
Green frog	*Rana clamitans*
Pickerel frog	*Rana palustris*
Northern leopard frog	*Rana pipiens*
Wood frog	*Rana sylvatica*
Snapping turtle	*Chelydra serpentina*
Painted turtle	*Chrysemys picta*
Spotted Turtle	*Clemmys guttata*
Blanding's Turtle	*Emydoidea blandingii*
Stinkpot	*Sternotherus odoratus*
Kirtland's snake	*Clonophis kirtlandii*
Smooth green snake	*Opheodrys vernalis*
Graham's crayfish snake	*Regina grahamii*
DeKay's snake*	*Storeria dekayi*
Butler's garter snake*	*Thamnophis butleri*
Western ribbon snake	*Thamnophis proximus*
Plains garter snake*	*Thamnophis radix*
Eastern ribbon snake	*Thamnophis sauritus*
Eastern garter snake	*Thamnophis sirtalis*
Eastern massasauga	*Sistrurus catenatus*

* - These snakes, while usually found near wetlands, generally go into wetlands only to hibernate. Possibly should not include them, but if we do, we should include *Storeria occipitomaculata* too.

Although there was some uncertainty as to which guild certain animals should be assigned, the reptile and amphibian model group decided to accept this as a preliminary break down in order to facilitate moving forward with the modeling process.

Reptile and Amphibian Location Datasets

Institutions and researchers with information on locations of reptiles and amphibians were contacted to see if they were willing to contribute location data to this project. The following datasets were obtained for use in the modeling process:

Dataset from Ralph Grundel (USGS, Porter, Indiana):
This dataset is based on locations of pitfall traps and it was part of a study done to see what savanna species are present in the study area. Because these data are from pitfall traps they can be considered to constitute absence data for species not present as well as presence data for those species that were captured. These data were contributed by Ralph Grundel as UTM coordinates and plotted as an event theme in ArcView 3.2 by Laura Barghusen.

Indiana Threatened and Endangered Reptile and Amphibian Dataset (Indiana Natural Heritage Data Center, contributed by Ron Hellmich)
This dataset was created by selecting all reptile and amphibian locations from a point coverage of endangered, threatened and rare species documented from Lake, LaPorte and Porter counties, Indiana. While this database is the result of many different sources and is the most complete available, not all areas have been surveyed for the presence of endangered species. Therefore the absence of any documented occurrences should not be interpreted to mean that the area does not support endangered species.

Midewin National Tallgrass Prairie Area Dataset Digitized by Laura Barghusen and Mike Redmer (USFWS):
Reptile and amphibian points digitized on screen using ArcView 3.2a by Mike Redmer and Laura Barghusen using 1 meter aerial photography as a background and using Mike Redmer's personal observations, and the following reports as source material for point placement:

Redmer 1994. Amphibians and Reptiles of the Joliet Training Area, Will County, Illinois.

Redmer and Anton, 1993. Surveys of the Joliet Training Area and Joliet Army Ammunition Plant for Endangered, Threatened, and Watchlist Reptiles.

Blandings Turtle Locations
This dataset represents localities where Mike Redmer captured/observed Blanding's turtles in DuPage County (with one observation in Will County). These locations were presented as decimal degrees in a spreadsheet. Mike Redmer used the website TopoZone.com to view USGS topographical maps. He placed the pointer on areas where Blanding's turtles have been observed , and recorded the coordinates from those areas. These coordinates were taken from the centers of wetland bodies that appeared to be discrete on the map. The points were then plotted by Laura Barghusen, using ArcView 3.2 and converted to a shapefile.

Chicago Wilderness Calling Frog Survey
This dataset consists of locations from which calling frogs were heard by volunteer surveyors. Volunteers were trained in frog call identification and then visited wetlands several times throughout the spring and summer and recorded data on presence/absence of calling species during the visit, and the intensity of the calls. These data cover the years 2000 through 2002 and were provided by Karen Glennemeier of Audubon with location information in lat/long in excel file format. They were plotted by Laura Barghusen using ArcView 3.2 to create a location shapefile.

Reptile and Amphibian Location Data from Illinois Natural History Survey
This dataset contained geo-referenced data on amphibians and reptiles from the Illinois Natural History Survey, the University of Illinois Museum of Natural History, and the Field Museum of Natural History. Each record had an accuracy value assigned to it depending on the explicitness of the original location data provided by the collector. Therefore, even though each record could be projected as a point, some (most) involved at least some level of extrapolation. These data were provided by the Illinois Natural History Survey in a spreadsheet containing x and y coordinates, day, month and year of collection, and collector.

Will County Forest Preserve Herp Data
This dataset comprised a spreadsheet of species present at various preserves in Will County. The dataset did not include all Will County Forest Preserve District preserves, but included most of those with the greatest diversity of reptiles and amphibians. Some information on Wood Frogs and 4-toed salamanders was reported to the quarter section. In addition the dataset included GPS coordinates for two wetland depressions where Dave Mauger and Tom Anton did extensive drift fence trapping and minnow trapping surveys in 1993 and 1994 (Thorn Creek Woods) and 2000.

Illinois Threatened and Endangered Reptile and Amphibian Locations
This dataset comprised Element Occurrence Records of endangered and threatened species, including reptiles and amphibians. The data were in the format of a point shapefile. All records of reptiles and amphibians were selected from this dataset and saved in shapefile format.

Wisconsin Threatened and Endangered Reptile and Amphibian Locations

This dataset comprised Element Occurrence Records of endangered and threatened species, including reptiles and amphibians. The data were in shapefile format and the occurrences were generalized to legal descriptions of property such as township, range and section. All records of reptiles and amphibians were selected from this dataset and saved in shapefile format.

Assessment of the Wetland Associate Model

Mike Redmer of U.S. Fish and Wildlife Service who has done extensive reptile and amphibian surveying in Northeastern Illinois, examined the Wetland Associate Reptile and Amphibian Model to assess how well it captures high quality reptile and amphibian habitat in the Forest Preserve holdings of DuPage County. He found that the model appears to accurately capture general areas with high wetland reptile and amphibian diversity and he found that the Pratts Wayne Woods complex and West Chicago Prairie, both of which are known to have diverse wetland reptile and amphibian assemblages appeared to be captured accurately in the model. However the very highest model scores did not as a general rule represent habitat that was higher quality for reptiles and amphibians than the habitat represented by the second and third highest scoring model categories. Mike noted that "there are numerous places where the highest ranked [habitat] is either exaggerated, misses a truly diverse but adjacent wetland-herp area, or where perhaps riparian areas were weighted a bit higher than they should have been."

Dave Mauger of the Will County Forest Preserve District also noted that a draft of the model did not highlight areas with isolated, temporary wetlands in the Thorn Creek Woods Preserve in Will County. He noted that these areas are probably the most crucial to sustaining salamanders and forest/savanna restricted frog species, and should reflect the highest model values, stating that from anecdotal observations in Will County, it appears that these smaller, temporary wetland depressions within oak-hickory-maple-basswood forest matrix is the key ingredient for salamander and frog diversity.

Both Mike Redmer and Dave Mauger noted that the very highest scoring areas in the models did not necessarily represent better reptile and amphibian habitat than areas scoring slightly lower. For this reason, areas scoring in the three highest model categories should be considered potentially high quality reptile and amphibian habitat.

Examination of model layers in areas that scored higher or lower than expected revealed that the most common reasons for this were 1) that the national wetlands inventory did not have an abundance of wetlands mapped in the area even though an abundance of wetlands exists in the area, 2) the land cover dataset utilized in the model coded some golf course areas as land cover types other than urban grassland, and 3) wetlands adjacent to river and stream corridors were usually numerous and were usually coded by the National Wetlands Inventory as "palustrine" types resulting in stream and river corridors scoring highly in the "wetland class," "wetland diversity," and "number of basins" model layers, and consequently scoring highly in the model.

Assessment of the National Wetlands Inventory and its Representation of Ephemeral Wetlands

While developing the model, we attempted to check the National Wetlands Inventory Polygon layer to see how well it was picking up small, ephemeral wetlands (which are known to be important habitat for amphibians and reptiles) by taking a sample of the guild 1 species locations (the ephemeral wetlands species guild) and assuming that the location of these species indicated the presence of ephemeral wetlands, and looking to see if these species locations corresponded to a National Wetlands Inventory wetland. The guild 1 points used were from the Chicago Wilderness Calling Frog Survey and from the Illinois Natural History Survey. The points were buffered with 500 meters to allow for some spatial inaccuracy of the point and some movement on the part of the animals.

Of the species locations from the Illinois Natural History Survey database, only 19 out of 325 (5.8%) were not within 500 meters of an NWI wetland, and the majority of these (16) were from 1970 or earlier, with 14 being from 1950 or before. This suggests that these areas may have been wetlands when the species observations were made but may have been developed or drained since then. Of the 3 records from the Illinois Natural History Database that were recent and were not within 500 meters of an NWI wetland, two of the records were wood frogs (from 1995) and both were found in areas classified as forest on IDNR's draft GAP Analysis land cover dataset. Perhaps this does indicate an ephemeral wetland within a forested area that is not represented in the National Wetlands Inventory. The third recent location point was referenced as a blue spotted salamander (from 1990) in an area coded as urban grass on the land cover dataset. An aerial photograph from 1998 showed this area to be a street in a residential area. It is unclear whether this observation was a mistake or whether the salamander was indeed in an urban location.

Of the species locations from the Chicago Wilderness Calling Frog Survey, 34 out of 933 records (3.6%) did not fall within 500 meters of a National Wetlands Inventory wetland. Of these 34 records 6 (including 5 chorus frogs and 1 American Toad) were in a residential area.

Despite the fact that this analysis with mapped guild 1 species locations indicated that the National Wetlands Inventory was picking up wetlands in the vicinity of ephemeral wetland species, biologists and land managers familiar with areas with an abundance of small ephemeral wetlands indicated that in many cases these wetlands were not represented in the National Wetlands Inventory resulting in their not showing up as high quality reptile and amphibian habitat in the model. Mike Redmer commented on the fact that the Morton Arboretum in DuPage County did not show up as especially high scoring in the model:

"The Morton Arboretum-Hidden Lake Complex has one of the most diverse amphibian assemblages, and a good constellation of different wetlands, including ephemeral ponds, semi-permanent woodland/woodland edge ponds, floodplain wetland, and marshes. However, the model did not capture this preserve complex as an area of especially high wetland density or especially good herp habitat."

Examining the National Wetlands inventory layer for the Morton Arboretum-Hidden Lake Complex shows that there are not an abundance of wetlands mapped in this area. This results in the three model layers dependent on the National Wetlands Inventory, "wetland class," "wetland diversity," and "number of basins" not carrying particularly high scores in this area.

The good correspondence of guild 1 species to at least one wetland in the National Wetlands Inventory may simply signify that there was at least one wetland represented in the National Wetland Inventory in areas that also have an abundance of smaller unmapped wetlands.

Ideas How Future Mapping and Modeling Might Better Include Ephemeral Wetlands

Ideas for how small ephemeral wetlands might be better included in a future model or in future wetland mapping include the following possibilities: 1) including hydric soils that fall into wooded areas as wetlands in the wetlands layer, if wetlands are not already mapped in these areas . This might help compensate for small wetlands usually obscured by tree cover which might be missing from the National Wetlands Inventory. 2) Looking for well drained and moderately well drained soils with hydric inclusions and picking up the areas of hydric inclusion in the wetlands layer if wetlands are not already mapped in these areas.

Assessment of the National Wetlands Inventory and its Representation of Wetlands Along River and Stream Corridors

The tendency of riparian areas to score slightly higher than they should have compared to other areas in the wetland associate model was noted by Mike Redmer. He observed that "most of the Waterfall Glen preserve [in DuPage County] has a landscape with scattered and diverse wetland types, as well as several different wetland herp assemblages. However, it would appear the riparian corridors are more heavily weighted [than they should be compared to other areas]." Examination of the National Wetlands Inventory and the model layers indicates that riparian corridors are often lined with wetlands coded by the National Wetland Inventory as "palustrine." The palustrine wetland types "palustrine aquatic bed," "palustrine emergent," "palustrine forested," and "palustrine scrub-shrub" received the highest scores in the model layer "wetland class" and many of the palustrine wetlands flanking rivers and streams fell into one of these high scoring cateogories. In addition, the abundance of wetlands lining rivers and streams mapped in the National Wetlands Inventory resulted in high scores for these areas in the model layer "wetland diversity," which is a count of the numbers of different kinds of wetlands in an area, and the layer "number of basins" which is a count of the number of wetlands in an area. The combination of the tendency of wetlands flanking streams and creeks to be abundantly mapped in the National Wetlands Inventory and small ephemeral wetlands to be more sparsely mapped appears to be the reason that riparian areas score highly compared to other non-riparian but valuable reptile and amphibian habitat in the Wetland Associate Model.

Assessment of the National Wetlands Inventory and its Representation of Ephemeral Wetlands

While developing the model, we attempted to check the National Wetlands Inventory Polygon layer to see how well it was picking up small, ephemeral wetlands (which are known to be important habitat for amphibians and reptiles) by taking a sample of the guild 1 species locations (the ephemeral wetlands species guild) and assuming that the location of these species indicated the presence of ephemeral wetlands, and looking to see if these species locations corresponded to a National Wetlands Inventory wetland. The guild 1 points used were from the Chicago Wilderness Calling Frog Survey and from the Illinois Natural History Survey. The points were buffered with 500 meters to allow for some spatial inaccuracy of the point and some movement on the part of the animals.

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Assessment of Other Limitiations of the Model

Mike Redmer also noted that in a few cases golf courses, which do not comprise good habitat for reptiles and amphibians, scored highly in the model. An example he gave was a high scoring golf course that falls between two preserves, the Herrick Lake-Danada Preserve complex.

Another example of a high scoring golf course was a residential area/golf course just northeast of the Swift Prairie Preserve. The preserve itself has a fairly characteristic marsh/sedge meadow reptile and amphibian assemblage, including Blanding's turtles, but it is the golf course/residential area just outside of the preserve that has a higher model score.

Examination of the model scores in the area of the Herrick Lake-Danada Preserve Complex shows that in the highest scoring area that falls mainly between the preserves, land cover contributes to almost half (40%) of the score indicating that this area has a high land cover score and thus is not coded as urban grass in the land cover dataset. This appears to be a case where the land cover dataset does not reflect the actual current land cover in the area. The area just northeast of Swift Prairie appears as a large palustrine emergent wetland in the national wetlands inventory dataset and wetland class makes up 39% of the total score in this area. This appears to be a case where National Wetland Inventory data is too old to reflect current conditions on the ground. In both these cases the model accuracy is limited by the accuracy of the input datasets.

Different levels of precision of species location points

Originally the reptile and amphibian model group planned to include the species location points collected and mapped for the reptile and amphibian models with a score added to the model in the area of each species point. Ephemeral guild species locations were to be added to the ephemeral wetland model, stream associate species locations were to be added to the stream associate model and the general wetland species guild locations were to be added to the general wetland associate model.

However, the group finally decided not to include species location points in the models because some areas of the region had been more intensively sampled for species than others which would cause these areas to show up as higher scoring in the models than areas that had not been so intensively sampled, and because the species location points were of widely varying precision.

The Index of Conservation Value for Reptiles & Amphibians of the Chicago Region developed by Dave Mauger and Tom Anton, was to be used to assign model values to different species. The Conservation Index Value (CIV) is an index ranging from 0 to 5 that reflects conservation importance or value of different species relative to the preservation and maintenance of natural areas biodiversity. The index is the summation of the rating of five factors. The rating of each factor is binary; a value of 1 is assigned if the factor is an important consideration to that species, or given a value of 0 if the factor is not important and/or is of minor or relatively negligible importance. The factors are defined as follows;

1) Distribution & Abundance

1 - Endemic or restricted species with disjunct or isolated occurrences associated with rare or restricted natural community or habitat types; Species that occur in low population numbers or low densities.
0 - Common, widely distributed species, or peripheral species on edge of range and rarity not attributable to rare or restricted natural community or habitat types; Generally occur in large population numbers and/or high densities.

2) Habitat Dependency

1 - Species restricted to or dependent upon specific natural community, ecosystem or habitat types that are rare or uncommon; Restricted to or dependent upon particular microhabitats that are rare, fragile or vulnerable to development, alteration or culturally induced degradation.
0 - Species that extend across a wide range of natural community, ecosystem or habitat types, and generally persist and/or thrive in culturally degraded, altered or successional community/habitat types.

3) Population Attributes & Trends

1 - Species with low R potential, or reproduction dependent upon and/or vulnerable to rare microhabitats, periods or events; Species especially vulnerable to stochastic processes or that exhibit declining population trends.
0 - Species with high R potential and generally not vulnerable to stochastic processes; Species typically with stable and/or increasing population trends.

4) Landscape Scale & Influences

1 - Species that require large, unfragmented habitats and that are especially vulnerable to fragmentation, edge effects or metapopulation dynamics.
0 - Species that persist or thrive in small habitat patches and across fragmented, degraded and culturally altered landscapes.

5) Conservation Status

1 - Species afforded Federal or State Endangered or Threatened status; regionally rare or uncommon species endemic to or indicative of unique natural community or ecosystem types.
0 - Non-listed, regionally common and ubiquitous species.

Buffer Size

The buffer size of 1000 meters for habitat analysis around any given point was chosen for the model layers as a distance thought to represent a distance that most reptiles and amphibians would be expected to move within. For example Semlitsch (2002) states that "…most individual amphibians cannot migrate long distances because of physiological limitations on water loss. Furthermore, the majority of adults return to "home" ponds, usually after migrating no more than 200-300 m to foraging or overwintering habitats." Some reptiles may be expected to move farther than this, for example, Ernst *et al.* (1994) reported that common map turtles' linear home range varied from 0 to a little over 6 kilometers with the average for males being 2.1 kilometers. However, it was generally agreed by the group participating in the modeling process for this project that 1000 meters was a reasonable size to consider for habitat analysis.

The Wetland Associate Model

Below is a brief description of all of the model inputs; this is followed by an explanation of the data sources that informed them and the procedures necessary to incorporate them into the model.

Layers

Wetland Class

Wetland Class	**Tentative Score**
Upland	0
Riverine	3
Lacustrine	3
Palustrine Open Water	3
Palustrine Aquatic Bed	10
Palustrine Emergent	10
Palustrine Forested	10
Palustrine Scrub-Shrub	10
Palustrine Unconsolidated Bottom	3
Palustrine Unconsolidated Shore	3

Grid cell values were obtained from a polygon layer consisting of National Wetland Inventory (NWI) wetland polygons for Illinois and Indiana, along with Wisconsin Wetland Inventory (WWI) and southeast Wisconsin Landuse (SEWRPC). The making of this layer is described above under the section "Preparing a Wetland Layer Including the Wisconsin Counties in Order to Extend the Basin Marsh Model into Wisconsin and to Prepare to Include Wisconsin in the Reptile and Amphibian Modeling."

Scoring Wetlands: A new data field in this wetland polygon layer was created to hold the wetland data value (0, 3, 6.5, or 10). All wetlands were selected based on the general classification presented in the table above, and the appropriate value was given to all wetland polygons. In the case where a wetland was coded as more than one type, for example Palustrine Scrub-Shrub/Palustrine Unconsolidated Bottom, the scores that would have been assigned for each of those weltand types was averaged. This is where the 6.5 score comes from since the average score of a wetland coded as two different types, one of which would score 10 and the other of which would score 3, is 6.5.

Creating the Grid: The polygon layer was converted to a 30-meter grid cell layer with the wetland data value as the cell value.

Wetland Diversity (based on the National Wetlands Inventory)

This layer expresses the number of different wetland types within 1000 meters of each cell. This layer was included in the model because a diversity of wetlands with different hydroperiods are thought to be important to amphibian habitat. Semlitsch (2002) states:

An effective recovery plan [for amphibians] must maintain or restore an array of natural wetlands with varying hydroperiods (e.g. from 30 days to 1-2 years) to ensure that all local species have sites where the probability of producing successful metamorphs is high, even in extremely dry or wet years.

For this layer "wetland type" is defined by the system, class and water regime of that wetland. For example, a palustrine forested "very wet" wetland is counted as a different type than a palustrine forested "wet soil" wetland because the water regimes are different. Altogether there are 57 different types of wetlands.

Each wetland type was assigned a number from 1-57 by creating a new data field in the polygon layer consisting of National Wetland Inventory (NWI) wetland polygons for Illinois and Indiana, along with Wisconsin Wetland Inventory (WWI) and southeast Wisconsin Landuse (SEWRPC). This layer was then converted to a 30-meter grid cell layer using spatial analyst with the wetland number assigned as the cell value. Then spatial analyst's neighborhood function "Variety" was used to create a layer in which each cell has a number assigned to it that corresponds to the number of different wetland types that occur within 1000 meters of the cell. For example if a cell was surrounded by several cells coded as type 1, a few cells coded as type 10 and one cell coded as type 57 then that cell would get a score of 3 because there are 3 different types of wetlands within 1000 meters of it (1, 10, and 57). The highest score received by any cell was 18, meaning that the maximum number of different kinds of wetlands within 1000 meters of any one cell was 18. In order to set the cell scores to a scale of 1-10 for inclusion in the model, these scores were recoded as follows:

Number of wetlands within 1000 meters	Score
1-2	1
3-4	2
5-6	3
7-8	4

9-10	5
11-12	6
13-14	7
15-16	8
17	9
18	10

Number of Basins

The number of basins (the count of all wetlands from the National Wetlands inventory layer) which are completely or partially within 1000 meters of each cell were counted. Boundaries between adjacent wetlands of the same system (riverine, lacustrine, palustrine) were dissolved so that, for example, two palustrine wetlands (like palustrine emergent and palustrine aquatic bed) sharing a boundary were counted as one wetland that was simply classified as "palustrine." After boundaries were dissolved, each wetland was assigned a unique number by creating a new data field in the polygon layer consisting of National Wetland Inventory (NWI) wetland polygons for Illinois and Indiana, along with Wisconsin Wetland Inventory (WWI) and southeast Wisconsin Landuse (SEWRPC). This layer was then converted to a 30-meter grid cell layer using spatial analyst with the wetland number assigned as the cell value. Then spatial analyst's neighborhood function "Variety" was used to create a layer in which each cell has a number assigned to it that corresponds to the number of different wetlands that occur within 1000 meters of the cell. For example if a cell was surrounded by six different wetlands then that cell would get a score of 6. The highest number of wetlands within 1000 meters of any cell was 64. In order to set cell scores to a scale of 1-10 for inclusion in the model, the "number of basins" scores were recoded as follows:

Basin Count	Model Score
1-6	1
7-12	2
13-18	3
19-24	4
25-30	5
31-36	6
37-42	7
42-49	8
50-56	9
56-64	10

Surrounding Land Cover

Land Cover Value
This layer contributes nearby non-wetland land cover types to the model. The formula involves multiplying the proportion of land use types within a 1000 meter radius times

that type's assigned value times the maximum contribution (10 points). Values assigned to non-wetland land cover types are highest for forest and rural grassland because these land cover types are considered most desirable to reptiles and amphibians when in close proximity to a wetland. Agriculture was assigned an intermediate value and urban grassland, considered least desirable, received the lowest value. Values assigned are as follows:

Land Cover Type	Value
Forest	1.0
Rural Grassland	1.0
Agriculture	0.4
Urban Grassland	0.3

Because of differing land cover classification schemes, there are differences among the Wisconsin, Illinois, and Indiana sources. The Illinois land cover source was a draft version of the Illinois Department of Natural Resources GAP Analysis Land Cover Dataset. In Indiana and Wisconsin the datasets used were The Indiana GAP Analysis Land Cover Dataset and Wisconsin Department of Natural Resources GAP Analysis Land Cover Dataset respectively. During the creation of the preliminary Basin Marsh Model David Clark discovered that in the Wisconsin land cover dataset there is an inordinate amount of land classified as "barren." When he checked those areas against digital orthophotos for McHenry County (which cross over the state line), it appeared that in most instances these were in fact agricultural fields, which may not have had any vegetation on them when the satellite image was taken. Therefore, he classed Wisconsin "barren" land with the agriculture category. The table below depicts how the values from each of the different land cover grids were reclassified for the model:

General Landcover Type	WI Classes	IL Classes	IN Classes	Value
Rural Grassland	150: Grassland (outside of municipal areas) 124: Agriculture, Forage Crops	44: Rural Grasses 31: Row Crop/Rural Grass	7: Pasture/Grassland (outside of municipal areas)	1.0
Forest/ Shrubland	163: Coniferous Forest, Red Pine 173: Coniferous Forest, Mixed/Other 177: Deciduous Forest, Oak 187: Deciduous Forest, Mixed/Other	71: Mesic Forest 72: Savanna/Mesic-Dry Mesic Forest 73: Dry Mesic Forest 76: Dry Savanna 146: Wet Floodplain Forest	8: Deciduous Successional Shrubland 9: Deciduous Woodland 10: Deciduous Forest 11: Evergreen Forest	1.0
Agriculture	111: Herbaceous/Field Crops 112: Agriculture , Row Crop 113: Agriculture, Corn	33: Agriculture-Mixed Uses 35: Agriculture-Corn 36: Agriculture-Small Grains	6: Row Crop	0.4

	118: Agriculture, Other Row Crop 240: Barren Land	37: Agriculture-Soy Beans 39: Agriculture-Winter Wheat		
Urban Grassland	105: Urban/Developed, Golf Course 150: Grassland (inside municipal areas)	41: Urban Grasses	7: Pasture/Grassland (inside municipal areas)	0.3

Creating and Combining the Land Cover Layers

Making these layers involved 1) making a separate layer for each general land cover type listed in the left most column in the table above. This was done for each land cover type by reclassifying all land cover types to 0 except the type featured in the layer. For example, in the rural grassland layer, all land covers were classified as zero except rural grassland types which were classified as 1. For Indiana and Wisconsin, municipal boundaries were overlaid and only the grassland cells outside of the boundaries of municipalities were coded as 1 (i.e. as rural grassland), all others were coded as zero. This was done because there was no distinction between rural and urban grass in these land cover datasets.

For each of these layers a count was done of the number of grid cells of each land cover type within a 1000 meter radius of each cell using spatial analyst's "sum" function. This yielded a layer for each land cover type where each grid cell had a value equal to the number of cells of that land cover type within a 1000 meter radius of it. For each layer this count was then converted into a proportion of the land cover type within the 1000 meter radius. A circle with a 1000 meter radius has a total area of 3,140,000 square meters (Pi * 1000m2). Each grid cell contains 900 square meters (30m * 30m) so there is a total of 3488.9 grid cells within each 1000 meter circle (3140000/900=3488.9). Dividing the number of grid cells in each land cover type by 3488.9 yields the proportion of that land cover type within the radius. This conversion was done by using spatial analyst's raster calculator to divide the layers produced using spatial analyst's "sum" function by 3488.9.

To calculate land cover contribution, spatial analyst's raster calculator was used to multiply the proportion layers by a factor of the land cover value times the maximum contribution of any grid cell to the output. For example, the forest contribution would be (proportion of forest land within the radius) * (1 [which is the value for forest land in the model]) * (10 [the maximum contribution of any cell]). Once a land cover contribution layer was created for each land cover type, the four land cover datasets were summed together using spatial analyst's cell statistics function to make one composite land cover layer.

The Stream Associate Model

The stream associate model was comprised of all the layers included in the wetland associate model plus another layer of streams and rivers. This layer was based on the National Hydrography Dataset. The following major rivers were buffered with 120 meters and assigned scores of 10 at the river center with decreasing scores as the edges of the buffer are approached:

Calumet River
Cal Sag Channel
Little Calumet River
Grand Calumet River
Chicago River
Sanitary and Ship Canal
North Branch Chicago River
DuPage River (including west and east branches)
Des Plaines River
Fox River
Kankakee River
Kishwaukee River

Other, smaller rivers and streams from the National Hydrography Dataset were included with a 120 meter buffer and a score of 3 at the river center with decreasing scores as the edges of the buffer are approached.

The idea of buffering the rivers with their floodplains instead of the 120 meter buffer was considered but digital floodplain data is not available for all the counties covered in this model. Porter County, Indiana and Racine County, Wisconsin do not have digital floodplain data, so the 120 meter buffer was used for the model instead.

This layer was created for use in the stream associate model because larger river systems are important in sustaining riverine turtles such as softshells, map turtles and sliders. This layer was created after receiving the following feedback from Dave Mauger of the Will County Forest Preserve District after he reviewed a draft of the model for the area of Thorn Creek Woods in Will County:

I think you might want to look at "de-emphasizing" the riverine corridor to some degree, or perhaps re-calibrate based on size of the system relative to its ability to sustain important elements of herp diversity. For example, when it comes to riverine turtles such as softshells, map turtles, sliders and to some degree even Blanding's, the large river systems such as the Des Plaines would seem to be critical. Disregarding Blanding's, the same importance would apply to the Kankakee and DuPage.

-Dave Mauger, Will County Forest Preserve District, after reviewing a draft of the model for the area of Thorn Creek Woods, fall 2003

This layer was created by buffering the streams and rivers from the National Hydrography Dataset with a 60 meter buffer. The data table for this buffer shapefile was given a “score” field, and a value of 10 was assigned to the following buffered rivers: the Calumet River, the Cal Sag Channel, the Little Calumet River, the Grand Calumet River, the Chicago River, the Sanitary and Ship Canal, the North Branch Chicago River, the DuPage River (including west and east branches), the Des Plaines River, the Fox River, the Kankakee River, and the Kishwaukee River, and a value of 3 was assigned to all other buffered rivers and streams. This shapefile was then converted to a 30-meter grid cell layer, with all cells within the buffered area being assigned the “10” or the “3” score, while all outside cells were assigned a score of zero.

To create a grid layer with diminishing values from the center of the stream or river, a Neighborhood analysis procedure was run in spatial analyst. In this procedure, each new cell represents the mean value of all grid cells within a 60 meter radius of that cell. This creates a layer where scores are highest (mean value 10 or 3) in the center of the original buffer (along the center line of the river or stream), with lower scores for grid cells further away from the center as their means contain fewer “10” cells or “3” cells and more “0” cells, with cells this values diminishing to 0 occurring 120 meters away from the cells at the center of the rivers and streams.

Reptile and Amphibian Model layers are shown in Figures 13, 14, 15, 16, and 17.

Creating Summary Shapefiles

Summaries of the models were created in shapefile format (Herpwetlndassoc.shp and Herpstrmassoc.shp) in order to show average model scores for 25 hectare areas as well as the percent contribution of each model layer to the average score for each model. This was done by using Spatial Analyst’s map calculator to divide each input layer by the final model and multiply by 100 to create a layer for each input where each 30 meter cell had a number representing the percentage contribution of that cell to the final model score.

25 hectare grids were created by generalizing the final model layer for each model to cells 25 hectares in size where each cell had the average score of the cells in that 25 hectare area. This was done using Spatial Analyst’s cell statistics, choosing average and specifying that the output layer should have a cell size of 25 hectares. The resulting Arc Grid layer was then converted from a raster Arc Grid layer to a vector layer. Adjacent cells with final model scores less that 0.1 different were generalized to larger areas. Each 25 hectare (or larger) polygon was given a unique number.

These vector polygon layers were then overlaid on the final model Arc Grid layers (with the 30 meter cell size) and spatial analysts’ neighborhood statistics was used to create a table for each model where the mean, minimum, maximum, range, sum, and standard deviation of the scores of all 30 meter cells in each 25 hectare (or larger) polygon was listed for each unique polygon number from the vector 25 hectare polygon layers.

Then each vector layer was overlaid on each 30 meter percentage contribution layer and spatial analysts’ neighborhood statistics was used to create a table for each model where the mean percent contribution of all 30 meter cells in each 25 hectare (or larger) polygon was listed for each unique polygon number from the vector 25 hectare polygon layer.

The unique id from the vector shapefile create for each model was then used to join these tables to the 25 hectare polygon shapefiles, resulting in a shapefiles for each model with tables containing the following fields:

Max: the maximum final model score of the 30 meter cells falling within each 25 ha (or larger) polygon

Range: the range in final model scores of the 30 meter cells falling within each 25 ha (or larger polygon)

Mean: the mean final model score of the 30 meter cells falling within each 25 ha (or larger polygon)

Std: the standard deviation of final model scores of the 30 meter cells falling within each 25 ha (or larger polygon)

Sum: the sum of the final model scores of the 30 meter cells falling within each 25 ha (or larger) polygon

Basin_per: the average percent contribution of the of layer "Number of basins" to the average final model score of each 25 ha (or larger) polygon

Lc_per: the average percent contribution of the of layer "Surrounding landcover" to the average final model score of each 25 ha (or larger) polygon

Diver_per: the average percent contribution of the of layer "Wetland diversity" to the average final model score of each 25 ha (or larger) polygon

Wetcl_per: the average percent contribution of the of layer "Wetland class" to the average final model score of each 25 ha (or larger) polygon

Strm_per: the average percent contribution of the of layer "Streams and major rivers" to the average final model score of each 25 ha (or larger) polygon (this field only appears in the shapefile summarizing the stream associate model.

These shapefiles can be used to display the average final model scores for each polygon and to examine what model inputs contributed most heavily to the determination of those scores.

Figure 13: Reptile and Amphibian Wetland Class

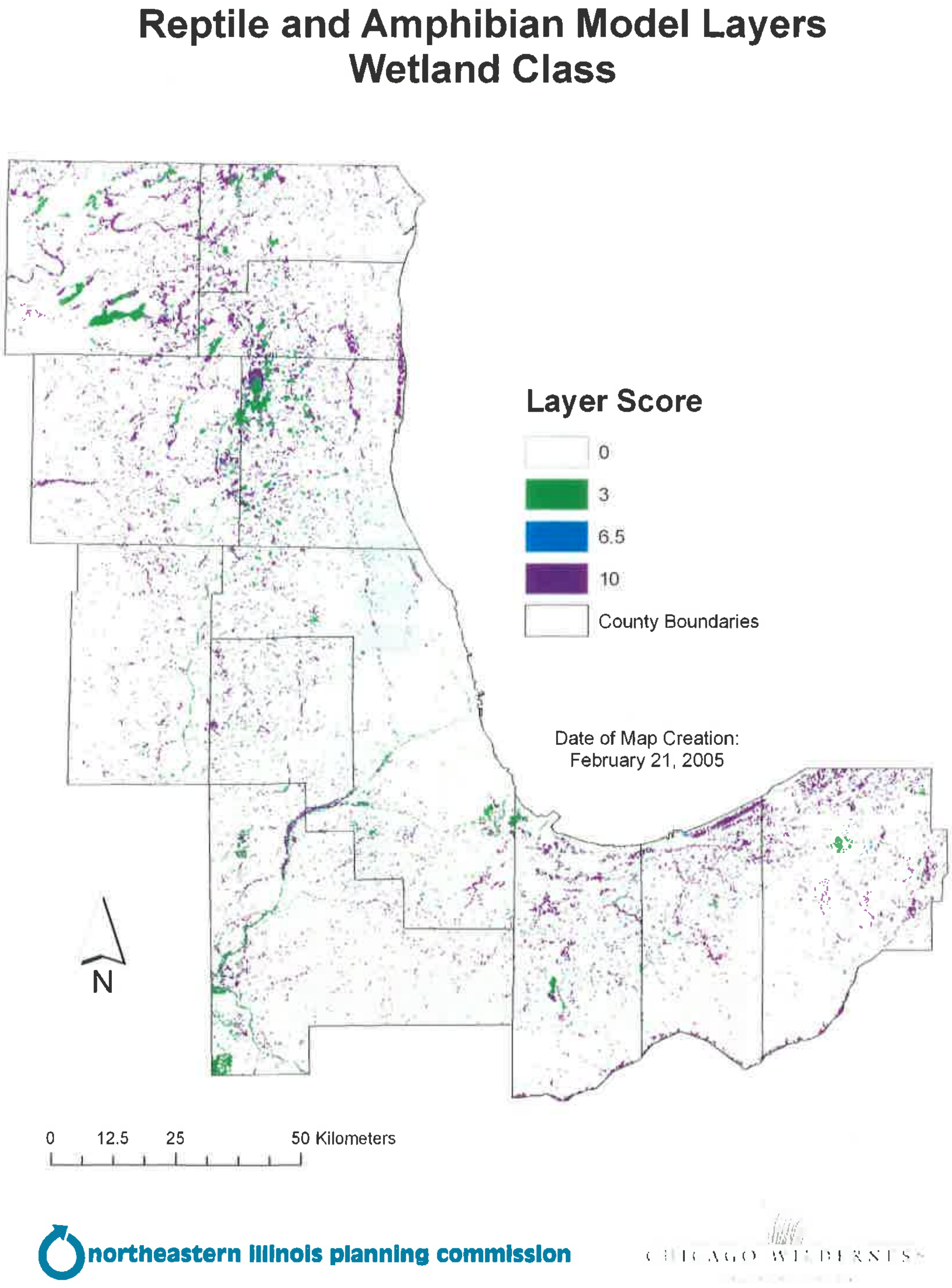

Figure 14: Reptile and Amphibian Model Wetland Diversity

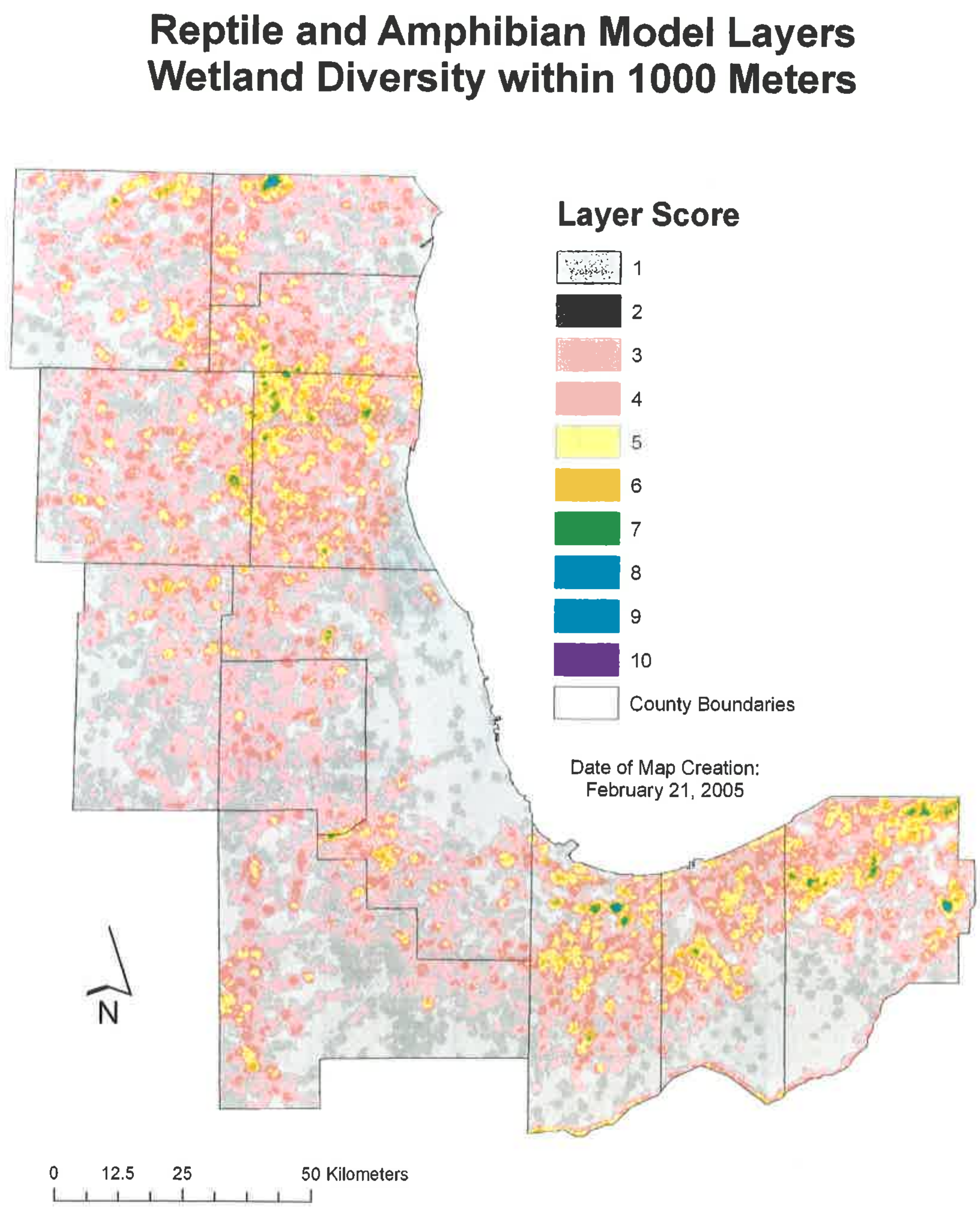

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Figure 15: Reptile and Amphibian Model Number of Basins

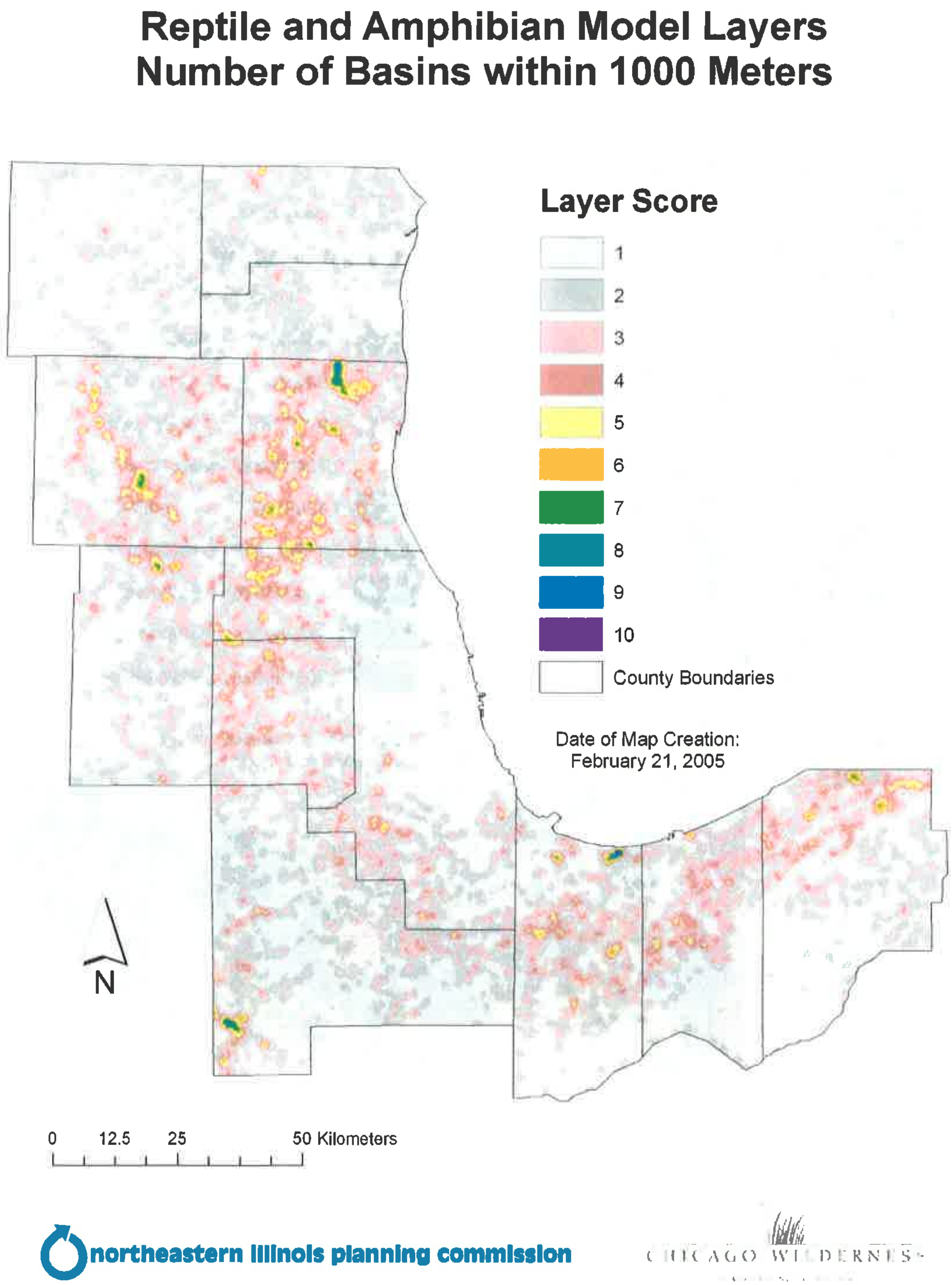


Figure 16: Reptile and Amphibian Model Non-Wetland Land Cover

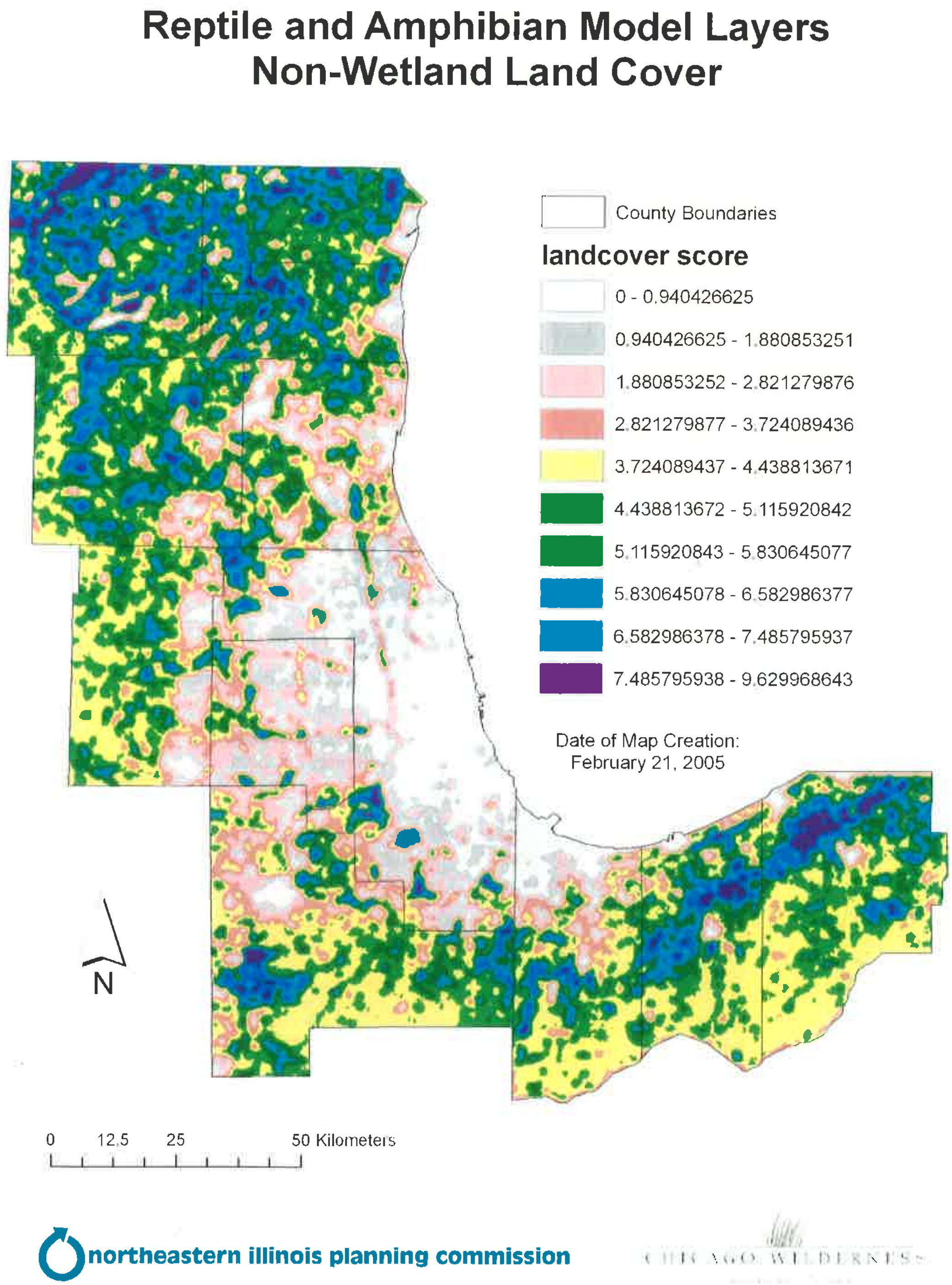
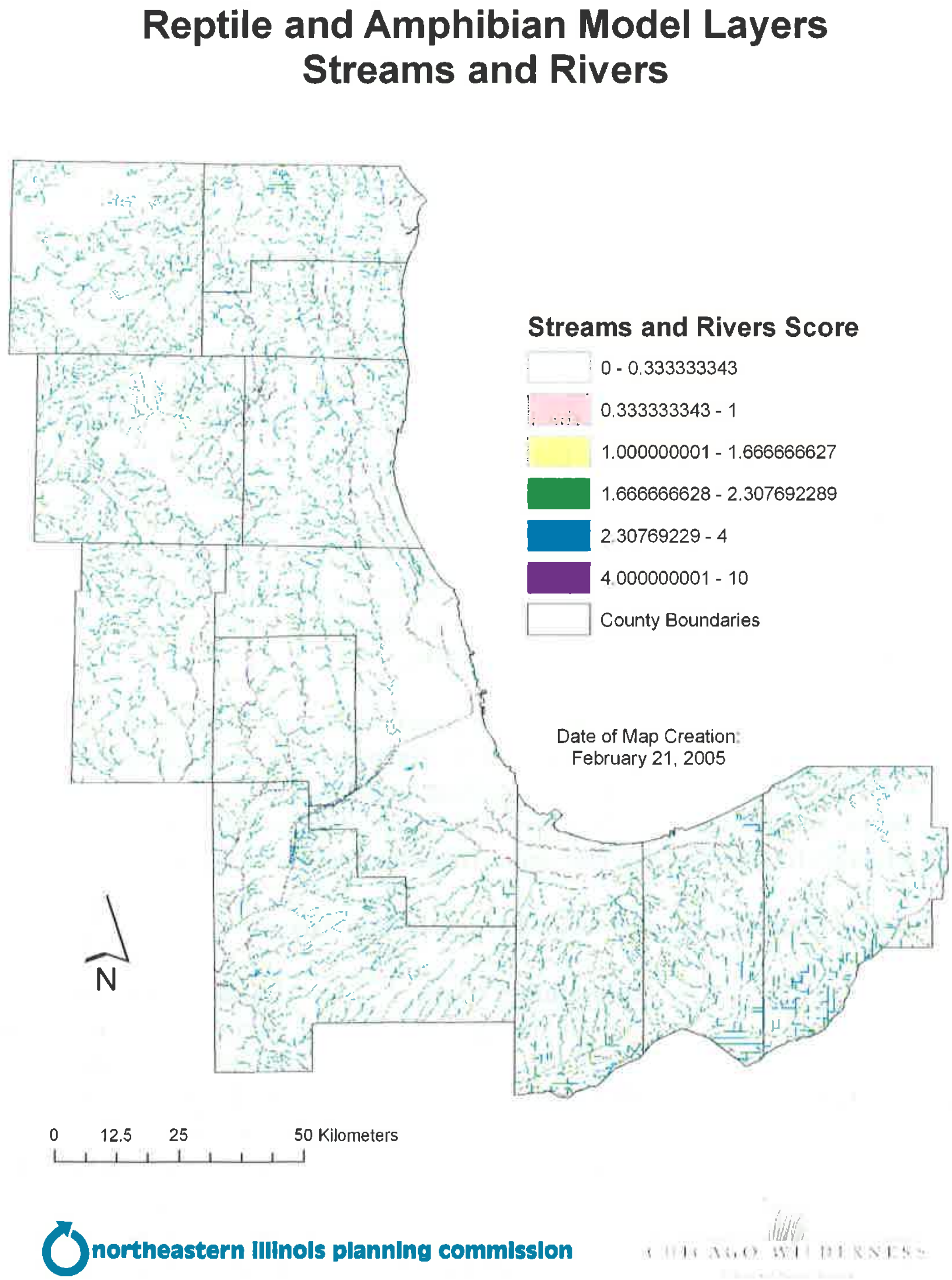


Figure 17: Reptile and Amphibian Model Streams and Rivers



Appendix C: Heritage Wetland Plant Community Mapping and Mapping of Aquatic Community Status and Goals

Using a map of heritage wetland plant communities in conjunction with the models can increase the likelihood that high quality wetland areas will be recognized. For example, wetland communities in more urbanized areas that provide important habitat for threatened and endangered wetland bird species or reptiles and amphibians may not score particularly highly in either the basin marsh model or the reptile and amphibian models. The Calumet area which is known to provide habitat for threatened and endangered wetland bird species does not score extremely highly in the basin marsh model, although it does score somewhat highly compared to its immediate surroundings. Looking at the percent contribution of the model layers in the Calumet area shows that on average land cover contributed a very low percent (10%) to the mean score for this area, reflecting the presence of urbanized land and other lower scoring land cover types. The mean contribution of wetland class (type of wetland) to the mean score from the Calumet area was even lower (6%). This reflects the fact that many of the wetlands in the Calumet area (such as Lake Calumet, George Lake, and Powderhorn Lake) are classified as lacustrine in the National Wetlands Inventory and lacustrine wetlands received a comparatively low score (3) in the model. However, the Calumet area does show up as containing a first tier wetland community, an exceptional lake, and several third tier and lower priority wetland community types on the heritage wetland and aquatic community maps. These community maps should be used in conjunction with the models when prioritizing wetlands for protection and restoration.

The Biodiversity Recovery Plan defines status, needs, and goals for terrestrial communities, including wetlands, in Chapter 5. The plan outlines the status and recovery goals for wetland communities which are defined as marshes, bogs, fens, sedge meadows, pannes, seeps, and springs. *The Biodiversity Recovery Plan* prioritizes community types for conservation by placing them into tiers. These tiers appear in the table below:

Wetland Communities: Conservation Targets in Top Tiers

Tier	Community Name	Rational For Tier
First (highest) tier	Graminoid Fen	Rarity, degraded condition, global significance
First (highest) tier	Panne	Rarity, loss of natural nourishment processes
Second tier	Basin Marsh	High value wildlife habitat, restoration efforts often have been successful
Second tier	Calcareous Floating Mat	Biological importance, global significance
Second tier	Calcareous Seep	Biological importance, poor condition
Second tier	Streamside Marsh	Few remain; degraded condition

Third tier	Forested Fen	Rarity, quality believed to be declining, more information about how to measure health
Third tier	Sedge Meadow	Managed sedge meadows are improving in condition but there is opportunity for more improvement if more sedge meadows are brought under management

Wetland types discussed in the biodiversity recovery plan but not included in this tiering system include bogs, seeps and springs. *The Plan* points out that most remaining bogs are protected and that seeps and springs are so small they do not generally harbor many species. Wetland types present in the Chicago Wilderness region but not discussed in *The Biodiversity Recovery Plan* include swamps.

For the purposes of the Wetland Conservation Strategy Model Development, wetland community types from the Natural Heritage Databases of Illinois, Wisconsin and Indiana were mapped according to their Biodiversity Recovery Plan tier. Community types not tiered by Chicago Wilderness were mapped as "Not Tiered" as were community types not discussed in the Biodiversity Recovery Plan (swamps). Heritage community types were mapped as points. Since Natural Heritage Community types from the state of Wisconsin were contributed to this project in the form of a polygon shapefile, the centroids of the polygons were located in ArcGIS and points corresponding to these centriods were mapped.

Some community types that the Wetland Task Force decided to include as wetland types for the purposes of the Wetland Conservation Strategy Model Development were not described as wetlands in *The Biodiversity Recovery Plan* but were instead described as forested communities and prairie communities. These include types such as wet prairie, floodplain forest, and northern wet forest (flatwoods). These community types were mapped for this project according to the tier to which they were assigned within the forested or prairie community type in which they were included in *The Biodiversity Recovery Plan*. For example, northern wet forest (flatwoods) is assigned to the second tier within the forested community restoration target scheme in *The Biodiversity Recovery Plan* so it was mapped as a second tier priority on the wetland community type map created for this project.

Natural Heritage Wetland Community Types Mapped

State	Community Type	Count	Tier
WI	Bog Relict	3	Not Tiered
WI	Calcareous Fen	21	Second Tier
WI	Emergent Marsh	31	Third Tier
WI	Floodplain Forest	4	Not Tiered
WI	Northern Wet Forest*	7	Second Tier
WI	Open Bog	1	Not Tiered
WI	Southern Hardwood Swamp	1	Not Tiered
WI	Southern Sedge Meadow	24	Third Tier
WI	Southern Tamarack Swamp	6	Not Tiered
WI	Springs and Spring Runs, Hard	9	Not Tiered
WI	Stream, Fast, Hard, Warm	2	Not Tiered
WI	Stream, Slow, Hard, Warm	1	Not Tiered
WI	Wet Prairie	2	Not Tiered
WI	Wet, Mesic Prairie	22	First Tier
IL	Acid Gravel Seep	1	Not Tiered
IL	Calcareous Floating Mat	10	Second Tier
IL	Calcareous Seep	4	Second Tier
IL	Forested Bog	3	Not Tiered
IL	Forested Fen	2	Third Tier
IL	Graminoid Bog	4	Not Tiered
IL	Graminoid Fen	26	First Tier
IL	Great Lake	1	Not Tiered
IL	Lake	2	Not Tiered
IL	Low Shrub Bog	3	Not Tiered
IL	Low Shrub Fen	3	Third Tier
IL	Marsh	29	Second Tier
IL	Medium Gradient River	1	Not Tiered
IL	Panne	2	First Tier
IL	Pond	14	Third Tier
IL	Sedge Meadow	32	Third Tier
IL	Seep**	8	Second Tier
IL	Shrub Swamp	2	Not Tiered
IL	Tall Shrub Bog	2	Not Tiered

IL	Wet Dolomite Prairie	1	First Tier
IL	Wet Floodplain Forest	3	Not Tiered
IL	Wet Prairie	13	Not Tiered
IL	Wet Sand Prairie	4	First Tier
IL	Wet-Mesic Dolomite Prairie	4	First Tier
IL	Wet-Mesic Floodplain Forest	2	Not Tiered
IL	Wet-Mesic Prairie	20	Not Tiered
IL	Wet-Mesic Sand Prairie	5	First Tier
IN	Forest-Floodplain Wet	1	Not Tiered
IN	Forest-Floodplain Wet-Mesic	5	Not Tiered
IN	Lake-Lake	2	Not Tiered
IN	Prairie-Sand Wet	8	First Tier
IN	Prairie-Sand Wet Mesic	19	First Tier
IN	Prairie -Wet	2	Not Tiered
IN	Primary-Dune Lake	2	Not Tiered
IN	Wetland-Bog Acid	4	Not Tiered
IN	Wetland-Bog Circumneutral	3	Not Tiered
IN	Wetland -Fen	8	Not Tiered
IN	Wetland-Fen Forested	2	Third Tier
IN	Wetland-Marsh	18	Second Tier
IN	Wetland-Meadow Sedge	6	Third Tier
IN	Wetland-Panne	6	First Tier
IN	Wetland Seep Circumneutral	2	Not Tiered
IN	Wetland-Swamp Shrub	13	Not Tiered

*rated as if it were northern flatwood
**all seeps are marked as forested fen types in IL, so they are given a third tier priority

Fens from the Kane County Advanced Identification of Aquatic Resources (ADID) project were also mapped for this project. Kane County ADID Fen types appear in the table below:

Kane County Fen Types Mapped

Community Type	Count	Tier
Fen	9	Not Tiered
Fen (Forested?)/Calcareous Seep	1	Second Tier
Fen/Woodland Seep	1	Third Tier
Fen Woodland Mosaic	1	Third Tier
Fen/Sedge Meadow	16	Third Tier
Forest Fen Mosaic	2	Third Tier
Graminoid Fen	3	First Tier
Graminoid Fen/Sedge Meadow	1	First Tier
Access Denied*	4	Not Tiered

* These areas are known to be fens from aerial photo interpretation or past experience but the community type could not be assessed during ADID field work because the landowner denied access to field teams.

The Wetland Task Force also decided to include aquatic community status, needs and goals from Chapter 6 of the *Biodiversity Recovery Plan* in the mapping for the Wetland Conservation Strategy Model Development. Lake communities from Chapter 6 of *The Biodiversity Recovery Plan* were mapped for this project if they were included in Table 6.2 as "exceptional" or if they were included in Table 6.3 as "important." The ratings displayed in these tables were based on assessments that utilized data from the Illinois Natural Heritage Database, the Illinois Department of Natural Resources, The Nature Conservancy, the McHenry County ADID Study, and expert opinion. The vision for exceptional lakes is to manage them for maximum aquatic biodiversity. The vision for important lakes is to improve their condition so that they can qualify as exceptional lakes. These lakes were mapped for this project by locating them in the Northeastern Illinois Planning Commission's 1:24,000 scale 1990 land use inventory and then using ArcGIS to locate and map the centroid of each lake as a point. These points were then mapped to show the lake locations.

Tables 6.2 and 6.3 of the Biodiversity recovery plan are reproduced below. Note that the Biodiversity Recovery Plan only deals with lakes and streams in Illinois. Any lake or stream appearing on the Wetland Conservation Strategy Model Development map in Indiana or Wisconsin appears based on information from the Natural Heritage Database of that state.

Table 6.2
Preliminary Assessment Showing Exceptional Lakes

County	Lake Name	No. of Native Fishes	No. of E/T Species
Cook	Wolf Lake	28	5
Lake	Bangs Lake	22	5
Lake	Cedar Lake	27	9
Lake	Cross Lake	>14*	5
Lake	Deep Lake	18	5

Lake	Deer Lake-Red Wing Slough	>14*	1
Lake	East Loon Lake	23	5
Lake	Fourth Lake	>14*	2
Lake	Gray's Lake	15	2
Lake	Timber Lake	>14*	1
Lake	Lake Catherine	21	1
Lake	West Loon Lake	23	8
Lake	Mud Lake	>14*	1
Lake	Petite Lake	17	1
Lake	Sullivan Lake	>14*	2
Lake	Sun Lake	>14*	1
Lake	Turner Lake	22	1
Lake	Wooster Lake	>14*	3
McHenry	Crystal Lake	23	2
McHenry	Elizabeth Lake	19	6
McHenry	Lake Defiance	18	1
McHenry	Lake Killarney	19	2
McHenry	Lily Lake	16	2
*For these lakes, data on number of native fishes was not available, but experts at the workshop expect high native fish diversity based on overall lake condition.			

Table 6.3
Preliminary Assessment Showing Important Lakes

County	Lake Name	No. of Native Fishes
Cook	Axehead Lake	14
Cook	Beck Lake	16
Cook	Busse Woods Lake	22
Cook	Maple Lake	15
Cook	Marquette Park Lagoon	16
Cook	Midlothian Reservoir	15
Cook	Tampier Lake	18
DuPage	Mallard Lake	18
DuPage	Pickerel Lake	18
DuPage	Silver Lake	18
Lake	Channel Lake	22
Lake	Diamond Lake	20
Lake	Fox/Nippersink	23
Lake	Gages Lake	22
Lake	Lake Marie	22
Lake	Lake Zurich	22
Lake	Long Lake	21
Lake	Old School Pond 2	20
Lake	Pistakee Lake	18

Lake	Sand Lake	14
Lake	Sterling Lake	25
McHenry	Griswold Lake	18
McHenry	Lac Louette	16
Will	Braidwood Lake	38
Will	Lake Milliken	19

Rivers and streams highlighted in Chapter 6, Figure 6.1 of *The Biodiversity Recovery Plan* were also mapped for this project according to their classification status as candidates for protection, restoration, rehabilitation, or enhancement. Definitions of these terms as they are used in the biodiversity recovery plan appear below (note: only streams in Cook, Kane, Lake, McHenry, Will and DuPage Counties in Illinois were prioritized in the *Biodiversity Recovery Plan* so prioritization refers only to those portions occurring in Illinois):

Stream Status Definitions

Status	Definition
Protection	Very high priority; the stream or stream segment has an Index of Biotic Integrity (IBI) score of 51-60 or contains a species or feature or special concern
Restoration	High priority; the stream or stream segment has an IBI of 41-50
Rehabilitation	The stream or stream segment has an IBI of 31-40
Enhancement	The stream or stream segment has an IBI < 31

Streams were mapped using the National Hydrography dataset and selecting and mapping the streams listed in Table 6.1 of *The Biodiversity Recovery Plan* from this dataset. The table below lists the streams highlighted in Table 6.1 of the Biodiversity Recovery Plan and mapped for this project. Note that the streams listed in Table 6.1 and mapped for this project do not include all streams in the six county area, just known examples of streams in each category.

Examples of Streams in Each Category

Status	Stream
Protection	Baker Creek
Protection	Big Rock Creek
Protection	Blackberry Creek
Protection	Coon Creek
Protection	Forked Creek
Protection	Fox River
Protection	Hickory Creek
Protection	Horse Creek
Protection	Kankakee River

Protection	Kishwaukee River
Protection	Manhattan Creek
Protection	Nippersink Creek
Protection	Pike Creek
Protection	Piscasaw Creek
Protection	Rock Creek
Protection	Rush Creek
Protection	Tyler Creek
Protection	Trim Creek

Status	**Stream**
Restoration	Black Walnut Creek
Restoration	Boone Creek
Restoration	Crystal Creek
Restoration	Lower West Branch DuPage River
Restoration	Ferson Creek (Ferson-Otter mapped)
Restoration	Hollenbeck Creek
Restoration	Jackson Creek
Restoration	Mill Creek (Fox)
Restoration	Plum Creek
Restoration	Prairie Creek
Restoration	Rob Roy Creek
Restoration	Stony Creek (Fox)
Restoration	Upper Des Plaines River

Status	**Stream**
Rehabilitation	Brewster Creek
Rehabilitation	Butterfield Creek
Rehabilitation	Calumet River
Rehabilitation	Cotton Creek
Rehabilitation	Deer Creek
Rehabilitation	Lower Des Plaines River
Rehabilitation	Dutch Creek
Rehabilitation	East Branch DuPage River
Rehabilitation	Ferry Creek
Rehabilitation	Flint Creek
Rehabilitation	Klein Creek
Rehabilitation	Lily Catche Creek
Rehabilitation	Little Rock Creek
Rehabilitation	Marley Creek
Rehabilitation	Mill Creek
Rehabilitation	Mokeler Creek
Rehabilitation	Norton Branch
Rehabilitation	Poplar Creek
Rehabilitation	Raynes Creek

Rehabilitation	Sawmill Creek
Rehabilitation	Spring Brook
Rehabilitation	Upper West Branch DuPage River
Rehabilitation	Waubonsee Creek
Rehabilitation	Welch Creek

Status	**Stream**
Enhancement	Addison Creek
Enhancement	Bull Creek
Enhancement	Cal-Sag Channel
Enhancement	Chicago River
Enhancement	Chicago Sanitary and Ship Canal
Enhancement	Flag Creek
Enhancement	Grant Creek
Enhancement	Indian Creek (Des Plaines)
Enhancement	Indian Creek (Kane Co.)
Enhancement	Little Calumet River
Enhancement	McDonald Creek
Enhancement	Midlothian Creek
Enhancement	North Branch Chicago River
Enhancement	North Creek
Enhancement	North Shore Channel
Enhancement	Rock Run
Enhancement	South Branch Chicago River
Enhancement	Salt Creek
Enhancement	Sequoit Creek
Enhancement	Silver Creek
Enhancement	Skokie River
Enhancement	Squaw Creek
Enhancement	Stony Creek (Des Plaines) – Not found; not mapped
Enhancement	Sugar Run
Enhancement	Thorn Creek
Enhancement	Tinley Creek
Enhancement	West Fork North Branch Chicago River
Enhancement	Willow Creek

Appendix D: Restoration Model

Hydric soils are soils that developed under wet conditions, and hydric soils that are not currently associated with wetlands can be used to indicate where wetlands were in the past and where opportunities to restore wetland communities may currently exist.

"Wetland restoration is generally more feasible than wetland creation: Find a site where wetlands previously existed or where nearby wetlands still exist. In an area such as this, the proper substrate may be present, seed sources may be on the site or nearby, and the appropriate hydrologic conditions may exist." (Mitsch and Gosselink 2000)

In order to highlight areas thought to have a high potential for restoration, a wetland restoration model was created for the Wetland Conservation Strategy Model Development project. This restoration model highlights areas of hydric soil that are not currently wetland, focusing on hydric soil outside of wetlands in agricultural areas and in "vacant" areas. Agricultural and vacant areas were chosen because both these land use types have a relatively high likelihood of being available in the future as potential open space and may constitute areas where opportunity exists for wetland restoration. In addition land currently used for agriculture tends to be available in large parcels offering opportunities for restoration of large wetlands or for restoring additional wetlands nearby in the future.

Because the restoration model was dependent on the availability of detailed hydric soils data in digital format, (NRCS SURRGO data) the restoration model only covers those counties for which SURRGO data was available as of August 2004. This included Walworth, Racine and Kenosha Counties in Wisconsin, McHenry, Lake, Kane, DuPage, and Will Counties in Illinois, and Porter and LaPorte Counties in Indiana. Cook County, Illinois and Lake County, Indiana are excluded from the model because no SURRGO digital soils layers were available for them.

Layers:

Hydric Soil
National wetlands inventory wetlands and Wisconsin wetland inventory wetlands were unioned with SSURGO hydric soils and a dataset was created that included only hydric soil that occurs outside of the boundaries of National Wetland Inventory and Wisconsin Wetland Inventory wetlands. This layer was then converted to raster with a 30 meter cell size and areas of hydric soil outside of wetlands were scored as 10 and all other cells were scored zero.

Agricultural Land
Agricultural land was selected from land cover datasets from Wisconsin, Illinois and Indiana. The classes considered "agricultural" from each of these datasets are detailed below:

Land Cover Classes Considered to be Agricultural

General Landcover Type	WI Classes	IL Classes	IN Classes
Agriculture	111: Herbaceous/Field Crops 112: Agriculture , Row Crop 113: Agriculture, Corn 118: Agriculture, Other Row Crop 240: Barren Land	33: Agriculture-Mixed Uses 35: Agriculture-Corn 36: Agriculture-Small Grains 37: Agriculture-Soy Beans 39: Agriculture-Winter Wheat	6: Row Crop

Vacant Land

"Vacant" land use types were then selected from SEWRPC's 1:24,000 1990 land use inventory, the USGS 1:250,000 land use inventory for Indiana, and Northeastern Illinois Planning Commission's 1:24,000 1995 land use inventory. The classes considered "vacant" are detailed below:

Land Use Classes Considered to be Vacant

Land use type	WI Classes	IL Classes	IN Classes
Vacant	922: Openlands, rural, unused 921: Openlands, urban, unused 440: Openlands, woodlands 441: Railroad right-of- ways 441F: Railroad right-of-ways woodland	4110: Vacant Forested and Grassland 3220: Abandoned right-of-way (usually railroad)	77: Mixed Barren Land 41: Deciduous Forest Land 42: Evergreen Forest Land 43: Mixed Forest Land

The agricultural and vacant land use shapefiles were then converted to raster layers with 30 meter grid cells with areas of agricultural and vacant land scored as 10 and all other cells scored as zero. Then these raster layers were combined with the raster layer of hydric soils outside of wetlands by using Spatial Analyst's Cell Statistics to add the layers together (using the SUM function). Then all cells scoring 20 (meaning they were both in hydric soil and outside of wetlands *and* they were in a land use that was vacant or agricultural) were displayed as areas with high restoration potential.

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