University of Illinois
Institute of Natural Resource Sustainability
William Shilts, Executive Director

ILLINOIS NATURAL HISTORY SURVEY
Brian D. Anderson, Director
1816 South Oak Street
Champaign, IL 61820
217-333-6830

Development of a Natural Areas Integrity and Restorability Index and Application to Lands of the Chicago Region.

By Diane L. Szafoni, Chad Hickman,
Brian D. Anderson and Tari A. Tweddale

INHS Technical Report 2011 (13)

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ILLINOIS NATURAL HISTORY SURVEY

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Part 1 – GIS Analysis

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2 Executive Summary

This project was conceived during the Rapid Implementation Phase of the Illinois Natural Areas Inventory (INAI) project. A series of workshops were held where county Conservation District (CD) and Forest Preserve District (FPD) staff from Northeastern Illinois participated. Staff at these agencies expressed the belief that, due to the rapid pace of development, few new areas will be found in the Chicago Region that can meet the standards of the Illinois Natural Areas Inventory. They expressed a need for identification of lands that have the capacity to be restored to natural area quality using modern restoration techniques, and also that occur in a landscape context that will allow them to be viable over the long-term once restored. They argued that this process should be conducted by an independent, objective, scientific team and be endorsed by the State of Illinois to ensure acceptance by their boards and their communities. The county CD and FPD staff also reiterated the necessity of identifying this "next tier" of lands worthy of public investment before most of these opportunities are lost.

The goal of this project was to identify a series of landscape-scale characteristics related to biotic and landscape integrity that could be used to quickly identify potential areas for protection. "Landscape Integrity Criteria" were used to identify data to perform a Geographic Information System (GIS) analysis of undeveloped lands in the Chicago Region. This GIS analysis identified lands that, if restored, have the potential for long-term ecological integrity. These landscape integrity and restorability criteria were aligned with the qualifying size criteria for registration of lands as Illinois Land and Water Reserves (a state designation resulting in protections almost as strong as Illinois Nature Preserve Dedication), to identify "large grade C's" that could currently qualify or be restored to qualify for designation as Land and Water Reserves. Smaller areas of undeveloped land of other community types were included if adjacent to larger qualifying parcels for the purposes of building a "connected system of conservation lands. This analysis provides a score that is used in a ranking system, developed in conjunction with INHS Scientists, to establish a hierarchical assessment of the intrinsic capacity of landscapes to sustainably support native flora and fauna with restoration.

A "Restorability Index" was also developed that would allow the analysis of the relative potential for restoration of undeveloped lands on a case by case basis. Armed with the "Inventory of Landscapes of Ecological Importance" and the "Restorability Index," land managers can identify opportunities and priorities for large-scale restoration in the context of their unique management and restoration capacities.

There has been some early interest in the products of this study. The scope and methods of this project was discussed with James Anderson, Natural Resource Manager at the Lake County

Forest Preserve and Jesse Elam, Senior Planner at the Chicago Metropolitan Agency for Planning.

3 Introduction

The landscapes of Illinois have changed greatly in the past 200 years. Before European settlement, Illinois was 41% forest, 55% prairie, and the remaining 4% open water and wetlands (Cordle, Szafoni and Greer, 2002). Illinois has lost over 90% of its original wetlands, 99.9% of its original prairie, and 36% of its forest. Much of the conversion of Illinois' land to agriculture was largely complete by the early 1900s. Today, most of the land conversion in Illinois is due to expanding urban areas (IDNR, 1996). McGrath (2005) calculated the total urban land areas for major cities in the United States, and found that Chicago increased in size from 708 square miles in 1950, to 960 square miles in 1960, 1,277 square miles by 1970, 1,498 square miles by 1980 and 1,585 square miles by 1990. This more than doubled the urban area (an increase of 877 square miles) in 40 years.

Illinois' population grew from 55,211 in 1820 (just after statehood in 1818) to 12,419,293 in 2000 (U.S. Census Bureau, 2000). The ten year period from 1990 – 2000 saw 8.6% increase in Illinois' population. Population is projected to increase an additional 8.2% between 2000 and 2030 (U.S. Census Bureau, 2000). Land development has increased even faster than population. The Sierra Club (US Census Bureau data) did a study of urban sprawl and found that Chicago's population increased by one percent from 1970 to 1990, while its urbanized area grew by 24 percent.

The scattered pattern of modern development not only consumes an excessive amount of land, it fragments the landscape. Numerous studies have shown the negative ecological effects of forest fragmentation in the landscape (Wilcox and Murphy, 1985, Robertson et al, 1995). As forest areas are divided and isolated by roads and development, interior habitat decreased. This coupled with increased human disturbance and the spreading of opportunistic edge species results in the populations of many animals become too small to persist.

Besides the negative effect on animal populations through the loss of wildlife habitat and migration corridors, normal ecosystem functions such as absorption of nutrients, recharging of water supplies and replenishment of soil are disturbed or destroyed (Saunders et al., 1991). Water quality has been degraded in many rivers and streams and many of Illinois' remaining wetlands have been altered by filling, drainage and impoundment, livestock grazing, logging, direct discharges of industrial wastes and municipal sewage, and indirect pollution from urban and agricultural runoff.

Today, with urban land continuing to sprawl into the surrounding landscape, there is an even more urgent need to accurately identify and protect the most important unprotected natural lands in the state before they are lost.

The Illinois Department of Natural Resources (IDNR), and Conservation and Forest Preserve Districts have many programs for land acquisition, easements, and other forms of land and resource protection. Timely knowledge of where key lands and corridors are situated would facilitate these processes.

The purpose of this study was to develop a way of assessing the landscape quickly, efficiently and frequently. A spatial analysis using existing statewide digital data and Geographic Information System (GIS) software was used because it met the project goals. Indeed, the use of GIS software and landscape ecology has been a proven tool to aid the locating of remaining areas of ecological significance.

3.1 Past Illinois Studies

3.2 Resource Rich Areas

The IDNR has long recognized the value of a landscape level approach to identify natural resources. Past research, such as the Inventory of Resource Rich Areas (RRA) (Suloway et al., 1996), has evaluated the distribution of recognized ecological resources in Illinois. The Resource Rich Areas report identified and characterized areas rich in biological resources by Illinois Environmental Protection Agency (IEPA) watersheds. A list of ecological characteristics and functions of large ecological reserves, and criteria to identify and evaluate these areas was developed. Eight hundred sixteen watersheds were evaluated using existing data appropriate for GIS analysis. These datasets included: percent of forest and wetlands from the 1995 Critical Trends Assessment Project land cover, total area of Illinois Natural Areas Inventory (INAI) sites, total length of Biologically Significant Streams (BSS), as well as supplemental data such as state and federally owned land, Illinois Nature Preserves, and natural divisions. The four variables of percent forest cover, percent wetland cover, total area of INAI, and total length of BSS were given equal weight. Each watershed was ranked against all other watersheds for each variable. Watersheds were placed into 10% quantiles for each variable and given a score of 10 points for the top quantile, 9 for 81-90% quantile, 8 for 71-80% quantile, etc. Watersheds in which variables did not occur were given a 0 score for that variable. The scores for each variable in each watershed were summed. The maximum possible cumulative score was 40. Watersheds were considered to be rich in resources if their cumulative score ranked in the top 10%. This study, with its watershed -scale analysis was fine as a first attempt to identify important wildlife habitats. However, this process could have been improved by a finer scale analysis of potential sites for protection or restoration, more detailed assessment of landscape variables, and the input of plant and animal scientists. The current project addresses this shortcoming.

3.2.1 Green Infrastructure

Whereas Resource Rich Areas aggregated ecological information at the watershed level, Green Infrastructure looked at all possible blocks of undeveloped land individually (Szafoni, 2006). The components of Green Infrastructure consist of core reserves - large patches of natural vegetation, and corridors connecting the core reserves. The corridors are wide swashes of vegetation that provide corridors for wildlife movement, and connections between the core reserves. Together, the core reserves and corridors represent the most efficient means of connecting the largest and highest natural quality lands remaining in Illinois.

The core reserves or *hub*s are blocks of land that provide living space and areas of origins and destinations for plants and animals. *Links* are the connecting corridors that tie the hubs. These linear remnants of natural land allow plants and animals to move from one hub to another, helping to ensure long-term survival and continued diversity. The hubs and links can range in size, function and ownership, but in order to be successful, they need to be provided long-term protection.

Hubs identified in the proceeding process were next characterized based on the relative importance as potential habitat for wildlife. The ecological parameters used include measures of size such as the area of critical habitat types within the hub, presence of natural communities or of unique natural resources, amount of protected areas, and spatial relationships. Threat parameters include development pressures, remoteness from roads, and road density within the hubs. Weighting factors were applied to the final results and a final rank for each hub was derived. The ranked hubs were divided into 3 natural breaks and the top third was used in the corridor analysis.

All potential corridor types were combined with the creation of forest and wetland layers to assess the quality or cost of using these corridors to move between hubs. A GIS technique called lease-cost path analysis was used to determine the best paths between the top one third of hubs. In this analysis, the ‘cost’ is a measure of the difficulty for wildlife to travel along the corridors. The best corridor is the pathway between two hubs with the fewest obstacles (roads, bridges, and urban areas), and the most favorable habitat (forest, grassland, wetlands), was the least-cost path.

The goal of this study was the creation of a statewide, GIS database of habitat ‘hubs’ and connecting ‘corridors’ that can be used to help identify the important wildlife habitat remaining in Illinois. While this study was a fine first attempt to incorporate more landscape ecology principles, the ranking system employed needed refinement and evaluation by botanists, mammalogists, herpetologists, and ornithologists to better reflect the needs of these species. This weakness has been addressed in the current project.

3.3 Literature Review

Many landscape scale studies use satellite imagery as a way of assessing vegetation canopies at a regional scale (Reinke and Jones, 2006). An early research project that used satellite imagery and GIS for a regional assessment of natural areas was the Maryland Green Infrastructure project (Weber et al. 2006). In this study, large contiguous blocks of natural areas (hubs) and interconnecting natural corridors were identified using satellite imagery, and ranked using GIS software. A variety of digitally available ecological and development risk parameters were used for the assessment. Maryland is currently using the results as a guide for land conservation efforts, and it has been expanded to a multi-state scale for the Chesapeake Bay program.

An evaluation process was developed in many studies to identify potential ecologically significant areas. Several studies champion the idea of 3-level systems of evaluation. Vance (2009), assessing wetlands in Montana, and Faber-Langendeon (2007) at NatureServe used a 3-level system with four categories of data - biotic, abiotic, size, and landscape context. Higgins et al. (2007) also devised a 3-level system of evaluation, but used conservation indicators in three major categories – Biodiversity Status (size, condition, landscape context), Conservation Management Status (intent, tenure, effective management, potential), and Impacts and Threats Status (severity, scope). Tierney et al. (2009) employed a 3-level system of evaluation, using metrics of status and trends in structure (size, snag abundance, percent of stand in late-succession, and amount of coarse woody debris), composition (tree regeneration, condition, biotic homogenization, presence of deer browse and invasive exotic plants), and function (tree growth and mortality rates, soil chemistry – acid stress and nitrogen saturation) in temperate forests in the northeastern United States. Regardless of which metrics are use used to evaluate the landscape, Parkes and Lyon (2006) and Tierney et al. (2009) maintain that it is critical that the landscape-scale assessment used meets state policy and legislative requirements. To that end, they feel it is necessary to set regional targets and evaluate progress.

In this project, we have expanded on the Resource Rich Areas study to include all of the study area, not just select watersheds. We adapted the methods used in the Maryland study (Weber et al. 2008 to Illinois, adding a grassland land cover category to the forest and wetland categories. We evaluated the parameters used in the Maryland study for appropriateness in Illinois, and included additional parameters, if statewide data sets were available. We used three-level system: Ecological, Spatial and Threat parameters. Finally, we had mammalogists, ornithologists, herpetologists, and botanists assess the value of the parameter and suggest weights used in the final ranking.

4 Methods

The study area for this project was Northeastern Illinois (Greater Chicago Region). For purposes of some of the GIS analysis, all of the Illinois, Wisconsin, Indiana, and Michigan watersheds of the Upper Illinois River were included. The Hydrologic Unit Code (HUC) Watersheds (USDA

Natural Resources Conservation Service, 2002) was used for the outline of the study area (Figure 1).

The base land cover data used for this study was the United States Department of Agriculture, National Agricultural Statistics Service (USDA-NASS) Cropland Data Layer (CDL) for 2007 (Figure 2) (USDA, National Agricultural Statistics Service, 2007). The specifications for this data are as follows:

"The USDA, NASS Cropland Data Layer (CDL) is a raster, geo-referenced, crop-specific land cover data layer with a ground resolution of 56 meters. The CDL is produced using satellite imagery from the Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS) collected during the current growing season. Ancillary classification inputs include: the United States Geological Survey (USGS) National Elevation Dataset (NED), the USGS National Land Cover Dataset 2001, and the National Aeronautics and Space Administration (NASA) Moderate Resolution Imaging Spectroradiometer (MODIS) 250 meter 16 day Normalized Difference Vegetation Index (NDVI) composites. Agricultural training and validation data are derived from the Farm Service Agency (FSA) Common Land Unit (CLU) Program. The NLCD 2001 is used as non-agricultural training and validation data" (USDA, National Agricultural Statistics Service, 2007).

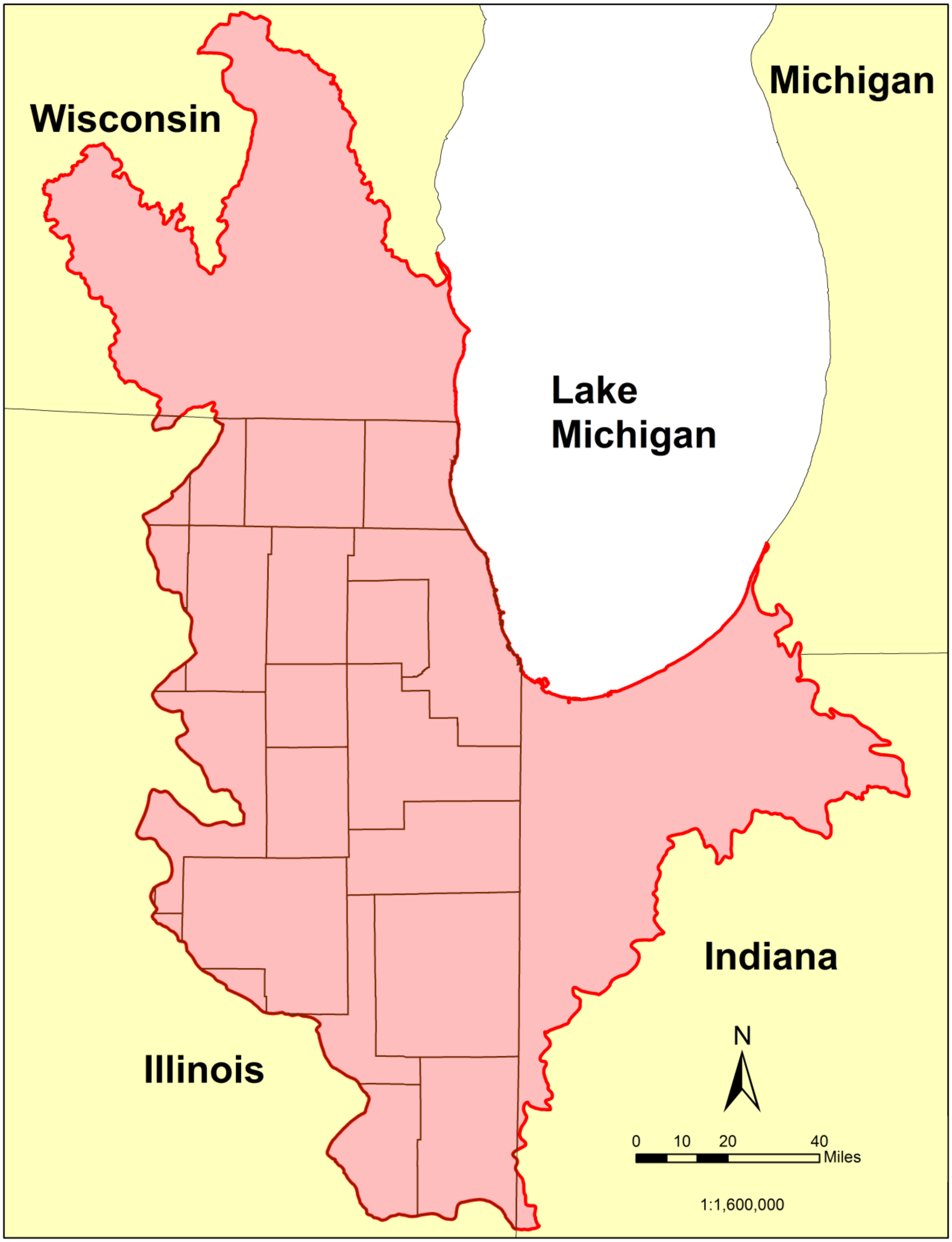


Figure 1. Study area.

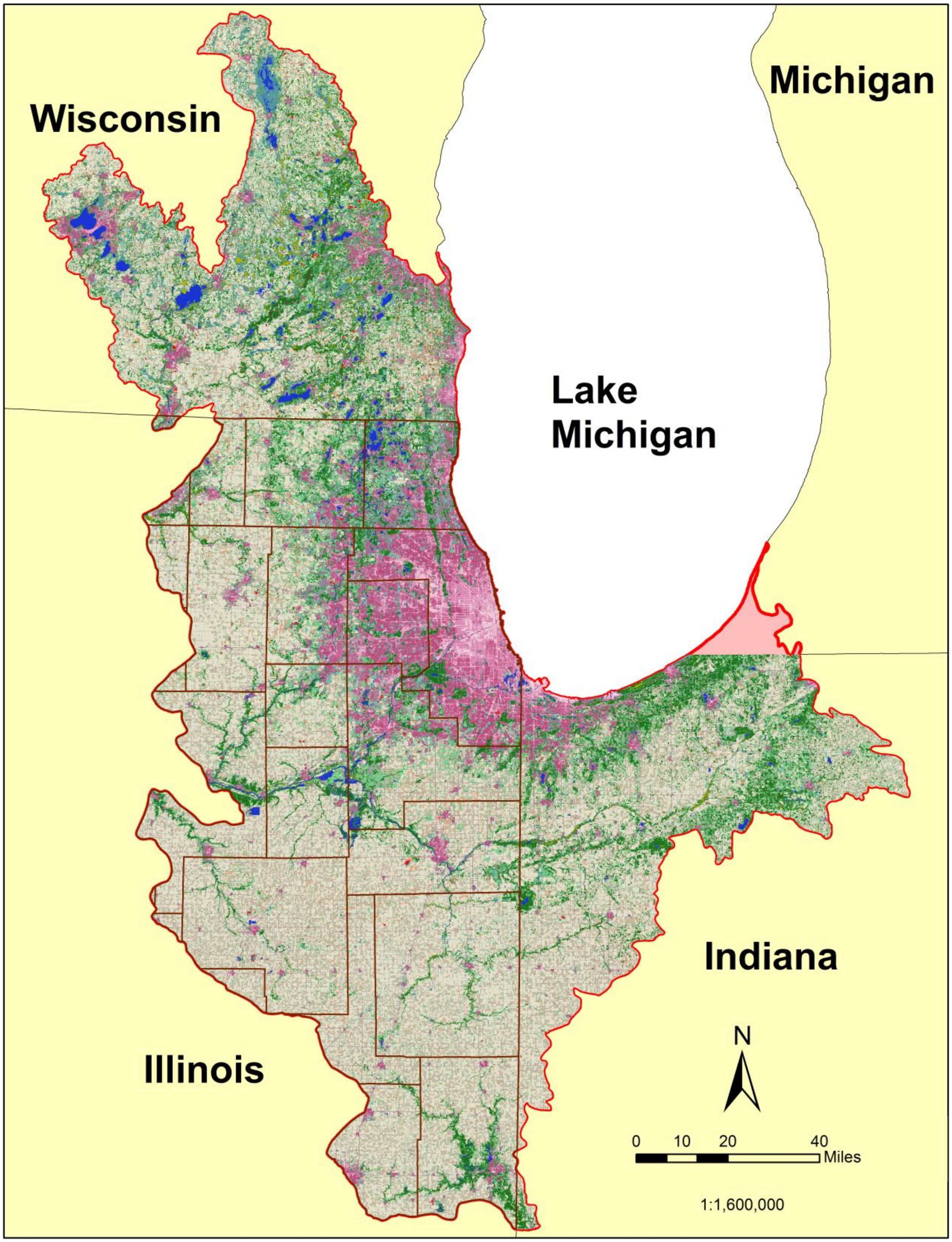


Figure 2. Original USDA-NASS 2007 land cover.

Major roads were buffered from the center lines to the distances appropriate to the road type (Interstates were buffered out to a distance of 30 meters, US and State Highways to 16 meters and County Roads to 12 meters.), and "erased" from the land cover data (NAVTEQ, 2007). This step was done to mask out the vegetation canopy that often hangs over the roads, thereby giving the false illusion of more intact forested tracts.

After removing roads from the NASS-CDL land cover, the Forest, Grassland and Wetland land cover categories were extracted for separate analysis (Table 1).

Forest	**Grassland**	**Wetland**
Min. Size: **100 acres**	**Min. Size:** **80 acres**	**Min. Size:** **50 acres**
63 Woodland	62 Grass/Pasture	87 Wetlands
141 NLCD Deciduous Forest	171 NLCD Grassland Herbaceous	190 NLCD - Woody Wetlands
142 NLCD Evergreen Forest	181 NLCD Pasture/Hay	195 NLCD - Herbaceous Wetlands
143 NLCD Mixed Forest		

Table 1. NASS 2007 Land Cover categories used in the GIS analysis.

Size constraints, based on the criteria for registration as Illinois Land and Water Reserves (1994), were applied to each land cover category: Forest >= 100 acres, Grassland >= 80 acres, Wetland >= 50 acres (Land and Water Reserve, 1994). Figures 3-5 shows the extent of each land cover category that remained.

Figure 3. Forests at least 100 acres in size.

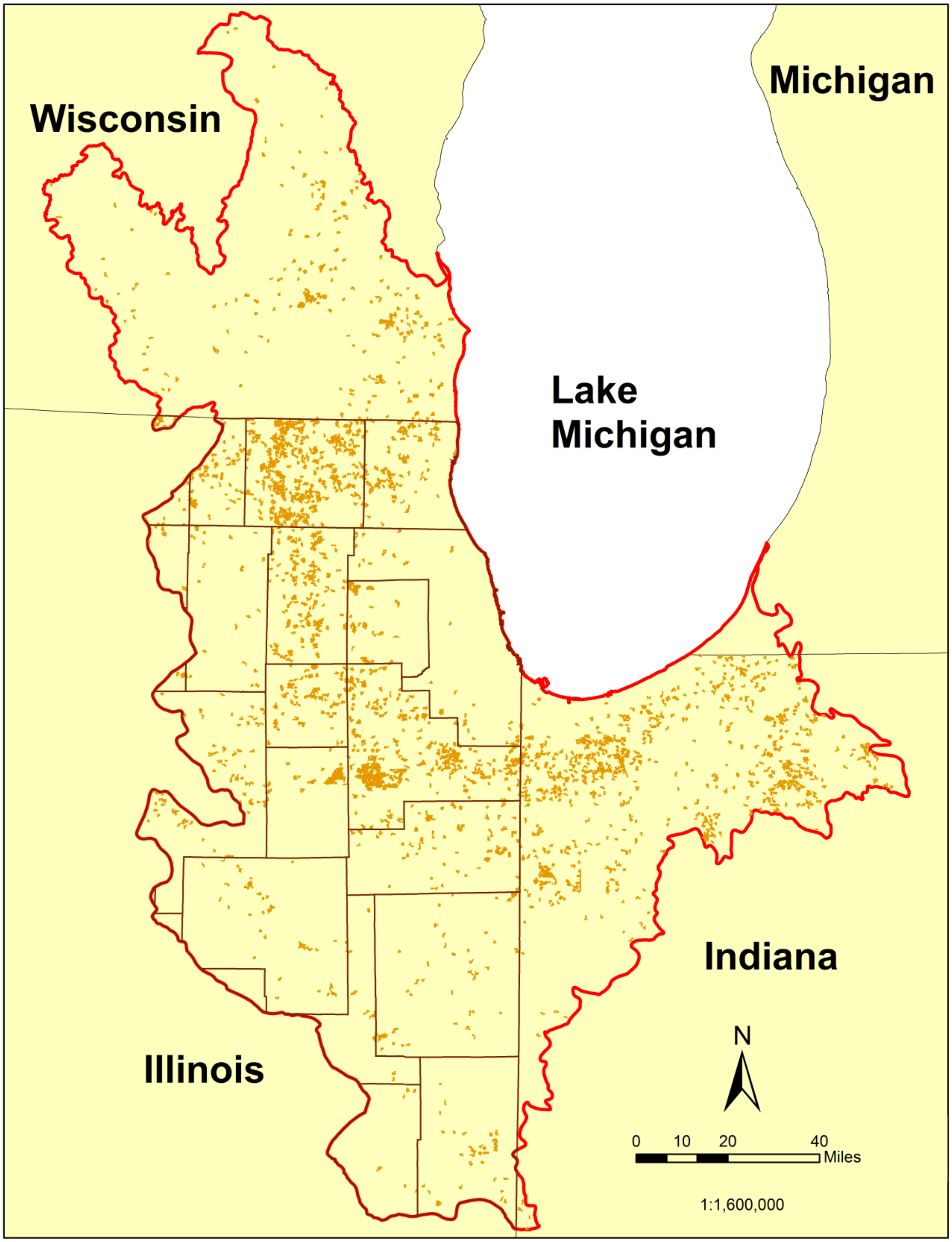


Figure 4. Grasslands at least 80 acres in size.

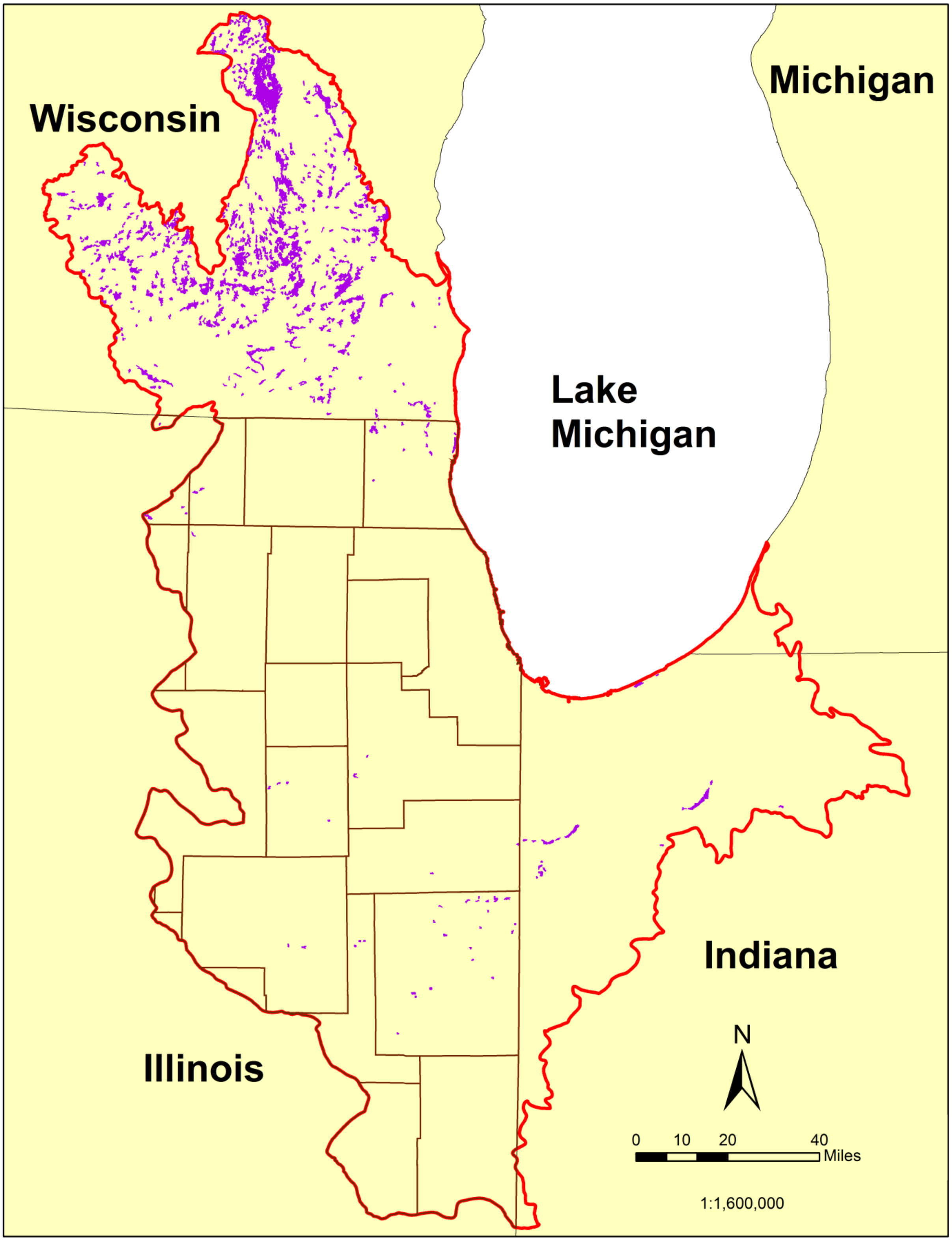


Figure 5. Wetlands at least 50 acres in size.

After selecting the desired land cover categories and applying the size constraints, the resulting Forest, Grassland, and Wetland tracts were evaluated for Landscape Integrity using a suite of data layers and ArcGIS software (ESRI, 2009). The data layers are grouped into Ecological Parameters, Spatial Parameters, and Threat Parameters (Table 2) employing a 3 tier analysis as previously discussed. The parameters chosen were those available as statewide GIS data sets. The ecological parameters used include presence of various ecological quality indicators such as natural communities, amount of protected areas, and presence of unique natural resources. The spatial parameters used include measures of the shape of the area, amount of interior gap or "holes" of different land cover types, and nearness to tracts of similar type. The threat parameters used include development pressures, such as amount of road density, remoteness from roads, and adjacency to agricultural and urban areas.

Type	Source	Date	Cell Size/ Resolution	Source Data
Ecological				
Area of (various) Land Use Category	USDA, National Agricultural Statistics Service 2007 Illinois Cropland Data Layer (CDL)	2007	56 meter	Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS)
Area of Threatened and Endangered Species[1]	Threatened and Endangered Species, Rare Communities, and Valuable Natural Resources of Illinois, Edition 2.0	2009	1:24,000	Illinois Department of Natural Resources, Natural Heritage Database Program
Area of Public Land[1]	Illinois Natural History Survey's 1:100,000 Scale Illinois Gap Analysis Stewardship Layer	2003	1:100 000	Illinois Natural History Survey
Area of Nature Preserves – IDNR (forest and grassland only)[1]	Nature Preserves, Land and Water Reserves, and Natural Heritage Landmarks in Illinois	2009	1:24,000	Illinois Department of Natural Resources, Natural Heritage Database Program
Area of Railroad Prairie Remnant (grassland only)[1]	Prairie Remnants for the Illinois Dept. of Transportation, based on U.S. Geological Survey 1:100,000 Digital Line Graph file, railroad layer	2004	1:100,000	Illinois Natural History Survey, from U.S. Geological Survey railroad data

Type	Source	Date	Cell Size/ Resolution	Source Data
Area of Appropriate Soil (grassland = prairie, forest = forest, wetland = hydric)[1]	SSURGO Soils in Illinois	2007	1:12,000	U.S. Dept. of Agriculture, Natural Resources Conservation Services
Area of Interior Forest (forest only)[1]	USDA, National Agricultural Statistics Service 2007 Illinois Cropland Data Layer (CDL)	2007	56 meter	Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS)
Area of Flood Zones (wetland only) [1]	Illinois State Water Survey (ISWS) – digitized from FEMA FIRM maps	1996	1:6,000 to 1:24,000	Illinois 100-year and 500-year floodzones
Length of Stream Width BSC Diversity ranking[2]	Integrating Multiple Taxa in a Biological Stream Rating System – Diversity component	1997-2006	1:100,000	Illinois Natural History Survey, from U.S. Geological Survey data
Number of Stream Sources and Junctions (wetland only)[2]	National Hydrography Dataset (NHD) Flowline – Medium-resolution (based on Digital Line Graph Data (DLG)	1999 (1994)	1:100,000	U.S. Geological Survey in cooperation with the U.S. Environmental Protection Agency
Illinois GAP Predicted Species Distributions for Bird and Herps (Reptile and Amphibian) Species in Greatest Need of Conservation (SGNC)[3]	Illinois Natural History Survey's 30m x 30m Amphibian, Bird, Reptile Predicted Species Distribution Models.	2003	30 meter	Illinois Natural History Survey
Spatial				
Proportion of Interior gap (holes) in area[1]	USDA, National Agricultural Statistics Service 2007 Illinois Cropland Data Layer (CDL)	2007	56 meter	Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS)
Patch Shape – used V-LATE software[4]	Vector-based Landscape Analysis Tools Extension (V-LATE) 1.1 for ArcGIS 9.x	2005	N/A	Centre for Geoinformatics (Z_GIS) at Salzburg University
Nearness to Area with same Land Cover Type (nearest neighbor) – used V-LATE software[2]	USDA, National Agricultural Statistics Service 2007 Illinois Cropland Data Layer (CDL)	2007	56 meter	Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS)

Type	Source	Date	Cell Size/ Resolution	Source Data
Threat				
Remoteness from Roads within 1 mile (1609 meters) - NAVTEQ[2]	NAVTEQ's NAVSTREET Street Data	2007	5 meter	NAVTEQ, 425 W. Randolph St., Chicago, IL 60606
Road Density - NAVTEQ	NAVTEQ's NAVSTREET Street Data	2007	5 meter	NAVTEQ, 425 W. Randolph St., Chicago, IL 60606
Proximity to Urban Area[2]	USDA, National Agricultural Statistics Service 2007 Illinois Cropland Data Layer (CDL)	2007	56 meter	Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS)
Adjacent to Agriculture (wetlands only - buffer distance for forest and forested wetlands = 275ft, 550ft, 1100ft, all other land use categories = 162ft, 325ft, 650ft[2]	USDA, National Agricultural Statistics Service 2007 Illinois Cropland Data Layer	2007	56 meter	Indian Remote Sensing RESOURCESAT-1 (IRS-P6) Advanced Wide Field Sensor (AWiFS)

Table 2. List of GIS data layers used for analysis. [1]units = acres, [2]units = meters, [3]units = richness, [4] = index.

The individual parameters for each land cover type were reviewed and weighted by six INHS ecologists covering a broad range of disciplines. The scientist's indicated if the parameter was worth keeping, and suggested a weight to apply. The parameter remained if more than half of the scientists voted to keep it. Once a parameter was selected, the average of the suggested weight was calculated to determine a final weight. The parameter choices and weights are listed in Tables 3–5.

Forest Parameters	INHS Scientists Retain (yes)	INHS Scientist Retain (no)	Weight (average)
Ecological			
Total area of forest	4	2	3
Area of T & E species	6	0	3
Area of public land	4	2	2
Area of nature preserves	5	1	2
Area of forest soils	4	2	2
Area of interior forest	6	0	4
Stream length BSC Diversity	4	2	2
SGNC bird species	5	1	2
SGNC herp species	6	0	3
Spatial			
Proportion of interior gap area in hub	5	1	3

Forest Parameters	INHS Scientists Retain (yes)	INHS Scientist Retain (no)	Weight (average)
Patch shape	4	2	2
Proximity to other forest tracts (nearest neighbor)	6	0	3
Threats			
Remoteness from roads	4	2	2
Road density	6	0	3
Proximity to urban area	4	2	3

Table 3. Forest parameters and weights used in the analysis.

Grassland Parameters	INHS Scientists Retain (yes)	INHS Scientist Retain (no)	Weight (average)
Ecological			
Total area of grassland	5	1	4
Area of T & E species	6	0	3
Area of public land	4	2	2
Area of nature preserves	4	2	2
Area of prairie soils	5	1	2
Area of railroad prairie remnant	6	0	3
Stream length BSC Diversity	6	0	3
SGNC bird species	6	0	4
SGNC herp species	5	1	3
Spatial			
Proportion of interior gap area in hub	5	1	3
Patch shape	5	1	3
Proximity to other forest tracts (nearest neighbor)	4	2	2
Threats			
Remoteness from roads	4	2	2
Road density	6	0	2
Proximity to urban area	4	2	2

Table 4. Grassland parameters and weights used in the analysis.

Wetland Parameters	INHS Scientists Retain (yes)	INHS Scientist Retain (no)	Weight (average)
Ecological			
Total area of wetland	6	0	4
Area of T & E species	5	1	2
Area of public land	4	2	2
Length of headwater streams within wetland	2	4	1
Area of flood zone	5	1	2
Area of hydric soils	5	1	3
Stream Length BSC Diversity	5	1	3
SGNC bird species	6	0	3
SGNC herp species	6	0	3
Spatial			
Proportion of interior gap area in hub	5	1	3
Patch shape	4	2	2
Proximity to other forest tracts (nearest neighbor)	5	1	2
Threats			
Remoteness from roads	5	1	3
Road density	6	0	3
Proximity to urban area	4	2	3
Adjacent to agriculture	4	2	2

Table 5. Wetland parameters and weights used in the analysis.

Parameters overlaid with the land cover are Threatened and Endangered Species, Public lands, Nature Preserves, Railroad prairie remnants (grassland only), Soils, Interior forest (forest only), Flood Zones (wetland only), Proximity to Urban Areas, and Adjacency to Agriculture (wetland only), Length of BSC Streams, Number of Stream Sources and Junctions (wetland only), SGNC Birds and Herps (Reptiles and Amphibians) – see Appendix I for a complete species list, Remoteness from Roads, and Road density. The Vector-based Landscape Analysis Tools Extension for ArcGIS software (V-LATE, 2005) was used to calculate patch shape and distance to the same land cover type - nearest neighbor. Detailed steps on the analyses for all parameters can be viewed in Appendix II. Pearson's Correlation Coefficient, which measures the degree of association between two variables, was calculated for all parameters.

The final, weighted parameters were combined (ecological + spatial – threats) for each of the land cover categories (Forest, Grassland, and Wetland) to derive a final rank. To avoid double or triple counting, only the first instance of the Proximity to Urban Areas and Adjacency to Agriculture were used in the final tally. The results were divided into three groups (High, Medium and Low) using the Natural Breaks function in ArcGIS.

Finally, all the areas of ranked Forest, Grassland, and Wetland land cover categories were combined to create a mosaic of the 3 land cover types. The original land cover data was examined to identify any neighboring Forest, Grassland, or Wetland areas that did not meet the initial size restraints. If these areas touched the mosaics, they were added. For example, a 150 acre forest and 50 acre grassland were combined in the mosaic and a 10 acre forest that neighbors 50 acre grassland is added to the mosaic. This gives a more complete picture of the surrounding landscape and includes areas animals may use if they can 'cross' the grassland.

5 Results and Discussion

The Forest, Grassland, and Wetland tracts were ranked within their land cover categories to give a sense of how each area compared to another. Each parameter was assigned an importance weight based on the advice of INHS scientists and the literature (Tables 3-5). This was also necessary as there were slight differences in parameter types used for each land cover type. The individual, weighted parameters for each area were then added together (for ecological and spatial parameters) or subtracted (for threat parameters). Details on all steps of the analyses are in Appendix II. Maps of the results of these individual calculations are shown in Appendix III. Figures 6-9 shows the final 3 rankings for each of the land cover types.

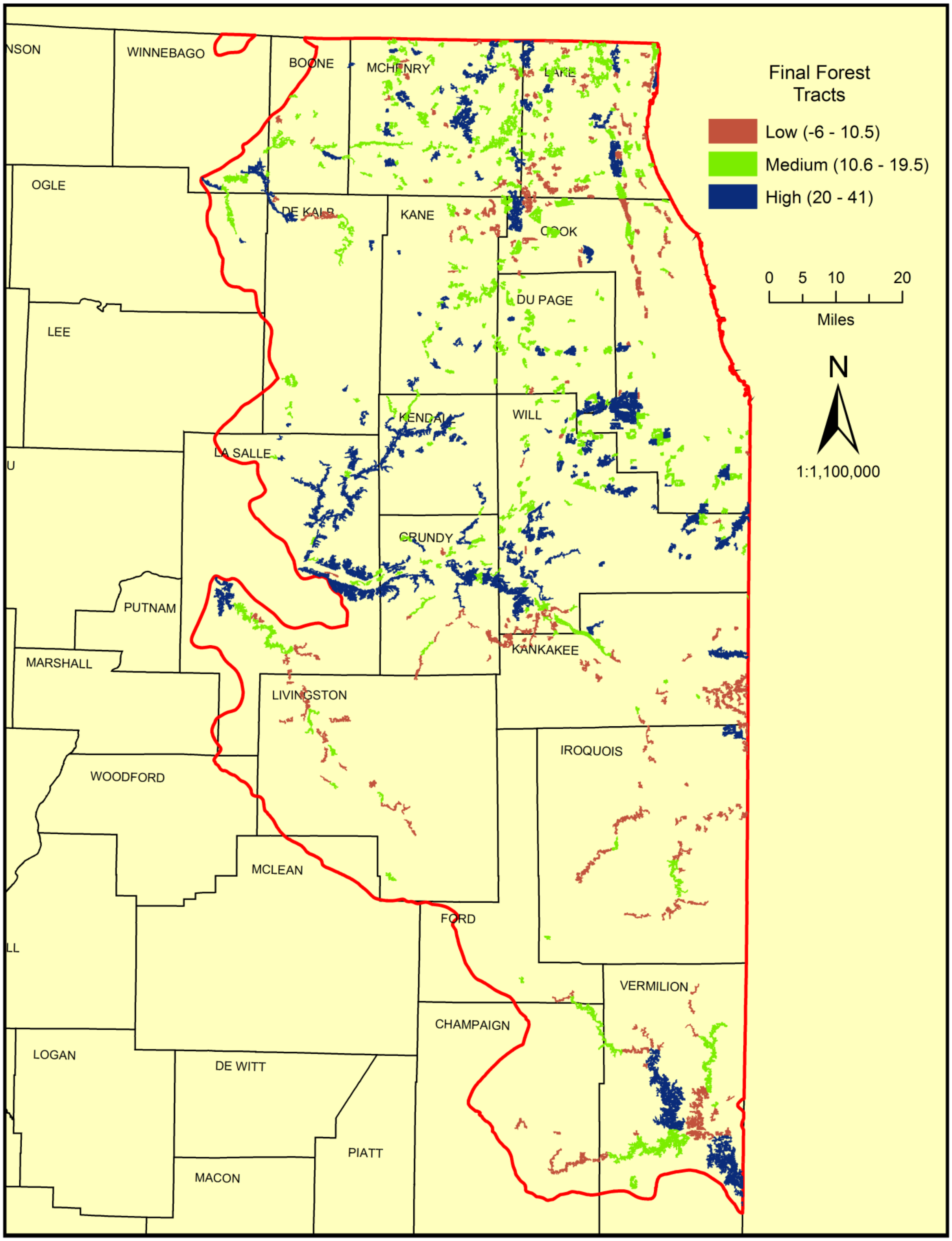


Figure 6. Final Forest rankings

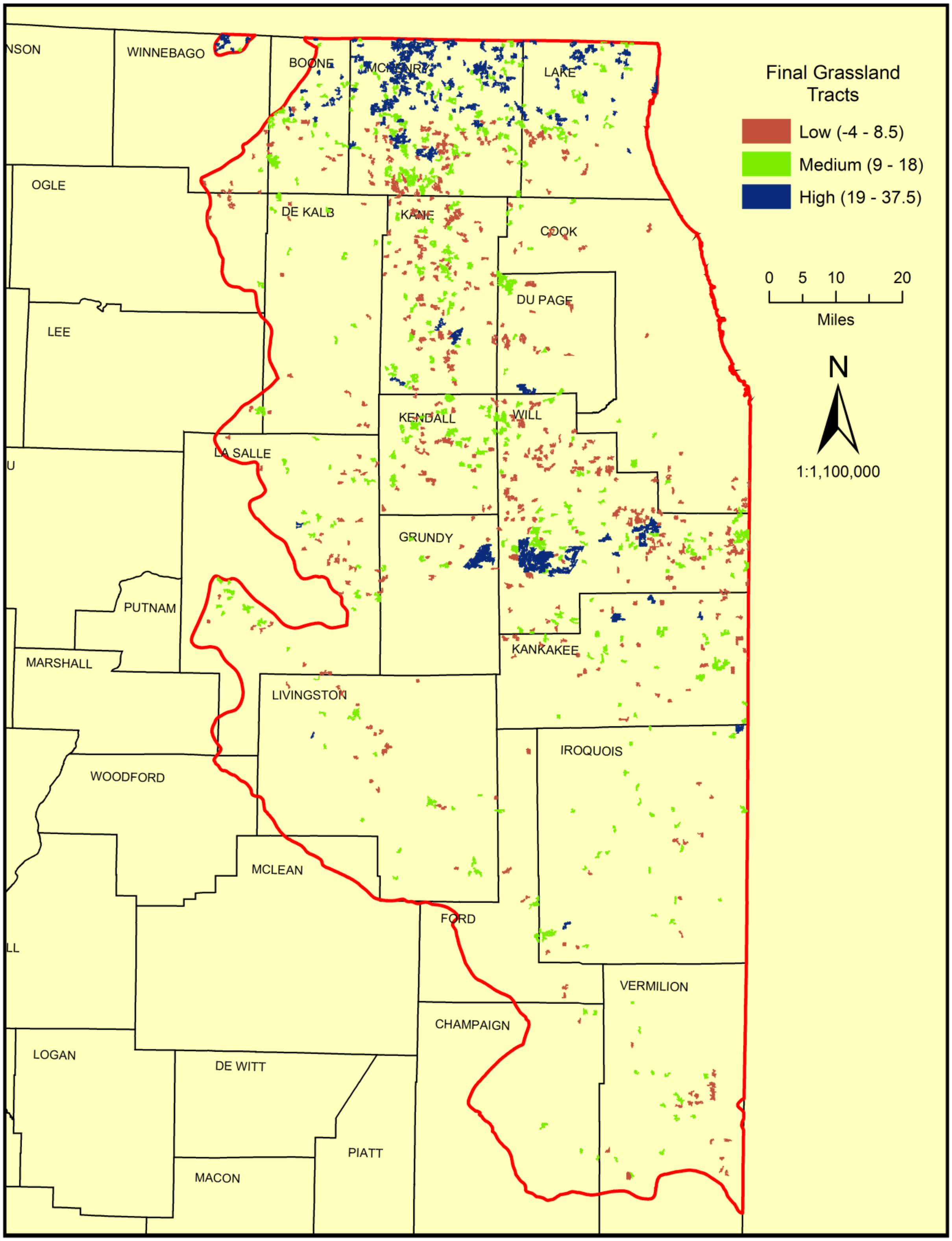


Figure 7. Final Grassland rankings.

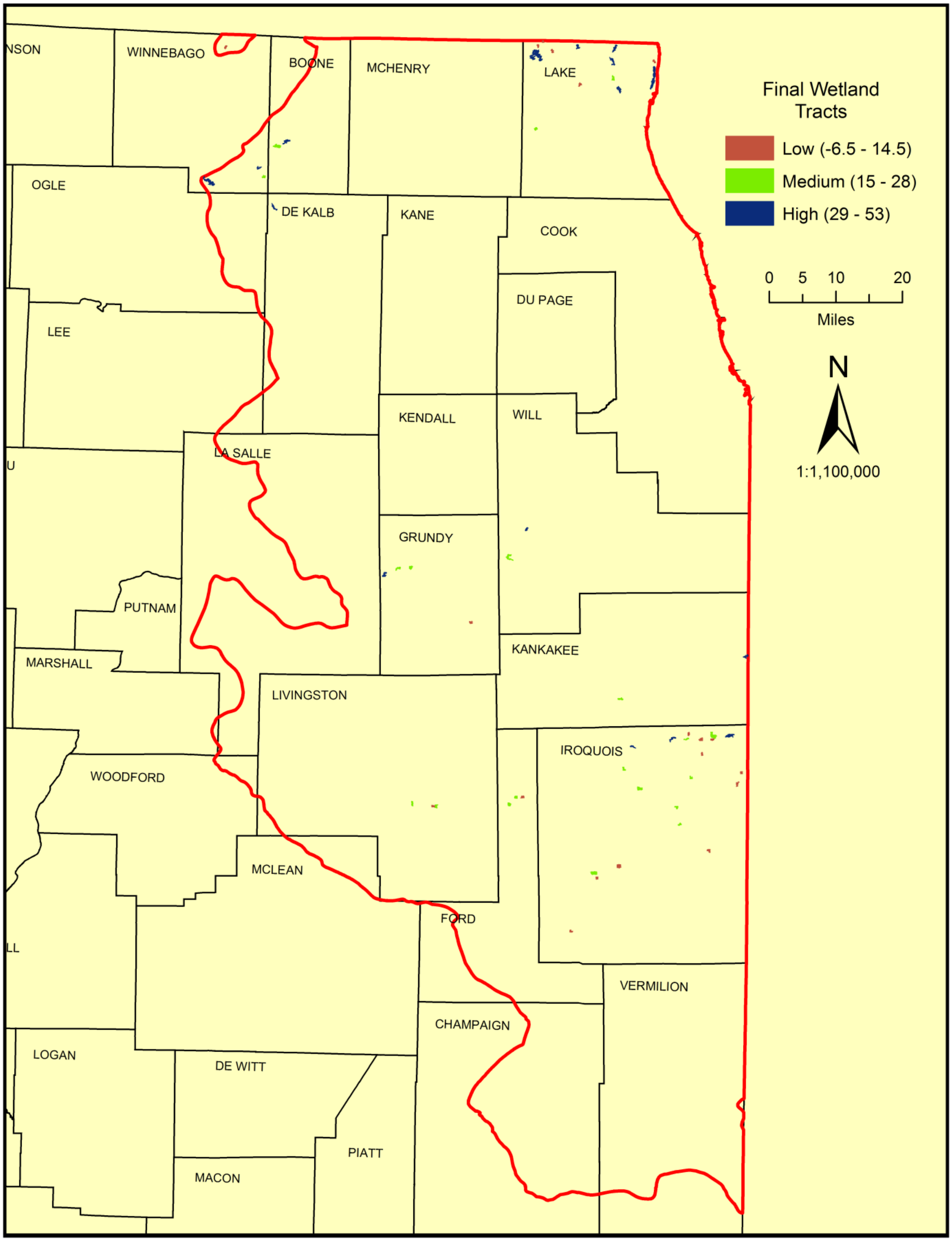


Figure 8. Final Wetland rankings.

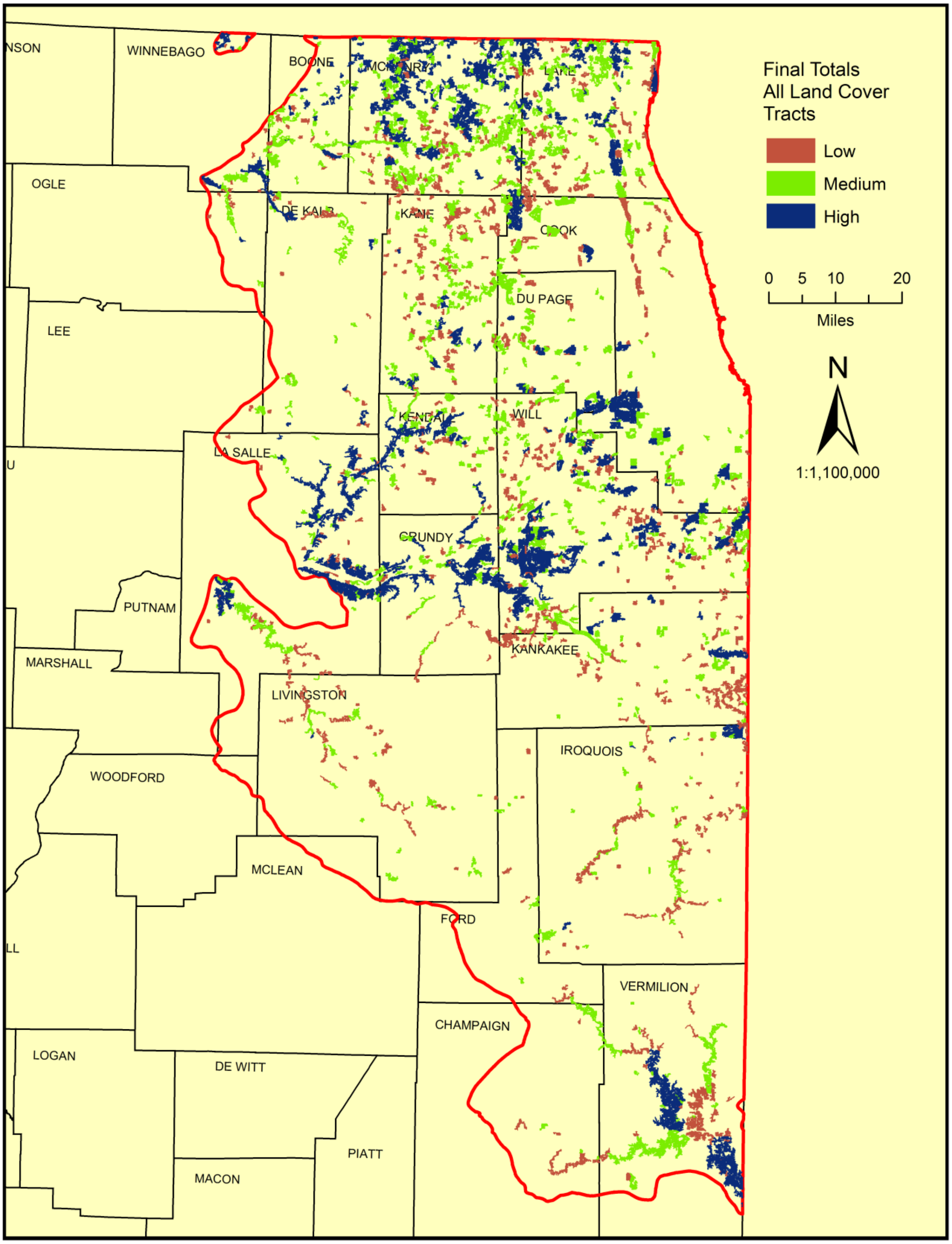


Figure 9. All Land Cover final rankings.

Pearson's Correlation Coefficient analysis was calculated for the parameters in the Forest, Grassland, and Wetlands categories to test for parameters looking at the same thing (strong correlation). Several highly correlated parameters were dropped after the Pearson test was performed. The results of this analysis and the parameters retained are listed in Tables 6-8. Correlation coefficient values greater than 0.8 (positively correlated), or less than –0.8 (inversely correlated) were considered strong correlation and are indicated in gray in the tables. Less than 20% of the parameters were highly correlated (> 80%). A few of the highly correlated parameters were retained and are explained in more detail below.

For Forest, total area and proportion of interior gap were strongly correlated. This can be explained by the fact that the larger the area, the greater the likelihood of interior gaps, so both were retained. Remoteness from Roads (1 mile) and Road Density and Proximity to Urban (275 feet) were also correlated. This is to be expected, as the number of roads increases with urban density, so all three were retained. The correlation between Road Density and Presence of Forest Soil is hard to explain and appears to be an anomaly, so both were retained.

Wetland parameters were strongly correlated for the presence of Threatened and Endangered Species and Public land. Since most of the known locations for Threatened and Endangered Species are on public land, a strong correlation is justified and both were retained. As expected, there was a strong correlation between the Presence of Hydric Soil and Flood Zones. The Flood Zones are found primarily along streams in Illinois, and can remain underwater for long periods of time. The wetland tracts, like grasslands, show a strong correlation for SGNC Birds and Herps. The acreage of Grassland and Wetlands in Illinois are small, much smaller than that for Forests. It is to be expected that the "Species in Greatest Need of Conservation (SGNC)" are found in these tracts. The SGNC Birds and Herps were also strongly correlated to the presence of Hydric Soils. The increased peril of Wetlands in Illinois reflects the strong correlation between these parameters. Many of the SGNC Herps require water for some part of their lifecycle, so the habitat requirements for these species would include water or wetlands. We decided to retain both SGNC Birds and Herps.

Forests	Total Area	T & E Species	Public Land	Nature Preserve	Presence of Forest Soil	Interior Forest	Stream Length BSC Diversity	SGNC Birds	SGNC Herps	Proportion Interior Gap	Patch Shape	Nearest Neighbor	Remoteness From Roads 1 mile	Road Density	Proximity to Urban Area 275 ft	Proximity to Urban Area 550 ft	Proximity to Urban Area 1100 ft
Total Area	1.00																
T & E Species	0.24	1.00															
Public Land	0.29	0.67	1.00														
Nature Preserve	0.26	0.57	0.56	1.00													
Presence of Forest Soil	0.30	0.57	0.60	0.39	1.00												
Interior Forest	0.63	0.29	0.38	0.26	0.31	1.00											
Stream Length BSC Diversity	0.22	0.33	0.34	0.23	0.53	0.19	1.00										
SGNC Birds	0.04	0.44	0.49	0.27	0.65	0.14	0.28	1.00									
SGNC Herps	0.04	0.41	0.48	0.26	0.63	0.14	0.30	0.95	1.00								
Proportion Interior Gap	0.87	0.21	0.23	0.22	0.22	0.54	0.17	0.01	0.01	1.00							
Patch Shape	0.58		0.19	0.20	0.23	0.30	0.22	0.02	0.02	0.60	1.00						
Nearest Neighbor	-0.12	-0.06	-0.05	-0.04	-0.07	-0.15	-0.07	-0.04	-0.03	-0.13	-0.21	1.00					
Remoteness From Roads 1 mile	0.20	0.62	0.68	0.40	0.77	0.27	0.48	0.73	0.72	0.14	0.16	-0.06	1.00				
Road Density	0.30	0.65	0.65	0.45	0.83	0.33	0.51	0.65	0.63	0.24	0.25	-0.07	0.86	1.00			
Proximity to Urban 275 ft	0.16	0.54	0.64	0.39	0.58	0.27	0.29	0.59	0.58	0.08	0.08	-0.04	0.82	0.66	1.00		
Proximity to Urban 550 ft	-0.02	0.01	0.04	-0.02	0.08	-0.02	0.03	0.14	0.14	-0.01	0.00	-0.03	0.07	0.08	-0.04	1.00	
Proximity to Urban 1100 feet	0.02	0.08	0.04	-0.01	0.11	0.02	0.05	0.11	0.10	0.03	0.05	-0.02	0.07	0.08	-0.04	-0.01	1.00

Table 6. Pearson Correlation Coefficient analysis for Forested tracts. The shaded cells indicate those with significant positive correlations.

Grasslands	Total Area	T & E Species	Public Land	Nature Preserve	Presence of Prairie Soil	Railroad Remnant	Stream Length BSC Diversity	SGNC Birds	SGNC Herps	Proportion Interior Gap	Patch Shape	Nearest Neighbor	Remote-ness from Roads 1 mile	Road Density	Proximity to Urban area 162 ft	Proximity to Urban area 325 ft	Proximity to Urban area 650 ft
Total Area	1.00																
T & E Species	0.35	1.00															
Public Land	0.31	0.63	1.00														
Nature Preserve	0.24	0.39	0.41	1.00													
Presence Prairie Soil	0.35	0.31	0.28	0.13	1.00												
Railroad Remnant	0.12	0.10	0.11	0.09	0.12	1.00											
Stream Length BSC Diversity	0.20	0.15	0.08	0.06	0.31	0.13	1.00										
SGNC Birds	0.07	0.17	0.08	0.07	0.17	-0.02	0.01	1.00									
SGNC Herps	0.05	0.17	0.08	0.07	0.17	-0.02	0.00	0.97	1.00								
Proportion Interior Gap	0.62	0.34	0.28	0.21	0.30	0.05	0.15	0.13	0.11	1.00							
Patch Shape	0.40	0.27	0.20	0.12	0.17	0.01	0.10	0.14	0.14	0.57	1.00						
Nearest Neighbor	-0.11	-0.05	-0.04	-0.01	-0.07	0.01	-0.03	-0.13	-0.14	-0.12	-0.16	1.00					
Remoteness from Roads 1 mile	0.02	0.05	0.04	0.02	0.22	0.12	0.08	0.05	0.05	0.02	0.04	0.01	1.00				
Road Density	0.34	0.31	0.29	0.13	0.66	0.13	0.27	0.26	0.26	0.35	0.27	-0.08	0.22	1.00			
Proximity to Urban 162 feet	0.06	0.23	0.29	0.06	0.29	0.00	-0.01	0.16	0.16	0.14	0.20	0.00	0.19	0.30	1.00		
Proximity to Urban 325 feet	-0.03	0.01	0.00	0.00	0.03	-0.01	-0.02	0.07	0.06	0.00	0.00	-0.03	0.06	0.09	-0.05	1.00	
Proximity to Urban 650 feet	-0.02	0.04	0.06	0.07	0.05	-0.01	0.01	0.07	0.06	-0.01	0.03	-0.01	0.14	0.04	-0.04	-0.01	1.00

Table 7. Pearson Correlation Coefficient analysis for Grassland tracts. The shaded cells indicate those with significant positive correlations.

Wetlands	Total Area	T & E Species	Public Land	Head water Stream	Flood zone	Presence of Hydric Soil	Stream Length BSC Diversity	SGNC Birds	SGNC Herps	Prop. Interior Gap	Patch Shape	Nearest Neighbor	Remote-ness to Roads	Road Density	Prox. to Urban Area 162ft	Prox. to Urban Area 325ft	Prox. to Urban Area 650ft	Adj. to Agric. Area 162ft	Adj. to Agric. Area 325ft	Adj. to Agric. Area 650ft
Total Area	1.00																			
T & E Species	-0.04	1.00																		
Public Land	-0.04	0.81	1.00																	
Headwater Stream	-0.04	0.47	0.40	1.00																
Flood zone	-0.06	0.64	0.69	0.36	1.00															
Presence of Hydric Soil	-0.07	0.67	0.65	0.45	0.86	1.00														
Stream Length BSC Diversity	-0.03	0.23	0.32	0.23	0.44	0.40	1.00													
SGNC Birds	-0.07	0.49	0.50	0.46	0.74	0.85	0.34	1.00												
SGNC Herps	-0.07	0.46	0.48	0.41	0.73	0.86	0.36	0.96	1.00											
Proportion Interior Gap	0.73	-0.03	0.00	-0.09	-0.06	-0.08	-0.04	-0.10	-0.09	1.00										
Patch Shape	0.50	0.00	0.03	-0.07	-0.05	-0.09	0.06	-0.13	-0.13	0.57	1.00									
Nearest Neighbor	-0.13	0.14	0.11	0.22	0.27	0.35	0.14	0.36	0.38	-0.16	-0.19	1.00								
Remoteness Roads	-0.03	-0.04	-0.04	-0.04	-0.06	-0.07	-0.03	-0.07	-0.07	0.02	-0.05	-0.08	1.00							
Road Density	-0.04	0.24	0.30	0.27	0.33	0.48	0.03	0.51	0.51	-0.04	-0.06	0.21	-0.04	1.00						
Proximity to Urban 162 ft	-0.03	0.31	0.19	0.22	0.20	0.31	0.12	0.22	0.23	-0.10	-0.05	0.15	-0.03	0.10	1.00					
Proximity to Urban 325 ft	-0.02	0.58	0.57	0.19	0.53	0.43	0.38	0.25	0.25	0.03	0.05	0.04	-0.02	0.10	-0.01	1.00				
Proximity to Urban 650 ft	0.32	-0.11	-0.12	-0.07	-0.17	-0.20	-0.08	-0.20	-0.22	0.33	0.30	-0.53	0.03	-0.11	-0.11	-0.08	1.00			
Adjacent Agric. 162feet	0.47	-0.09	-0.10	-0.08	-0.06	-0.04	-0.11	-0.03	-0.02	0.37	0.37	-0.10	0.12	0.00	-0.10	-0.03	0.16	1.00		
Adjacent Agric. 325feet	-0.04	0.04	0.06	-0.03	0.00	0.01	0.05	-0.01	0.01	-0.05	-0.10	0.02	-0.04	0.04	0.03	-0.01	-0.02	-0.28	1.00	
Adjacent Agric. 650feet	-0.05	0.03	0.07	0.01	0.05	0.06	0.13	0.01	0.05	-0.05	-0.08	0.04	-0.05	0.03	0.11	-0.02	-0.05	-0.34	0.80	1.00

Table 8. Pearson Correlation Coefficient analysis for Wetland tracts. The shaded cells indicate those with significant positive correlations.

A total of 1,780 land cover tracts were analyzed in the northeastern Illinois study area (Table 9). This number includes 768 Forest, 955 Grassland, and 57 Wetland tracts. The parameters listed in Tables 6-8 were used to rank each tract, following the methods described above.

Land Cover	Acres	Number of Tracts	Percent (by area)	Number with Rank Low	Number with Rank Medium	Number with Rank High
Forest	342,425	768	62.5%	256	348	164
Grassland	199,869	955	36.5%	455	365	135
Wetland	5,956	57	1.0%	17	21	19
Total	548,249	1,780	100%	728	734	318

Table 9. Land Cover categories in ranked tracts.

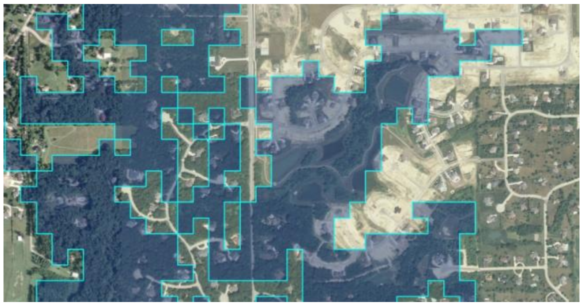
Quality Assurance/Quality Control (QA/QC)

The land tracts were derived from the 2007 NASS-CDL data. There are some complications associated with the analysis of landscape scale data obtained through remote sensing. The most apparent issues are of spatial compatibility and data quality. The most critical are the time of the year when the imagery was collected and relative positional accuracy between datasets (the satellite imagery and the other GIS layers used in the analysis). In addition, without field-based observations of native vegetation condition the relative natural quality of tracts is not distinguishable using satellite remote sensing data.

All the ranked forests, grasslands, and wetlands were compared to the 2007 NAIP aerial photos to identify any discrepancies. The NASSCDL data is classified into the various land cover types based on the reflectance of sunlight ‘bouncing’ off the vegetation and back to the satellite camera. Since this data is collected in a matrix of 56 meter cells or pixels, only the land cover type that makes up the majority of the cell is identified. The source satellite imagery used to create the NASS-CDL data is also collected during the growing season of April 1 through September 30 (leaf on). This can result in ‘missed’ classification of small inholdings of land cover types (less than 56 meters), or missed structures under tree canopies. To assess this issue, the final tracts were checked for accuracy by comparing the land cover types classified in the (56 meter) NASS-CDL data to the (1 meter) 2007 NAIP aerial photography. The NAIP 2007 data was chosen because it was collected the same year as the NASS satellite imagery, and from the growing season (leaf-on).

Ninety-six Forest tracts totaling 32,329 acres and 491 Grassland tracts totaling 98,374 acres were identified as having classification issues or were “culturally exploited.” None of the Wetland tracts were affected. The term “culturally exploited” in the context of this study, implies a limitation within a given tract that may prevent restoration efforts. Land cover misclassification, presence of residential area(s), presence of manicured areas (i.e. golf courses), and agricultural activity were the most common examples of cultural exploitation. Some examples of the classification problems are illustrated in Figure 10. Tracts that exhibited these types of discrepancies in 50% or more of their total area were determined to be culturally exploited. Tracts that exhibited discrepancies in 50% or less of their total area were determined not to be culturally exploited. While this approach to quality assurance and quality control (QA/QC) may quickly preclude a certain number of tracts from restoration, driving by the site would still be necessary in order ultimately determine if a tract is suitable for restoration. Application of the Restorability Index to each tract eligible for restoration would allow comparison across tracts. The field-based site assessment and calculation of the Restorability Index for each qualifying tract would be a significant undertaking and did not fall within the scope of this project. This project was, however, designed to provide Conservation Districts and Forest Preserve Districts the tools to undertake such assessments on a county by county basis.

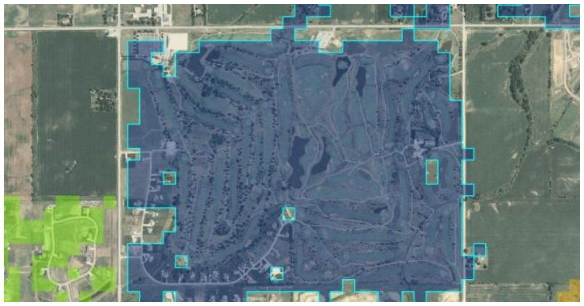
After the analysis, all three land cover types were combined to create a mosaic to identify Landscapes of Ecological Importance (LEIs) (see Figure 11). This was done, based on the recommendation of INHS scientists, and methods of other studies (Weber, 2006). There are a total of 919 LEIs in the study area (Table 10). Appendix IV has the complete list of LEIs by ID, along with the rank. This number includes 672 forest tracts, 464 grassland tracts, and 57 wetland tracts. Since the LEIs are a mosaic of the 3 land cover types, most LEIs have more than one land cover.   The total acres for each land cover type represent just the part of the LEIs with no cultural exploitation.



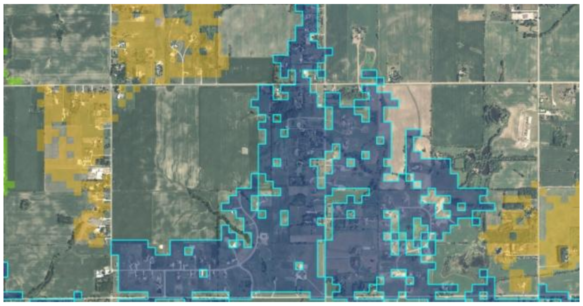
Houses located in Forest tract.

Unconnected houses in Forest tract.

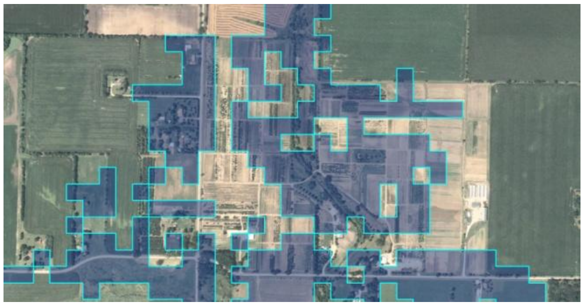
Possible incorrectly classified Forests tract surrounded by Wetland tract.



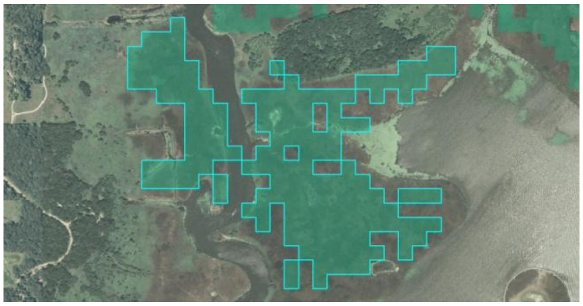
Golf course classified as grassland tract.



Houses located in Grassland tract.



Tree farm classified as Grassland tract.



Unclassified Wetland adjacent to Wetland tract.

Figure 10. Examples of classification problems with NASS-CDL data.

Land Cover	Total Acres	Number of LEI	Percent (by area)	Rank Low	Rank Medium	Rank High
Forest	310,095	672	74.3%	225	293	154
Grassland	101,495	464	24.3%	221	189	54
Wetland	5,956	57	1.4%	17	21	19
Total	417,547	919*	100%	463	503	277

Table 10. Land Cover for Landscapes of Ecological Importance (LEI) with no cultural exploitation. (* Some LEIs have more than one land cover type.)

The undeveloped (gray) land cover was added back into the LEIs (Figure 12). These gray areas were composed of different land cover types and fell below the initial size filters, but are adjacent or connected to the newly designated LEIs (Figure 12). Adding these areas back in gives a better sense of the true extent of the area of interest in a land conservation project, and accommodates species which exploit a variety of land covers for different parts of their life histories, for example species which breed in forest cover but may also forage in grasslands or wetlands. The QA/QC process was not applied to these additions to LEIs.

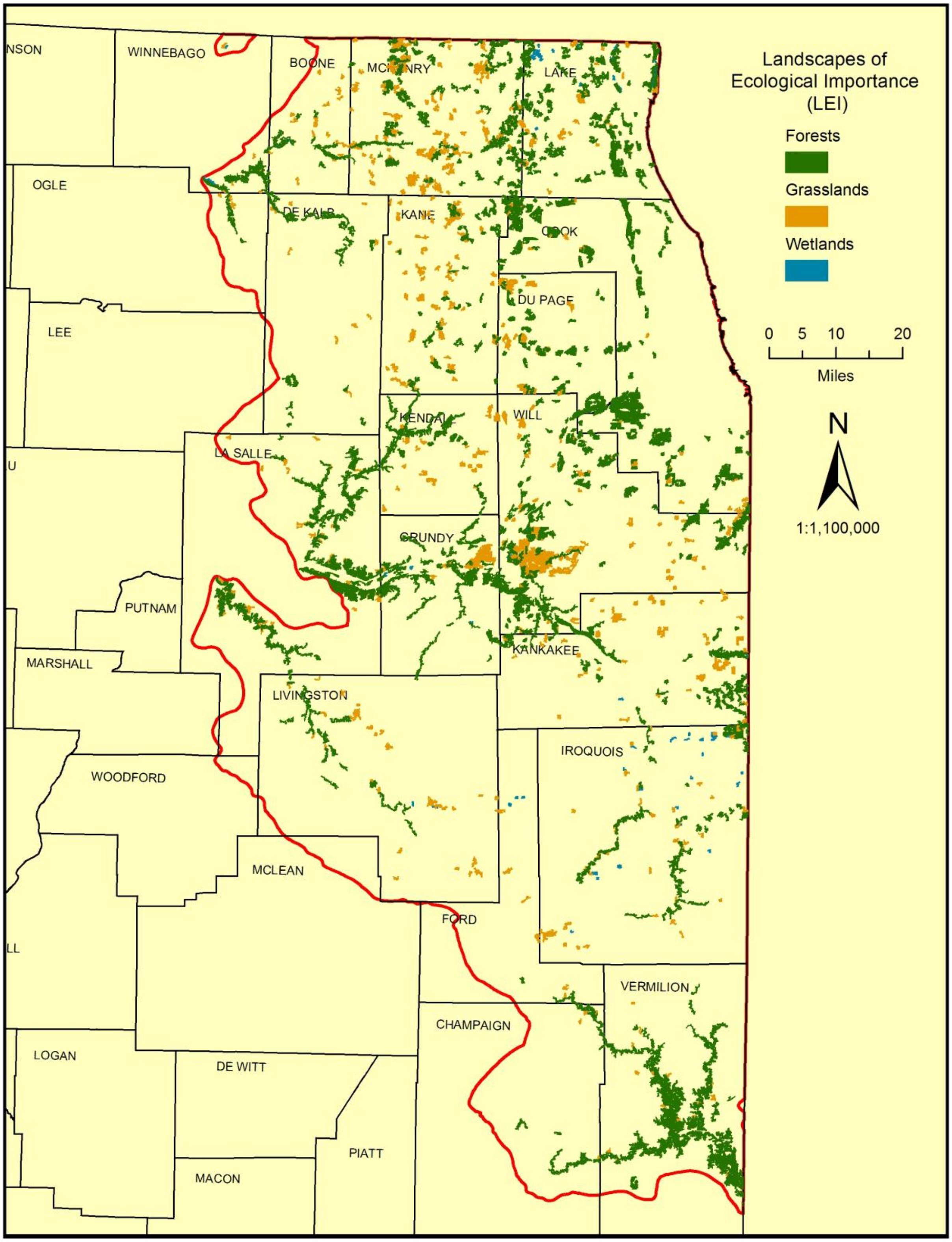


Figure 11. Forest, Grassland, and Wetland LEIs that are not culturally exploited.

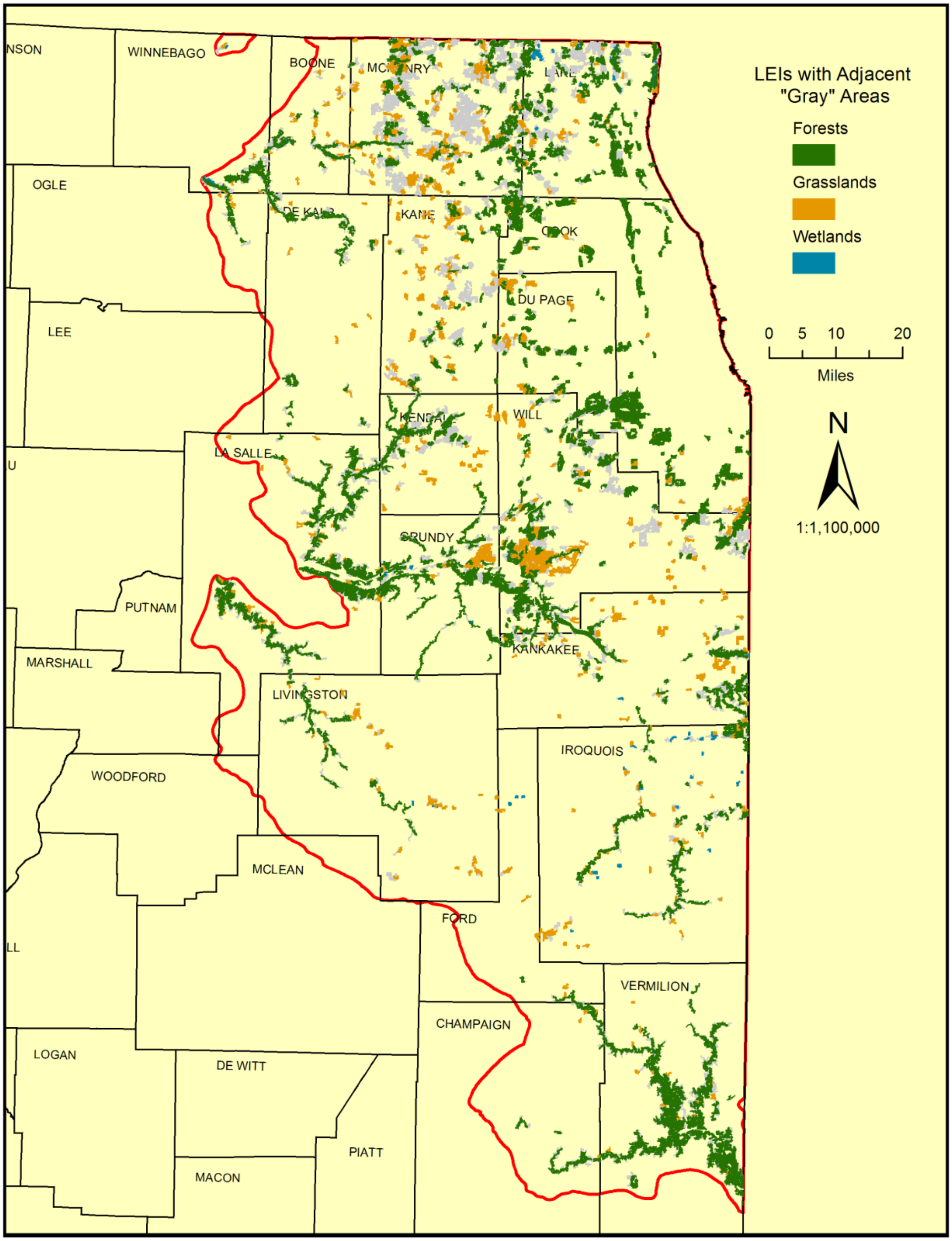


Figure 12. Forest, Grassland, and Wetland LEIs that are not culturally exploited. Adjacent "gray" areas at least 50 acres in size are shown in gray.

Finally, we looked at the relationship between LEIs and natural areas from the Illinois Natural Areas Inventory - INAI (Table 11). This was done to see which areas encompassed or were adjacent to areas already recognized as supporting significant natural resources. The comparison was done using the INAIs from the 1970's assessment, since natural areas identified in the INAI Update will not officially be added to the INAI until they are reviewed and approved for addition to the INAI by the Illinois Department of Natural Resources' Natural Areas Evaluation Committee per administrative rule. Appendix V has the complete list of INAI areas within the LEIs. Figure 13 identifies the number of natural areas by INAI category that is in spatial proximity to the LEIs. The close association of natural areas with LEIs suggests high potential for constructing connected systems of conservation lands that might be resilient to region wide threats like climate change and invasive species.

	Number of sites	Acreage
LEIs with INAI Sites	919	726,217
INAI with Category I	107	32,445
INAI with Category II	189	50,447
INAI with Category III	135	38,515
INAI with Category IV	37	3,000
INAI with Category VI	60	2,926

Table 11. Landscapes of Ecological Importance (LEI) areas encompassing INAI sites. NOTE: If a natural area is recognized in multiple categories, the acreage is counted again for each new category. In other words, summing the acreage of natural areas associated with LEIs for all categories will result in an overestimation of total acres of natural area associated with LEIs.

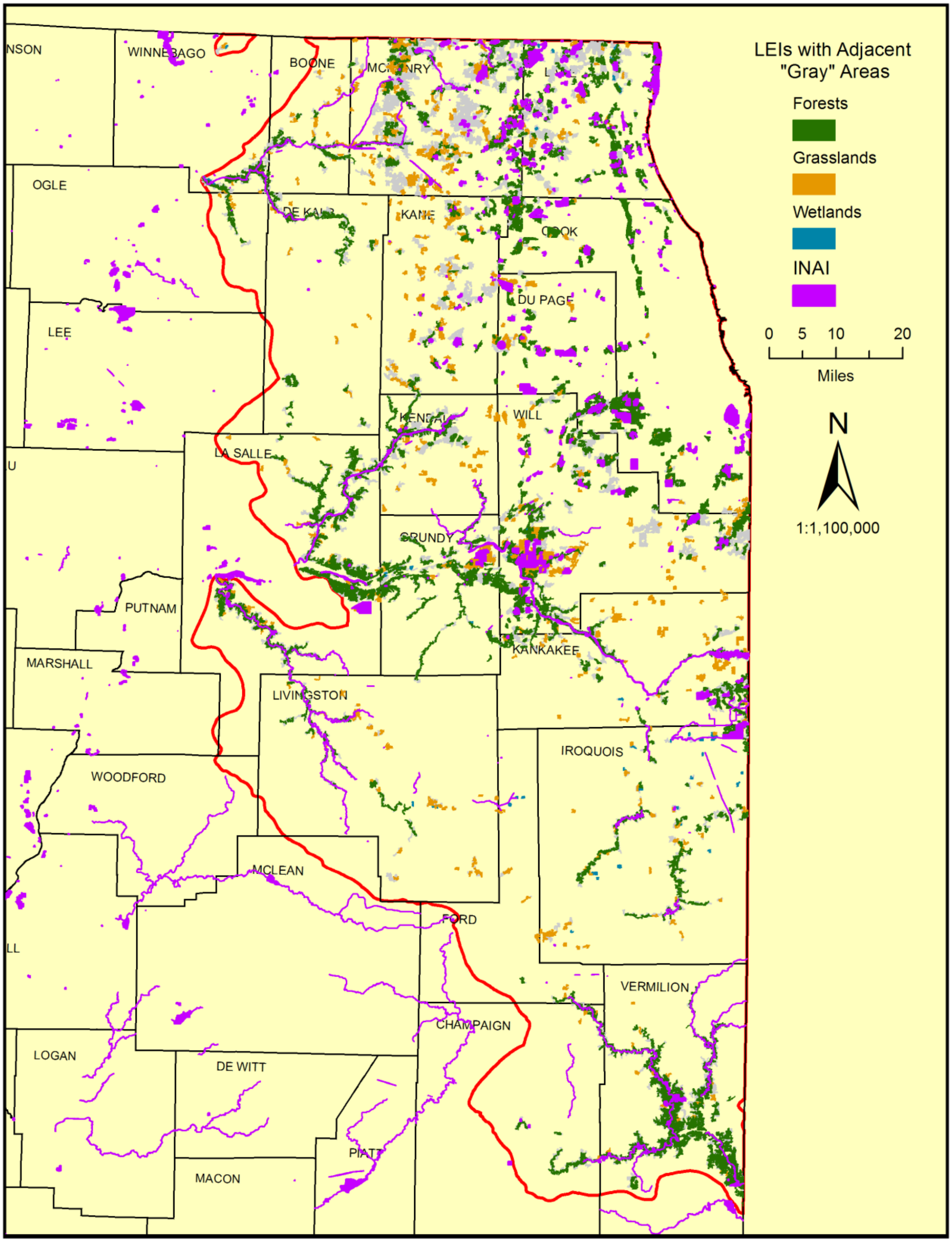


Table 13. LEIs with adjacent 'gray' areas and INAI sites.

6 Summary

The goal of this project was to test the methods of using landscape scale characteristics to identify areas of potential ecological importance using statewide GIS data. The NASS-CDL land cover data is released annually, so this process can be repeated yearly, allowing annual assessments of conservation outcomes. There are also many other sources of satellite imagery, some with higher resolution. We used only statewide digital data layers, so that this GIS analysis could be extended statewide. However, this study can easily be repeated statewide or regionally if additional data layers become available. If better defined or more precise boundaries are needed for LEIs, higher resolution imagery, where available, could be employed to re-map them.

A future step would be to examine the most efficient avenues of connectivity between LEIs, designing buffer areas around the LEIs, and assessing intrinsic flora and fauna potential within them (i.e., conduct natural community grading and assessment of restorability). An assessment of the connectivity between INAI natural areas, LEIs, and all other conservation lands is needed to cast a vision of what the "Connected System of Conservation Lands" (Connected System) that the Vital Lands Project has recently called for will actually look like.

Another important next step would be to promote the formal recognition of LEIs by the Illinois Nature Preserves Commission as properties that will qualify or at least have high potential for qualifying for designation as Illinois Land and Water Reserves. The statewide identification of LEIs and assessment of their natural quality and restorability, at least for a representative number of them statewide, may be necessary to convince the Nature Preserve Commission that such an acknowledgement is justified.

Finally, designating the elements of Connected Systems and further identifying the alternatives for potential connections between those elements is also an important step in designing a scientifically defensible Green Infrastructure Plan. However, the LEI's were identified solely on their capacity for supporting important components of Illinois' native flora and fauna. The Connected System will not only help protect Illinois' native flora and fauna against region-wide threats like climate change, but it will also provide many ecosystem services, like stormwater retention, groundwater recharge, recreational opportunities, clean air and water. While lands identified for inclusion in the Connected System should have the highest priority for delivering ecosystem services, a comprehensive analysis of land protection needs should be conducted relative to each service to assess whether addition lands should be included in a Green Infrastructure plan beyond those identified as important to achieving the vision for a Connected System of Conservation Lands.

Finally, this project sets the stage for a new generation of conservation work, the era of conservation connectivity. The LEIs will provide the matrix in which the gems that are Illinois' natural areas will thrive.

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Appendix I

List of Species of Greatest Need of Conservation (SGNC) for Forest tracts (37 species)

TNC Element Code	Common Name	Scientific Name
Amphibians		
AAAAA01050	Jefferson Salamander	*Ambystoma jeffersonianum*
AAAAA01060	Blue-spotted Salamander	*Ambystoma laterale*
AAAAA01120	Mole Salamander	*Ambystoma talpoideum*
AAAAAAAAAA	Silvery Salamander	*Ambystoma x platineum*
AAAAD03040	Dusky Salamander	*Desmognathus fuscus*
AAAAD08010	Four-toed Salamander	*Hemidactylium scutatum*
AAABC02030	Bird-voiced Treefrog	*Hyla avivoca*
AAABH01200	Wood Frog	*Rana sylvatica*
Birds		
ABNJB20010	Hooded Merganser	*Lophodytes cucullatus*
ABNKC19030	Red-shouldered Hawk	*Buteo lineatus*
ABNKC19050	Broad-winged Hawk	*Buteo platypterus*
ABNLC11010	Ruffed Grouse	*Bonasa umbellus*
ABNRB02010	Black-billed Cuckoo	*Coccyzus erythropthalmus*
ABNRB02020	Yellow-billed Cuckoo	*Coccyzus americanus*
ABNTA07010	Chuck-Will's-Widow	*Caprimulgus carolinensis*
ABNTA07070	Whip-Poor-Will	*Caprimulgus vociferus*
ABNYF04040	Red-headed Woodpecker	*Melanerpes erythrocephalus*
ABPAE33020	Acadian Flycatcher	*Empidonax virescens*

TNC Element Code	Common Name	Scientific Name
ABPBA01010	Brown Creeper	*Certhia americana*
ABPBG07010	Bewick's Wren	*Thryomanes bewickii*
ABPBJ19010	Wood Thrush	*Hylocichla mustelina*
ABPBX01020	Blue-winged Warbler	*Vermivora pinus*
ABPBX03190	Prairie Warbler	*Dendroica discolor*
ABPBX03240	Cerulean Warbler	*Dendroica cerulea*
ABPBX07010	Prothonotary Warbler	*Protonotaria citrea*
ABPBX08010	Worm-eating Warbler	*Helmitheros vermivorus*
ABPBX09010	Swainson's Warbler	*Limnothlypis swainsonii*
ABPBX10010	Ovenbird	*Seiurus aurocapillus*
ABPBX11010	Kentucky Warbler	*Oporornis formosus*
ABPBX11020	Connecticut Warbler	*Oporornis agilis*
ABPBXB5010	Rusty Blackbird	*Euphagus carolinus*
Mammals*		
AMABA01250	Pygmy Shrew	*Sorex hoyi*
AMACC01030	Southeastern Myotis	*Myotis austroriparius*
AMACC01100	Indiana Bat	*Myotis sodalis*
AMACC08020	Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*
AMAEB01080	Swamp Rabbit	*Sylvilagus aquaticus*
AMAFB08010	Red Squirrel	*Tamiasciurus hudsonicus*
AMAFF03080	Cotton Mouse	*Peromyscus gossypinus*
AMAFF11150	Woodland Vole	*Microtus pinetorum*
AMAJA04010	Common Gray Fox	*Urocyon cinereoargenteus*
AMAJH03020	Bobcat	*Lynx rufus*

TNC Element Code	Common Name	Scientific Name
Reptiles		
ARAAE01050	Eastern Mud Turtle	*Kinosternon subrubrum*
ARADB14010	Mud Snake	*Farancia abacura*
ARADB22020	Plainbelly Water Snake	*Nerodia erythrogaster*
ARADB35040	Flathead Snake	*Tantilla gracilis*
ARADB36120	Eastern Ribbon Snake	*Thamnophis sauritus*
ARADE02040	Timber Rattlesnake	*Crotalus horridus*

* Mammals were not included in this project

List of Species of Greatest Need of Conservation (SGNC) for Grassland tracts (27 species)

TNC Element Code	Common Name	*Scientific Name*
Amphibians		
AAABC05061	Illinois Chorus Frog	*Pseudacris streckeri illinoensis*
AAABH01010	Crawfish Frog	*Rana areolata*
Birds		
ABNKC11010	Northern Harrier	*Circus cyaneus*
ABNLC13010	Greater Prairie-Chicken	*Tympanuchus cupido*
ABNLC21020	Northern Bobwhite	*Colinus virginianus*
ABNNF06010	Upland Sandpiper	*Bartramia longicauda*
ABNSA01010	Barn Owl	*Tyto alba*
ABNSB13040	Short-eared Owl	*Asio flammeus*
ABNTA02020	Common Nighthawk	*Chordeiles minor*
ABPBG10010	Sedge Wren	*Cistothorus platensis*
ABPBR01030	Loggerhead Shrike	*Lanius ludovicianus*
ABPBW01110	Bell's Vireo	*Vireo bellii*
ABPBX65010	Dickcissel	*Spiza americana*
ABPBX99010	Savannah Sparrow	*Passerculus sandwichensis*
ABPBXA0020	Grasshopper Sparrow	*Ammodramus savannarum*
ABPBXA0030	Henslow's Sparrow	*Ammodramus henslowii*
ABPBXA0040	Le Conte's Sparrow	*Ammodramus leconteii*
ABPBXA0070	Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
ABPBXA6030	Smith's Longspur	*Calcarius pictus*
ABPBXA9010	Bobolink	*Dolichonyx oryzivorus*
Mammals*		
AMAFB05120	Franklin's Ground Squirrel	*Spermophilus franklinii*
AMAJF02020	Least Weasel	*Mustela nivalis*
AMAJF04010	American Badger	*Taxidea taxus*
Reptiles		
ARAAD08020	Western Box Turtle/Ornate Box Turtle	*Terrapene ornata*
ARACB02010	Slender Glass Lizard	*Ophisaurus attenuatus*
ARADB06010	Kirtland's Snake	*Clonophis kirtlandii*
ARADB17010	Western Hognose Snake	*Heterodon nasicus*
ARADB38010	Lined Snake	*Tropidoclonion lineatum*
ARADB47010	Smooth Green Snake	*Opheodrys vernalis*
ARADE03011	Eastern Massasauga	*Sistrurus catenatus catenatus*

* Mammals were not included in this project

List of Species of Greatest Need of Conservation (SGNC) for Wetland tracts (53 species)

TNC Element Code	Common Name	Scientific Name
Amphibians		
AAAAA01050	Jefferson Salamander#	*Ambystoma jeffersonianum*
AAAAA01060	Blue-spotted Salamander#	*Ambystoma laterale*
AAAAA01120	Mole Salamander#	*Ambystoma talpoideum*
AAAAAAAAAA	Silvery Salamander#	*Ambystoma x platineum*
AAAAD08010	Four-toed Salamander#	*Hemidactylium scutatum*
AAABC02030	Bird-voiced Treefrog#	*Hyla avivoca*
AAABC05061	Illinois Chorus Frog+	*Pseudacris streckeri illinoensis*
AAABE01010	Eastern Narrowmouth Toad+	*Gastrophryne carolinensis*
AAABH01010	Crawfish Frog+	*Rana areolata*
AAABH01200	Wood Frog#	*Rana sylvatica*
Birds		
ABNCA02010	Pied-billed Grebe+	*Podilymbus podiceps*
ABNGA01020	American Bittern+	*Botaurus lentiginosus*
ABNGA02010	Least Bittern+	*Ixobrychus exilis*
ABNGA11010	Black-crowned Night-Heron#	*Nycticorax nycticorax*
ABNGA13010	Yellow-crowned Night-Heron#	*Nyctanassa violacea*
ABNKC11010	Northern Harrier+	*Circus cyaneus*
ABNKC19030	Red-shouldered Hawk#	*Buteo lineatus*
ABNME01010	Yellow Rail+	*Coturnicops noveboracensis*
ABNME03040	Black Rail+	*Laterallus jamaicensis*
ABNME05020	King Rail+	*Rallus elegans*
ABNME13010	Common Moorhen+	*Gallinula chloropus*
ABNMK01010	Sandhill Crane+	*Grus canadensis*
ABNNB02030	American Golden-Plover+	*Pluvialis dominica*
ABNNF01020	Greater Yellowlegs+	*Tringa melanoleuca*
ABNNF11190	Stilt Sandpiper+	*Calidris himantopus*
ABNNF14010	Buff-breasted Sandpiper+	*Tryngites subruficollis*
ABNNF16010	Short-billed Dowitcher+	*Limnodromus griseus*
ABNNF18030	Wilson's Snipe+	*Gallinago delicata*
ABNNF20010	Wilson's Phalarope+	*Phalaropus tricolor*
ABNNM08090	Forster's Tern+	*Sterna forsteri*
ABNNM10020	Black Tern+	*Chlidonias niger*
ABNUA03010	Chimney Swift#	*Chaetura pelagica*
ABPAE33040	Willow Flycatcher+	*Empidonax traillii*
ABPBA01010	Brown Creeper#	*Certhia americana*
ABPBG10010	Sedge Wren+	*Cistothorus platensis*
ABPBG10020	Marsh Wren+	*Cistothorus palustris*
ABPBX07010	Prothonotary Warbler#	*Protonotaria citrea*
ABPBX09010	Swainson's Warbler#	*Limnothlypis swainsonii*
ABPBXA0070	Nelson's Sharp-tailed Sparrow+	*Ammodramus nelsoni*

TNC Element Code	Common Name	Scientific Name
ABPBXB3010	Yellow-headed Blackbird[+]	*Xanthocephalus xanthocephalus*
ABPBXB5010	Rusty Blackbird[#]	*Euphagus carolinus*
Mammals*		
AMAEB01080	Swamp Rabbit	*Sylvilagus aquaticus*
AMAFF01010	Marsh Rice Rat	*Oryzomys palustris*
AMAFF03080	Cotton Mouse	*Peromyscus gossypinus*
AMAFF15010	Muskrat	*Ondatra zibethicus*
Reptiles		
ARAAD02010	Spotted Turtle[+]	*Clemmys guttata*
ARAAD04010	Blanding's Turtle[+]	*Emydoidea blandingii*
ARAAD07020	River Cooter[#]	*Pseudemys concinna*
ARAAE01020	Yellow Mud Turtle[+]	*Kinosternon flavescens*
ARAAE01050	Eastern Mud Turtle[#]	*Kinosternon subrubrum*
ARADB06010	Kirtland's Snake[+]	*Clonophis kirtlandii*
ARADB14010	Mud Snake[#]	*Farancia abacura*
ARADB22010	Mississippi Green Water Snake[#]	*Nerodia cyclopion*
ARADB22020	Plainbelly Water Snake[#]	*Nerodia erythrogaster*
ARADB22030	Southern Water Snake[#]	*Nerodia fasciata*
ARADB36120	Eastern Ribbon Snake[#]	*Thamnophis sauritus*
ARADE03011	Eastern Massasauga[+#]	*Sistrurus catenatus catenatus*

* Mammals were not included in this project.
+ Indicates species found in Herbaceous Wetlands
# Indicates species found in Wooded Wetlands

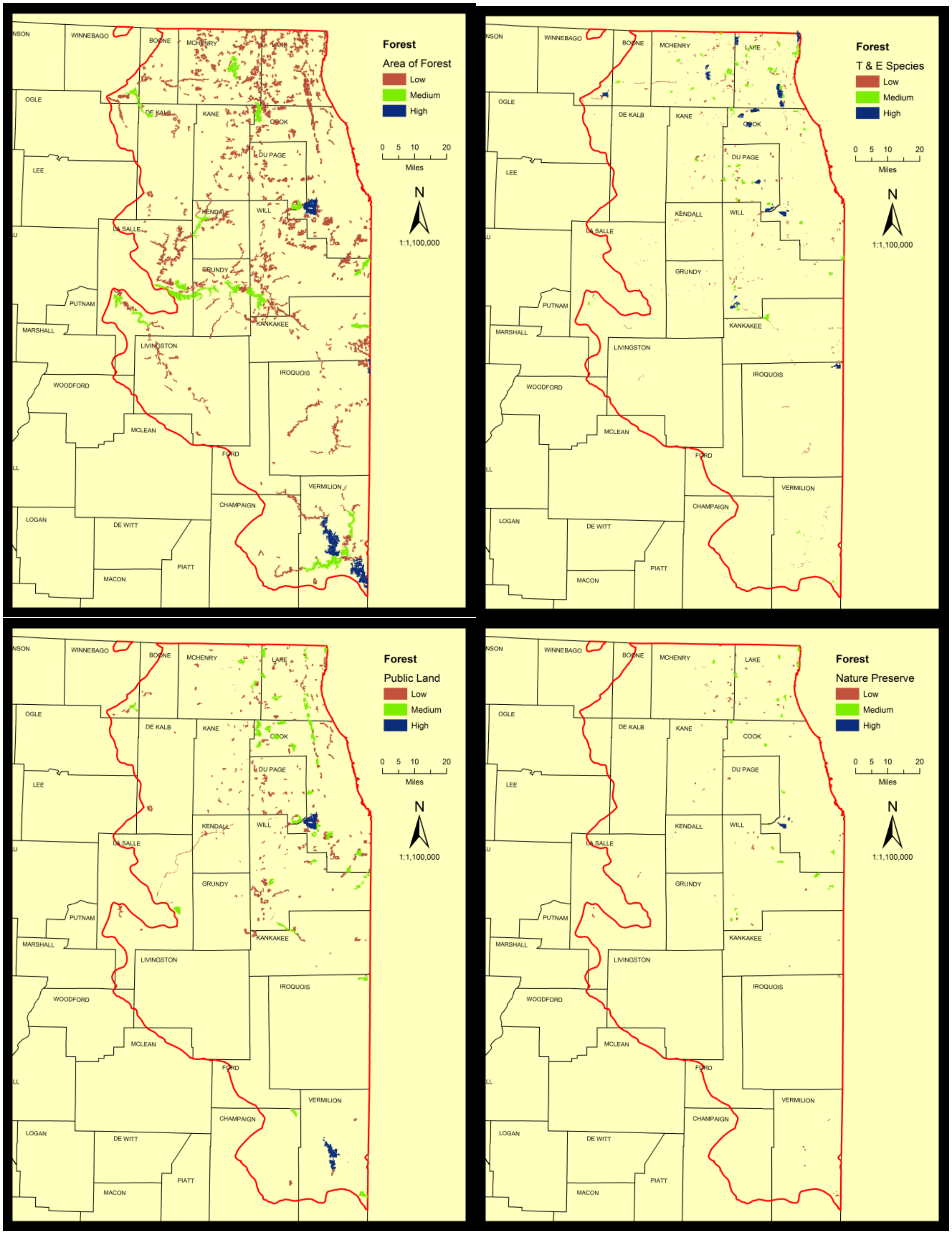
Appendix II

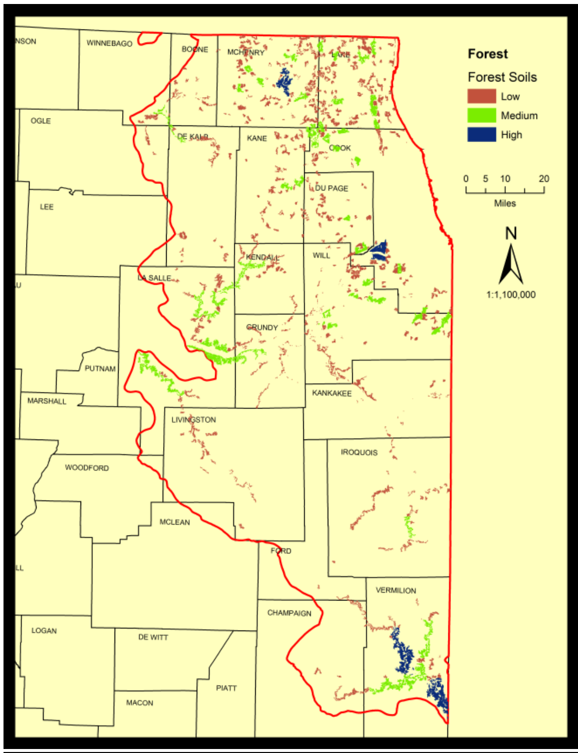
Please contact Diane Szafoni for information on this appendix

Diane Szafoni
Research Scientist/GIS/IT Coordinator
Illinois Natural History Survey (INHS)
Institute of Natural Resource Sustainability
University of Illinois at Urbana-Champaign
1816 S. Oak St. Champaign, IL 61820-0904

Phone: (217) 244-2160 Fax: (217) 244-0802
Email: szafoni@illinois.edu

Appendix III

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Forest Soils
Low
Medium
High
0 5 10 20
Miles
N
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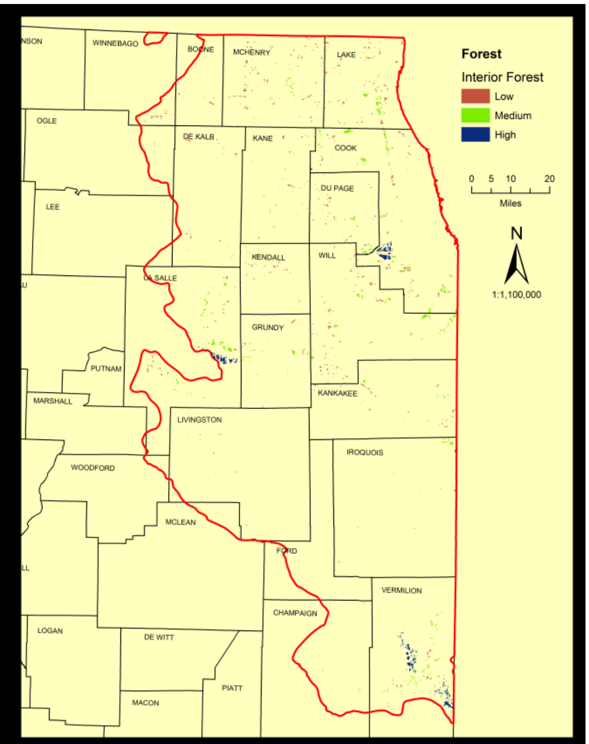
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON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Medium
High
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Miles
N
1:1,100,000
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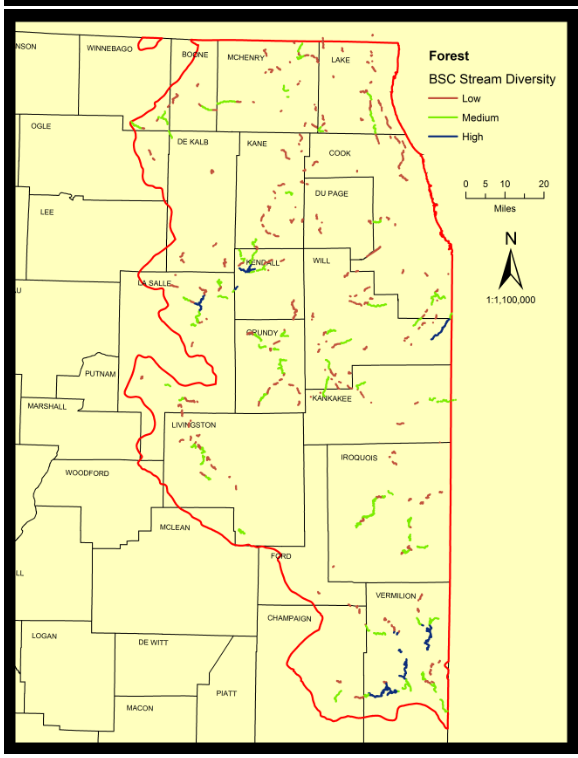
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON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Medium
High
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Miles
N
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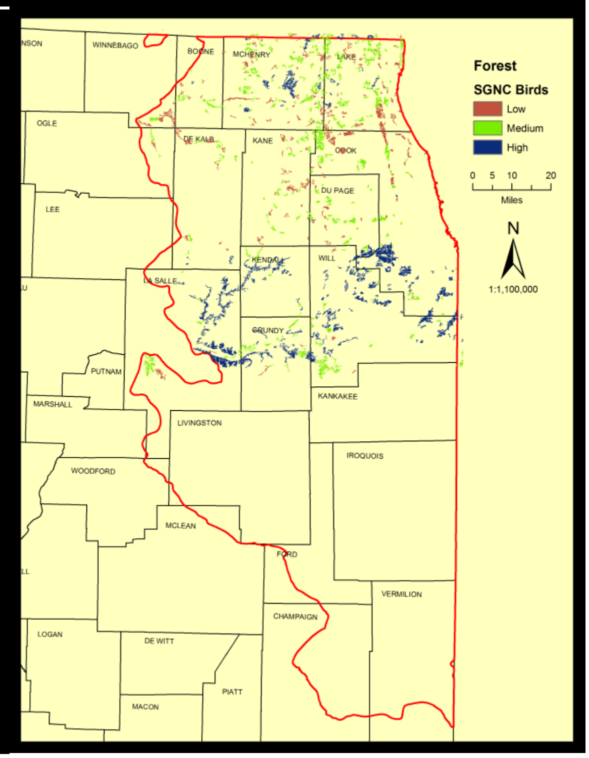
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON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SGNC Birds
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Medium
High
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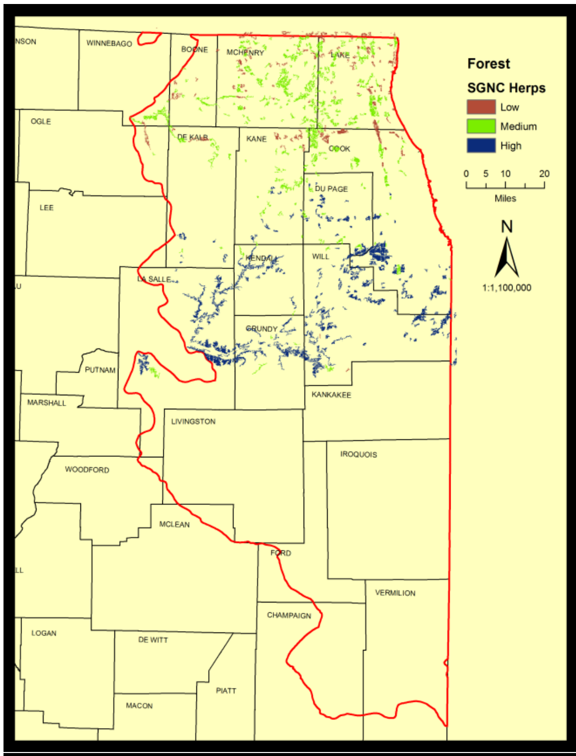
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON


Forest
SGNC Herps
Low
Medium
High
0 5 10 20
Miles
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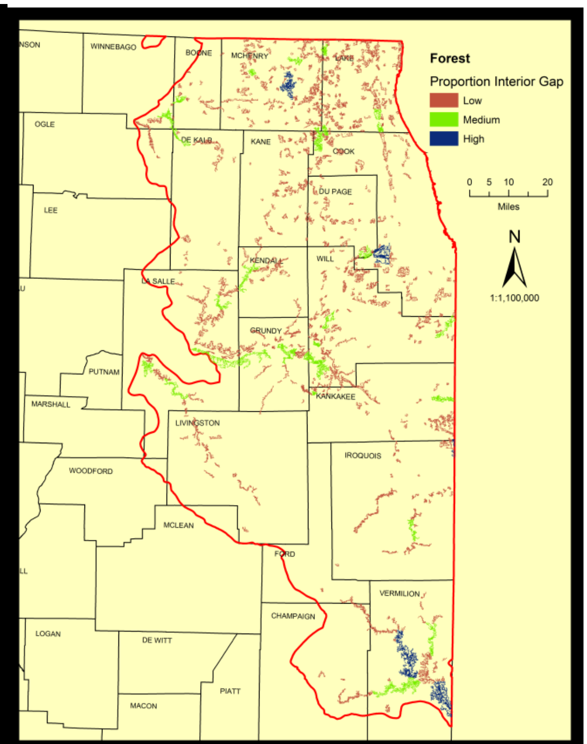
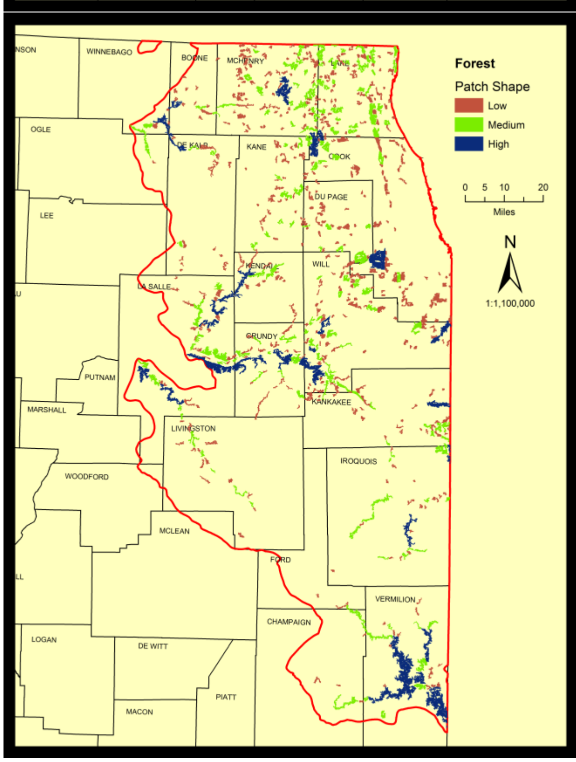
1:1,100,000


Forest
Proportion Interior Gap
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000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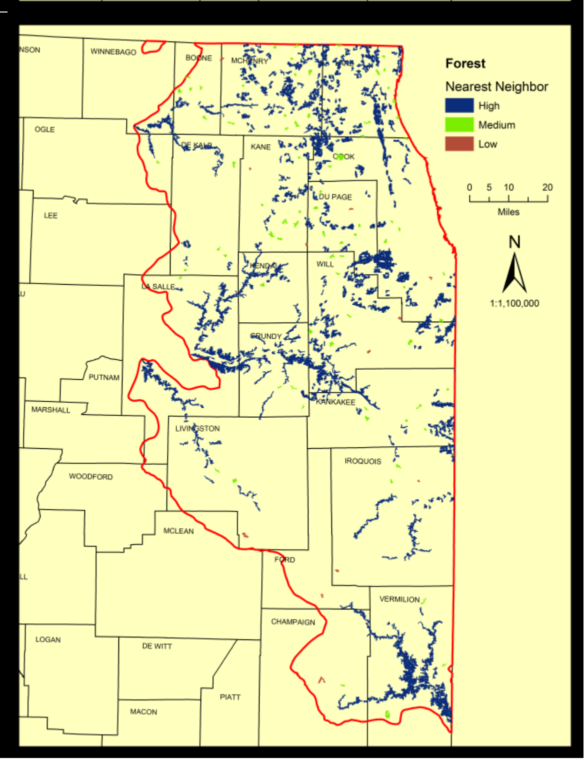
Patch Shape
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000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Nearest Neighbor
High
Medium
Low
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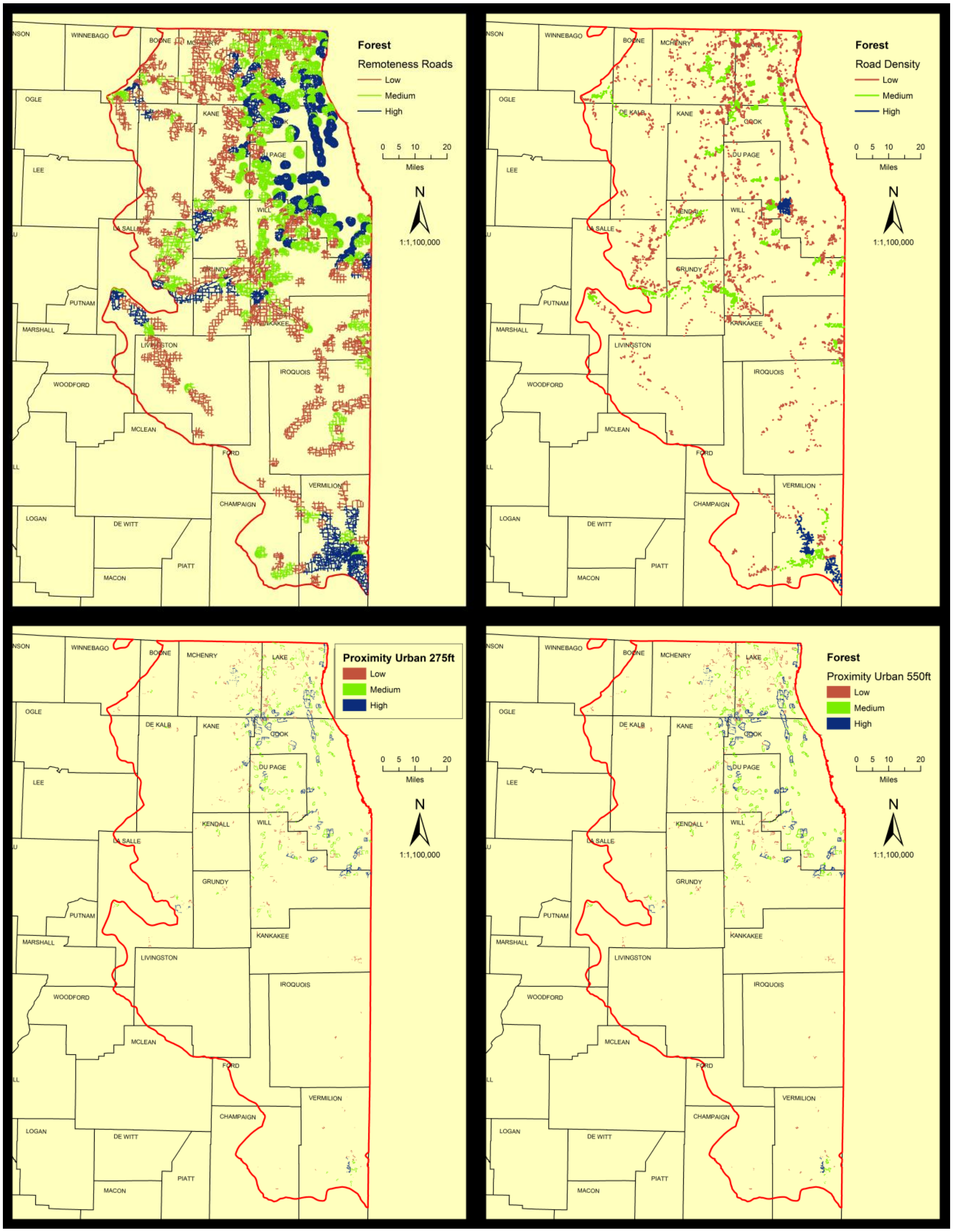
Miles
N
1:1,100,000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Remoteness Roads
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Forest
Road Density
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Proximity Urban 275ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Forest
Proximity Urban 550ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
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IROQUOIS
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
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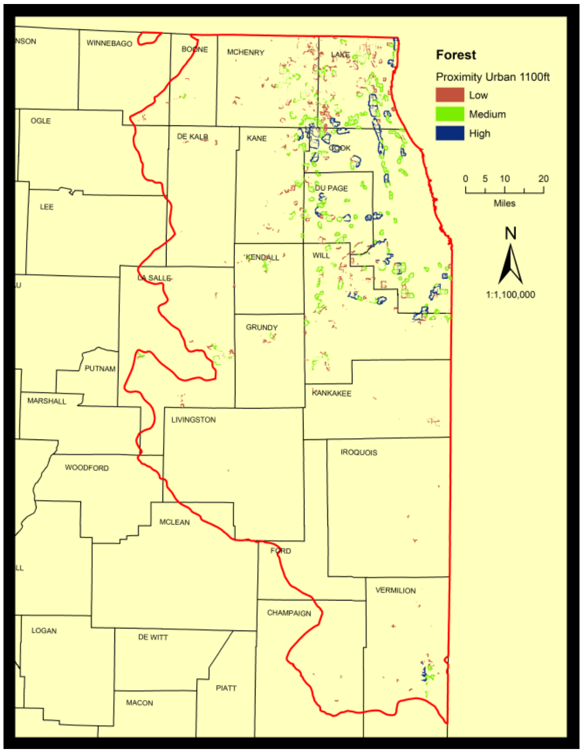
MACON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Proximity Urban 1100ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
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BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
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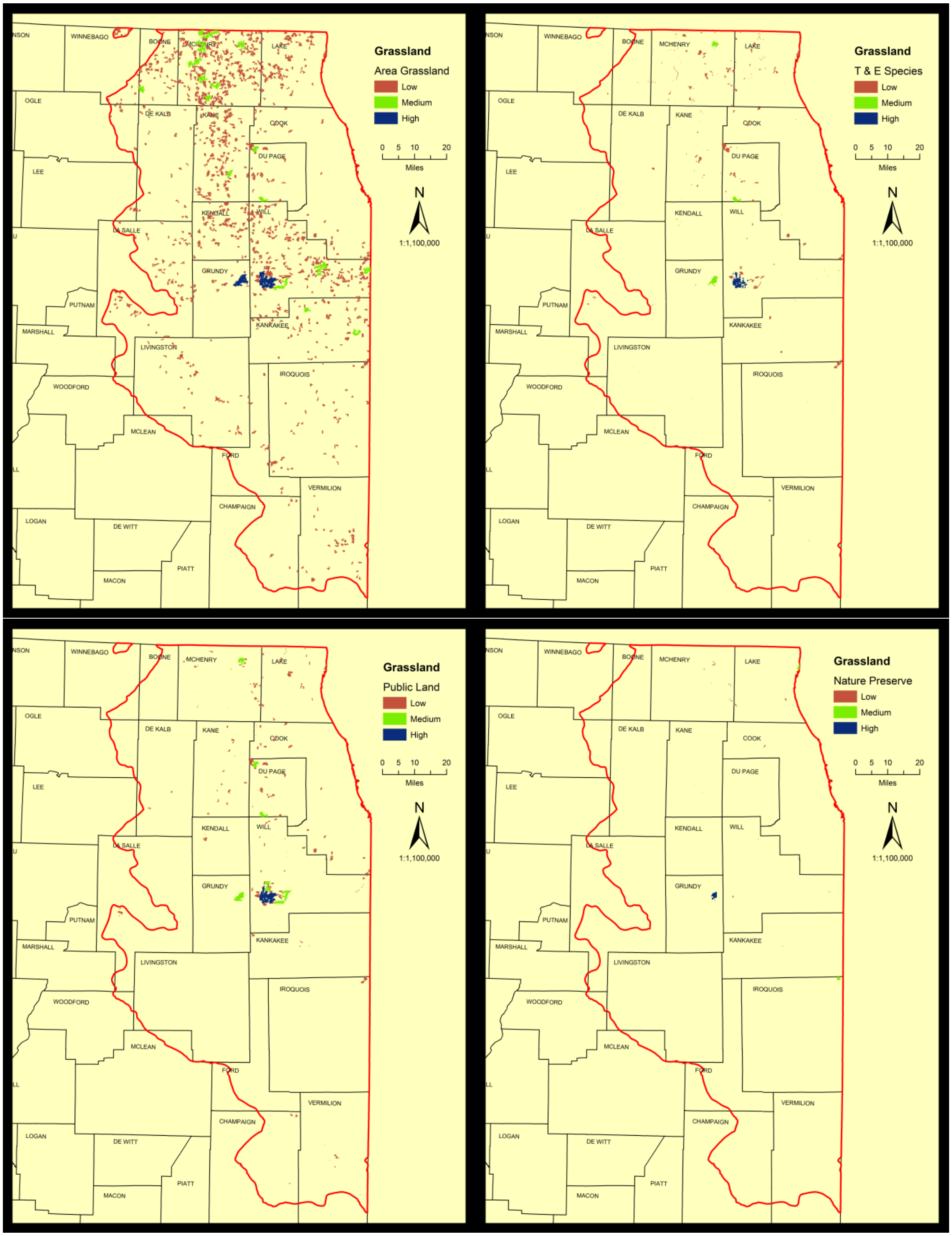
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Area Grassland
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
T & E Species
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Public Land
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Nature Preserve
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
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KANKAKEE
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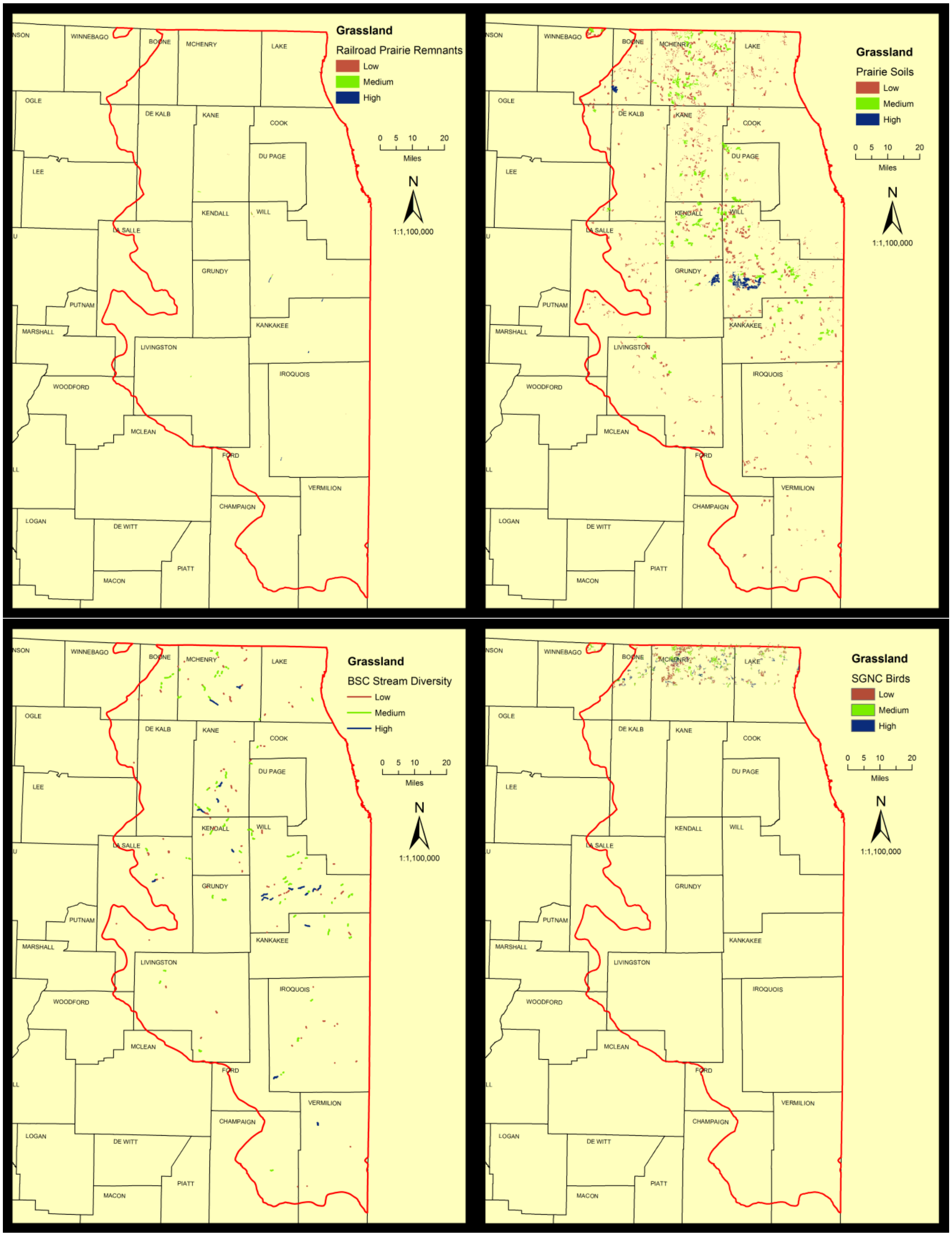
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Railroad Prairie Remnants
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Prairie Soils
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
BSC Stream Diversity
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
SGNC Birds
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
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WOODFORD
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DE WITT
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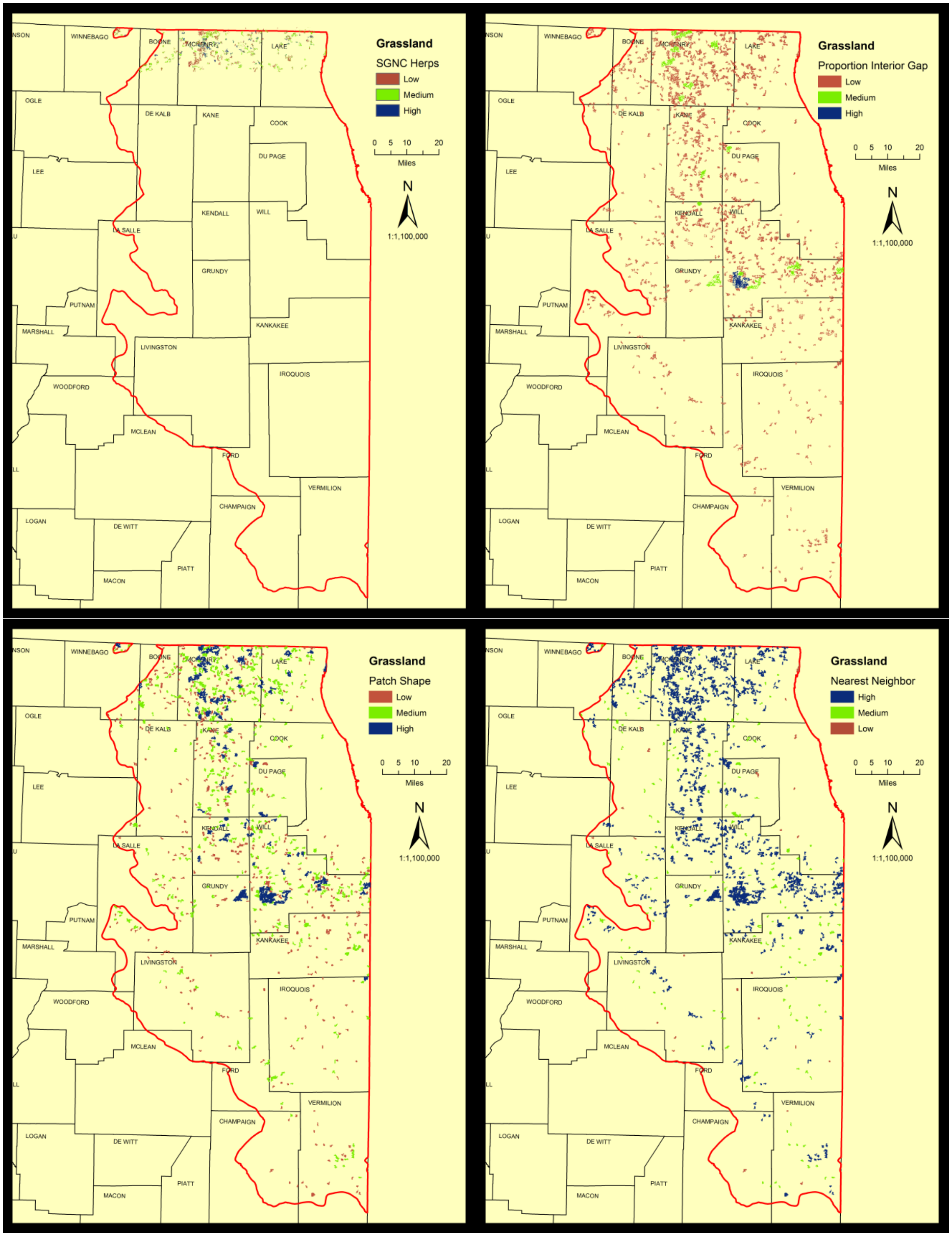
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Low
Medium
High
0 5 10 20
Miles
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1:1,100,000
Grassland
Proportion Interior Gap
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Patch Shape
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Nearest Neighbor
High
Medium
Low
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
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KANKAKEE
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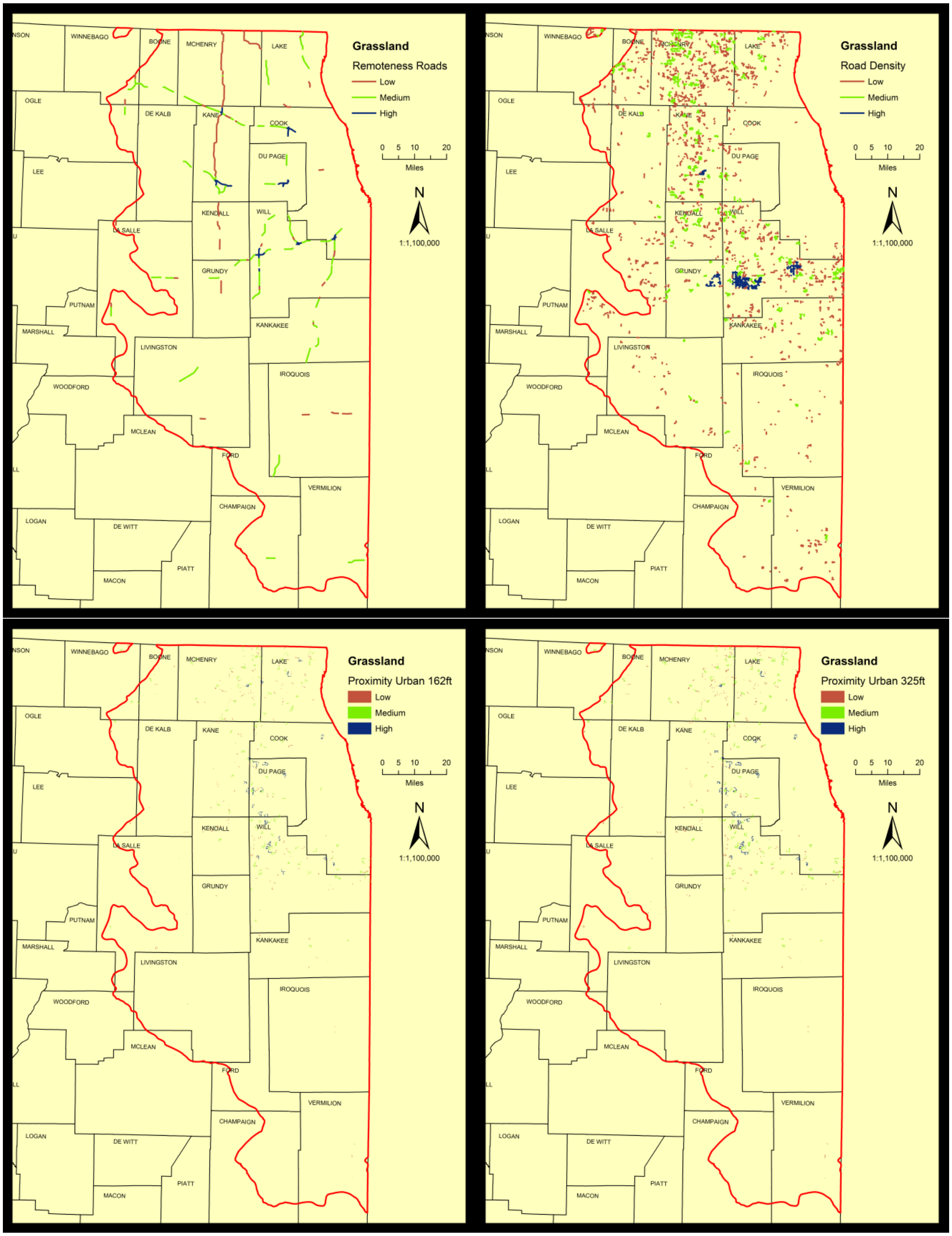
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Remoteness Roads
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Medium
High
0 5 10 20
Miles
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1:1,100,000
Grassland
Road Density
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Proximity Urban 162ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Grassland
Proximity Urban 325ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
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MARSHALL
KANKAKEE
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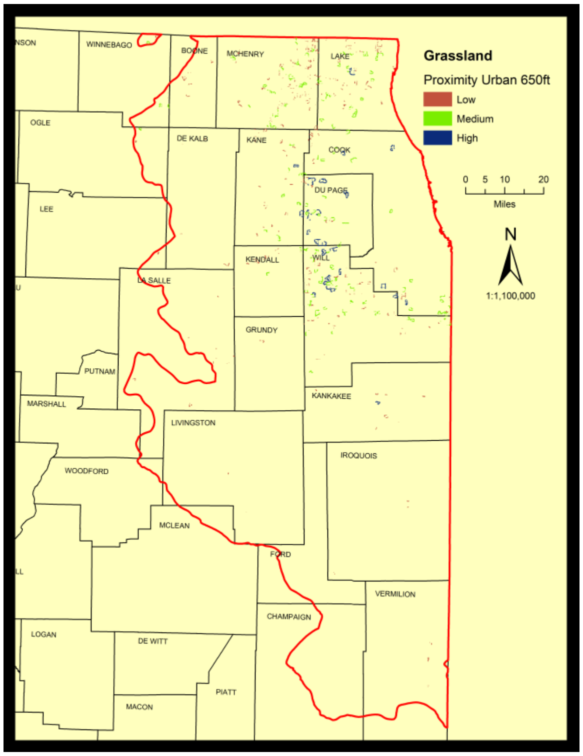
LOGAN
DE WITT
PIATT
MACON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Medium
High
0 5 10 20
Miles
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BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
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WOODFORD
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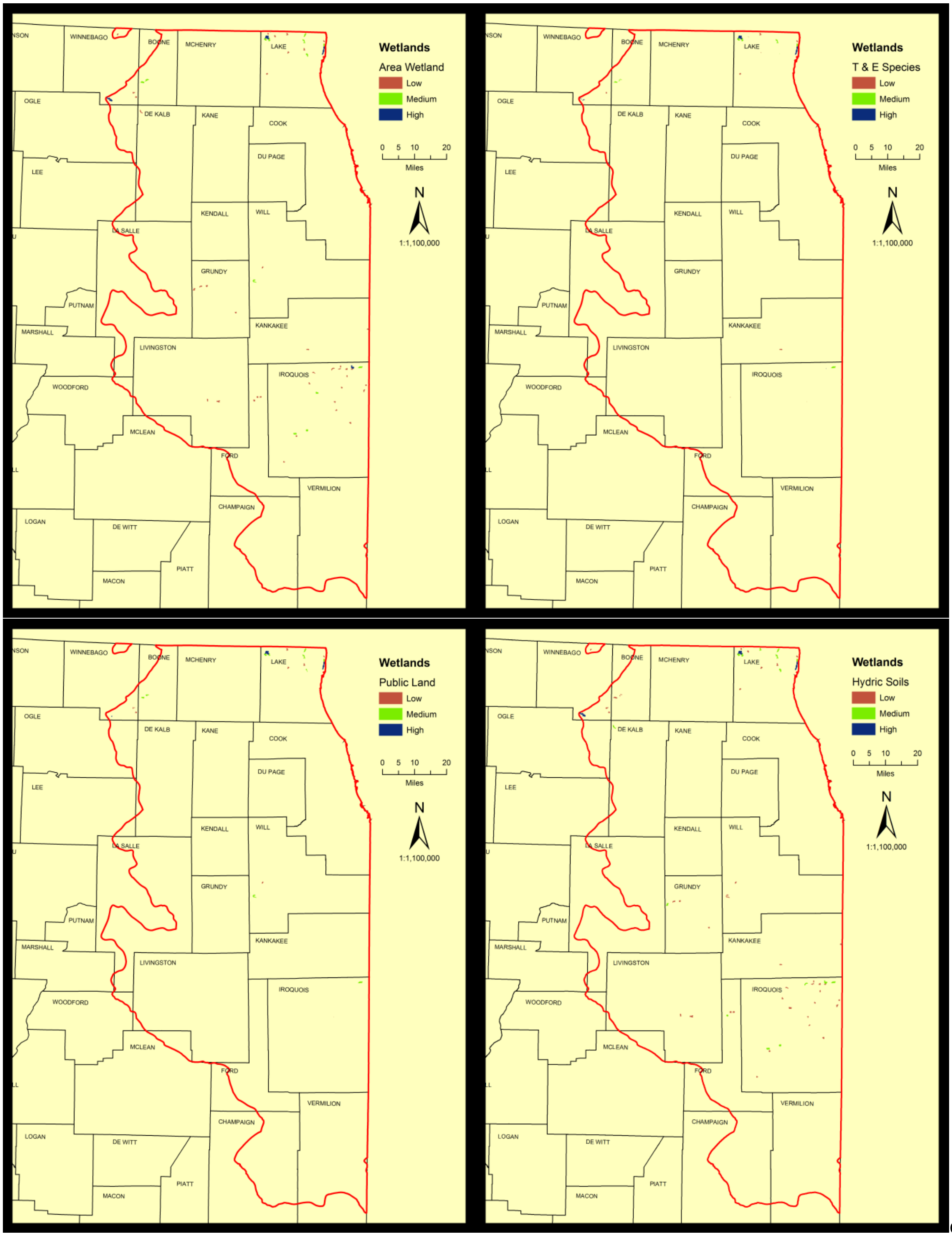
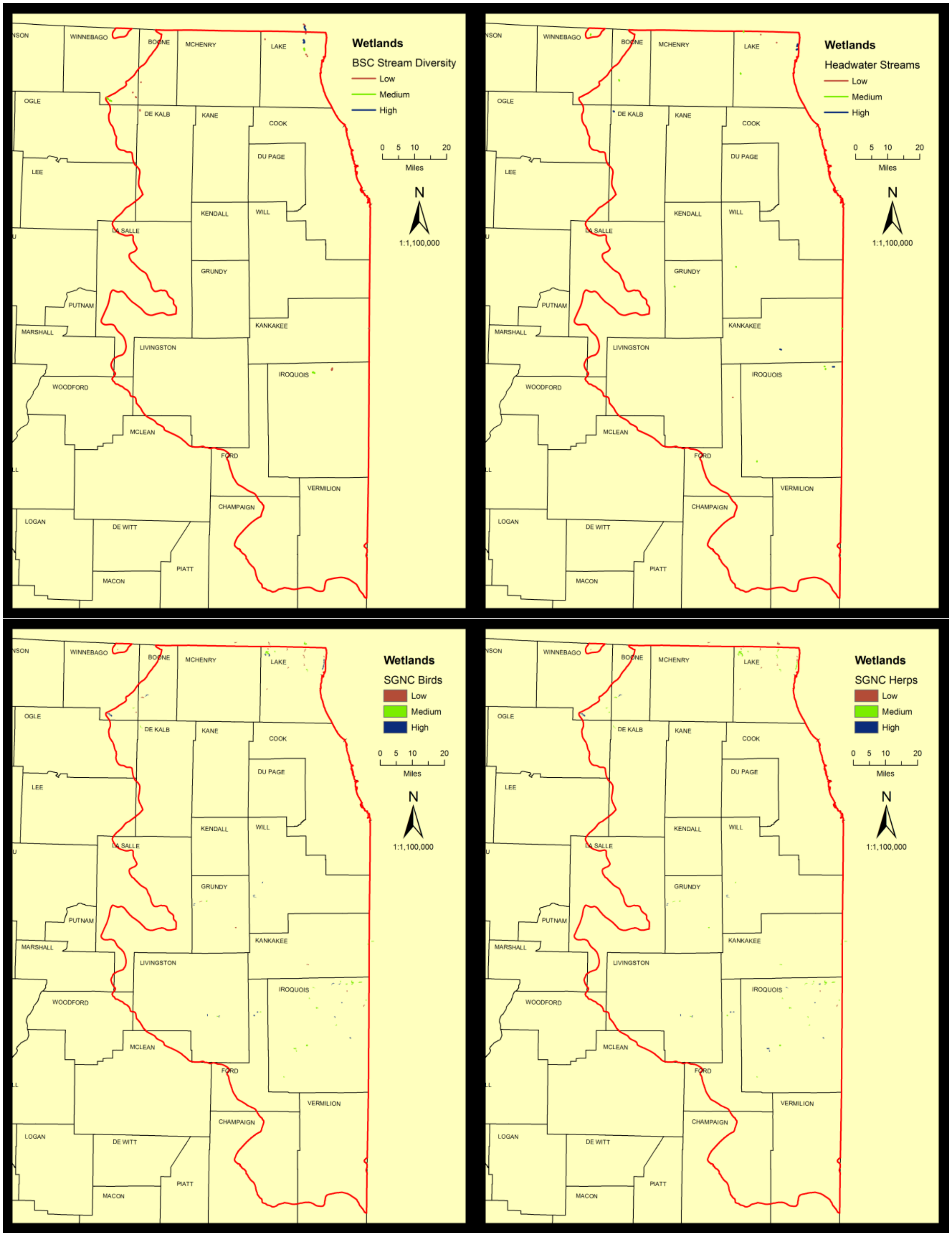
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON


Wetlands
Area Wetland
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Wetlands
T & E Species
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Wetlands
Public Land
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Wetlands
Hydric Soils
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON
e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High
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OGLE
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COOK
DU PAGE
LEE
KENDALL
WILL
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GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON
Wetlands
Headwater Streams
Low
Medium
High
0 5 10 20
Miles
N
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SGNC Birds
Low
Medium
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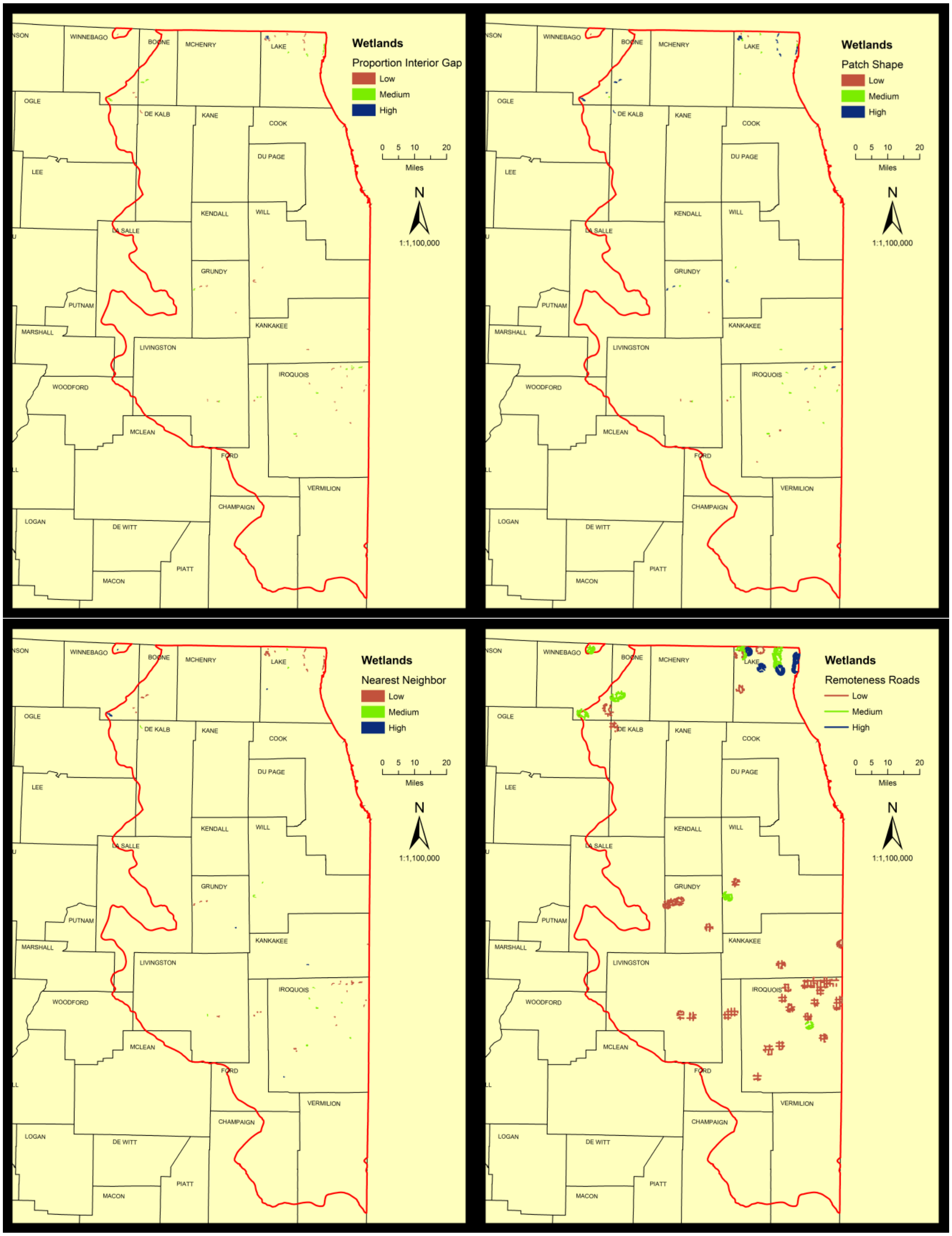
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MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON
Wetlands
Proportion Interior Gap
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
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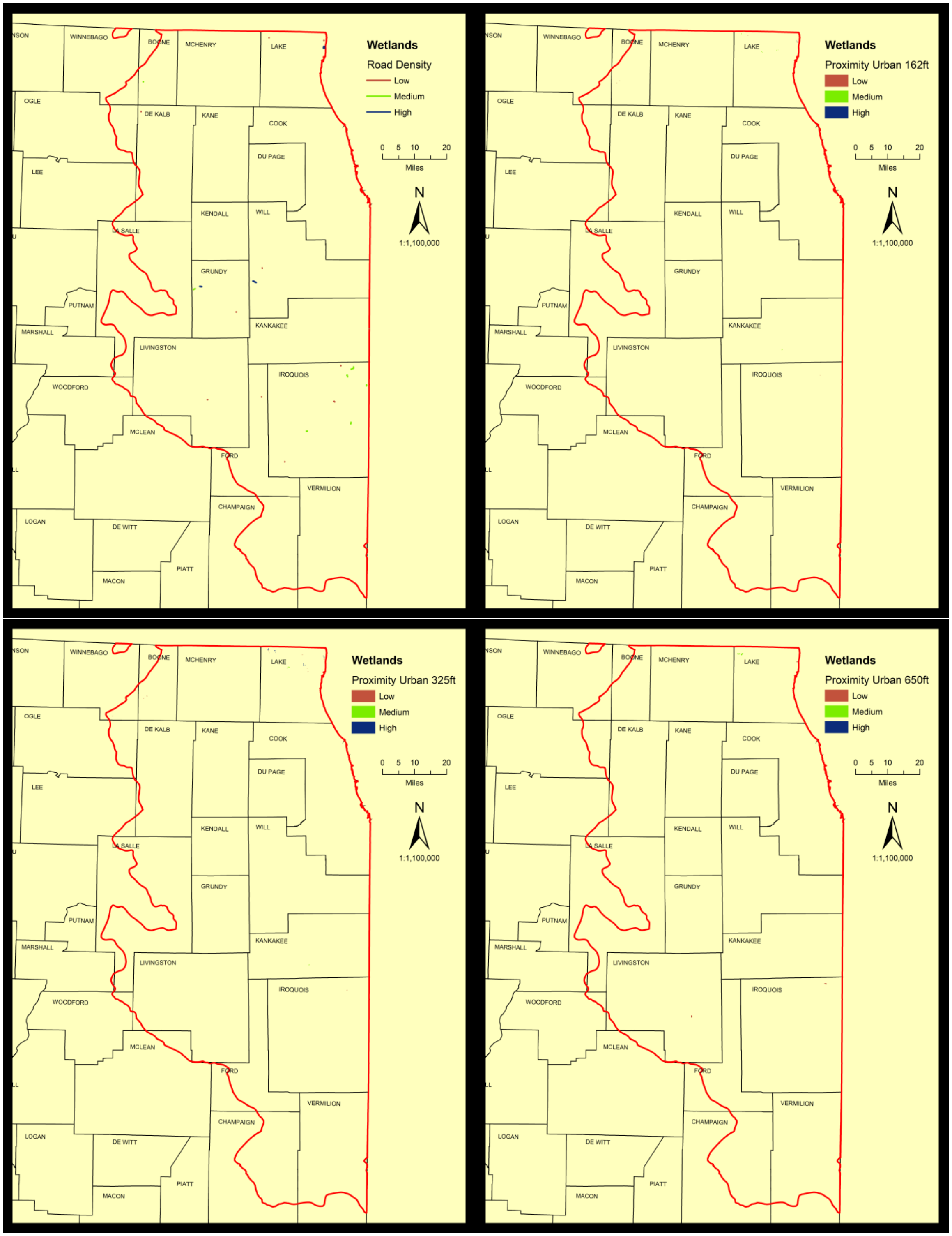
Low
Medium
High
Wetlands
Nearest Neighbor
Low
Medium
High
Wetlands
Remoteness Roads
Low
Medium
High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High
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Miles
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Proximity Urban 162ft
Low
Medium
High
0 5 10 20
Miles
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Wetlands
Proximity Urban 325ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
Wetlands
Proximity Urban 650ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
LEE
KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
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WOODFORD
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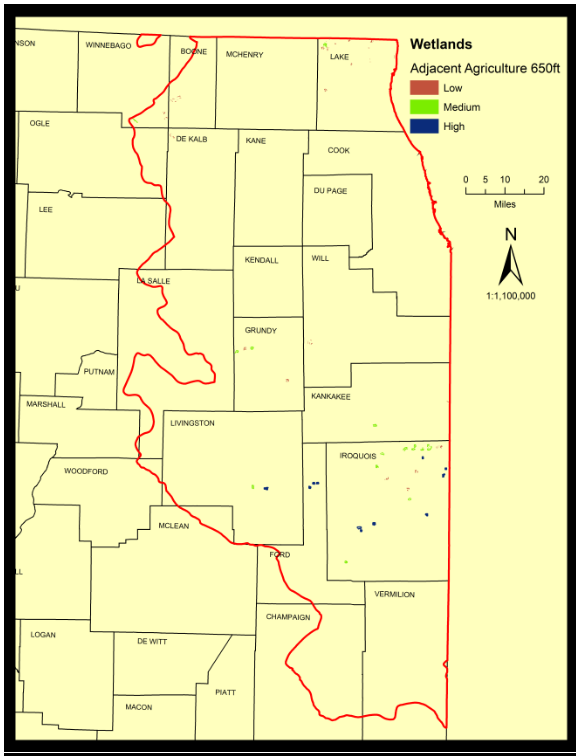
MACON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Medium
High
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Miles
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OGLE
DE KALB
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KENDALL
WILL
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GRUNDY
PUTNAM
MARSHALL
KANKAKEE
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CHAMPAIGN
LOGAN
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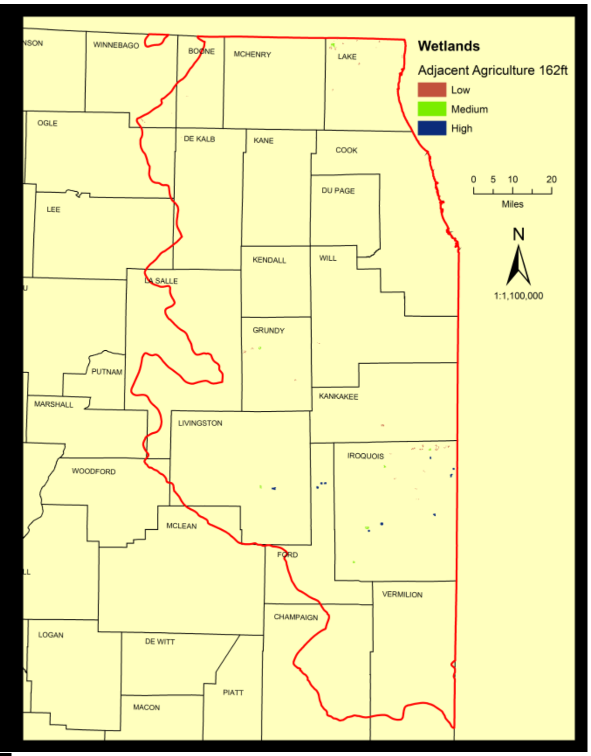
MACON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Adjacent Agriculture 162ft
Low
Medium
High
0 5 10 20
Miles
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WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
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KENDALL
WILL
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PUTNAM
MARSHALL
KANKAKEE
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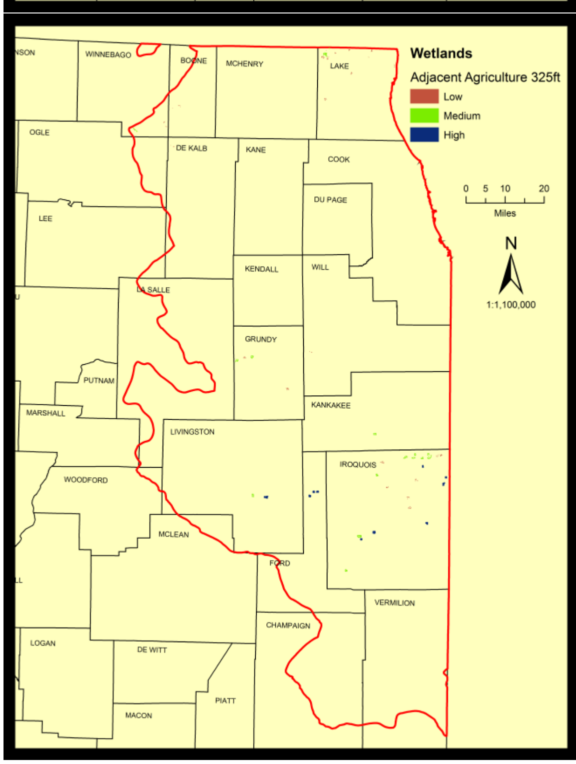
Wetlands
Adjacent Agriculture 325ft
Low
Medium
High
0 5 10 20
Miles
N
1:1,100,000
WINNEBAGO
BOONE
MCHENRY
LAKE
OGLE
DE KALB
KANE
COOK
DU PAGE
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KENDALL
WILL
LA SALLE
GRUNDY
PUTNAM
MARSHALL
KANKAKEE
LIVINGSTON
IROQUOIS
WOODFORD
MCLEAN
FORD
VERMILION
CHAMPAIGN
LOGAN
DE WITT
PIATT
MACON

Appendix IV

LEI ID	Total Rank	LEI ID	Total Rank
1	34.5	1360	-6.5
3	22.0	1532	-6.0
4	20.0	1055	-4.0
5	21.0	1547	-3.5
6	16.0	1296	-3.0
8	686.0	1545	-3.0
9	43.5	392	-2.0
11	53.5	689	-2.0
13	471.0	997	-2.0
14	14.5	859	-1.0
15	8.0	917	-1.0
16	130.0	205	0.0
19	141.5	435	0.0
20	25.0	701	0.0
22	15.0	943	0.0
23	17.0	957	0.0
24	17.0	1012	0.0
26	21.0	1197	0.0
28	14.0	1201	0.0
29	44.0	1255	0.0
30	17.5	372	1.0
32	21.0	884	1.0
33	228.0	914	1.0
34	10.0	938	1.0
36	15.0	1044	1.0
38	8.5	1267	1.0
39	20.0	1506	1.0
42	9.0	1549	1.0
43	22.0	497	1.5
45	8.5	511	1.5
48	22.5	553	1.5
49	14.0	694	1.5
50	22.0	232	2.0
51	35.0	329	2.0
55	46.5	356	2.0
58	36.0	377	2.0
62	26.0	381	2.0

LEI ID	Total Rank	LEI ID	Total Rank
63	26.0	383	2.0
64	284.5	390	2.0
65	21.0	415	2.0
66	21.0	430	2.0
68	152.0	659	2.0
70	11.5	845	2.0
71	38.5	851	2.0
72	45.0	874	2.0
74	98.0	940	2.0
76	18.0	961	2.0
77	18.0	990	2.0
78	26.0	999	2.0
80	4.0	1077	2.0
81	26.0	1229	2.0
84	3.5	1231	2.0
85	11.5	1232	2.0
87	8.0	1234	2.0
88	22.5	1281	2.0
90	9.0	1297	2.0
91	27.0	1399	2.0
94	25.0	1476	2.0
96	96.5	1489	2.0
97	56.0	1500	2.0
98	3.5	1529	2.0
100	11.5	1543	2.0
101	87.0	1058	2.5
102	39.5	1372	2.5
104	16.0	204	3.0
105	104.0	260	3.0
107	28.0	347	3.0
108	13.5	368	3.0
109	321.0	404	3.0
110	45.5	679	3.0
111	28.0	768	3.0
112	13.0	866	3.0
113	156.5	876	3.0
114	20.5	84	3.5
116	11.0	98	3.5
117	57.0	422	3.5
118	106.0	426	3.5
119	22.0	443	3.5

LEI ID	Total Rank	LEI ID	Total Rank
120	51.0	850	3.5
121	15.0	80	4.0
122	29.0	263	4.0
123	19.0	271	4.0
130	9.0	316	4.0
131	11.5	317	4.0
137	13.0	365	4.0
138	10.0	400	4.0
141	15.0	527	4.0
143	13.0	536	4.0
145	9.0	607	4.0
147	14.0	619	4.0
148	49.0	773	4.0
149	23.0	837	4.0
150	135.5	848	4.0
152	36.5	863	4.0
153	15.5	894	4.0
154	21.0	920	4.0
156	27.0	982	4.0
157	22.0	995	4.0
160	43.0	1011	4.0
163	10.5	1093	4.0
165	28.0	1102	4.0
166	39.0	1159	4.0
167	15.0	1176	4.0
168	21.0	1289	4.0
169	5.0	1295	4.0
171	28.5	1301	4.0
172	15.0	1319	4.0
173	16.0	1354	4.0
174	82.5	1362	4.0
175	19.0	1400	4.0
176	42.0	1419	4.0
177	61.0	1444	4.0
179	24.5	1548	4.0
180	403.0	1558	4.0
182	22.5	545	4.5
184	6.5	631	4.5
186	35.0	1037	4.5
187	30.5	1484	4.5
188	14.0	169	5.0

LEI ID	Total Rank	LEI ID	Total Rank
191	13.0	199	5.0
192	205.5	230	5.0
193	40.5	288	5.0
195	13.5	386	5.0
196	14.0	520	5.0
199	5.0	677	5.0
202	13.5	680	5.0
204	3.0	744	5.0
205	0.0	857	5.0
207	31.0	892	5.0
208	12.0	930	5.0
209	17.5	1001	5.0
210	8.5	1078	5.0
211	14.5	1196	5.0
214	6.0	1205	5.0
215	9.5	1492	5.0
216	27.0	1513	5.0
217	6.0	1521	5.0
219	9.5	361	5.5
221	6.5	414	5.5
222	109.0	467	5.5
223	17.0	468	5.5
225	8.0	555	5.5
226	12.0	594	5.5
228	42.0	988	5.5
229	18.5	1101	5.5
230	5.0	214	6.0
232	2.0	217	6.0
234	7.0	248	6.0
235	19.0	284	6.0
237	15.0	285	6.0
238	11.0	290	6.0
239	11.0	295	6.0
240	9.5	394	6.0
248	6.0	470	6.0
251	7.0	490	6.0
253	16.5	525	6.0
256	16.0	552	6.0
257	55.0	617	6.0
258	11.0	622	6.0
259	201.0	642	6.0

LEI ID	Total Rank	LEI ID	Total Rank
260	3.0	715	6.0
261	36.0	759	6.0
262	12.0	770	6.0
263	4.0	855	6.0
264	43.0	882	6.0
265	14.5	897	6.0
267	69.5	922	6.0
269	18.5	931	6.0
271	4.0	987	6.0
272	17.0	1053	6.0
275	46.0	1054	6.0
276	9.5	1063	6.0
278	14.0	1073	6.0
280	8.0	1098	6.0
282	12.0	1116	6.0
283	9.0	1137	6.0
284	6.0	1148	6.0
285	6.0	1158	6.0
286	7.0	1167	6.0
287	13.0	1180	6.0
288	5.0	1228	6.0
289	191.0	1259	6.0
290	6.0	1264	6.0
291	12.0	1271	6.0
292	68.0	1287	6.0
293	19.0	1326	6.0
294	15.5	1332	6.0
295	6.0	1343	6.0
296	137.5	1427	6.0
297	14.0	184	6.5
307	23.0	221	6.5
308	16.5	345	6.5
309	18.5	534	6.5
311	11.0	540	6.5
314	8.0	579	6.5
316	4.0	587	6.5
317	4.0	605	6.5
319	9.0	667	6.5
320	11.0	1314	6.5
322	15.5	1452	6.5
323	9.0	1455	6.5

LEI ID	Total Rank	LEI ID	Total Rank
324	23.5	1546	6.5
325	12.0	234	7.0
327	20.5	251	7.0
328	22.0	286	7.0
329	2.0	332	7.0
330	10.5	413	7.0
332	7.0	459	7.0
333	18.0	471	7.0
334	14.0	509	7.0
335	21.0	554	7.0
337	11.0	599	7.0
338	22.0	602	7.0
339	46.5	614	7.0
340	9.0	633	7.0
341	17.0	641	7.0
343	80.5	748	7.0
345	6.5	757	7.0
346	11.0	834	7.0
347	3.0	913	7.0
349	10.0	962	7.0
351	18.5	965	7.0
352	17.0	1065	7.0
355	18.5	1182	7.0
356	2.0	1193	7.0
357	19.0	1210	7.0
358	9.5	1331	7.0
359	15.5	1348	7.0
361	5.5	1366	7.0
362	54.0	1442	7.0
364	12.0	1485	7.0
365	4.0	1522	7.0
368	3.0	440	7.5
372	1.0	896	7.5
374	9.0	15	8.0
375	101.0	87	8.0
377	2.0	225	8.0
378	8.0	280	8.0
381	2.0	314	8.0
383	2.0	378	8.0
384	9.5	401	8.0
386	5.0	403	8.0

LEI ID	Total Rank	LEI ID	Total Rank
388	9.0	425	8.0
390	2.0	433	8.0
391	24.5	454	8.0
392	-2.0	455	8.0
394	6.0	512	8.0
395	8.5	515	8.0
397	11.0	532	8.0
399	52.5	542	8.0
400	4.0	548	8.0
401	8.0	549	8.0
402	12.5	564	8.0
403	8.0	643	8.0
404	3.0	738	8.0
408	10.0	778	8.0
409	15.5	817	8.0
410	8.5	843	8.0
411	48.5	853	8.0
412	10.0	880	8.0
413	7.0	891	8.0
414	5.5	903	8.0
415	2.0	941	8.0
416	18.0	978	8.0
419	11.0	1005	8.0
422	3.5	1008	8.0
425	8.0	1033	8.0
426	3.5	1048	8.0
428	11.5	1064	8.0
430	2.0	1094	8.0
431	8.5	1123	8.0
432	16.0	1144	8.0
433	8.0	1156	8.0
434	15.5	1172	8.0
435	0.0	1174	8.0
438	13.5	1183	8.0
439	18.5	1189	8.0
440	7.5	1194	8.0
443	3.5	1222	8.0
445	16.5	1224	8.0
446	12.0	1243	8.0
447	10.0	1248	8.0
448	11.0	1251	8.0

LEI ID	Total Rank	LEI ID	Total Rank
449	10.0	1260	8.0
450	26.5	1263	8.0
454	8.0	1269	8.0
455	8.0	1272	8.0
456	10.0	1291	8.0
459	7.0	1303	8.0
461	32.0	1307	8.0
467	5.5	1334	8.0
468	5.5	1353	8.0
470	6.0	1378	8.0
471	7.0	1380	8.0
476	12.0	1386	8.0
478	19.0	1387	8.0
479	29.5	1441	8.0
480	9.5	1470	8.0
482	20.0	1472	8.0
483	31.0	1475	8.0
487	14.0	1496	8.0
488	10.0	38	8.5
490	6.0	45	8.5
492	38.0	210	8.5
496	12.5	395	8.5
497	1.5	410	8.5
500	39.0	431	8.5
501	8.5	501	8.5
502	30.0	610	8.5
503	11.0	646	8.5
505	29.0	733	8.5
507	9.0	1292	8.5
509	7.0	1377	8.5
510	85.5	1423	8.5
511	1.5	42	9.0
512	8.0	90	9.0
515	8.0	130	9.0
517	9.0	145	9.0
518	10.5	283	9.0
520	5.0	319	9.0
522	15.0	323	9.0
525	6.0	340	9.0
527	4.0	374	9.0
528	25.0	388	9.0

LEI ID	Total Rank	LEI ID	Total Rank
531	9.0	507	9.0
532	8.0	517	9.0
533	17.5	531	9.0
534	6.5	586	9.0
536	4.0	593	9.0
539	11.0	601	9.0
540	6.5	628	9.0
541	18.0	695	9.0
542	8.0	702	9.0
544	12.0	714	9.0
545	4.5	749	9.0
548	8.0	752	9.0
549	8.0	832	9.0
552	6.0	867	9.0
553	1.5	887	9.0
554	7.0	900	9.0
555	5.5	992	9.0
557	28.0	1042	9.0
560	121.0	1043	9.0
561	11.0	1049	9.0
564	8.0	1050	9.0
568	50.5	1074	9.0
574	24.0	1103	9.0
579	6.5	1136	9.0
582	13.0	1219	9.0
583	12.0	1262	9.0
586	9.0	1359	9.0
587	6.5	1368	9.0
588	11.5	1405	9.0
590	15.0	1406	9.0
593	9.0	1416	9.0
594	5.5	1428	9.0
596	99.0	1445	9.0
598	13.0	1468	9.0
599	7.0	1471	9.0
601	9.0	1474	9.0
602	7.0	1507	9.0
603	19.5	215	9.5
605	6.5	219	9.5
607	4.0	240	9.5
609	19.0	276	9.5

LEI ID	Total Rank	LEI ID	Total Rank
610	8.5	358	9.5
611	14.5	384	9.5
612	24.0	480	9.5
614	7.0	654	9.5
617	6.0	1132	9.5
618	23.5	1247	9.5
619	4.0	1449	9.5
622	6.0	34	10.0
623	58.5	138	10.0
625	17.0	349	10.0
626	16.0	408	10.0
628	9.0	412	10.0
630	16.5	447	10.0
631	4.5	449	10.0
633	7.0	456	10.0
634	10.5	488	10.0
635	14.0	649	10.0
636	62.0	658	10.0
639	35.5	700	10.0
641	7.0	710	10.0
642	6.0	1181	10.0
643	8.0	1190	10.0
646	8.5	1200	10.0
648	28.5	1207	10.0
649	10.0	1225	10.0
652	100.5	1256	10.0
654	9.5	1313	10.0
656	17.0	1401	10.0
658	10.0	1402	10.0
659	2.0	1457	10.0
663	26.0	1494	10.0
664	13.0	1512	10.0
665	14.0	163	10.5
667	6.5	330	10.5
668	23.5	518	10.5
671	62.5	634	10.5
672	28.5	814	10.5
673	12.0	1015	10.5
675	18.0	1499	10.5
676	12.0	1533	10.5
677	5.0	116	11.0

LEI ID	Total Rank	LEI ID	Total Rank
679	3.0	238	11.0
680	5.0	239	11.0
681	12.0	258	11.0
684	17.0	311	11.0
685	16.5	320	11.0
686	14.5	337	11.0
688	46.0	346	11.0
689	-2.0	397	11.0
692	19.0	419	11.0
694	1.5	448	11.0
695	9.0	503	11.0
696	17.0	539	11.0
698	24.5	561	11.0
700	10.0	816	11.0
701	0.0	825	11.0
702	9.0	847	11.0
706	14.5	937	11.0
707	145.0	1104	11.0
709	44.5	1273	11.0
710	10.0	1274	11.0
711	14.5	1316	11.0
712	14.5	1407	11.0
714	9.0	1453	11.0
715	6.0	1464	11.0
717	28.5	70	11.5
719	22.0	85	11.5
722	42.5	100	11.5
730	129.0	131	11.5
733	8.5	428	11.5
734	17.0	588	11.5
736	29.0	782	11.5
738	8.0	1276	11.5
739	37.0	208	12.0
741	23.0	226	12.0
742	18.0	262	12.0
744	5.0	282	12.0
746	32.5	291	12.0
747	19.0	325	12.0
748	7.0	364	12.0
749	9.0	446	12.0
750	37.0	476	12.0

LEI ID	Total Rank	LEI ID	Total Rank
751	12.5	544	12.0
752	9.0	583	12.0
753	15.0	673	12.0
755	33.0	676	12.0
757	7.0	681	12.0
758	23.0	794	12.0
759	6.0	888	12.0
760	14.5	911	12.0
761	18.5	969	12.0
762	19.0	989	12.0
763	21.0	1023	12.0
764	14.0	1217	12.0
766	14.5	1227	12.0
768	3.0	1306	12.0
770	6.0	1443	12.0
771	17.0	1539	12.0
772	20.5	402	12.5
773	4.0	496	12.5
776	17.0	751	12.5
778	8.0	1431	12.5
779	27.0	112	13.0
780	313.5	137	13.0
781	25.0	143	13.0
782	11.5	191	13.0
783	42.0	287	13.0
786	16.0	582	13.0
788	16.0	598	13.0
791	25.5	664	13.0
794	12.0	823	13.0
795	14.0	841	13.0
796	74.5	916	13.0
797	18.0	1080	13.0
798	21.0	1309	13.0
799	15.5	1375	13.0
800	19.5	1385	13.0
802	34.0	1412	13.0
806	16.0	1480	13.0
812	27.5	108	13.5
813	17.0	195	13.5
814	10.5	202	13.5
815	15.5	438	13.5

LEI ID	Total Rank	LEI ID	Total Rank
816	11.0	831	13.5
817	8.0	835	13.5
818	93.0	923	13.5
819	19.5	924	13.5
821	20.0	951	13.5
822	17.0	1294	13.5
823	13.0	1312	13.5
824	15.0	1340	13.5
825	11.0	1403	13.5
826	15.5	1440	13.5
827	20.5	28	14.0
829	19.0	49	14.0
830	68.0	147	14.0
831	13.5	188	14.0
832	9.0	196	14.0
834	7.0	278	14.0
835	13.5	297	14.0
837	4.0	334	14.0
839	201.0	487	14.0
840	19.0	635	14.0
841	13.0	665	14.0
843	8.0	764	14.0
844	20.5	795	14.0
845	2.0	1027	14.0
847	11.0	1066	14.0
848	4.0	1106	14.0
849	17.0	1171	14.0
850	3.5	1218	14.0
851	2.0	1390	14.0
852	18.5	1525	14.0
853	8.0	14	14.5
854	62.5	211	14.5
855	6.0	265	14.5
857	5.0	611	14.5
859	-1.0	686	14.5
860	18.0	706	14.5
862	93.0	711	14.5
863	4.0	712	14.5
866	3.0	760	14.5
867	9.0	766	14.5
868	38.0	908	14.5

LEI ID	Total Rank	LEI ID	Total Rank
870	15.5	1293	14.5
872	55.0	1469	14.5
874	2.0	22	15.0
875	59.5	36	15.0
876	3.0	121	15.0
878	15.0	141	15.0
880	8.0	167	15.0
882	6.0	172	15.0
884	1.0	237	15.0
886	44.0	522	15.0
887	9.0	590	15.0
888	12.0	753	15.0
890	15.0	824	15.0
891	8.0	878	15.0
892	5.0	890	15.0
894	4.0	996	15.0
895	113.5	1036	15.0
896	7.5	1127	15.0
897	6.0	1128	15.0
900	9.0	1145	15.0
903	8.0	1164	15.0
905	61.0	1192	15.0
906	23.0	1266	15.0
908	14.5	1280	15.0
909	15.5	1369	15.0
911	12.0	1454	15.0
912	57.0	153	15.5
913	7.0	294	15.5
914	1.0	322	15.5
916	13.0	359	15.5
917	-1.0	409	15.5
918	79.0	434	15.5
920	4.0	799	15.5
921	15.5	815	15.5
922	6.0	826	15.5
923	13.5	870	15.5
924	13.5	909	15.5
925	42.0	921	15.5
929	17.0	963	15.5
930	5.0	6	16.0
931	6.0	104	16.0

LEI ID	Total Rank	LEI ID	Total Rank
936	25.0	173	16.0
937	11.0	256	16.0
938	1.0	432	16.0
940	2.0	626	16.0
941	8.0	786	16.0
943	0.0	788	16.0
950	74.5	806	16.0
951	13.5	1283	16.0
955	20.5	1299	16.0
957	0.0	253	16.5
961	2.0	308	16.5
962	7.0	445	16.5
963	15.5	630	16.5
965	7.0	685	16.5
968	26.0	1125	16.5
969	12.0	23	17.0
970	216.0	24	17.0
971	20.0	223	17.0
972	569.5	272	17.0
973	199.0	341	17.0
974	18.5	352	17.0
975	17.0	625	17.0
976	32.0	656	17.0
978	8.0	684	17.0
980	40.5	696	17.0
982	4.0	734	17.0
984	30.0	771	17.0
986	18.0	776	17.0
987	6.0	813	17.0
988	5.5	822	17.0
989	12.0	849	17.0
990	2.0	929	17.0
992	9.0	975	17.0
994	43.0	1091	17.0
995	4.0	1096	17.0
996	15.0	30	17.5
997	-2.0	209	17.5
998	20.0	533	17.5
999	2.0	1555	17.5
1001	5.0	76	18.0
1003	26.0	77	18.0

LEI ID	Total Rank	LEI ID	Total Rank
1005	8.0	333	18.0
1008	8.0	416	18.0
1010	23.0	541	18.0
1011	4.0	675	18.0
1012	0.0	742	18.0
1015	10.5	797	18.0
1017	20.0	860	18.0
1020	23.0	986	18.0
1022	51.0	1068	18.0
1023	12.0	1257	18.0
1027	14.0	1435	18.0
1028	38.0	229	18.5
1033	8.0	269	18.5
1035	63.0	309	18.5
1036	15.0	351	18.5
1037	4.5	355	18.5
1040	22.0	439	18.5
1042	9.0	761	18.5
1043	9.0	852	18.5
1044	1.0	974	18.5
1045	67.5	1508	18.5
1048	8.0	123	19.0
1049	9.0	175	19.0
1050	9.0	235	19.0
1051	70.0	293	19.0
1052	30.0	357	19.0
1053	6.0	478	19.0
1054	6.0	609	19.0
1055	-4.0	692	19.0
1056	88.5	747	19.0
1058	2.5	762	19.0
1063	6.0	829	19.0
1064	8.0	840	19.0
1065	7.0	1186	19.0
1066	14.0	1393	19.0
1067	29.0	603	19.5
1068	18.0	800	19.5
1070	150.0	819	19.5
1071	28.0	1530	19.5
1072	52.5	4	20.0
1073	6.0	39	20.0

LEI ID	Total Rank	LEI ID	Total Rank
1074	9.0	482	20.0
1075	28.0	821	20.0
1077	2.0	971	20.0
1078	5.0	998	20.0
1080	13.0	1017	20.0
1081	23.5	1085	20.0
1085	20.0	114	20.5
1090	62.0	327	20.5
1091	17.0	772	20.5
1093	4.0	827	20.5
1094	8.0	844	20.5
1095	27.0	955	20.5
1096	17.0	1463	20.5
1097	73.5	5	21.0
1098	6.0	26	21.0
1101	5.5	32	21.0
1102	4.0	65	21.0
1103	9.0	66	21.0
1104	11.0	154	21.0
1105	29.5	168	21.0
1106	14.0	335	21.0
1116	6.0	763	21.0
1119	115.5	798	21.0
1120	162.5	1392	21.5
1123	8.0	3	22.0
1124	70.5	43	22.0
1125	16.5	50	22.0
1127	15.0	119	22.0
1128	15.0	157	22.0
1132	9.5	328	22.0
1136	9.0	338	22.0
1137	6.0	719	22.0
1139	115.0	1040	22.0
1144	8.0	1168	22.0
1145	15.0	1187	22.0
1146	63.0	1461	22.0
1148	6.0	48	22.5
1149	22.5	88	22.5
1156	8.0	182	22.5
1158	6.0	1149	22.5
1159	4.0	149	23.0

LEI ID	Total Rank	LEI ID	Total Rank
1164	15.0	307	23.0
1165	23.5	741	23.0
1166	29.0	758	23.0
1167	6.0	906	23.0
1168	22.0	1010	23.0
1171	14.0	1020	23.0
1172	8.0	1215	23.0
1174	8.0	1503	23.0
1175	102.0	1544	23.0
1176	4.0	1560	23.0
1179	245.5	1561	23.0
1180	6.0	324	23.5
1181	10.0	618	23.5
1182	7.0	668	23.5
1183	8.0	1081	23.5
1184	33.5	1165	23.5
1186	19.0	574	24.0
1187	22.0	612	24.0
1189	8.0	1389	24.0
1190	10.0	1395	24.0
1192	15.0	1397	24.0
1193	7.0	179	24.5
1194	8.0	391	24.5
1196	5.0	698	24.5
1197	0.0	1374	24.5
1200	10.0	20	25.0
1201	0.0	94	25.0
1205	5.0	528	25.0
1207	10.0	781	25.0
1210	7.0	936	25.0
1211	25.0	1211	25.0
1213	27.0	1381	25.0
1214	30.5	791	25.5
1215	23.0	1410	25.5
1217	12.0	62	26.0
1218	14.0	63	26.0
1219	9.0	78	26.0
1222	8.0	81	26.0
1224	8.0	663	26.0
1225	10.0	968	26.0
1226	26.0	1003	26.0

LEI ID	Total Rank	LEI ID	Total Rank
1227	12.0	1226	26.0
1228	6.0	450	26.5
1229	2.0	1328	26.5
1231	2.0	91	27.0
1232	2.0	156	27.0
1234	2.0	216	27.0
1235	83.5	779	27.0
1243	8.0	1095	27.0
1245	29.5	1213	27.0
1247	9.5	1553	27.0
1248	8.0	812	27.5
1251	8.0	107	28.0
1255	0.0	111	28.0
1256	10.0	165	28.0
1257	18.0	557	28.0
1259	6.0	1071	28.0
1260	8.0	1075	28.0
1262	9.0	171	28.5
1263	8.0	648	28.5
1264	6.0	672	28.5
1266	15.0	717	28.5
1267	1.0	122	29.0
1269	8.0	505	29.0
1271	6.0	736	29.0
1272	8.0	1067	29.0
1273	11.0	1166	29.0
1274	11.0	479	29.5
1276	11.5	1105	29.5
1279	35.0	1245	29.5
1280	15.0	502	30.0
1281	2.0	984	30.0
1283	16.0	1052	30.0
1287	6.0	1559	30.0
1289	4.0	187	30.5
1291	8.0	1214	30.5
1292	8.5	1330	30.5
1293	14.5	1370	30.5
1294	13.5	207	31.0
1295	4.0	483	31.0
1296	-3.0	461	32.0
1297	2.0	976	32.0

LEI ID	Total Rank	LEI ID	Total Rank
1299	16.0	746	32.5
1300	70.5	755	33.0
1301	4.0	1398	33.0
1303	8.0	1447	33.0
1306	12.0	1184	33.5
1307	8.0	802	34.0
1309	13.0	1	34.5
1312	13.5	1497	34.5
1313	10.0	51	35.0
1314	6.5	186	35.0
1316	11.0	1279	35.0
1318	123.0	639	35.5
1319	4.0	58	36.0
1326	6.0	261	36.0
1328	26.5	152	36.5
1330	30.5	1518	36.5
1331	7.0	739	37.0
1332	6.0	750	37.0
1333	41.5	492	38.0
1334	8.0	868	38.0
1335	41.0	1028	38.0
1337	39.0	71	38.5
1339	41.0	166	39.0
1340	13.5	500	39.0
1343	6.0	1337	39.0
1344	41.5	102	39.5
1348	7.0	193	40.5
1353	8.0	980	40.5
1354	4.0	1335	41.0
1359	9.0	1339	41.0
1360	-6.5	1466	41.0
1362	4.0	1333	41.5
1366	7.0	1344	41.5
1368	9.0	176	42.0
1369	15.0	228	42.0
1370	30.5	783	42.0
1372	2.5	925	42.0
1374	24.5	722	42.5
1375	13.0	160	43.0
1376	45.0	264	43.0
1377	8.5	994	43.0

LEI ID	Total Rank	LEI ID	Total Rank
1378	8.0	9	43.5
1380	8.0	29	44.0
1381	25.0	886	44.0
1385	13.0	1551	44.0
1386	8.0	709	44.5
1387	8.0	72	45.0
1389	24.0	1376	45.0
1390	14.0	110	45.5
1391	56.5	275	46.0
1392	21.5	688	46.0
1393	19.0	55	46.5
1395	24.0	339	46.5
1397	24.0	1411	46.5
1398	33.0	411	48.5
1399	2.0	148	49.0
1400	4.0	1424	50.0
1401	10.0	568	50.5
1402	10.0	120	51.0
1403	13.5	1022	51.0
1405	9.0	399	52.5
1406	9.0	1072	52.5
1407	11.0	11	53.5
1410	25.5	1438	53.5
1411	46.5	1498	53.5
1412	13.0	362	54.0
1416	9.0	257	55.0
1419	4.0	872	55.0
1423	8.5	1552	55.5
1424	50.0	97	56.0
1425	86.0	1391	56.5
1427	6.0	117	57.0
1428	9.0	912	57.0
1431	12.5	623	58.5
1435	18.0	875	59.5
1438	53.5	177	61.0
1440	13.5	905	61.0
1441	8.0	636	62.0
1442	7.0	1090	62.0
1443	12.0	671	62.5
1444	4.0	854	62.5
1445	9.0	1035	63.0

LEI ID	Total Rank	LEI ID	Total Rank
1447	33.0	1146	63.0
1449	9.5	1045	67.5
1452	6.5	292	68.0
1453	11.0	830	68.0
1454	15.0	1488	68.0
1455	6.5	267	69.5
1457	10.0	1051	70.0
1461	22.0	1124	70.5
1463	20.5	1300	70.5
1464	11.0	1097	73.5
1466	41.0	796	74.5
1468	9.0	950	74.5
1469	14.5	918	79.0
1470	8.0	343	80.5
1471	9.0	174	82.5
1472	8.0	1235	83.5
1474	9.0	510	85.5
1475	8.0	1425	86.0
1476	2.0	101	87.0
1480	13.0	1056	88.5
1484	4.5	1510	91.0
1485	7.0	818	93.0
1488	68.0	862	93.0
1489	2.0	96	96.5
1492	5.0	74	98.0
1494	10.0	596	99.0
1496	8.0	652	100.5
1497	34.5	375	101.0
1498	53.5	1175	102.0
1499	10.5	105	104.0
1500	2.0	118	106.0
1503	23.0	222	109.0
1506	1.0	895	113.5
1507	9.0	1139	115.0
1508	18.5	1119	115.5
1510	91.0	560	121.0
1512	10.0	1318	123.0
1513	5.0	730	129.0
1518	36.5	16	130.0
1521	5.0	150	135.5
1522	7.0	296	137.5

LEI ID	Total Rank	LEI ID	Total Rank
1525	14.0	19	141.5
1529	2.0	707	145.0
1530	19.5	1070	150.0
1532	-6.0	68	152.0
1533	10.5	113	156.5
1539	12.0	1120	162.5
1543	2.0	289	191.0
1544	23.0	973	199.0
1545	-3.0	259	201.0
1546	6.5	839	201.0
1547	-3.5	192	205.5
1548	4.0	970	216.0
1549	1.0	33	228.0
1551	44.0	1179	245.5
1552	55.5	64	284.5
1553	27.0	780	313.5
1555	17.5	109	321.0
1558	4.0	180	403.0
1559	30.0	13	471.0
1560	23.0	972	569.5
1561	23.0	8	686.0

Appendix V

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
8	Alden Sedge Meadow	I, II	1262	316.96		
8	Blair Fens and Wet Prairie	I	1709	12.09		
8	Clemetsen "Maunk-Sook" Sedge Meadow and Savanna	II-R	1710	54.31		
8	Harvard East Geological Area	IV	98	22.94		
8	Harvard Savanna	I, II	1268	68.12		
8	Hebron Peatland	I	1491	312.82		
8	Kishwaukee River	II, VI	720	3.40		
8	Nippersink Creek	II, III	1506	13.31		
8 Total				803.95	17,232.66	4.67
9	Kaskel Fen	I, II	1566	10.89		
9 Total				10.89	562.59	1.94
11	Genoa City Sedge Meadow	II	1264	119.31		
11	North Branch of Nippersink Creek	II, VI	1507	7.93		
11 Total				127.23	1,176.33	10.82
13	Channel Lake	I, II	673	0.86		
13	Elizabeth Lake	I, II, III	1014	247.48		
13	Gander Mountain Geological Area	I, II, IV	1569	295.54		
13	Grass Lake Wetlands	I, II	648	1,122.31		
13	Horserace Springs Fen	I	1565	102.56		
13	Nippersink Marsh	I	1492	211.33		
13	North Branch of Nippersink Creek	II, VI	1507	11.84		
13	Turner Lake	I, II, III	987	101.57		
13	Wadley Marsh	II	1571	95.37		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
13 Total				2,188.87	9,863.95	22.19
14	Channel Lake	I, II	673	6.84		
14 Total				6.84	117.01	5.85
16	Antioch Bog	I	650	25.34		
16	Redwing Slough	II, III	1050	574.54		
16 Total				599.88	2,355.75	25.46
30	Illinois Dunes North	I, II, III	1066	792.14		
30 Total				792.14	1,218.95	64.99
33	Wadsworth Prairie and Savanna	I, II, III	649	437.05		
33 Total				437.05	3,789.36	11.53
38	Little Silver Lake	I, II	1700	26.38		
38 Total				26.38	471.93	5.59
48	Loon Lake	II	670	50.87		
48 Total				50.87	752.45	6.76
51	Grass Lake Wetlands	I, II	648	142.53		
51 Total				142.53	263.47	54.10
63	Piscasaw Creek	VI	1508	3.27		
63 Total				3.27	716.80	0.46
64	Delta Kames	I, II, III, IV	711	1,309.43		
64	North Branch of Nippersink Creek	II, VI	1507	12.28		
64 Total				1,321.71	6,045.92	21.86
68	Illinois Beach	I, II, III	1083	1,547.31		
68	Lyons Woods	II, III	1250	317.58		
68	Waukegan Beach	II	1049	100.95		
68 Total				1,965.84	2,647.90	74.24
71	Beck Woods Conservation Area	II	710	6.82		
71	Piscasaw Creek	VI	1508	1.24		
71 Total				8.05	340.19	2.37

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
72	Spring Grove Fen	I, III	712	43.32		
72 Total				43.32	1,149.21	3.77
74	Deep Lake	II	1244	4.01		
74	Sun Lake	II	1248	1.03		
74 Total				5.05	2,693.62	0.19
87	McDonald Woods Marsh	II	1249	17.26		
87 Total				17.26	275.10	6.27
96	Barber Fen	I, II, III	1267	0.00		
96	Lind Forest	II, III	1266	89.80		
96	Nippersink Creek	II, III	1506	14.93		
96 Total				104.73	1,142.23	9.17
105	Fourth Lake - Rollins Road Savanna	I, II, III	652	529.90		
105 Total				529.90	2,169.77	24.42
108	Piscasaw Creek	VI	1508	2.82		
108 Total				2.82	374.29	0.75
109	Barber Fen	I, II, III	1267	119.21		
109	Boloria Meadows	I, III	1705	43.71		
109	Boone Creek Fen and Seep	I, III	1015	461.33		
109	Gladstone Fen	I, III	1265	40.17		
109	Nippersink Creek	II, III	1506	7.75		
109	Parker Fen	I, II, III	1257	51.40		
109 Total				723.56	11,511.43	6.29
113	Kishwaukee River	II, VI	720	2.12		
113 Total				2.12	4,018.73	0.05
114	Gavin Bog and Prairie	I, II, III	794	222.64		
114 Total				222.64	800.49	27.81
117	Piscasaw Creek	VI	1508	10.58		
117 Total				10.58	552.52	1.91

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
118	Standlee Fen	I	1614	47.64		
118 Total				47.64	1,693.97	2.81
119	Piscasaw Creek	VI	1508	3.33		
119 Total				3.33	237.13	1.40
120	Bystricky Prairie	I, II, III	1254	16.20		
120	Slough Creek Sedge Meadow	II, III	715	23.61		
120 Total				39.81	373.51	10.66
121	Weingart Road Sedge Meadow	I, III	709	76.10		
121 Total				76.10	237.13	32.09
123	Harrison - Benwell Conservation Area	II	706	50.68		
123 Total				50.68	200.70	25.25
131	Wooster Lake	II	1572	9.95		
131 Total				9.95	531.59	1.87
147	Queen Anne Prairie - Eckert Cemetery	III	1051	1.02		
147 Total				1.02	439.38	0.23
148	Piscasaw Creek	VI	1508	8.68		
148 Total				8.68	334.77	2.59
150	Lac Louette	I, II	1000	91.31		
150	Pistakee - Brandenburg Bog	I, II, III	983	420.66		
150	Stanley Road Bog	I, II	651	11.50		
150	Volo Bog	I, II, III	1005	252.90		
150 Total				776.37	2,905.17	26.72
152	Fish Lake and Marl Flat Forest Preserve	I, II	1682	215.55		
152 Total				215.55	852.41	25.29
157	Piscasaw Creek	VI	1508	7.10		
157 Total				7.10	281.30	2.52
160	Deep Cut Marsh Wildlife Refuge	II	705	14.66		
160	Lakota Boy Scout Camp Marsh	I	1525	19.55		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
160 Total				34.21	530.04	6.45
171	Round Lake Marsh	II	1243	111.31		
171 Total				111.31	780.34	14.26
177	Ascension Sedge Meadow	II	1554	52.95		
177	River Road Woods	I	653	13.99		
177	St. Francis Boys Camp	I	70	72.22		
177 Total				139.15	1,171.68	11.88
179	West Woodstock Prairie	I	1568	69.08		
179 Total				69.08	2,025.64	3.41
180	HUM Railroad Prairie West	I, II	1270	16.59		
180	Kishwaukee River	II, VI	720	170.59		
180 Total				187.18	12,174.76	1.54
182	Almond Marsh	I, II, III	1253	346.91		
182 Total				346.91	796.62	43.55
184	Oak Grove Botanical Area	II	654	278.46		
184 Total				278.46	375.06	74.25
192	Black - Crown Marsh	II, III	1503	263.50		
192	Kettle Moraine	I, II, III	1012	507.84		
192	Lily Lake	II	1271	2.56		
192	Sterne's Fen	I, II, III	1013	168.78		
192	Stickney Run Conservation Area	I, II	1273	469.98		
192	Thunderbird Lake	I, II	1558	50.52		
192	Wingate Prairie	I, II, II-R, III	1258	57.23		
192 Total				1,520.40	7,516.72	20.23
193	Sargent Marsh	II	1570	11.23		
193 Total				11.23	364.99	3.08
195	Wheeler Fen	III	1764	25.66		
195 Total				25.66	175.13	14.65

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
207	Liberty Prairie	I, III	1252	60.42		
207 Total				60.42	633.11	9.54
209	Kishwaukee River	II, VI	720	3.45		
209 Total				3.45	434.73	0.79
222	Kishwaukee River	II, VI	720	69.72		
222 Total				69.72	2,970.27	2.35
240	Blair Woods	I, II	655	98.74		
240	Blodgett Bluff	II	1246	2.89		
240	Crabtree Farm Woods	I	656	29.82		
240 Total				131.45	290.59	45.23
256	Cotton Creek Marsh	I, II, III	707	237.54		
256 Total				237.54	314.62	75.50
257	Elm Road Woods	I, II	1555	86.89		
257	Grainger Flatwoods	II, III	667	225.02		
257	Lloyd's Woods	I, III	663	166.84		
257	MacArthur Woods	I, II, III	1003	420.42		
257 Total				899.18	4,394.57	20.46
258	Skokie River	I, III	658	70.87		
258 Total				70.87	320.04	22.14
259	Pleasant Valley	I, II	1509	178.23		
259 Total				178.23	6,562.79	2.72
261	Middle Fork Savanna	I, II, III	1245	509.95		
261 Total				509.95	1,123.63	45.38
264	Fairfield Road Marsh South	II	1237	0.01		
264	Schreiber Lake Bog	II	1502	17.72		
264	Wauconda Bog	I, II, III	1002	220.74		
264 Total				238.47	2,531.66	9.42
267	Bates Fen	I, II, III	708	473.97		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
267 Total				473.97	1,074.04	44.13
272	Kishwaukee River	II, VI	720	8.51		
272 Total				8.51	296.79	2.87
287	Farm Trails North	II, III	0	15.22		
287	Lyons Prairie and Marsh	I, II, III	1001	12.04		
287 Total				27.27	255.72	10.66
289	Kishwaukee River	II, VI	720	38.43		
289	Kishwaukee River South Branch	VI	1789	154.21		
289 Total				192.64	7,223.02	2.67
292	Carl and Claire Marie Sands/Main Street Prairie	I, III	1259	92.02		
292	Detrana Fen	I, II, III	1557	161.35		
292	Lyons Prairie and Marsh	I, II, III	1001	311.95		
292 Total				565.32	1,822.61	31.02
293	Hollows Conservation Area	II	1255	53.69		
293 Total				53.69	280.52	19.14
308	Kishwaukee Fen	I, III	1256	0.19		
308 Total				0.19	626.91	0.03
309	Tower Lake Fen	I, II, III	662	174.63		
309 Total				174.63	464.18	37.62
311	McCormick Ravine	I, II	1008	116.60		
311 Total				116.60	195.28	59.71
322	Florsheim Park	II, III	1500	101.93		
322 Total				101.93	349.49	29.17
327	Lake-in-the-Hills Fen	I, II, III	1011	217.97		
327 Total				217.97	528.50	41.24
333	Kishwaukee River	II, VI	720	22.47		
333 Total				22.47	908.21	2.47
338	Kishwaukee River	II, VI	720	30.38		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
338 Total				30.38	1,173.23	2.59
339	HUM Railroad Prairie East	I, II	1269	33.05		
339	Kloempken Marsh	I	1504	196.42		
339 Total				229.47	1,272.42	18.03
341	Prairie White Fringed Orchid Preserve	II, III	1231	4.35		
341	Reed - Turner Woodland	II, III	228	75.92		
341 Total				80.27	788.87	10.18
343	Kishwaukee River	II, VI	720	34.45		
343 Total				34.45	1,417.33	2.43
355	Cuba Marsh	II	1238	10.93		
355 Total				10.93	1,067.06	1.02
357	Exner Marsh	I, II, III	1263	116.05		
357 Total				116.05	185.98	62.40
359	Edward L. Ryerson Conservation Area	I, II, III	1007	344.15		
359	Herrmann's Woods	I, III	664	20.84		
359 Total				364.99	1,299.54	28.09
362	Kilbuck Prairie	II	1108	1.17		
362 Total				1.17	2,019.44	0.06
375	Barrington Hills Botanical Area	II	633	1.74		
375	Helm Woods	I, III	623	225.53		
375	Spring Creek Prairie	I	391	21.16		
375	Spring Lake - Cook	II, III	390	491.91		
375 Total				740.35	7,718.97	9.59
388	Dixie Fromm Briggs Prairie	III	1625	52.79		
388 Total				52.79	1,035.29	5.10
391	Deer Grove West	II, III	1775	1,091.00		
391 Total				1,091.00	1,599.43	68.21
392	Hemmer - Kloempken Wetland	I, III	1519	1.05		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
392 Total				1.05	253.40	0.41
399	Freeman Kame	III	1474	33.93		
399	Powers Road Fen	I, II	1576	39.90		
399 Total				73.83	2,896.65	2.55
402	Somme Prairie	I, II, III	254	344.08		
402 Total				344.08	364.99	94.27
404	Baker's Lake	II, III	1386	57.87		
404 Total				57.87	179.01	32.33
409	Crabtree Nature Center	II	266	756.29		
409	Palatine Road Marsh	II	1384	1.37		
409 Total				757.65	1,454.52	52.09
411	Kishwaukee River South Branch	VI	1789	6.86		
411 Total				6.86	2,088.41	0.33
412	Shaw Fen and Woods	III	1771	37.81		
412 Total				37.81	386.68	9.78
438	Carle Woods	II	1379	130.98		
438 Total				130.98	1,471.57	8.90
440	Glenview Naval Air Station Prairie	II	1495	11.48		
440 Total				11.48	208.45	5.51
443	Chicago Junior School Area	I, III	968	21.41		
443 Total				21.41	451.78	4.74
449	Fox River Fen	I, II, III	632	14.23		
449 Total				14.23	260.37	5.46
456	Kennicott's Grove	II, III	1469	72.21		
456 Total				72.21	213.88	33.76
467	Harms Woods Forest Preserve	II	1573	211.84		
467 Total				211.84	417.68	50.72
479	Shoe Factory Road Prairie	I, II, III	394	31.95		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
479 Total				31.95	1,384.01	2.31
487	Burlington Prairie	I, III	626	7.07		
487 Total				7.07	149.56	4.73
500	Busse Woods	I, II, III	534	567.58		
500 Total				567.58	1,655.23	34.29
507	St. Paul's Forest Preserve	II	1574	155.94		
507 Total				155.94	223.18	69.87
510	Russell Prairie	I, II	1442	15.50		
510 Total				15.50	2,415.42	0.64
522	Bluff Spring Fen	I, II, III	537	94.78		
522 Total				94.78	323.14	29.33
539	Sidney R. Yates Flatwoods	I, II	397	73.12		
539 Total				73.12	175.91	41.57
544	Tri-County Wetland	II, III	1443	28.84		
544 Total				28.84	622.26	4.63
555	Schiller Woods Prairie	II	1377	10.03		
555 Total				10.03	731.52	1.37
560	Brewster Creek Fen	III	1538	11.14		
560	DeSanto's Brewster Creek Site	II	1499	3.37		
560	Pratts Wayne Woods	II	1401	1,161.88		
560 Total				1,176.39	4,659.59	25.25
568	Burr Woods Marsh	II	1407	109.15		
568	Murray Prairie	I, III	630	5.39		
568 Total				114.54	2,084.53	5.49
582	Wood Dale Grove	II	1392	102.45		
582 Total				102.45	141.04	72.64
590	Norris Woods	I, III	629	81.27		
590 Total				81.27	182.11	44.63

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
594	Lily Lake Marsh	II	1408	10.41		
594 Total				10.41	396.76	2.62
598	Fischer Woods	II	1404	95.62		
598 Total				95.62	130.19	73.45
599	East Branch Marsh	II	1399	2.36		
599 Total				2.36	418.46	0.56
603	Campton Hills Park	II, III	1690	96.16		
603 Total				96.16	247.97	38.78
612	Elburn Forest Preserve	I	627	57.51		
612 Total				57.51	171.26	33.58
614	Thatcher Woods Prairie	II	1431	2.70		
614 Total				2.70	189.86	1.42
618	West Chicago Prairie	I, II, III	505	269.56		
618 Total				269.56	389.78	69.16
623	Johnson's Mound	I, III, IV	631	104.47		
623 Total				104.47	742.37	14.07
625	Churchill Prairie	II, III	524	0.09		
625 Total				0.09	140.26	0.06
635	West DuPage Forest Preserve	II	1395	324.63		
635 Total				324.63	402.18	80.72
636	Nelson Lake Marsh	I, II, III	971	527.82		
636 Total				527.82	1,717.22	30.74
639	Blackberry Maples Marsh	II	1635	157.03		
639 Total				157.03	805.92	19.48
648	McKee Marsh	II	1398	100.21		
648 Total				100.21	975.62	10.27
652	Fermilab	II	533	528.79		
652 Total				528.79	2,866.43	18.45

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
663	Mooseheart Ravine	I, II	972	43.25		
663 Total				43.25	354.14	12.21
665	Brookfield Prairie	II	1375	1.08		
665 Total				1.08	116.24	0.93
668	Salt Creek Woods	III	420	243.81		
668	Wolf Road Prairie	I, II, III	251	72.35		
668 Total				316.16	887.28	35.63
671	Herrick Lake Forest Preserve	II	1397	672.34		
671 Total				672.34	1,282.49	52.42
672	Morton Arboretum	I	506	777.93		
672 Total				777.93	1,167.03	66.66
673	Fullersburg Woods Nature Center	II	530	148.18		
673 Total				148.18	498.27	29.74
676	Lyman Woods	II	1471	68.58		
676 Total				68.58	146.46	46.82
681	Morton Arboretum	I	506	339.01		
681 Total				339.01	456.43	74.27
688	Bliss Woods	III	1531	55.01		
688	Bliss Woods Marsh	II	1498	22.15		
688 Total				77.16	826.06	9.34
694	Carson Marsh	II	1405	42.24		
694 Total				42.24	172.03	24.55
696	Maple Grove Forest Preserve	I, II	527	47.70		
696 Total				47.70	148.01	32.23
722	Springbrook Prairie	II	1516	1,597.74		
722 Total				1,597.74	1,719.55	92.92
730	Cap Sauers Holdings	III	422	1,439.90		
730	Cranberry Slough	III	423	332.92		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
730	Lemont East Geological Area	IV	529	44.14		
730	Little Red Schoolhouse Nature Center	II	267	276.29		
730	Paw Paw Woods	I, III	399	114.07		
730	Sagawau Canyon	I, III	256	142.10		
730	Waterfall Glen	II	532	969.89		
730 Total				3,319.32	12,648.23	26.24
750	Palos Fen	I, II, III	421	54.61		
750 Total				54.61	1,573.09	3.47
758	Black Partridge Woods	I, II, III	255	71.08		
758 Total				71.08	665.66	10.68
780	Dixon Valley Sedge Meadow	I, III	646	93.99		
780	Emmons' Woods Land and Water Reserve	II, III	1691	46.67		
780	Fox River	II, III, VI	1444	236.41		
780	Maramech Woods	II, III	1541	66.20		
780	Millhurst Fen	II, III	981	7.32		
780	Millington Fen	II, III	1416	17.83		
780	Silver Springs Fen	I	1578	9.82		
780	Silver Springs Railroad Prairie	I, III	645	0.32		
780	Yorkville Forested Seep and Fen	I, II	1579	12.65		
780	Yorkville Prairie	I, III	69	42.00		
780	Yorkville Seep	I, II	982	24.08		
780 Total				557.30	13,778.84	4.04
786	Romeoville Prairie	I, II, III	936	149.67		
786 Total				149.67	320.04	46.77
791	O'Hara Woods	II, III	1372	68.59		
791 Total				68.59	298.34	22.99
796	Long Run Seep	I, II, III	1039	75.68		
796 Total				75.68	1,984.57	3.81

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
800	McGinnis Slough	II	1357	48.64		
800 Total				48.64	904.33	5.38
806	Powderhorn Lake and Prairie	I, II	1071	89.06		
806 Total				89.06	109.26	81.51
815	Material Services Prairie	I, II	881	29.45		
815 Total				29.45	295.24	9.97
819	Burnham Prairie	I, III	461	94.39		
819 Total				94.39	139.49	67.67
839	Camp River Trails	III	1739	71.61		
839	Fox River	II, III, VI	1444	160.71		
839	Sheridan Bluffs	II	78	56.99		
839	Sheridan Fen	I, II	1648	18.15		
839 Total				307.46	8,154.48	3.77
841	Sand Ridge Nature Center	II	269	229.40		
841	Sand Ridge Prairie - A	I, II, III	499	109.44		
841 Total				338.84	444.80	76.18
844	Lake Renwick East	III	1748	122.91		
844	Lake Renwick Heron Rookery	II, III	1060	57.39		
844 Total				180.30	464.95	38.78
854	Messenger Woods	I, III	884	404.46		
854 Total				404.46	2,739.34	14.76
868	Lockport Prairie	I, II, III	932	234.53		
868	Lockport Prairie East	II, III	883	138.94		
868 Total				373.47	814.44	45.86
872	Orland Grassland	II, III	1713	812.92		
872 Total				812.92	813.67	99.91
886	Jurgensen Woods	I, II, III	501	114.83		
886	Thornton - Lansing Road	I, II, III	504	428.68		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
886	Wampum Lake Seepage Area	I	428	50.86		
886 Total				594.36	1,636.63	36.32
895	Hickory Creek Sedge Meadow	I	886	28.32		
895	Pilcher Park	I	937	282.34		
895 Total				310.66	2,871.85	10.82
905	Vollmer Road Area	II, III	1358	424.01		
905 Total				424.01	1,363.86	31.09
916	Rock Run	III	1757	109.89		
916 Total				109.89	175.13	62.75
918	Hickory Creek Barrens	III	1636	520.26		
918 Total				520.26	2,065.94	25.18
925	Aux Sable Creek	II, VI	1577	15.18		
925 Total				15.18	325.47	4.66
950	Aux Sable Creek	II, VI	1577	42.57		
950 Total				42.57	850.09	5.01
955	Rockdale Railroad Prairie	II	1082	5.34		
955 Total				5.34	454.88	1.17
970	Fox River	II, III, VI	1444	77.51		
970	Lower Fox River - Blake's Landing	III	1633	31.63		
970	Marsh Relicts	VI	678	5.26		
970	Wedron Palisades	II, III	676	10.79		
970 Total				125.19	6,915.38	1.81
972	Grant Creek Prairie	I, II, III	888	182.73		
972	Joliet Army Ammunition Plant	II	1369	4,804.53		
972	Kankakee River	II, III	980	19.56		
972	Plaines Station Geological Area	IV	892	3.08		
972	Schweizer West Geological Area	IV	891	2.53		
972 Total				5,012.43	22,864.00	21.92

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
973	Goodenow Grove	II, III	1485	428.18		
973 Total				428.18	8,596.96	4.98
974	Rock Run Botanical Area	II	1371	2.97		
974	Rockdale Geological Area	IV	897	0.34		
974 Total				3.30	526.17	0.63
975	Mound Road Botanical Area	II	1370	0.76		
975 Total				0.76	836.91	0.09
994	Thorn Creek Woods	I, III	933	859.74		
994 Total				859.74	2,234.09	38.48
998	Aux Sable Creek	II, VI	1577	41.04		
998 Total				41.04	950.05	4.32
1017	Fox River	II, III, VI	1444	4.73		
1017 Total				4.73	199.93	2.36
1022	Goodenow Grove	II, III	1485	62.62		
1022 Total				62.62	1,034.52	6.05
1035	Fox River	II, III, VI	1444	23.82		
1035 Total				23.82	1,832.68	1.30
1036	Manhattan Creek	VI	1462	2.45		
1036 Total				2.45	162.73	1.50
1045	Aux Sable Creek	II, VI	1577	45.51		
1045	Illinois River - Dresden	II	1438	2.72		
1045 Total				48.23	2,089.96	2.31
1052	Illinois River - Dresden	II	1438	2.40		
1052				2.40	578.09	0.41

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
Total						
1056	Blodgett Road Dolomite Prairie	II, III	1513	405.65		
1056	Des Plaines Dolomite Prairie	I, II, III	889	225.66		
1056	Illinois River - Dresden	II	1438	3.46		
1056 Total				634.78	2,989.64	21.23
1070	Collins Station Prairie	I	560	14.27		
1070	Goose Lake Prairie	I, II, III	1067	1,530.04		
1070	Illinois River - Dresden	II	1438	6.25		
1070	Mazon Creek Geological Area	IV	561	11.95		
1070 Total				1,562.51	10,351.37	15.09
1071	Raccoon Grove	I, III	887	198.40		
1071 Total				198.40	628.46	31.57
1075	Third Avenue Prairie	I	1361	2.66		
1075 Total				2.66	607.54	0.44
1081	Fox River	II, III, VI	1444	14.27		
1081 Total				14.27	702.08	2.03
1097	Marseilles North Hill Prairie Complex	I	1643	33.87		
1097	Seneca Hill Prairie	I	80	10.45		
1097 Total				44.31	4,149.69	1.07
1119	Commonwealth Edison Hill Prairie	I	54	7.98		
1119	Dupont Hill Prairies	I	55	25.76		
1119	Hildy Prairies	II, III	1360	0.99		
1119	Illinois River - Marseilles	II	1446	18.38		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
1119	LaSalle Lake	VI	1689	0.15		
1119	Marseilles Hill Prairie	I	1520	37.07		
1119	Waupecan Creek Geological Area	IV	432	6.87		
1119 Total				97.21	15,273.66	0.64
1124	Short Pioneer Cemetery Prairie	III	1545	1.65		
1124 Total				1.65	3,955.19	0.04
1132	Illinois River - Marseilles	II	1446	6.22		
1132 Total				6.22	205.35	3.03
1139	Deer Park South Geological Area	IV	474	3.41		
1139	Margery C. Carlson Woods	II, III, IV	81	238.54		
1139	Matthiessen Dells	I, II, III	79	138.72		
1139	Vermilion River - Illinois Drainage	II, III, VI	1447	50.72		
1139 Total				431.40	5,407.39	7.98
1146	Braidwood Dunes and Savanna	I, II, III	935	392.49		
1146	Hitts Siding Prairie	I, II, III	1047	296.47		
1146	Kankakee River	II, III	980	11.25		
1146	Munch Area	I, II, III	902	226.83		
1146	Wilmington Shrub Prairie	I, II, III	934	173.33		
1146	Wilmington West Geological Area	IV	896	36.58		
1146 Total				1,136.96	5,814.22	19.55
1175	Otter Creek	VI	1489	0.99		
1175	Sandy Ford	III	1759	184.71		
1175	Vermilion River - Illinois Drainage	II, III, VI	1447	122.38		
1175				308.08	8,160.68	3.78

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
Total						
1179	Kankakee River	II, III	980	203.71		
1179	Kankakee River Nature Preserve Addition	I, III	903	95.93		
1179	Kankakee River Prairie	I, II	67	102.69		
1179	Rock Creek Canyon	I	636	28.25		
1179 Total				430.59	10,169.27	4.23
1181	LaSalle Lake	VI	1689	33.15		
1181 Total				33.15	135.61	24.45
1184	Kankakee River	II, III	980	10.74		
1184 Total				10.74	2,325.53	0.46
1214	Essex Pit Number Eleven Geological Area	IV	640	82.96		
1214 Total				82.96	1,630.43	5.09
1226	Otter Creek	VI	1489	21.66		
1226 Total				21.66	1,542.09	1.40
1235	Kankakee River	II, III	980	82.83		
1235	Momence Wetlands	I, II, III	635	2,120.10		
1235 Total				2,202.93	4,978.86	44.25
1245	Kankakee River	II, III	980	0.00		
1245 Total				0.00	700.53	0.00
1247	Kankakee River	II, III	980	25.89		
1247 Total				25.89	256.50	10.09
1256	Bourbonnais Geological Area	III, IV	639	20.89		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
1256	Kankakee River	II, III	980	0.24		
1256 Total				21.13	180.56	11.70
1267	Vermilion River - Illinois Drainage	II, III, VI	1447	22.29		
1267 Total				22.29	396.76	5.62
1276	Aroma Forest Preserve	III	1737	76.64		
1276	Kankakee River	II, III	980	1.22		
1276 Total				77.86	241.77	32.20
1279	Little Beaver Creek	II	1365	7.99		
1279	Stateline Savanna	I	768	40.90		
1279	Sweet Fern Savanna	II, III	1581	136.17		
1279	Tallmadge Sand Forest	II, III	1706	158.86		
1279 Total				343.92	6,400.83	5.37
1281	Kankakee River	II, III	980	2.06		
1281 Total				2.06	165.06	1.25
1283	Vermilion River - Illinois Drainage	II, III, VI	1447	13.78		
1283 Total				13.78	401.41	3.43
1289	Pembroke Savanna	I, II, III	975	126.34		
1289 Total				126.34	657.13	19.23
1293	Kankakee River	II, III	980	1.38		
1293 Total				1.38	550.19	0.25
1294	Pembroke Savanna	I, II, III	975	403.42		
1294				403.42	453.33	88.99

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
Total						
1295	Vermilion River - Illinois Drainage	II, III, VI	1447	6.56		
1295 Total				6.56	153.43	4.27
1296	Guiding Star Savanna	I	974	69.47		
1296	Pembroke Savanna	I, II, III	975	49.22		
1296 Total				118.69	309.19	38.39
1300	Vermilion River - Illinois Drainage	II, III, VI	1447	107.48		
1300 Total				107.48	3,854.45	2.79
1301	Guiding Star Savanna	I	974	8.92		
1301 Total				8.92	704.40	1.27
1309	Campbell's Woods	I, III	65	47.28		
1309 Total				47.28	181.33	26.07
1318	Hooper Branch Savanna	I, II, III	577	511.76		
1318	Iroquois County Conservation Area	I, II, III	763	1,503.97		
1318	Leesville Savanna	I, II	638	234.23		
1318	Little Beaver Creek	II	1365	1.29		
1318 Total				2,251.25	4,100.10	54.91
1328	Iroquois River - Sugar Island Site	II, VI	1580	22.17		
1328 Total				22.17	827.61	2.68
1331	Vermilion River - Illinois Drainage	II, III, VI	1447	13.42		
1331 Total				13.42	233.25	5.75
1333	Vermilion River - Illinois Drainage	II, III, VI	1447	135.33		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
1333 Total				135.33	1,768.37	7.65
1335	Little Beaver Creek	II	1365	7.59		
1335 Total				7.59	592.04	1.28
1337	Little Beaver Creek	II	1365	12.39		
1337 Total				12.39		
1339	Little Beaver Creek	II	1365	12.51		
1339 Total				12.51	286.72	4.36
1340	Little Beaver Creek	II	1365	2.26		
1340 Total				2.26	165.06	1.37
1366	Iroquois River - Sugar Island Site	II, VI	1580	0.00		
1366 Total				0.00	354.14	0.00
1368	Vermilion River - Illinois Drainage	II, III, VI	1447	18.97		
1368 Total				18.97	192.18	9.87
1369	Vermilion River - Illinois Drainage	II, III, VI	1447	40.36		
1369 Total				40.36	566.47	7.13
1389	Kelly Creek - Charlotte Reach	VI	1714	1.17		
1389 Total				1.17	94.54	1.24
1392	Spring Creek - Crescent City Segment	VI	1584	45.79		
1392 Total				45.79	1,211.20	3.78
1398	Watseka Sand Pond	I, II, III	1363	41.80		

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
1398 Total				41.80	387.46	10.79
1403	Kelly Creek - Charlotte Reach	VI	1714	0.25		
1403 Total				0.25	268.12	0.09
1410	Spring Creek - Crescent City Segment	VI	1584	40.36		
1410 Total				40.36	1,263.12	3.20
1425	Mud Creek - Milford Reach	VI	1583	56.96		
1425 Total				56.96	6,144.34	0.93
1484	North Fork Vermilion River	II, III	1141	6.39		
1484 Total				6.39	242.55	2.63
1488	Middle Fork of the Vermilion River	II, III, IV, VI	494	61.95		
1488 Total				61.95	2,750.19	2.25
1492	North Fork Vermilion River	II, III	1141	12.94		
1492 Total				12.94	441.70	2.93
1497	Middle Fork of the Vermilion River	II, III, IV, VI	494	79.12		
1497 Total				79.12	2,365.83	3.34
1498	Jordan Creek of the North Fork	III	1638	44.41		
1498	North Fork Vermilion River	II, III	1141	187.25		
1498 Total				231.66	6,644.93	3.49
1499	North Fork Vermilion River	II, III	1141	18.41		
1499 Total				18.41	376.61	4.89

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
1508	Middle Fork of the Vermilion River	II, III, IV, VI	494	57.74		
1508 Total				57.74	1,266.22	4.56
1510	Fairchild Cemetery Savanna	I, III	1073	2.53		
1510	Horseshoe Bottom	III	1540	98.13		
1510	Kennekuk Cove County Park	II	1142	771.72		
1510	Kinney's Ford Seep	I, III	1511	39.24		
1510	Middle Fork of the Vermilion River	II, III, IV, VI	494	189.00		
1510	Middle Fork Seeps	I	1512	19.99		
1510	Middlefork Woods	I, II, III	810	86.03		
1510	Orchid Hill	III	805	145.69		
1510	Rock Cut Road Botanical Area	II	1718	15.07		
1510	Windfall Prairie	I, II, III	804	57.45		
1510 Total				1,424.84	16,982.36	8.39
1518	North Fork Vermilion River	II, III	1141	5.51		
1518 Total				5.51	3,138.42	0.18
1533	Brownfield Woods	I	52	60.94		
1533	Trelease Woods	I	51	44.87		
1533 Total				105.81	718.35	14.73
1544	Camp Drake	I	104	4.81		
1544	Middle Fork of the Vermilion River	II, III, IV, VI	494	22.65		
1544	Salt Fork Vermilion River	II, III, VI	1427	57.44		
1544 Total				84.89	5,627.46	1.51
1545	Vermilion River - Wabash Drainage	II, III	495	1.71		
1545				1.71	1,494.82	0.11

LEI ID	SITE NAME	CATEGORIES	INAI NO.	Total INAI Acreage	LEI Total Acreage	Percent INAI
Total						
1547	Vermilion River - Wabash Drainage	II, III	495	12.20		
1547 Total				12.20	261.15	4.67
1551	Edgewood Farm	III	1742	102.02		
1551	Salt Fork Vermilion River	II, III, VI	1427	392.41		
1551 Total				494.43	5,110.59	9.67
1552	Craver's Seep	I	1627	4.84		
1552	Doris Westfall Prairie Restoration	I-R, III	1587	30.92		
1552	Forest Glen Seep	I, II, III	879	19.55		
1552	Russell M. Duffin Natural Area	II, III	41	214.79		
1552	Vermilion River - Wabash Drainage	II, III	495	87.51		
1552	Willow Creek Seep	I, III	23	28.59		
1552 Total				386.19	12,191.81	3.17
1553	Salt Fork Vermilion River	II, III, VI	1427	17.37		
1553 Total				17.37	3,648.32	0.48
1555	Edgewood Farm	III	1742	25.62		
1555	Salt Fork Vermilion River	II, III, VI	1427	11.35		
1555 Total				36.97	325.47	11.36
	Total Acreage			**9,496.65**	**32,527.24**	

Development of a Natural Areas Integrity and Restorability Index and Application to Lands of the Chicago Region

Part 2 – Restorability Index

By
Dr. Brian D. Anderson
Director, Illinois Natural History Survey

1. Contents

2. Conceptual Development

Our capacity to restore the natural quality of natural communities through restoration management practices has improved dramatically over the last 30 years. As we protect and manage the remaining high quality (Illinois Natural Areas Inventory Category I) natural areas, many of which are small, the attention of conservationists naturally turns to areas that are of lesser quality, but still possess significant natural values. These lands are often larger than the remaining high quality natural areas, and still have the potential for restoration at a reasonable cost. The first part of this project focused on identifying such lands using metrics related to landscape integrity, in this part of the project we have developed a "Restorability Index" which can be used to rapidly assess the restoration potential of lands possessing landscape integrity.

Since our objective is to identify lands supporting natural communities that can be restored to high natural quality, the "Restorability Index" is not designed to be applied to existing high quality natural communities. Using the terminology of the Illinois Natural Areas Inventory (INAI) the Restorability Index is not really designed to be applied to Grade A or B natural communities, though it can be calculated for them, but rather degraded, i.e., Grade C, D, or E natural communities in the parlance of the INAI. However, since Grade E communities have essentially had the original community completely removed, Grade E communities cannot be "restored" in the same sense as grade C and D natural communities, but must be "reconstructed" from scratch, often at great cost and seldom achieving very high natural quality. Examples of Grade E communities include cleared land, cropland, improved pasture, residential/commercial development, parking lots, road or railroad embankments and rights of way. Consequently the Restorability Index was not designed to be applied to them either. If it is calculated for grade E natural communities it will yield extremely high scores, indicating the very high cost in human and financial resources and the low probability of success in achieving high quality results associated with reconstructions. Since restorability is related to community grade, we have chosen to build the Restorability Index upon the foundation of the updated INAI grading methods refined as part of the INAI Update. Much of the data collected in the grading process can be used to assess restorability. Consequently, familiarity with the revised INAI grading methods is integral to an understanding of the principles underlying the Restorability Index.

To provide a foundation for further discussion of the Restorability Index several relevant sections from the INAI Update Grading Handbook are incorporated hereafter (White, John. 2009. *Illinois Natural Areas Inventory Update: Grading Handbook*, Fourth edition. June 29

2009. Ecological Services, Urbana, Illinois, hereafter Grading Handbook, attached as Appendix I). Appendices referenced in the following excepts as numerals (1,2,3,4,10) are appendices to the Grading Handbook.

3. "Illinois Natural Areas Inventory Update – Grading Handbook"

Natural Quality and Grades
Natural Quality is defined as measure of the effects of degrading disturbance to a Natural Community. * A system of five letter grades (A, B, C, D. and E) expresses degrees of Natural Quality. The Illinois Department of Natural Resources' (IDNR) definitions and descriptions of Natural Quality Grades are in Appendix 1.

Regimes, Factors, and Indicators
Information about the attributes of a Natural Community that are useful for determining the community's Natural Quality are organized with a three-level system:

Disturbance Regime
Disturbance Factor
Quality Indicator

Disturbance Regimes
Disturbances that can have a significant effect on Natural Quality are grouped into 25 broad categories, or *Disturbance Regimes*:

Clearing
Cultivation
Deer Overabundance
Drainage
Earthmoving
Farming
Faunal Exploitation and Disturbance
Fire
Fire Suppression
Flooding
Grazing
Insects and Pathogens
Intrusions
Invasive Species
Logging
Mowing
Soil Movement, Erosion, and Deposition
Water Impoundment
Water Pollution
Weather and Climatic Extremes

Other Natural Biotic Processes
Other Natural Abiotic Processes
Other Artificial Disturbances
Artificial Disturbances in General
Natural Disturbances in General

Most Quality Indicators are found during the Final Field Survey or Initial Ground Survey, but they can also be identified during the Map & Aerial Photo Stage, Aerial Survey Stage, or Existing Information Stage.

In addition to the 25 Disturbance Regimes, two more categories are necessary to cover all of the possibilities that are encountered when evaluating Survey Sites:

Unknown disturbance
No evident disturbance

The 25 Disturbance Regimes and two additional categories are defined in Appendix 2.

Disturbance Factors

A *Disturbance Factor* is an *intrusion*, an *activity*, or a *condition* of a Natural Community that affects or may affect the Natural Quality of the community. The factor may or may not be directly observable in the field, and it can be either an *explanation for* or a *consequence of* a Quality Indicator.

Disturbance Factors are listed in Appendix 3.

Quality Indicators

A *Quality Indicator* is a feature that (a) usually can be observed in the field, * and (b) can be interpreted as an *indication* of some kind of disturbance or lack of disturbance to a Natural Community. The indicator may be (a) a kind of *intrusion* (a physical thing), (b) evidence of an *activity*, or (c) a *condition* of a Natural Community. A Quality Indicator is *evidence* of either a disturbance or the lack of disturbance in a community. In other words, a Quality Indicator is an *expression* of the Natural Quality of a community; a Disturbance Factor is a *reason* for the quality of a community. A Quality Indicator is "what you see." A Disturbance Factor is "what caused what you see." Appendix 4 consists of an ever-expanding list of Quality Indicators. When grading a Natural Community, the Surveyor identifies Quality Indicators and then documents and analyzes them in terms of Disturbance Factors on a Grading Form.

Relationship between Disturbance Regimes, Disturbance Factors, and Quality Indicators

The hierarchical relationship between a Disturbance Regime, Disturbance Factor, and Quality Indicator is roughly equivalent to the taxonomic relationship between a biological *family*, *genus*, and *species*. A Disturbance Regime is a *family* grouping of Disturbance Factors. A Disturbance Factor is stated in *generic* terms, and it may be indicated by a number of Quality Indicators. A Quality Indicator is a *specific* expression of either a disturbance or the lack of disturbance. Each Quality Indicator is expressed individually and differently whenever it occurs in a Survey Site. The list of Quality Indicators in Appendix 4 is dynamic: it continually grows as more indicators are identified during field investigations, consultations with natural area specialists, and literature review. On the other hand, the list of Disturbance Regimes and Disturbance Factors in Appendix 3 has been designed and developed to provide a more stable, inclusive classification structure. The system for classifying Disturbance Regimes, Factors, and Indicators is ad hoc in the sense that it consists of groupings that serve the practical purposes of grading even though some elements of the classification are defined with different criteria than others ("mixing apples and oranges")."

For the purpose of assessing restorability, Quality Indicators are important because they are what you *see* on the landscape, but once the associated Disturbance Factors are identified, they are more important in assessing restorability, because as discussed above, a Disturbance Factor is the *reason* for the quality of the site; it is the cause of what you see (the Quality Indicator). In this context restoration management is a process of altering disturbance factors, either through elimination, alteration, or substitution. How easily this is done, or how costly it is to do, is therefore a measure of restorability. However, the same disturbance factor can have degrees of effects at different locations. So we must also assess the severity of the effect on natural quality of a community. In actual application natural communities are not the unit graded, but rather grades are assigned to "grading patches." This accommodates a situation, for example, where several acres of contiguous dry-mesic prairie composed of "grading patches" of A, B, and C prairie. To help us assess the severity of the effect we can again turn to another aspect of the INAI Update Grading Methods (White, John. 2009. *Illinois Natural Areas Inventory Update: Grading Handbook*, Fourth edition. June 29, 2009. Ecological Services, Urbana, Illinois, hereafter Grading Handbook, attached as Appendix I):

"Documenting the Impact of a Disturbance Factor
The *Impact* of a Disturbance Factor is assessed by observing and documenting three attributes: the factor's *Extent*, *Level*, and *Trend*. These attributes are recorded for each Disturbance Factor on page 1 of the Grading Form.

Extent
The *Extent* of a Disturbance Factor is an estimate of the proportion of a Grading Patch that is occupied or affected by the factor. The Grading Form [*the last 3 pages of Appendix I, the Grading Handbook, which are unpaginated*] provides four choices for recording a Disturbance Factor's Extent:

Not seen: The factor or its effect is not found in the Grading Patch. *

Localized: The factor occupies or affects less than about one-tenth of the Grading Patch, often in several scattered spots.

Moderate: The factor occupies or affects roughly one-tenth to one-half of the Grading Patch.

Widespread: The factor occupies or affects more than half of the Grading Patch.

***Guidelines for documenting the Extent*.—**The Extent of a Disturbance Factor is estimated on the basis of visual inspection during field reconnaissance. It is not ordinarily determined by any kind of measurement.

Level

The *Level* of a Disturbance Factor is the degree of development of the factor and its effects. There are four choices:

None or N/A: If a Disturbance Factor is present in a Grading Patch but it is having no apparent, active effect on the community, then the *Level* is None. Or if the *Extent* of the Disturbance Factor is recorded as Not seen, then the *Level* must be N/A (not applicable).

Low: In the parts of a Grading Patch that the Disturbance Factor occupies or affects, it is poorly developed and has a minor effect on the community.

Medium: The level of development is judged to be between Low and High.

High: In the parts of a Grading Patch that the Disturbance Factor occupies or affects, it is well developed and has a major effect on the community.

Trend

The *Trend* describes whether the *Extent* or *Level* of a Disturbance Factor appears to be increasing or decreasing. Four options:

Unknown or N/A: If a trend cannot be determined, it is Unknown. If the *Extent* of a disturbance is recorded as Not seen or if the *Level* is None or N/A, then the Trend must be N/A (not applicable).

Decreasing: The Disturbance Factor is judged to be declining, either by shrinking in area or dropping toward a lower level of development.

Stable: The factor appears to be in a steady state, neither increasing nor decreasing overall — although it may be increasing or decreasing locally within the Grading Patch.

Increasing: The factor is judged to be increasing, either in its extent or its level of development, or both.

***Guidelines for documenting the Trend*.—**The Trend of a Disturbance Factor may be obvious, or it may be difficult or impossible to judge on the basis of the available information. Often the growth or decline of vegetation is a good indicator of a trend. Are frost-damaged plants re-sprouting? Is a patch of weeds obviously dying back?”

If the trend is stable or increasing and both the extent and level of a disturbance factor is high, it is likely to significantly lower the Condition Rating of Grading Components and Subcomponents which are at the heart of the grading methodology. The Grading Components, Subcomponents, and Condition Ratings are described by White (2009) in the Grading Handbook in this way:

> **"Grading Components and Sub-components**
> For the purposes of grading Natural Quality, a Natural Community is described and analyzed in terms of four *Grading Components*:
>
> Species composition
> Vegetation structure
> Ecological processes
> Physical environment
>
> Briefly termed:
>
> Composition
> Structure
> Processes
> Environment
>
> Each Grading Component can be broken down into a number of *Sub-components*, which are elements of a Grading Component that can be observed and evaluated, and that have a major bearing on the condition of the Grading Component.
>
> The four Grading Components and important Sub-components are defined and discussed under the next several headings.
>
> **Composition**
>
> ***Definition***
> The *composition* of a community refers to the species that are present in the community, plus three attributes of each species: its *nativity*, *abundance*, and *autecology*.
>
> A species' *nativity* may be simply denoted as either *native* or *exotic*. A detailed and comprehensive terminology for describing nativity is in Appendix 6.
>
> Terms for annotating the *abundance* of a species are in Appendix 7.
>
> *Autecology* refers to the ecology of an individual species, as opposed to the *synecology* of a community. Aspects of autecology include phenology (spring ephemeral, fallblooming, etc.), length of the reproductive cycle (annual, biennial, perennial), reproductive strategy (r/K selection), photosynthetic pathway (C3 vs. C4), tolerance to environmental extremes, tolerance to disturbances, competitive ability (allelopathy, shade tolerance), and palatability to herbivores.

Sub-components
Many aspects of the species composition of a Natural Community lend themselves to analysis when grading Natural Quality. The following Sub-components are listed on the Grading Form because they are considered to be the primary ones that indicate the condition of the Grading Component:

> **Richness**: The number of species in a given area. This number may be derived from vegetation plot sampling, or it may be simply estimated by looking at the Grading Patch, ideally while making a plant species list.
>
> **Conservatives**: Native plant species that do not tolerate most disturbances, and that usually do not occur in degraded habitats.
>
> **Decreasers**: Native plant species that tend to decrease in number or vigor when their habitat is lightly to moderately disturbed. *
>
> **Increasers**: Native or non-native plant species that tend to increase in number or vigor when their habitat is lightly to moderately disturbed.
>
> **Ruderals**: Native or non-native plant species that grow in highly disturbed areas, often becoming established on bare soil; often annuals that do not persist unless the site is repeatedly disturbed or the substrate is unnatural (*e.g.* a cindery railroad embankment).
>
> **Exotics**: Species that are not native to an area.

Additional Sub-components may be added to the Grading Form on a patch-by-patch basis to characterize other relevant aspects of a Grading Patch's species composition.

Structure

Definition
Structure has three aspects:

a) the physiognomy or physical form and appearance of the vegetation as a whole,

b) the pattern of distribution of species or groups of species within a community, and

c) the growth form and morphology of individual species and even single plants in a community.

In other words, structure relates to:
a) the vertical arrangement and character of vegetation layers (including the size and density of trees),

b) the horizontal distribution of individual species or groups of species in a community (*e.g.* zones related to environmental gradients, or patches that develop in response to disturbance history and succession, or apparently random or patternless distribution), and

c) a species' growth form (graminoid, forb, shrub, tree) and the appearance of individual plants (vigor; disfigurement from herbivory, pathogens, and environmental stressors).

Sub-components

During the grading process, the Structure component is evaluated according to the Natural Community's vertical vegetation layers. A community may have as many as four possible vegetation layers:

> **Ground layer**: Herbaceous plants and woody plants up to 1 meter tall.
>
> **Shrub layer**: Shrubs, saplings, and small trees.
>
> **Subcanopy layer**: Small trees that form a canopy directly beneath the overstory canopy.
>
> **Overstory layer**: Trees that form the uppermost canopy in a community.

In addition, as an alternative, the shrub layer and subcanopy layer may be referred to collectively as the **understory layer** when it is efficient to do so, and when it is possible to clearly record observations or analyses about both layers at once.

Structure is also commonly evaluated in terms of another Sub-component:

> **Horizontal pattern**: The horizontal distribution of individual species or groups of species in a community, including the size and shape of vegetation patches, the relationship between patches and environmental gradients and disturbances, and the character of boundaries between patches.

The above Sub-components are listed on the Grading Form. Other aspects of vegetation structure may be identified and added to the form as additional Sub-components if they do not fit well into any of the above Sub-components.

Processes

Definition

Ecological *processes* consist of the biological and physical actions that shape and control an ecosystem and cause it to function.

Here is a sampling of ecological processes and their effects on an ecosystem: (a) formation of soil by chemical weathering and decomposition of organic matter; (b) changes in vegetation structure, microclimate, soil, and species composition through ecological succession; (c) control of animal populations by predators, diseases, and parasites, and (d) changes in natural communities that result from disturbances such as fires and floods.

When evaluating a Survey Site, one must recognize and accept that ecological processes are significantly different now than they were two centuries ago. Farming has fundamentally transformed the hydrology of streams. Wildfires no longer sweep the plains, so a remnant prairie may no longer experience the fires that it requires for its continued existence. Large predators have been eradicated, so the population dynamics of animals as well as plants have changed dramatically. There are no free-ranging bison and no passenger pigeons. NOTE 3 The natural landscape is so fragmented that local dispersal as well as long-distance migration are severely curtailed for many species. Acid rain, atmospheric deposition of nitrogen, and global warming add new dimensions of change. Regardless of such major alterations of ecosystem processes, evaluation standards need to be applied in a manner that allows the Processes component of some Survey Sites to be rated as High.

Sub-components

Biological and physical processes are myriad and they operate at every scale, from intracellular to cosmic. An ecological process that is evidenced by a Quality Indicator may originate or extend beyond the limits of a Grading Patch and far from a Survey Site. Most processes operate well beyond the control and outside the capacity of natural area managers. The grading procedure should focus primarily on processes that function at the approximate scale of a Survey Site or a Natural Community — not at a much higher or lower level.

Two kinds of ecological processes are most important to examine when grading a community: (a) those that are most significant in determining the species composition and structure of the community, and (b) those that have been modified so much that the basic character of the local ecosystem has changed.

The Grading Form has blanks for rating the following four Sub-components of the Processes component:

> **Reproduction and Growth**: Addition of new plants (genets) through sexual reproduction, and addition of new stems (ramets) via asexual reproduction; also, increase in the size of plants.
>
> **Succession**: The process in which communities of plants and animals in a particular area are replaced over time by a series of different communities.

Fire: Actions of fire on a community, primarily by consuming organic matter and killing or injuring plants and animals.

Hydrology: Actions of running or standing water on a community: scouring soil and vegetation, inundating and drowning living things, moving nutrients, etc.

As appropriate, any number of other Sub-components may be recognized and evaluated to assess the condition of the Processes component.

Environment

Definition
The physical *environment* is the abiotic component of an ecosystem, including the substrate or medium in which plants and animals live.

Sub-components
Three main parts of the physical environment for a community are the *microclimate*, *soil*, and *water*. The microclimate (or "climate near the ground") is a basic element of the environment, but it does not usually figure into the grading equation. Even though soil and water are so full of life that it is impossible to separate the living from the nonliving environment, they are classified here as abiotic features of an ecosystem.

Three elements of the Environment component are preprinted on the Grading Form because they are most likely to come into play when evaluating an area:

Soil: The surface of the earth, extending downward to include the upper part of the parent material.

Water: Streams, diffuse surface runoff, standing surface water, soil water, and groundwater.

Intrusions: Relatively small, manmade physical features (such as a structure) or localized sites of intensive human disturbance (such as a trail).

Other environmental Sub-components may be added to the Grading Form and analyzed on an ad hoc basis (that is, to describe the unique situation of an individual Grading Patch).

Rating the Condition of Grading Components and Sub-components

When evaluating a Grading Patch, the overall condition of each of the four Grading Components and its Sub-components is estimated with a Condition Rating, which is a simple, qualitative, relative scale: Low, Medium, and High. The Medium rating has the widest latitude:

Low Lower quarter	**Medium** Middle half	**High** Upper quarter

A Grading Component or Sub-component is rated High if it is judged to have more than 75% of the characteristics that it would have if it were in a theoretical, pristine natural area (*i.e.*, without any degradation). A component or sub-component is rated Low if it is judged on the same basis to be in the bottom third. Any case in-between is Medium.
To rate the condition of a Grading Component in a Grading Patch, the Surveyor must do the following:

(1) Examine the Grading Patch to identify Quality Indicators.

(2) Document each Quality Indicator with a written description and photography.

(3) Determine which Disturbance Factor or Factors are indicated by each Quality Indicator.

(4) Decide whether the Effect of each Disturbance Factor on the community is clearly positive, clearly negative, variable or approximately neutral, or uncertain or unknown.

(5) Determine the Impact (Extent, Level, and Trend) of each Disturbance Factor.

(6) Evaluate the Grading Component by examining relevant Sub-components and rating their condition as High, Medium, or Low. Base this rating on (a) the observed characteristics of the Sub-component and (b) the impact of Disturbance Factors on the Sub-component.

(7) Summarize the condition of the Grading Component with a rating (High, Medium, or Low) and a descriptive narrative. Base the rating on the condition of the Sub-components as well as other characteristics of the Grading Component that were not formally classified as Sub-components.

Condition Ratings for Grading Components and Sub-components are based on experienced, professional judgment and comparative knowledge of many different sites. A rating is not derived from any sort of multifactorial, numerical scoring system."

The Grading Components and Sub-components are listed on page 2 of the Grading Form (next to last page of the Grading Handbook, Appendix I). The Condition Ratings (High, Medium, or Low) are entered for each Component and Sub-component. **It is the Condition Rating for each Grading Component (Composition, Structure, Processes, Environment) that is used in the Restorability Index** (not Sub-components, they are used to arrive at the aggregate Component Rating for each Grading Component**)**. Since the number and combinations of Disturbance Factors affecting a grading patch are so potentially numerous we chose NOT to focus on individual Disturbance Factors in calculating the Restorability Index, but rather chose to assess their cumulative impact on the Condition Ratings for Grading Components. HOWEVER, a thorough documentation of all Disturbance Factors and their impacts (trends, extent, and level) is critical in justifying the Condition Ratings of Grading Components AND in assessing their cumulative effects on Condition Ratings for each Grading Component.

The Restorability Index is, therefore, based upon the following sequence of logic: Community Grade is an inverse measure of the need for restoration; Quality Indicators are how we detect the need for restoration; Disturbance Regimes are categories of Disturbance Factors which are the reasons we need restoration and define what must be maintained, altered, eliminated, or replaced; and the degree of impacts (trend, extent, and level) associated with Disturbance Factors determine how much restoration is needed. Cost is a function of how much restoration is needed and how costly that type of restoration is. Restorability is a composite of the technical feasibility of restoration and the relative cost of restoration.

What we are missing is consideration of the technical feasibility and relative cost of restoration. Feasibility and cost are usually indirectly related (the less feasible the higher cost). The Restorability Index assumes all lands are restorable, though research may be needed to increase the efficacy of restoration (research is usually expensive). To address these considerations we have constructed a composite numerical score around several categories of restoration management that we call “Restoration Sequences.” The methodology for application of these scores generally assumes an indirect relationship between feasibility and cost. The Restorability index allows the user to adjust up or down between sequences based on the category of restoration needed to address the most expensive type of restoration called for.

The four categories of restoration the Restoration Sequences are associated with are:

- Passive Restoration – restoration can be achieved by doing nothing, for example by allowing succession to continue in a forest; or by simply eliminating the disturbance factor through institutional controls, for example by limiting bicycle access to a property administratively. Small costs, such as placement of a few signs at key access points, are allowed in this category. However, if it is necessary to place a 20-ft fence around a 640-acre property to control access, this would constitute capital restoration. This demonstrates how the Restorability Index may generate different values when applied by different landowners. If it is the policy of the landowner to fence all their properties, the Restorability Index will generate higher values for that landowner.

- Manual Restoration - this type of restoration includes hand removal of exotics, herbicide application, prescribed burning, placement of boundary signs every 100 feet around a property, etc. Anything that requires one or more staff to invest multiple hours daily over one to several days. Equipment may be needed for this kind of restoration, but the kind of equipment used (e.g., a truck mounted sprayer), while it may have had a high initial cost, has a low per hour operational cost. Again, a landowner that has not made the initial investment in such equipment may need to treat the initial investment in such equipment as capital restoration. Most currently known restoration technologies fall into this category.

- Mechanical Restoration – this type of restoration requires the employment of mechanized equipment that has a high hourly operational cost, for example brush removal equipment or earth moving equipment, but the restoration work can be achieved in one to several days using the mechanized equipment.

- Capital Restoration – this type of restoration takes its name from the capital budgeting process, because restoration in this category is so resource intensive or requires such specialized equipment it is often requires supplemental funding and is usually out-sourced. This type of restoration may also include design and engineering costs. A few resource management agencies may have in-house engineering capabilities, the heavy equipment and dedicated operators, and stores of materials available, to rank what most landowners would consider capital restoration as mechanical restoration, but this will be rare. Some Disturbance Factors, which might ordinarily be considered in another of the above categories, that are extremely pernicious and/or for which there is no know or accessible method of management, can also be placed in this category. Anything requiring research is placed in this category. There may be some exotic species removal that falls in this sequence, or if the hydrology is altered and you need access to another landowner's property and know you can't get it (i.e., restoration would actually require land acquisition) it would also employ the capital restoration sequence. Use of a high value on this scale can often simply be a means of eliminating a potential natural area from further consideration for restoration.

In general, the per acre cost associated with effecting restoration in each Restoration Sequence increases as you move from passive, to manual, to mechanical, to capital restoration. However, cost is also a function of the impact of the Disturbance Factor (larger extent and level, when the trend is negative, lowering the Condition Rating), but this is accounted for by assigning a higher number within the Restoration Sequence when the Condition Rating is lower.

The Restoration Sequences are:

Passive Restoration Sequence: 1, 2, or 3
Manual Restoration Sequence: 1, 3, or 5
Mechanical Restoration Sequence: 1, 4, 7
Capital Restoration Sequence: 1, 5, 9

With the lowest number assigned when the Condition Rating is Very High or High, use of the middle number when the Condition Rating is Medium, with the highest number reserved for Condition Ratings of Low.

By examining the Disturbance Factors affecting the Grading Components (Composition, Structure, Processes, and Environment), we can choose the appropriate Restoration Sequence to apply to that Grading Component. The Condition Rating (High, Medium, or Low) can then be used to choose the appropriate value from the Restoration Sequence.

Let's look at a hypothetical example employing a new Patch Restorability Form (See Attachment I):

If species composition is largely being negatively impacted in a dry-mesic forest by invasive exotic plants that can be removed or controlled through herbicide application or prescribed fire, the Manual Restoration Sequence should be applied. If the Species Grading Component Condition Rating is rated as "high" or "very high" the first score in the Manual Restoration Sequence, or "1," should be applied for that Grading Component and entered into the example Patch Restorability Form (Attachment II). If the Structure Grading Component Condition Rating is "medium" due to lack of a mid-story as a result of past grazing, but recovery is evident, the Passive Restoration Sequence should be applied and a score of "2" used. If the Natural Processes Grading Component Condition Rating is "high" and no Disturbance Factors are indicated, the score of "1" from the Passive Restoration Sequence should be applied. Finally, if the Physical Grading Component Condition Rating is "low" because of a massive recent alteration of drainage to put in a subdivision, and this alteration is unlikely to be correctable, the Capital Restoration Sequence score of "9" should be applied, even though this Disturbance Factor hasn't manifested itself yet in the species composition and community structure. Then all 4 Restoration Scores should be summed to yield a Restorability Index Score of 13 for this grading patch. If a tract is composed of multiple grading patches, the scores of all grading patches should be multiplied by their acreages and summed, then divided by the total acreage. A "Site Restorability Form" is provided for this purpose as Attachment III. In this hypothetical case we have only a single grading patch, so the score of "13" is also the Site Restorability Rating.

4. Restorability Index Implementation

4.1. Pilot Sites and Methodology

The Restorability Index was piloted on August 25th and 26th in 2010. Dr. Brian D. Anderson, of the Illinois Natural History Survey and Dr. Wayne Schennum and Mr. Randy Vogel, of Applied Ecological Services, participated in the pilot. Several tracts of land representing Illinois Natural Areas Inventory (INAI) natural community classes and sub-classes of various INAI natural quality grades were visited in Lake and McHenry Counties including:

- Grades A, B, C, and D Mesic Upland Forest
- Grades A, B, and C Mesic Prairie
- Grades B, C, and D Mesic Savanna
- Grade D Sedge Meadow
- Grade D Freshwater Marsh

Grade A and B examples of these natural communities had already been visited, mapped, and graded using improved grading methodologies developed as part of the Illinois Natural Areas Inventory Update (Appendix I). While participating in the INAI Update, Dr. Schennum has become one of the most experienced people in applying the new INAI Update grading methodologies. Grades were assigned to the more disturbed Grade C and D natural communities employing the same protocols. The Restorability Index was then calculated for each of the graded units. The unit for which the Restorability Index is actually calculated is referred to in the INAI Update Standards and Guidelines as a "Grading Patch." One or more grading patches of different natural community grades, but the same natural community sub-class, which are physically connected to each other form a "natural community." One or more natural communities (each potentially composed of patches of different grades) which are physically connected to each other form a "Site." If the site includes a Grade A or Grade B grading patch which meets the minimum INAI acreage standards for the subject natural community sub-class, the site is considered a "Category I INAI Natural Area." Category I, therefore, refers to a high quality example of an Illinois natural community, whereas other INAI categories are assigned to other rare natural features of a property. For example a Category II natural area is a site that provides habitat for a federal or state listed endangered or threatened species. Consequently, when someone refers to a "natural area" it is important to understand whether they are simply referring to a tract of land being kept "natural" (i.e., undeveloped); whether they are referring to any of the several categories of INAI natural areas; or whether they are referring to an example of a high quality natural community, an INAI Category I natural area. Category I natural areas are therefore, in more colloquial terminology, the "gold standard" of natural areas. Category I natural areas are very rare.

The Restorability Index is designed to provide an indication of the potential for, effort associated with, and cost of, restoring a site to higher natural quality, for example in moving a grading patch from a grade of C to a grade of B. A Patch Grading Form (Attachment I) was completed for each graded patch in each site. A "Site Restorability Index" can also be calculated using the Site Restorability Form (Attachment III), if Restorability Indices have been calculated for all grading patches composing a site (Shaw Prairie discussed later is an example).

The sites visited in the pilot and the associated grading patches for which Restorability Indices were calculated were:

Daniel Wright Forest, Grade D Forest, Lake Co., IL

Kettle Moraine, Grade D Savanna and Grade D Sedge Meadow, McHenry Co., IL

McCormick Woods, Grade A Dry-Mesic Forest, Lake Co., IL

Middlefork Savanna, Grades B, C, Savanna and Grade D Savanna Reconstruction, Lake Co., IL

Pike Marsh, Grade D Freshwater Marsh, McHenry Co., IL

Ryerson Woods, Grades B and C Dry-Mesic Forest, Lake Co., IL

Shaw Prairie, Grade A, B, and C Mesic Prairie, Lake Co., IL

4.2. Results of the Pilot

Patch grading forms for the sites described above are presented in Appendix II along with one or more photographs of each area graded. Restorability indices were calculated for each grading patch based on the objective of maintaining or restoring the natural quality of each grading patch to at least grade B, the minimum quality rating for an INAI Category I designation. Generally this meant that a single restorability index was calculated for each grading patch. In other words, in most cases, an index score was calculated for restoring grade C mesic prairie to grade B mesic prairie, or grade D forest to grade B dry-mesic forest. Notice that we made no attempt to assign a natural community sub-class to Grade D natural communities. Grade D examples of natural communities are often very disturbed, and this disturbance is often related to an altered hydrologic regime, the result is these two characteristics in many cases make accurate assignment of the grading patch to a natural community sub-class problematic. For Shaw Prairie we evaluated multiple patches of prairie of different grades and filled out a "Site Restorability Form" based on the different restorability indices calculated for each grading patch (Attachment IV). Another interesting opportunity presented itself when we visited a forested tract in Kettle Moraine State Park that has been under restoration for some time. We had difficulty determining whether the grading patch should currently be considered dry-mesic upland forest or dry-mesic woodland. The site had been burned and exhibited some of the more open characteristics of woodland and other characteristics, such as a higher tree density and greater canopy cover, of a forest. After a period of consideration, all participants agreed that the site historically had been a savanna, that at some point after a long period of grazing, the cattle had been removed and due to fire suppression trees had re-established themselves on the site. Currently, so many trees are well established it might not be reasonable to restore it to its original community type, but it appears that the current management regime has resulted in an intermediate condition between woodland and forest. This situation provided an opportunity to test the usefulness of the Restorability Index in informing such decisions. To explore this possibility Restorability Indices were calculated for moving Grade D Savanna to Grade B Dry-mesic Savanna, Grade D Savanna to Grade B Dry-mesic Woodland, and Grade D Savanna to Grade B Dry-mesic Upland Forest. This situation also validates the concept of the Prairie-Forest Continuum which was eloquently articulated by Steve Apfelbaum during the Rapid Implementation Meeting on Woodlands which was convened as part of the initial implementation of the INAI Update. To capsulate those arguments: in degraded upland sites current restoration technologies allow us to "force" restoration along the prairie-savanna-woodland-forest continuum, to whatever end point we desire. Achieving that end point is limited more by effort and cost than site conditions. Since technological capacity, effort, and cost are all components built into the Restorability Index, it may be possible to use it as a tool in assessing restoration alternatives along the continuum. In this treatment I have not addressed Grade E tracts, which are placed in the "Cultural Community Class" in the INAI community classification, and are either cleared, plowed, planted, paved, drained, or landscaped. Most natural areas professionals refer to restoration of such lands to a natural community as "reconstructions," and are by their very definition very costly and time consuming to pursue. As such, restoration of existing native natural communities should always receive priority. We did assess the potential restorability of a reconstructed Grade D savanna to Grade B dry-mesic savanna located along the entrance road to Middlefork Savanna.

4.3. Discussion and Observations

To be useful the Restorability Index should meet several criteria:

- It should correlate with natural community quality, reflecting the greater costs associated with restoring more disturbed natural communities.
- It can be calculated rapidly with a minimum of effort.
- It should reflect the efficacy of restoration of a land parcel and the potential effort and cost associated with restoration of that parcel
- It should avoid referencing dollar and cents costs, but rather reflect the demand on all needed tangible resources including expertise, technical feasibility, human resources (staff or volunteer), seed, fuel, equipment, etc. Some of which are more or less available depending on the land management entity involved, and all of which may not be calculated into a dollars and cents "restoration cost" typically presented to executive authorities.
- It must allow comparison of restorations within a community class (prairie, savanna, woodland, forest, wetland, etc.) at a minimum, and preferably across community classes.

4.3.1. Does Restorability Correlate with Natural Quality?

To assess how the Restorability Index changes in relation to Natural Quality Grade we graphed the natural quality grades of the pilot grading patches relative to their calculated Restorability Indices. Figure 1 illustrates an inverse correlation between the Natural Quality Grade (A,B,C or D) and the Restorability Index (the lower the Restorability Index the more "restorable" the grading patch) and plots the trend line that describes this relationship. Further review of Figure 1 suggests another characteristic of the Restorability Index. There is clearly much greater separation in the Restorability Indices associated with the restoration of Grade D natural communities. This higher resolution in lower grades is helpful in that most restoration efforts (and the majority of costs in human and fiscal resources) are associated with restoring grade C and D natural communities. The separation apparent in Restorability Indices for restoration of Grade D communities could be a function of the design of the grading procedures. Since there are four “Grading Components” (Composition, Structure, Processes, and Environment) and three possible “Condition Ratings” (Low, Medium, and High), there are 81 possible combinations of “Grading Models” (Grading Handbook, Appendix 10). Of these 81 models, only 4 combinations unquestionably yield grades of A, with another 5 combinations potentially resulting in grades of A or B, 9 combinations unquestionably result in grades of B, with another 9 combinations potentially yielding grades of B or C, 27 combinations unquestionably yielding grades of C, and 27 combinations yielding grades of D. Consequently, one might hypothesize that there might be greater variability in Restorability Index scores for Grade C and D natural communities. This is exactly where we would hope to see greater separation, since this tool was developed primarily to compare the restorability of Grade C and D communities. However, it must be remembered that White (Grading Handbook, 2008) cautions that some combinations (Grading Models) may not actually occur in the landscape, and some combinations suggest a community is in transition. For example, the physical environment of a grading patch might have been altered (for example by drainage), yet the species composition, community structure, and detectable environmental processes appear to remain intact – however, as a consequence of the drainage alteration the quality of the natural community is destined with time to degrade. This is exactly the situation in the hypothetical example previously employed. Finally, while the separation for grade D community restorations in the pilot was very good, the three grade C restorability scores were closely clumped. Only additional applications of the Restorability Index will determine how broad the range of calculated Restorability Indices for Grade C restorations might be.

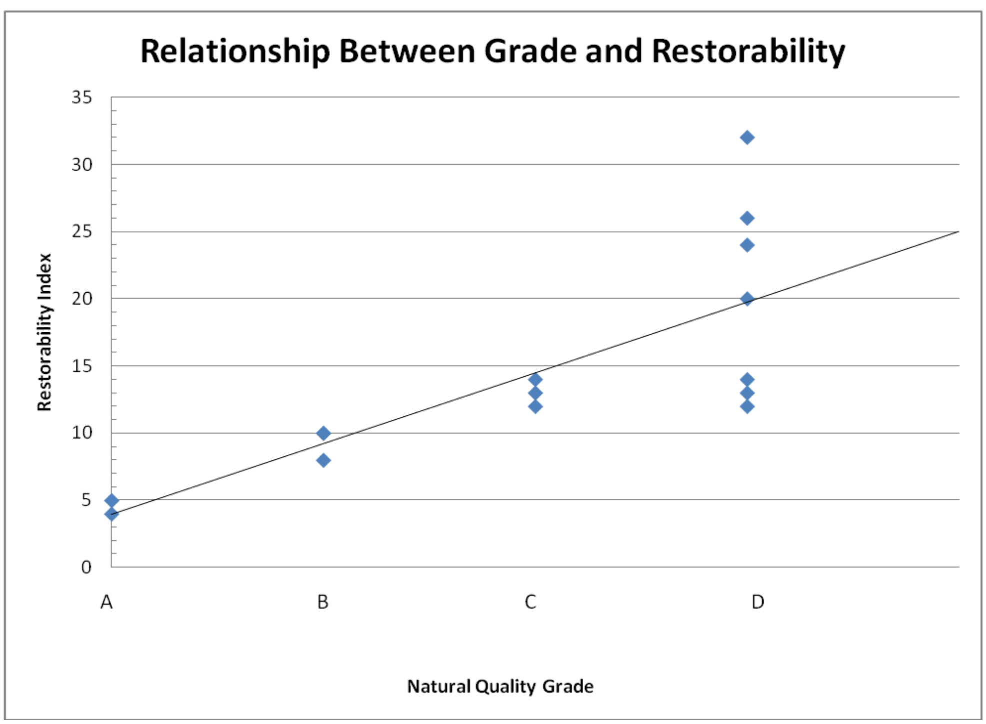

Figure 1.

4.3.2. Can the Restorability Index be Calculated with a Minimum of Effort?

Experience in the pilot project demonstrated that calculation of the Restorability Index can be done very rapidly if INAI Update grading forms for grading patches have already been filled out. In fact, if the person calculating the Restorability Index is a natural resource manager familiar with the site, and they are familiar with the restoration methods available to respond to natural community Disturbance Factors described in the Grading Handbook, the Restorability Index could be calculated in the office directly from the INAI Update grading form. There was one problem encountered with using the INAI Update grading form to calculate the Restorability Index. On page 1 of the INAI Update grading form (Figure 2) "Quality Indicators" are listed and described. Quality Indicators are things that you see, e.g., a browse line, that are indicators of a Disturbance Factor, in this case grazing by an overabundance of deer. The Disturbance Factor is only coded on the INAI Update grading form, using codes from Tables 7.1-Table 7.14 of the Grading Handbook. It is tedious to look up the codes to identify the Disturbance Factor that must be addressed through restoration. However, in actual practice the Disturbance Factor indicated by the Quality Indicator was often referenced in the "Description of Quality Indicators," or it is self-evident. Botanists who have been working on the INAI Update also found use of Appendix 3, Table 5 of the Grading Handbook tedious and developed a "Cheat Sheet" for use in the field which is attached as Attachment V (Items highlighted in yellow were added as part of this exercise). It may eventually be necessary to modify the grading form to require graders to input both "Descriptions of Quality Indicators and Disturbance Factors" as text (refer to Figure 2).

With practice, an experienced natural resource manager can calculate the Restorability Index on site in less than 15 minutes for each grading patch. If the grading form has not already been completed, doing both can be achieved by an experienced natural resource manager/restoration specialist in 45 minutes. The majority of the time consumed in calculating the Restorability Index during the pilot was in traveling between grading patches at a site and travel between sites.

GRADING FORM **ILLINOIS NATURAL AREAS INVENTORY UPDATE**

Survey Site Identifier: Page 1

Site Name:

Surveyor: Date:

NC/NQ polygon:

Natural Community: Grade:

Notes:

Description of Quality Indicators	Photo	DF	Effect	Extent	Level	Trend	Notes

Figure 2.

4.3.3. Does the Restorability Index Assess the Efficacy and Relative Cost of Restoration?

Some Disturbance Factors may preclude the possibility of restoration of a site under prevailing circumstances. However, a Restorability rating can still be calculated for such properties. For example, there may be no known practical method for elimination of a newly-introduced, very aggressive invasive plant. But there is always the possibility that research could result in a practical method of control. However, if research is required to address any Disturbance Factor our methodology requires that the Capital Restoration Sequence be applied (since research must be contracted), so if the Condition Rating is medium or low for the Composition Grading Component, the Restorability Index rating is likely to be very high. Likewise, if a Disturbance Factor originates offsite, for example alteration of the hydrology of a site, and is therefore out of the control of the landowner of the subject property, the Capital Restoration Sequence automatically applies (since other land would have to be bought to address the change in hydrology), again quickly driving up the Restorability Index for the site. The Restorability Index is in a way intrinsically “optimistic” in assuming any property is potentially restorable.

The four categories of restoration built into the Restorability Index (Passive, Manual, Mechanical, and Capital) suggest increasing investments of human, material, and financial resources, but this perceived progression of investment may not hold up in all cases. For example, there may be cases where it is cheaper to outsource mechanical restoration that might otherwise be done in-house by staff. However, when you consider the effort involved in development of scopes-of-work, performance standards, and executing procurement through bids as is often required in contracted projects, the times when the Capital project route actually represents less investment are rare. The numerical progression in the restoration sequences, for example from 1 to 3 to 5 in the Mechanical Restoration category, respective to High, Medium, and Low condition ratings, reflects the increase in resources necessary to address a Disturbance Factor along the gradient of increasing extent of disturbance, increasing level of disturbance, and upward trend in the disturbance. As impacts associated with a disturbance increase in extent, level, and as they trend upward, it almost always requires more resources to address them. However, while those relationships are always positively correlated, they may not be directly correlated because of economies of scale. Having the expertise of AES staff participate in the pilot was very helpful since they often are asked to bid on restoration work. Not only is the Restorability Index constructed to positively correlate with all the costs of restoration, even hidden costs, it was also our impression that restoration of the sites with higher Restorability Index Ratings would be more costly to restore through contracting as well.

4.3.4. Does the Restorability Index Avoid Dollars and Cents Comparisons?

Yes. And it is, in a way, a more comprehensive assessment of actual costs in human, material, and financial resources than many dollars and cents comparisons of restoration costs. The example given above demonstrates that there are many hidden costs to a sponsoring agency or organization in outsourcing projects that are not reflected in the final project “bid” from a contractor. Yet, it is not unusual to see restoration costs cited that never consider the in-house burdens associated with executing them.

4.3.5. Does the Restorability Index allow Comparisons across Natural Community Classes?

Based on the results of the pilot it appears the index can be used to make comparisons between forest, prairie, savanna, and sedge meadow restorations. Another way to approach this question is to consider whether within each restoration category (Passive, Manual, Mechanical, and Capital) there are restoration techniques specific to a community class that are significantly more expensive than those commonly employed in other community classes. The actual range of restoration techniques available to land managers is really quite limited. You can remove vegetation manually (weeding), mechanically (plowing, chain sawing, chipping), or chemically (herbicide); plant vegetation manually (broadcasting seed or hand planting) or mechanically (planters, seed drills, tree spade); or you can simulate natural processes (prescribed burning, flooding, watering, fertilizing). The only situation encountered in the pilot that raised this concern was associated with tree removal. Tree removal to reduce canopy cover in restoring a savanna or woodland can be very expensive and no corollary exists in prairies and wetlands, except perhaps cattail removal in marshes. However, in this case, the trees removed can have value as lumber or fuel, which might be used to offset the removal costs. Further, it may soon be possible to employ processes like shrub removal to generate biostock for biofuel production. Broader application of the Restorability Index and comparisons between Restorability Ratings and the actual costs of restorations will be needed to unequivocally answer this question.

5. Summary

The results of the pilot implementation project suggest the Restorability Index holds promise as a tool for rapid assessment of the relative restorability of natural communities across natural community classes. The next logical step is to place this tool in the hands of the management agencies who originally requested such a tool, primarily Illinois' Forest Preserve and Conservation Districts. Broader application of the Restorability Index will, however, require that agencies and organizations have access to and become familiar with the new INAI Update grading protocols which at this point have not been formally adopted by the Natural Areas Evaluation Committee of the IDNR and integrated into their "Standards and Guidelines for Illinois Natural Areas." It is preferable that IDNR codify the grading methods articulated in the Grading Handbook, but if they do not, they will still become available as a matter of public policy.

6. Frequently Asked Questions

6.1. What if more than one Disturbance Factor is affecting a Grading Component? For example if several invasive species are affecting Plant Community Composition as is deer grazing by overabundant deer?

You should identify which disturbance requires the more resource- intensive response, and choose the restoration category that response falls into (Passive, Manual, Mechanical, or Capital). If all the invasive species problems can be addressed using manual restoration (pulling and herbicide application), but the overabundance of deer can be addressed passively by allowing deer hunting, then the restoration sequence for the Mechanical category should be used. However, if the property lies in a county where deer hunting is not allowed, and you would have to contractually hire sharpshooters, you would choose the restoration sequence for the Capital restoration category.

6.2. Do you "double count" the Disturbance Factors that affect more than one Grading Component? For example, if deer grazing due to deer overabundance is affecting both Composition and Structure grading components do you record a number for both components or just put in a zero for one.

During the pilot it became clear that you should enter a value under both components. Doing so clearly generated greater separation among Restorability Ratings, and it appeared that if a disturbance factor like cattail invasion or deer browse affect composition and structure, for example it was a reflection of either a greater extent or level of disturbance, and therefore required more resources than one affecting just one or the other.

6.3. Do you ever enter a 0?

No. Even if the Composition, Structure, Physical Processes, and Physical Environment grading components all have condition ratings of "High" and no disturbances were obvious for any of the grading components, you should always enter a "1" from the "Passive Management" sequence for each of the four grading components. Consequently, the lowest Restorability Rating possible is 4. This acknowledges the fact that even grade A communities require some passive management if nothing more than periodic observation. Where this practice appeared to have the greatest impact was in assessing grade C and D communities where disturbance of Ecological Processes and to the Physical Environment were often not observed. If 0 were entered in such cases some of the separation between restorability ratings appeared to be reduced. This also compensates for disturbances that are just missed or less observable in these two grading components.

6.4. Can the Restorability Index Ratings be compared across landowners?

Probably not. The management and restoration capacities of owners and managers of natural communities vary dramatically. A small land trust may not possess any management capacity beyond Passive Management. This can result in them having to develop a capital campaign to accomplish even minor restoration work, resulting in use of the Capital restoration sequence, and thereby resulting in high restorability indices. A landowner like a Forest Preserve District may have heavy equipment in their possession that may make it unnecessary to contract all but the most ambitious restorations in-house. In a previously cited example, deer control can be addressed passively by allowing public hunting in most counties, but in a few counties deer control would require the use of an expensive contractor, since public hunting is not allowed. It is possible, however, that land management entities with comparable restoration capacities, like two adjoining Forest Preserve Districts, could make such comparisons.

Attachment I.

Grading Patch Restorability Form	Page _ of_ Pages
Survey Site Identifier:	
NC/NQ polygon:	Community:

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating:	Rating:	Rating:	Rating:	
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____**Passive** ____**Manual** ____**Mechanical** ____**Capital**	____**Passive** ____**Manual** ____**Mechanical** ____**Capital**	____**Passive** ____**Manual** ____**Mechanical** ____**Capital**	____**Passive** ____**Manual** ____**Mechanical** ____**Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch

Attachment II.

Grading Patch Restorability Form				Page 1 of 1 Pages
Survey Site Identifier: **Example Forest as Attachment I**				
NC/NQ polygon:		Community: Dry-Mesic Forest		
Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Very High**	Rating: **Medium**	Rating: **High**	Rating: **Low**	
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
A few invasive exotic plants	**Impacted shrub layer due to deer browse**	**None evident**	**Offsite drainage alteration**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Increase prescribed fire or manual removal	**Deer hunting program is beginning to have effect, simple continue it**	**Nothing needed**	**May not be correctable without buying adjacent property and reconfiguring hydrology**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive __1__Manual ____Mechanical ____Capital	**__2__Passive ____Manual ____Mechanical ____Capital**	**__1__Passive ____Manual ____Mechanical ____Capital**	**____Passive ____Manual ____Mechanical __9__Capital**	
Restoration Score Based on Rating	Restoration Score Based on Rating	Restoration Score Based on Rating	Restoration Score Based on Rating	Index of Restorability for the Grading Patch
1	**2**	**1**	**9**	**13**

Attachment III.

Site Restorability Form				Page 1
Survey Site Identifier:				
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
Site Name	**Sum of Acres of All NA/NQ Polygons**		**Sum of Products**	**Average Site Restorability Rating**

Attachment IV.

Site Restorability Form				Page 1
Survey Site Identifier: Shaw Prairie Grades A, B, C				
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
#1	**7.5**	**4**	**7.5X4 = 30**	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
#3 – South of Trail	**2.5**	**8**	**2.5X8= 20**	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
None (not Grade A or B)	**5.5**	**13**	**5.5X13=71.5**	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
NA/NQ Polygon	Total Acres of Polygon	Restorability Rating	Product	
Site Name	**Sum of Acres of All NA/NQ Polygons**		**Sum of Products**	**Average Site Restorability Rating**
Shaw Prairie	**15.5**		**121.5**	**7.8**

Attachment V.

1. Clearing

1.01. Recent or active clearing
 QI: Dominance by one or a few plant species
 QI: Clearing/maintenance of open conditions along corridor or right-of-way by infrequent mowing
1.02. Former clearing
 QI: Boundary between communities/vegetation types is extra sharp or rectilinear
 QI: Young trees growing in a dense stand
 QI: Dead *Juniperus virginiana* trees standing beneath overstory layer
1.98. Unknown clearing effect
1.99. Other clearing effect

2. Cultivation

2.01. Plowing or other tilling
 QI: Distinct vegetation pattern, not obviously related to environmental patchiness
 QI: Low species diversity
 QI: Dominance by one or a few plant species
 QI: Weedy herbaceous plants (native or non-native)
 QI: Exotic species
 QI: *Juniperus virginiana* growing anywhere except on/near bedrock outcrops or natural firebreaks
 QI: Boundary between communities/vegetation types is extra sharp or rectilinear
2.98. Unknown cultivation effect
2.99. Other cultivation effect

3. Deer Overabundance

3.01. Damage to the native herbaceous flora and woody vegetation (including prevention of recruitment)
 QI: Gap in tree size classes
 QI: Lindera benzoin browsed
3.02. Encouragement of weedy and unpalatable plants
 QI: Overabundance of *Asimina triloba*
 QI: Abundance of thorny plants
 QI: Weedy herbaceous plants (native or non-native)
 QI: Abundance of native "hitchhiker" herbs with stickery fruits
3.03. Damage to the soil (trampling, erosion)
3.98. Unknown effect from deer overabundance
3.99. Other effect of deer

4. Drainage

4.01. Ditching for surface drainage (including stream channelization)
 QI: Ditches
4.02. Subsurface drainage tile line
 QI: Ditches
4.03. Groundwater drawdown from wells (including irrigation systems)
4.04. Depletion of soil water by trees encroaching on a herbaceous wetland

Highlighted items added for this exercise

- 4.05. Change in vegetation composition or structure in response to drainage
  - QI: Young trees growing in a dense stand
  - QI: Wetland species growing on well-drained soil
- 4.98. Unknown drainage effect
- 4.99. Other drainage effect

5. Earthmoving

- 5.01. Excavation (digging a hole)
  - QI: Presence of *Equisetum arvense* and/or *Equisetum hyemale*
- 5.02. Filling (raising a mound or filling a low area)
- 5.03. Re-contouring the land surface (scraping and re-depositing soil)
  - QI: Distinct vegetation pattern, not obviously related to environmental patchiness
- 5.98. Unknown earthmoving effect
- 5.99. Other earthmoving effect

6. Farming

- 6.01. Deposition of soil at the edge of a field
- 6.02. Herbicide application and herbicide drift
- 6.03. Planting
- 6.98. Unknown farming effect
- 6.99. Other farming effect

7. Faunal Exploitation and Disturbance

- 7.01. Hunting, trapping, fishing
- 7.02. Disturbance by human visitation
- 7.03. Disturbance by urbanized and residential environs (roadkill, noise, lights, pets)
- 7.98. Unknown disturbance to animals
- 7.99. Other disturbance to animals

8. Fire

- 8.01. Reduction of invasive species (not including native woody encroachment)
- 8.02. Reduction of encroachment by fire-sensitive native species
- 8.03. Stimulation of fire-adapted native species
  - QI: Presence of *Erechtites hieracifolia*
  - QI: Presence of *Phytolacca americana*
- 8.04. Thinning of the structure of a fire-adapted woody community that has grown up because of fire suppression
- 8.05. Accelerated soil erosion
- 8.06. Stimulation of invasive vegetation
- 8.07. Consumption of leaf litter and woody debris
  - QI: Lack of leaf litter and duff buildup
  - QI: Fire scars
  - QI: Charred tree trunks and woody debris
- 8.08. Death or injury to woody plants (including re-sprouting and coppice growth)
  - QI: Lack of understory
  - QI: Abundant dead trees, standing
  - QI: Gap in tree size classes
  - QI: Open, discontinuous tree canopy and subcanopy

Highlighted items added for this exercise

QI: Small gaps in the tree canopy

8.98. Unknown fire effect

8.99. Other fire effect

9. Fire Suppression

9.01. Exotic cool-season grasses and other exotics fostered by a lack of fire

9.02. Fire-adapted, native species declining or not reproducing

9.03. Fire-sensitive, native species spreading into formerly fire-maintained habitat

QI: *Juniperus virginiana* growing anywhere except on/near bedrock outcrops or natural firebreaks

QI: Young trees growing in a dense stand

9.04. Increase in the density and canopy closure of woody vegetation

QI: Vigorous growth or abundance of *Juniperus virginiana*

9.05. Shade-pruning of major lateral crown limbs on overstory trees

QI: oldest trees display large, shade-pruned lateral limbs and stubs on mid to lower trunk

9.06. Suppression of vegetative growth, flowering, and fruiting

9.98. Unknown fire suppression effect

9.99. Other fire suppression effect

10. Flooding

10.01. Death of vegetation caused by unusually prolonged inundation

QI: Abundant dead trees, standing

10.02. Decrease in flooding (volume, velocity, duration, impact)

10.03. Increase in flooding (volume, velocity, duration, impact)

QI: Ditches

10.04. Mechanical injury of floodplain vegetation and scouring of the soil surface, promoting early successional vegetation

QI: Young trees growing in a dense stand

QI: Trees broken (limbs), scraped, knocked down, or partially pushed over

10.05. Seasonal water level fluctuation

10.06. Major stream downcutting

10.98. Unknown flooding effect

10.99. Other flooding effect

QI: Abundance of native "hitchhiker" herbs with stickery fruits

11. Grazing

11.01. Enhancement of snap diversity

11.02. Maintenance of habitat for native species that require bare soil and sparse vegetation

QI: Lack of leaf litter and duff buildup

11.03. Reduction or control of woody growth in a formerly fire-maintained community

11.04. Browsing and hedging of woody plants; creation of a browse line; suppression of woody reproduction; coppice growth

QI: Boundary between communities/vegetation types is extra sharp or rectilinear

QI: Lack of understory

QI: Gap in tree size classes

QI: Open, discontinuous tree canopy and subcanopy

Highlighted items added for this exercise

QI: Small gaps in the tree canopy

11.05. Decrease in favored forage species; reduction in the diversity and abundance of conservative native species

11.06. Increase or persistence of unpalatable or grazing-adapted species

- QI: Abundance of *Asimina triloba*
- QI: Abundant thorny plants
- QI: Dominance by one or a few plant species
- QI: Weedy herbaceous plants (native or non-native)
- QI: Exotic species
- QI: Abundance of native "hitchhiker" herbs with stickery fruits
- QI: *Juniperus virginiana* growing anywhere except on/near bedrock outcrops or natural firebreaks
- QI: Abundance of non-conservative (but not weedy) spring ephemerals

11.07. Soil erosion and compaction (trails, terracettes), root damage and injury or death of trees

- QI: Abundant dead trees, standing
- QI: Small gaps in the tree canopy

11.08. Current or abandoned fencing present

11.98. Unknown grazing effect

11.99. Other grazing effect

12. Insects and Pathogens

12.01. Disease damage

- QI: Young trees growing in a dense stand
- QI: Abundant dead trees, standing

12.02. Insect damage

- QI: Young trees growing in a dense stand
- QI: Abundant dead trees, standing

12.98. Unknown insect/pathogen effect

12.99. Other insect/pathogen effect

13. Intrusions

13.01. Building or group of buildings (homesite, farmstead), abandoned

- QI: Presence of non-invasive horticultural species growing unintended
- QI: Presence of old foundations, basements, cellars, chimneys, driveways, bricks, etc.

13.02. Building or group of buildings (homesite, farmstead), active

13.03. Road, active

13.04. Road, abandoned

13.05. Footpath or horse trail

13.06. Fence

13.07. Utility line, aboveground

13.08. Utility line, belowground

13.09. Other building, structure, or other intrusion

13.10. Dump, active

13.11. Dump, inactive

13.12. Cemetery

- QI: Presence of non-invasive horticultural species growing unintended

Highlighted items added for this exercise

QI: *Juniperus virginiana* growing anywhere except on/near bedrock outcrops or natural firebreaks

13.13. Illegal ATV trail(s)

13.98. Unknown intrusion

13.99. Other intrusion

14. Invasive Species

14.01. Exotic invasive species

QI: Low species diversity

QI: Abundance of species commonly planted for wildlife food and cover

QI: Dominance by one or a few plant species

14.02. Native invasive species

QI: Low species diversity

QI: Dominance by one or a few plant species

14.98. Unknown invasive species effect

14.99. Other invasive species effect

15. Logging

15.01. Selective timber harvest

QI: Lack of large, well formed, high-value hardwoods

QI: Coppice growth

QI: Trees broken (limbs), scraped, knocked down, or partially pushed over

QI: Logging skid trails, haul roads, yarding areas, discarded cables

QI: Tree cutting, stumps, tops, logs

QI: Small gaps in the tree canopy

15.02. Clearcutting

QI: Dominance by few or one plant species

QI: Boundary between communities/vegetation types is extra sharp or rectilinear

QI: Lack of old trees in a mature stand of trees

QI: Logging skid trails, haul roads, yarding areas, discarded cables

QI: Tree cutting, stumps, tops, logs

15.03. Other tree-cutting (removal of firewood or hazardous trees)

QI: Tree cutting, stumps, tops, logs

15.04. Logging followed by release of advance regeneration and growth of new trees

QI: Young trees growing in a dense stand

15.98. Unknown tree-cutting effect

15.99. Other tree-cutting effect

16. Mowing

16.01. Mowing of herbaceous vegetation (other than haying)

QI: Exotic species

QI: Lack of leaf litter and duff buildup

16.02. Mowing of woody vegetation, not maintaining desirable native vegetation

QI: Dominance by one or a few plant species

QI: Boundary between communities/vegetation types is extra sharp or rectilinear

QI: Clearing/maintenance of open conditions along corridor or right-of-way by infrequent mowing

QI: Coppice growth

Highlighted items added for this exercise

- 16.03. Infrequent cutting of native vegetation (*e.g.* under a powerline) inadvertently maintaining desirable native vegetation
  - QI: Clearing/maintenance of open conditions along corridor or right-of-way by infrequent mowing
- 16.04. Haying
  - QI: Exotic species
  - QI: Lack of leaf litter and duff buildup
- 16.98. Unknown mowing effect
- 16.99. Other mowing effect

17. Soil Movement, Erosion, and Deposition

- 17.01. Sheet, rill, or gully erosion and deposition
- 17.02. Mass wasting (soil creep, slumping, rockfall)
- 17.03. Stream entrenchment
  - QI: Decrease in the frequency and duration of over-bank flooding
- 17.04. Stream meandering
  - QI: Young trees growing in a dense stand
- 17.05. Floodplain scouring or sedimentation
  - QI: Young trees growing in a dense stand
  - QI: Ditches
  - QI: Abundant dead trees, standing
- 17.06. Wind erosion and deposition
- 17.07. Bioturbation
- 17.98. Unknown soil movement, erosion, or deposition effect
- 17.99. Other soil movement, erosion, or deposition effect

18. Water Impoundment

- 18.01. Dam or dike
- 18.02. Inhibition of migration by aquatic life
- 18.03. Raising and stabilization of wetland water level (reduction or elimination of seasonal water-level fluctuations)
  - QI: Abundant dead trees, standing
- 18.98. Unknown water impoundment effect
- 18.99. Other water impoundment effect

19. Water Pollution

- 19.01. Oil or other chemical spill
- 19.02. Nutrient enrichment from cropland runoff and sewage effluent (including livestock containment operations and septic tanks)
- 19.03. Sedimentation
- 19.98. Unknown water pollution effect
- 19.99. Other water pollution effect

20. Weather and Climatic Extremes

- 20.01. Storm damage (windthrow, broken limbs)
  - QI: Young trees growing in a dense stand
  - QI: Dead trees, downed
  - QI: Lack of old trees in a mature stand of trees

Highlighted items added for this exercise

QI: Trees broken (limbs), scraped, knocked down, or partially pushed over
20.02. Drought
20.03. Temperature extremes (heat, cold)
20.98. Unknown effect from weather or climatic extreme
20.99. Other effect from weather or extreme climate

21. Other Natural Biotic Processes
21.01. Interspecific competition
QI: Overabundance of *Asimina triloba*
QI: Dominance by one or a few plant species
QI: Lack of understory
QI: Abundant dead trees, standing
21.02. Succession
QI: Patches of shrubs and saplings growing in a matrix of herbaceous vegetation
QI: Young trees growing in a dense stand
21.03. Beaver disturbance
QI: Young trees growing in a dense stand
QI: Abundant dead trees, standing
21.04. High rate of biological decomposition
QI: Lack of leaf litter and duff buildup
21.98. Unknown effect of a natural biotic process
21.99. Other effect of a natural biotic process

22. Other Natural Abiotic Processes
22.01. Presence of a clear or non-polluted stream
22.02. Seasonal fluctuations in water level
22.98. Unknown effect of a natural abiotic process
22.99. Other effect of a natural abiotic process

23. Other Artificial Disturbances
23.01. Herb gathering (root digging), flower-picking, mushroom hunting,
plant poaching (orchids)

23.02. Seed gathering for off-site restoration
23.03. Damage from road salt runoff and spray
23.04. Soil contamination (petroleum or other chemicals other than road salt)
23.05. Mine subsidence
23.06. Damage to vegetation and soil by recreational visitors
QI: Abundance of native "hitchhiker" herbs with stickery fruits
QI: Lack of understory
23.07. Vegetation restoration and management (planting, killing plants)
QI: Abundance of vegetation commonly planted for wildlife food and cover
QI: Tree cutting, stumps, tops, logs
23.08. Clearing of understory
QI: Coppice growth
QI: Gap in tree size classes
23.09. Poaching
QI: Rocks noticeably disturbed (flipped over)

Highlighted items added for this exercise

23.10. Sites of human visitation
- QI: Presence of disposed refuse
- QI: Vandalism
- QI: Presence of campfire ring(s)
- QI; Rockclimbing

23.98. Unknown artificial disturbance
23.99. Other artificial disturbance

24. Artificial Disturbances in General

24.01. Past agricultural usage
- QI: Distinct vegetation pattern, not obviously related to environmental patchiness
- QI: Exotic species
- QI: Abundance of native "hitchhiker" herbs with stickery fruits

24.02. Disturbances that create bare soil
- QI: Abundance of *Ambrosia trifida*

24.03. Other human activities
- QI: Boundary between communities/vegetation types is extra sharp or rectilinear
- QI: Open, discontinuous tree canopy and subcanopy

25. Natural Disturbances in General

25.01. Disturbances modifying stand structure
- QI: Abundance of native "hitchhiker" herbs with stickery fruits
- QI: Open, discontinuous tree canopy and subcanopy

25.02. Disturbances that create bare soil
- QI: Abundance of *Ambrosia trifida*

26. Unknown disturbance

27. No evident disturbance

27.01. Possibly long-term absence of disturbance
- QI: Lack of stumps or logging evidence
- QI: Lack of non-native species
- QI: Presence of lichen/moss covered bedrock exposures
- QI: Well developed shrub layer (high structure and composition)
- QI: High structural integrity and diversity of mosses and lichens
- QI: Presence of northern glacial relict species
- QI: Presence of conservative fern species and/or high diversity of ferns
- QI: Lack of disturbance by recreational visitors

27.02. Old-growth conditions
- QI: Oldest trees display tall trunk, lack of lateral limbs
- QI: Dominance by one or a few plant species
- QI: Woody vegetation (*Quercus sp.*, *Carya sp.*, and *Vaccinium arboreum*) with small trunks, and many low, twisted, spreading, lateral limbs

27.03. Protection and recovery from a long period of past disturbance
- QI: Oldest trees display large, shade-pruned lateral limbs on mid to lower trunk

27.04. Big, old trees
- QI: Pit and mound topography

Highlighted items added for this exercise

QI: Relatively few, large-diameter limbs
QI: Presence of many large trees, spread throughout community

27.05. Lack of cultivation
QI: Pit and mound topography

27.06 Absence of degrading disturbances
QI: Presence of conservative species in general
QI: High overall plant diversity

27.07. Naturally sandy soil
QI: Presence of *Equisetum arvense* and/or *Equisetum hyemale*

27.08. A natural condition: The soil only appears to be well drained
QI: Wetland species growing on well-drained soil

27.09. Lack of degrading disturbances (grazing in particular)
QI: Presence of relatively conservative understory trees and shrubs

27.10. Long term stability and lack of disturbance
QI: Dead trees, downed

27.11. Wet or wet-mesic soil
QI: Lack of understory

27.12. Old age of trees (natural mortality)
QI: Abundant dead trees, standing
QI: Lack of old trees in a mature stand of trees

27.13. Other Quality Indicators related to high natural quality
QI: Presence of a buffer community
QI: High diversity of oak species
QI: Dominance by native, community obligate plant species
QI: Presence of critical habitat for rare and protected plant species
QI: Presence of critical habitat for rare and protected animal species
QI: High scenic quality
QI: Community structure favorable for heterogeneity of microhabitats

Highlighted items added for this exercise

ILLINOIS NATURAL AREAS INVENTORY UPDATE GRADING HANDBOOK

Fourth edition

Appendices

Tables

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ILLINOIS NATURAL AREAS INVENTORY UPDATE GRADING HANDBOOK

Natural Quality and Grades

Natural Quality is defined as measure of the effects of degrading disturbance to a Natural Community. * A system of five letter grades (A, B, C, D. and E) expresses degrees of Natural Quality. The Illinois Department of Natural Resources' definitions and descriptions of Natural Quality Grades are in Appendix 1. NOTE 1 †

Regimes, Factors, and Indicators

Information about the attributes of a Natural Community that are useful for determining the community's Natural Quality are organized with a three-level system:

Disturbance Regime
Disturbance Factor
Quality Indicator

Disturbance Regimes

Disturbances that can have a significant effect on Natural Quality are grouped into 25 broad categories, or *Disturbance Regimes*:

Clearing
Cultivation
Deer Overabundance
Drainage
Earthmoving
Farming
Faunal Exploitation and Disturbance
Fire
Fire Suppression
Flooding
Grazing
Insects and Pathogens
Intrusions
Invasive Species
Logging
Mowing
Soil Movement, Erosion, and Deposition
Water Impoundment
Water Pollution
Weather and Climatic Extremes
Other Natural Biotic Processes
Other Natural Abiotic Processes
Other Artificial Disturbances
Artificial Disturbances in General
Natural Disturbances in General

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* A term is italicized or bolded when it is defined in this handbook. Terms that are formally defined specifically for the Illinois Natural Areas Inventory Update are capitalized.

† Notes begin on page 30.

In addition to the 25 Disturbance Regimes, two more categories are necessary to cover all of the possibilities that are encountered when evaluating Survey Sites:

Unknown disturbance
No evident disturbance

The 25 Disturbance Regimes and two additional categories are defined in Appendix 2.

Disturbance Factors

A *Disturbance Factor* is an *intrusion*, an *activity*, or a *condition* of a Natural Community that affects or may affect the Natural Quality of the community. The factor may or may not be directly observable in the field, and it can be either an *explanation for* or a *consequence of* a Quality Indicator.

Disturbance Factors are listed in Appendix 3.

Quality Indicators

A *Quality Indicator* is a feature that (a) usually can be observed in the field, [*] and (b) can be interpreted as an *indication* of some kind of disturbance or lack of disturbance to a Natural Community. The indicator may be (a) a kind of *intrusion* (a physical thing), (b) evidence of an *activity*, or (c) a *condition* of a Natural Community. A Quality Indicator is *evidence* of either a disturbance or the lack of disturbance in a community.

In other words, a Quality Indicator is an *expression* of the Natural Quality of a community; a Disturbance Factor is a *reason* for the quality of a community. A Quality Indicator is "what you see." A Disturbance Factor is "what caused what you see."

Appendix 4 consists of an ever-expanding list of Quality Indicators. When grading a Natural Community, the Surveyor identifies Quality Indicators and then documents and analyzes them in terms of Disturbance Factors on a Grading Form.

Relationship between Disturbance Regimes, Disturbance Factors, and Quality Indicators

The hierarchical relationship between a Disturbance Regime, Disturbance Factor, and Quality Indicator is roughly equivalent to the taxonomic relationship between a biological *family*, *genus*, and *species*. A Disturbance Regime is a *family* grouping of Disturbance Factors. A Disturbance Factor is stated in *generic* terms, and it may be indicated

[*] Most Quality Indicators are found during the Final Field Survey or Initial Ground Survey, but they can also be identified during the Map & Aerial Photo Stage, Aerial Survey Stage, or Existing Information Stage.

by a number of Quality Indicators. A Quality Indicator is a *specific* expression of either a disturbance or the lack of disturbance. Each Quality Indicator is expressed individually and differently whenever it occurs in a Survey Site.

The list of Quality Indicators in Appendix 4 is dynamic: it continually changes as indicators are refined or newly recognized during field investigations, consultations with natural area specialists, and literature review. On the other hand, the list of Disturbance Regimes and Disturbance Factors in Appendix 3 has been designed and developed to provide a more stable, inclusive classification structure. The system for classifying Disturbance Regimes, Factors, and Indicators is ad hoc in the sense that it consists of groupings that serve the practical purposes of grading even though some elements of the classification are defined with different criteria than others ("mixing apples and oranges").

Artificial Disturbances versus Natural Disturbances

An *artificial disturbance* is one that results directly from human actions. A *natural disturbance* is one that is not directly caused by people. This simple dichotomy of "artificial" versus "natural" is not always unambiguous and incontrovertible because many ostensibly natural disturbances are initiated or fostered by human actions. For instance the great majority of fires that shaped the natural vegetation of Illinois probably were set by humans, but there is no direct evidence from the distant past that people set fire to the vegetation. Another example: Dutch elm disease is caused by a fungus that is spread by a beetle; both of these organisms were brought to America by international commerce — so, is mortality from Dutch elm disease a natural disturbance or an artificial one? According to the above definition, it is not an artificial disturbance because the elms are not killed by direct human actions. [Note 2] Grazing by livestock is classified as an artificial disturbance even though it can be argued that human actions are not directly responsible for the disturbing impacts of the domestic stock.

As a rule, artificial disturbances are deleterious to a Natural Community. To a large degree, natural disturbances are benign or beneficial. Artificial disturbances often damage or destroy a Natural Community; natural disturbances often maintain or rejuvenate a community.

Intrusions versus Cultural Communities

An *intrusion* is a relatively small, manmade physical feature or a localized site of intensive human disturbance. The activity that created the feature may have occurred in the distant past. Examples:

Old, abandoned wagon road	Fence
Small trash dump	Shack
Small gravel pit	Ditch

An intrusion is a disturbance feature within a Natural Community; it is not a separate community. If the disturbance is more extensive, then it is not treated as an intrusion: instead it is classified and mapped as a Community Type in the Cultural Community Class.

The *Cultural Community Class* is defined by the Illinois Natural Areas Inventory to include communities that were created by human disturbance, such as Cropland and Developed Land.

An old intrusion can often be viewed as a scar or an injury that has not completely healed. An intrusion may or may not have a substantial effect on the Natural Community that it occupies, and its effect may or may not extend far beyond the limited area that it occupies. For instance an old, long-abandoned excavation in a Gravel Prairie may be little more than a scar that has no apparent effect on the adjacent prairie. On the other hand, a ditch is likely to have a wide-ranging effect if it cuts through a wetland. The presence of an intrusion does not lower the Natural Quality of the surrounding community if the community is not significantly affected by it.

A single campsite that does not break the canopy of a forest is an intrusion, but a large group campground with cleared vegetation and buildings is Developed Land (a different Natural Community) — not an intrusion in the surrounding forested Natural Community. A single campsite in a forest would not normally affect the grade of the forest because its disturbing impact is so limited. A group campground in a forest is a separate Natural Community, and it does not necessarily lower the grade of the adjacent forest unless the impacts of the campsites and campers are significant and extend into the forest. [*]

Disturbance Features

During the Initial Ground Survey or Final Field Survey, if a disturbed area is marked and labeled on a site map, the disturbed area is treated as a *Disturbance Feature*. [†] Disturbances are classified in this manner so that they can be handled in the project's information system in the same way as the other elements of a Survey Site that are recorded, classified, and mapped as *features*: *i.e.* Significant Features, Exceptional Features, and Notable Features.

A Disturbance Feature is classified as either an Artificial Disturbance Feature or a Natural Disturbance Feature.

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[*] Offsite impacts from the campground might include light pollution, free-roaming pets, trampling by people, littering, firewood removal, and polluted runoff and groundwater.

[†] A Disturbance Feature may be mapped as a point, a line, or a polygon.

Artificial Disturbance Features

An *Artificial Disturbance Feature* is an *intrusion*: that is, it is a relatively small, man-made physical feature or a localized site of intensive human disturbance — as discussed above and in the definition of Intrusions in Appendix 2.

Natural Disturbance Features

A *Natural Disturbance Feature* is a place that has been disturbed by a natural agent. Examples:

Part of a forest that was blown down by a storm
Area that was burned
Stand of trees that were killed by a disease
Area that was scoured by a flooding stream

A Natural Disturbance Feature is a *feature* of a Natural Community rather than a distinct community. It may be any size — even as extensive as the community or group of communities where it occurs.

A natural disturbance is usually not considered when grading a community unless the disturbance is so severe that it mimics the effects of a significant artificial disturbance (for instance, a blowdown that looks like a clearcut, or a meandering stream that is removing a seepage community as effectively as a dragline).

Grading Form

During field surveys, the Natural Quality of a Survey Site is documented on a Grading Form, which provides a means for recording *observations* (descriptions of a community and its components), *analyses* (evaluations of quality), and a *decision* (a Natural Quality Grade). The form and instructions for completing it are in Appendix 10.

Grading Patches

Although an entire Survey Site is graded during the Final Field Survey, the grades are assigned to subdivisions of the site, termed Grading Patches. If a site is simple and uniform in terms of its Natural Communities and Natural Quality, it might consist of a single Grading Patch, but usually there are more than one patch in a Survey Site.

Definition

A *Grading Patch* is defined as having two main characteristics: (1) the patch consists of Natural Communities that are in the same Community Class, and (2) the patch must appear to be relatively uniform in Natural Quality (*i.e.* all of the patch will be assigned to a single Natural Quality Grade). Each of these characteristics is discussed in more detail under the next two numbered headings.

(1) ***A Grading Patch consists of Natural Communities that are in the same Community Class.***

A Grading Patch can consist of several *related* Natural Communities (*i.e.* communities that are in the same Community Class). [*] It is often efficient to combine adjacent communities and evaluate them at the Community Class (or Subclass) level. However, it is not always necessary (and not even always desirable) to combine all of the adjacent, related Natural Communities into a single grading patch — even if they appear to have the same grade. If the characteristics that affect the assignment of a grade vary significantly from one community to another, then it is better to delineate separate patches and complete a series of Grading Forms for individual Natural Communities instead of treating them as one patch and combining them on one form; by using several Grading Forms in this situation, each community can be clearly described, analyzed, and documented.

(2) ***A Grading Patch must be relatively uniform in Natural Quality.***

A Grading Form cannot be used to document more than one Natural Quality Grade. At the beginning of the grading process, the boundaries of the patch that is being graded are likely to be tentative, unknown, or only partially decided. If the Surveyor determines during the grading process that part of the patch should be assigned a different grade, then the patch must be subdivided and another Grading Form must be started.

A Grading Patch is rarely entirely uniform in quality. A patch is likely to have parts that would be given a higher or lower grade if those parts were larger and separated from their surroundings by sharp boundaries. [†] To help address the inherent variability of the natural landscape, it is allowable for as much as one-quarter of a Grading Patch to consist of parts that would be assigned a different grade if those parts were larger

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[*] A woodlot that consists, for example, of both Dry-mesic Upland Forest and Mesic Upland Forest would often be evaluated as a single Grading Patch on a single Grading Form. But a Swamp and its surrounding Wet-mesic Floodplain Forest must be treated as separate patches and documented with separate forms because the forested wetland (swamp) and the floodplain forest are in different Community Classes.

[†] An example to illustrate this point: A Grade B patch may have small parts within it that are more degraded and that would be assigned Grade C if those parts were bigger and separated from the surrounding area by sharp boundaries. A more common situation is for a Grade B patch to vary continuously — with some parts in better condition than others, but with continuous variation instead of clear boundaries or abrupt transitions between the parts. A series of "cookie cutter" samples of such a patch might appear to represent different Natural Quality Grades, but when the area is viewed as a whole, there are no internal patches — only a complex mosaic of gradual transitions.

and clearly distinct (*i.e.*, sharply bounded instead of part of a complex mosaic or gradual transition).

In a complex situation, one part of a Natural Community at a site could be a certain grade because of a certain set of factors, and another part of the same community at the same site might be the same grade because of a different set of factors. In this situation, it may be necessary to delineate two adjacent Grading Patches and use two Grading Forms to sort out and clearly record the decision-making and grading process for the two parts of the community.

Acreage Guidelines

To deal in a practical manner with the heterogeneous nature of Natural Communities, a set of acreage guidelines is defined for recognizing and delineating Grading Patches. The acreage standard for a Grading Patch varies according to the kind of community. As a general rule, a Grading Patch of a forest community should be 5 acres or larger; it is usually not necessary — and not necessarily even desirable — to distinguish smaller areas when grading. A Grading Patch of a prairie should be at least one-quarter acre. As a general rule, the size of a Grading Patch for other communities should be at least one-quarter of the minimum acreage that has been defined for a Significant Feature of that community, but not less than 0.25 acre. * For instance the minimum acreage for the Significant Feature of a Marsh is 20 acres, so a Grading Patch in a Marsh should generally be at least 5 acres.

These are guidelines, not hard-and-fast rules: a smaller area may be (and often should be) be graded separately if it is clearly distinct. For instance if a 30-acre, old-growth, Grade B woods is bordered by a 0.5-acre strip of 20-year-old trees that have grown up in an old clearing, this area of young regrowth (Grade D) should be delineated and graded separately because it is clearly distinct from the rest of the forest.

Entitation

A Grading Patch does not have an identity and boundaries until a Surveyor carves it out of the landscape. The process of *entitation* ("making an entity") consists of recognizing a Grading Patch and delineating its boundaries. The Surveyor recognizes a Grading Patch by applying the definition on page 5, which calls for all of the patch to be in a single Community Class, and for the patch to be relatively uniform in its Natural Quality.

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* Minimum acreage standards for the various Natural Communities are stated in the *Illinois Natural Areas Inventory Standards and Guidelines* by Illinois Department of Natural Resources (2006).

It is a fairly straightforward exercise to delineate an area that is all in the same Community Class, but it is often more difficult to draw a line around an area that is more-or-less uniform in quality. The quality of a community is assessed by analyzing and rating the four Grading Components that are spelled out beginning on page 12: species composition, vegetation structure, ecological processes, and physical environment (or Composition, Structure, Processes, and Environment for short). Sometimes those components are expressed hand-in-hand: for instance the Structure of a community is often a reflection of its Composition, and disturbances (or Processes) often determine both Composition and Structure. It is easiest to draw a line around a Grading Patch wherever the boundaries of different components coincide (for instance where the extent of an area that is rated Medium in Composition coincides with an area that is rated Low in Structure). Otherwise it may be necessary to draw the boundary line as a series of interpolations, extrapolations, compromises, and surmises.

Degree of Documentation

During the Final Field Survey of a site, the entire area is graded. Natural Quality Grades are assigned to one or more Grading Patches within the boundaries of the site. Although every Grading Patch must be documented with a Grading Form, it is not always necessary to describe the quality of each patch in detail. If a Grading Patch is low quality (Grade D or E), it can usually be documented by recording one or a few severe, overriding Disturbance Factors — without needing to mention any lesser disturbances. At the other extreme, if a patch is Grade A or Grade B, it must be thoroughly described and analyzed with a Grading Form.

A Grade C area may or may not call for detailed and thorough records on the Grading Form. If a patch is clearly Grade C, the assessment may often be documented sufficiently with very few photos and entries in the blanks on the form. But if the Grade C determination cannot be reached without an in-depth evaluation, then the Grading Form needs to be filled out in detail. The "B/C split" is critical: if an area appears to be on the border between a "low Grade B" and a "high Grade C," then the observations and analysis that led to the grading decision need to be thoroughly and carefully recorded.

A Grading Patch that is a Category I Significant Feature or a Category I Exceptional Feature must be documented in detail. This includes not only Grade A and Grade B areas — but also any Grade C area that appears to be a good candidate for recognition as either a Best-of-Kind Site or a Local Natural Area.

Identifying and Documenting Quality Indicators

A Surveyor identifies a Quality Indicator by looking for any feature of a Natural Community that is an indication of the community's history of disturbance, recovery from disturbance, or lack of disturbance. As defined on page 2, a Quality Indicator may be a physical thing, or evidence of an activity, or a condition of a Natural Community. Guidelines for identifying Quality Indicators are in Appendix 5.

A Quality Indicator is documented by recording it on page 1 of the Grading Form and by photographing it. Photos serve several purposes. They show what the Surveyor observed and analyzed when assigning a Natural Quality Grade to a community. They are a permanent record, and they can be distributed to people who have not been to the site.

The process of photographing a Quality Indicator helps ensure that the Surveyor's impression of the indicator is accurate: the indicator might not be as well developed and expressed as the Surveyor first thought. An attempt to document a Quality Indicator with photography is sometimes frustrating and disappointing. For instance, it may be difficult or impossible to capture the structure of an old-growth forest with a camera. Or, a woods may turn out to have fewer stumps than it first seemed to have — because it proves impossible to photograph many stumps at once even though they seemed to be "all over the place" during the initial reconnaissance. If one cannot convincingly document a Quality Indicator with a camera, one may need to rethink whether the indicator well enough developed to be significant.

Interpreting Quality Indicators and Identifying Disturbance Factors

After a Quality Indicator is identified, the corresponding Disturbance Factor or Factors need to be identified. Ideally both the Quality Indicator and Disturbance Factor are listed in Table 7. If they are not in Table 7, the table needs to be revised — or perhaps the Surveyor has misinterpreted the evidence from the field. When a Disturbance Factor is identified, it is recorded on page 1 of the Grading Form beside its Quality Indicator. Guidelines for interpreting Quality Indicators and identifying Disturbance Factors are in Appendix 5.

Documenting the Impact of a Disturbance Factor

The *Impact* of a Disturbance Factor is assessed by observing and documenting three attributes: the factor's *Extent*, *Level*, and *Trend*. These attributes are recorded for each Disturbance Factor on page 1 of the Grading Form.

Extent

The *Extent* of a Disturbance Factor is an estimate of the proportion of a Grading Patch that is occupied or affected by the factor. The Grading Form provides four choices for recording a Disturbance Factor's Extent:

> **Not seen**: The factor or its effect is not found in the Grading Patch. *

* A Disturbance Factor is not normally recorded on a Grading Form unless it is identified in a Grading Patch, so the "Not seen" option is rarely if ever applicable. But "Not seen" could be the default entry in the electronic version of the Grading Form if a default is needed.

Low (localized): The factor occupies or affects less than about one-tenth of the Grading Patch, often in several scattered spots.

Medium (moderate): The factor occupies or affects roughly one-tenth to one-half of the Grading Patch.

High (widespread): The factor occupies or affects more than half of the Grading Patch.

Guidelines for documenting the Extent.—The Extent of a Disturbance Factor is estimated on the basis of visual inspection during field reconnaissance. It is not ordinarily determined by any kind of measurement.

Level

The *Level* of a Disturbance Factor is the degree of development of the factor and its effects. There are four choices:

None or N/A: If a Disturbance Factor is present in a Grading Patch but it is having no apparent, active effect on the community, then the *Level* is None. Or if the *Extent* of the Disturbance Factor is recorded as Not seen, then the *Level* must be N/A (not applicable).

Low: In the parts of a Grading Patch that the Disturbance Factor occupies or affects, it is poorly developed and has a minor effect on the community.

Medium: The level of development is judged to be between Low and High.

High: In the parts of a Grading Patch that the Disturbance Factor occupies or affects, it is well developed and has a major effect on the community. (Note that the Level of a Disturbance Factor may be High even though its Extent is Low or Medium.)

Guidelines for documenting the Level.—The Level of a Disturbance Factor may vary in different parts of a Grading Patch — for instance High in one part and Low (or absent) in other parts. In such a case, the Surveyor should choose the level that best represents the patch as a whole, and explain the choice with notes on the Grading Form. For instance if the level is High in a few small spots but mostly Low, one should choose Low and explain the situation; do not "average" the level and call it Medium. However, if most of the Disturbance Factor is judged to be Low but an area of high-level development is especially significant, then the level should be recorded as High to give a better assessment of the situation. In this case too, the complex situation needs to be documented with notes.

Trend

The *Trend* describes whether the *Extent* or *Level* of a Disturbance Factor appears to be increasing or decreasing. Four options:

> **Unknown or N/A**: If a trend cannot be determined, it is Unknown. If the *Extent* of a disturbance is recorded as Not seen or if the *Level* is None or N/A, then the Trend must be N/A (not applicable).
>
> **Low (decreasing)**: The Disturbance Factor is judged to be declining, either by shrinking in area or dropping toward a lower level of development.
>
> **Medium (stable)**: The factor appears to be in a steady state, neither increasing nor decreasing overall — although it may be increasing or decreasing locally within the Grading Patch.
>
> **High (increasing)**: The factor is judged to be increasing, either in its extent or its level of development, or both.

Guidelines for documenting the Trend.—The Trend of a Disturbance Factor may be obvious, or it may be difficult or impossible to judge on the basis of the available information. Often the growth or decline of vegetation is a good indicator of a trend. Are flood-damaged plants resprouting? Is a patch of weeds obviously dying back?

Interpreting the Effect of a Disturbance Factor

When grading a Natural Community, a Disturbance Factor is assessed according to its *Effect* on the Natural Quality of the community. Most Disturbance Factors have the potential for lowering the Natural Quality. Some factors have a positive effect on quality. Others may have a positive, negative, approximately neutral, variable, uncertain, or unknown effect — depending on the community and sometimes on the individual circumstances of the community. The duration of the effect of a disturbance may range from ephemeral to permanent.

Although most disturbances may lower the quality of a community, many disturbances have an effect that is often considered positive — such as enhancement of native biodiversity, maintenance of early seral stages, stimulation of plant growth and reproduction, and reduction of interspecific competition. [*] Periodic disturbances are even

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[*] An example of a disturbance that has mixed impacts on a community is grazing on a dry, rocky prairie, which prevents woody encroachment and fosters some disturbance-dependent prairie forbs, but which eliminates conservative species and encourages weedy species (including exotics). Three Disturbance Factors with a positive Effect can be identified in this situation, based on Table 5: 11.01 (Enhancement of snap diversity), 11.02 (Maintenance of habitat for native species that require bare soil and sparse vegetation), and 11.03 (Reduction or control of woody growth in

necessary for the long-term persistence of some communities (*e.g.* to maintain a prairie that would otherwise succeed to forest).

The Effect of each Disturbance Factor is recorded on page 1 of the Grading Form. The combined impacts of all the various disturbances on a Natural Community have a major bearing on the community's species composition, vegetation structure, ecological processes, and physical environment. The condition of those four components, in turn, determines the quality of a community.

Guidelines to keep in mind when identifying Quality Indicators and Disturbance Factors and when thinking about what they mean are spelled out in Appendix 5. The basic procedures for grading a Natural Community on the basis of Quality Indicators and Disturbance Factors are outlined on the following pages.

Grading Components and Sub-components

For the purposes of grading Natural Quality, a Natural Community is described and analyzed in terms of four *Grading Components*:

Species composition
Vegetation structure
Ecological processes
Physical environment

Briefly termed:

Composition
Structure
Processes
Environment

Each Grading Component can be broken down into a number of *Sub-components*, which are elements of a Grading Component that can be observed and evaluated, and that have a major bearing on the condition of the Grading Component.

The four Grading Components and important Sub-components are defined and discussed under the next several headings.

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a formerly fire-maintained community). Two Disturbance Factors with a negative Effect can also be identified: 11.05 (Decrease in favored forage species; reduction in the diversity and abundance of conservative native species), and 11.06 (Increase or persistence of unpalatable or grazing-adapted species).

Composition

Definition

The *composition* of a community refers to the species that are present in the community, plus three attributes of each species: its *nativity*, *abundance*, and *autecology*.

A species' *nativity* may be simply denoted as either *native* or *exotic*. A detailed and comprehensive terminology for describing nativity is in Appendix 6.

Terms for annotating the *abundance* of a species are in Appendix 7.

Autecology refers to the ecology of an individual species, as opposed to the *synecology* of a community. Aspects of autecology include phenology (spring ephemeral, fall-blooming, etc.), length of the reproductive cycle (annual, biennial, perennial), reproductive strategy (r/K selection), photosynthetic pathway (C3 vs. C4), tolerance to environmental extremes, tolerance to disturbances, competitive ability (allelopathy, shade tolerance), and palatability to herbivores.

Sub-components

Many aspects of the species composition of a Natural Community lend themselves to analysis when grading Natural Quality. The following Sub-components are listed on the Grading Form because they are considered to be the primary ones that indicate the condition of the Grading Component:

> **Richness**: The number of species in a given area. This number may be derived from vegetation plot sampling, or it may be simply estimated by looking at the Grading Patch, ideally while making a plant species list.
>
> **Conservatives**: Native plant species that do not tolerate most disturbances, and that usually do not occur in degraded habitats.
>
> **Decreasers**: Native plant species that tend to decrease in number or vigor when their habitat is lightly to moderately disturbed. [*]
>
> **Increasers**: Native or non-native plant species that tend to increase in number or vigor when their habitat is lightly to moderately disturbed.

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[*] This concept of *increasers* and *decreasers* originated with range scientists and managers who were assessing the response of plant species to grazing by domestic livestock. Here in the *Grading Handbook*, the terms are employed in reference to any kind of disturbance, not just grazing.

Ruderals: Native or non-native plant species that grow in highly disturbed areas, often becoming established on bare soil; often annuals that do not persist unless the site is repeatedly disturbed or unless the substrate is unnatural (*e.g.* a cindery railroad embankment).

Exotics: Species that are not native to an area.

Additional Sub-components may be added to the Grading Form on a patch-by-patch basis to characterize other relevant aspects of a Grading Patch's species composition.

Structure

Definition

Structure has three aspects:

(a) the physiognomy or physical form and appearance of the vegetation as a whole,

(b) the pattern of distribution of species or groups of species within a community, and

(c) the growth form and morphology of individual species and even single plants in a community.

In other words, structure relates to:

(a) the vertical arrangement and character of vegetation layers (including the size and density of trees),

(b) the horizontal distribution of individual species or groups of species in a community (*e.g.* zones related to environmental gradients, or patches that develop in response to disturbance history and succession, or apparently random or patternless distribution), and

(c) a species' growth form (graminoid, forb, shrub, tree) and the appearance of individual plants (vigor; disfigurement from herbivory, pathogens, and environmental stressors).

Sub-components

During the grading process, the Structure component is evaluated according to the Natural Community's vertical vegetation layers. A community may have as many as four possible vegetation layers:

Ground layer: Herbaceous plants and woody plants up to 1 meter tall.

Shrub layer: Shrubs, saplings, and small trees.

Subcanopy layer: Small trees that form a canopy directly beneath the overstory canopy.

Overstory layer: Trees that form the uppermost canopy in a community.

In addition, as an alternative, the shrub layer and subcanopy layer may be referred to collectively as the **understory layer** when it is efficient to do so, and when it is possible to clearly record observations or analyses about both layers at once.

Any of the vertical layers that are present in a community may be characterized and evaluated during the grading process. In addition, it is sometimes useful to document the vegetation structure in terms of another Sub-component:

Horizontal pattern: The horizontal distribution of individual species or groups of species in a community, including the size and shape of vegetation patches, the relationship between patches and environmental gradients and disturbances, and the character of boundaries between patches.

The above Sub-components are listed on the Grading Form. Other aspects of vegetation structure may be identified and added to the form as additional Sub-components if they do not fit well into any of the above Sub-components.

Processes

Definition

Ecological *processes* consist of the biological and physical actions that shape and control an ecosystem and cause it to function.

Here is a sampling of ecological processes and their effects on an ecosystem: (a) formation of soil by chemical weathering and decomposition of organic matter; (b) changes in vegetation structure, microclimate, soil, and species composition through ecological succession; (c) control of animal populations by predators, diseases, and parasites, and (d) changes in natural communities that result from disturbances such as fires and floods.

When evaluating a Survey Site, one must recognize and accept that ecological processes are significantly different now than they were two centuries ago. Farming has fundamentally transformed the hydrology of streams. Wildfires no longer sweep the plains, so a remnant prairie may no longer experience the fires that it requires for its continued existence. Large predators have been eradicated, so the population dynamics of animals as well as plants have changed dramatically. There are no free-ranging bison and no passenger pigeons. [Note 3] The natural landscape is so fragmented that local dispersal as well as long-distance migration are severely curtailed for many species. Acid rain, atmospheric deposition of nitrogen, and global warming add new dimensions of change. Regardless of such major alterations of ecosystem processes, evaluation standards need to be applied in a manner that allows the Processes component of some Grading Patches in some Survey Sites to be rated as High.

Sub-components

Biological and physical processes are myriad and they operate at every scale, from intracellular to cosmic. An ecological process that is evidenced by a Quality Indicator may originate or extend beyond the limits of a Grading Patch and far from a Survey Site. Most processes operate well beyond the control and outside the capacity of natural area managers. The grading procedure should focus primarily on processes that function at the approximate scale of a Survey Site or a Natural Community — not at a much higher or lower level.

Two kinds of ecological processes are most important to examine when grading a community: (a) those that are most significant in determining the species composition and structure of the community, and (b) those that have been modified so much that the basic character of the local ecosystem has changed.

The Grading Form has blanks for rating the following four Sub-components of the Processes component:

> **Reproduction and Growth**: Addition of new plants (genets) through sexual reproduction, and addition of new stems (ramets) via asexual reproduction; also, increase in the size of plants.
>
> **Succession**: The process in which communities of plants and animals in a particular area are replaced over time by a series of different communities.
>
> **Fire**: Actions of fire on a community, primarily by consuming organic matter and killing or injuring plants and animals.
>
> **Hydrology**: Actions of running or standing water on a community: scouring soil and vegetation, inundating and drowning living things, moving nutrients, etc.

As needed, any number of other Sub-components may be recognized and evaluated to assess the condition of the Processes component.

Environment

Definition

The physical *environment* is the abiotic component of an ecosystem, including the substrate or medium in which plants and animals live.

Sub-components

Three main parts of the physical environment for a community are the *microclimate*, *soil*, and *water*. The microclimate (or "climate near the ground") is a basic element of the environment, but it does not usually figure into the grading equation. Even though soil and water are so full of life that it is impossible to separate the living from the non-living environment, they are classified here as abiotic or physical features of an eco-system.

Three elements of the Environment component are preprinted on the Grading Form because they are most likely to come into play when evaluating an area:

> **Soil**: The surface of the earth, extending downward to include the upper part of the parent material.
>
> **Water**: Streams, diffuse surface runoff, standing surface water, soil water, and groundwater.
>
> **Intrusions**: Relatively small, manmade physical features (such as a structure) or localized sites of intensive human disturbance (such as a trail).

Other environmental Sub-components may be added to the Grading Form and analyzed on an ad hoc basis (that is, to describe the unique situation of an individual Grading Patch).

Rating the Condition of Grading Components and Sub-components

When evaluating a Grading Patch, the overall condition of each of the four Grading Components and its Sub-components is estimated with a Condition Rating, which is a simple, qualitative, relative scale: Low, Medium, and High. The Medium rating has the widest latitude:

Low	**Medium**	**High**
Lower quarter	Middle half	Upper quarter

A Grading Component or Sub-component is rated High if it is judged to have more than 75% of the characteristics that it would have if it were in a theoretical, pristine natural area (*i.e.* without any degradation). A component or sub-component is rated Low if it is judged on the same basis to be in the bottom quarter. Any case in-between is Medium.

To rate the condition of a Grading Component in a Grading Patch, the Surveyor must do the following:

(1) Examine the Grading Patch to identify Quality Indicators.

(2) Document each Quality Indicator with a written description and photography.

(3) Determine which Disturbance Factor or Factors are indicated by each Quality Indicator.

(4) Decide whether the Effect of each Disturbance Factor on the community is clearly positive, clearly negative, variable or approximately neutral, or uncertain or unknown.

(5) Determine the Impact (Extent, Level, and Trend) of each Disturbance Factor.

(6) Evaluate the Grading Component by examining relevant Sub-components and rating their condition as High, Medium, or Low. Base this rating on (a) the observed characteristics of the Sub-component and (b) the impact of Disturbance Factors on the Sub-component.

(7) Summarize the condition of the Grading Component with a rating (High, Medium, or Low) and a descriptive narrative. Base the rating on the condition of the Sub-components as well as other characteristics of the Grading Component that were not formally classified as Sub-components.

Condition Ratings for Grading Components and Sub-components are based on experienced, professional judgment and comparative knowledge of many different sites. A rating is not derived from any sort of multifactorial, numerical scoring system.

Tables 1 to 4 characterize Condition Ratings (High, Medium, and Low) for each of the Grading Components.

Table 1. Condition Ratings for Composition.

Description	Examples
HIGH The species composition reflects conditions that develop under a long-term lack of degrading disturbances. The Grading Patch may or may not have native species that require early seral conditions that are created and maintained by natural disturbances. Species diversity is natural, usually indicated by relatively high native species richness. Conservative species are present, except in Natural Communities that do not normally have such species (*i.e.* highly dynamic, naturally disturbed communities with open habitats). Less conservative species are present, but they are not as abundant as in lower quality occurrences of the community. Exotic species may be present, but they do not have a significant impact on the community's composition, structure, or processes.	Wet-mesic Floodplain Forest dominated by Acer saccharinum, Populus deltoides, Quercus macrocarpa, and Q. bicolor, with scattered Carya illinoensis and C. laciniosa; understory of Fraxinus lanceolata; ground layer a mix of flood-tolerant native herbs.
	Mesic Prairie dominated by Andropogon gerardii and Sporobolus heterolepis, with 80 native plant species per acre, including conservative forbs such as Dalea and Baptisia; no heavy invasion by exotics (but Poa pratensis grows in a suppressed condition throughout).
	Sedge meadow covered by clumps of Carex stricta, with a wide variety of native herbs in the interstices.
MEDIUM Conservative plants are reduced in the number of species and individuals, compared to what they would be in a high quality community. Less conservative species (increasers) are common to abundant. Exotic species may have a significant impact on the community's composition, structure, or processes.	Wet-mesic Floodplain Forest that has a natural woody species composition except for scattered exotic understory trees and shrubs (Maclura, Morus, Lonicera). Alliaria is invading the ground layer but has not significantly suppressed the native herbs.
	Mesic Prairie that lacks some of the expected conservative species (Dalea, Eryngium) but has an abundance of less conservative natives (Oligoneuron rigidum, Ratibida). Exotics such as Daucus and Pastinaca are conspicuous.
	Sedge Meadow dominated by Carex stricta but with an abundance of less conservative natives (Asclepias incarnata, Eupatoriadelphus maculatus).
LOW Species composition is substantially altered from natural conditions. A few disturbance-tolerant species may dominate. Native species diversity is depleted, often replaced by exotics or weedy natives.	Wet-mesic Floodplain Forest where Alliaria has largely taken over the ground layer.
	Mesic Prairie dominated by Bromus inermis, with 20 native species per acre.
	Sedge Meadow overwhelmed by Lythrum salicaria.

Table 2. Condition Ratings for Structure.	
Description	**Examples**
HIGH The structure of the community has all of the vertical layers and horizontal patterns that a natural example of the community is expected to have. For the Forest Community Class, a significant part of the overstory canopy is composed of old trees.	Wet-mesic Floodplain Forest with an overstory dominated by old trees, and understory and ground layers that are well developed except in areas that are too wet or have recently been scoured by floodwater.
	Mesic Prairie that has an intact sod and little or no shrub invasion.
	Sedge Meadow that has an intact array of sedge tussocks and little or no shrub invasion.
MEDIUM The structure of the community is significantly altered: woody layers may be partially disrupted, but they are not largely or completely missing. For the Forest Community Class, the overstory canopy may lack old trees. Less conservative species often predominate in patches.	Wet-mesic Floodplain Forest with an overstory of young to mature trees because the old trees have been removed by logging.
	Mesic Prairie with patches of clonal weedy natives (Helianthus and Solidago).
	Sedge Meadow with sedge tussocks that are shorn by grazing cattle, and with the mucky interstices trampled and enlarged.
LOW The structure if the community is substantially damaged. Woody layers or size classes may be missing. Horizontal patterns are arrayed in response to unnatural disturbances instead of natural processes and the physical environment.	Wet-mesic Floodplain Forest with most of the overstory trees killed by a prolonged flood.
	Mesic Prairie with heavy invasion by Rhamnus cathartica thickets and Cornus racemosa clones, which are dense enough to shade out most of the herbaceous plants.
	Sedge Meadow that is well along in the process of succeeding to a shrubland because of the growth of Frangula alnus and Salix.

Table 3. Condition Ratings for Processes.	
Description	**Examples**
HIGH Processes that are necessary for the continuance of the community are intact and functioning.	Wet-mesic Floodplain Forest with no evident problems with ecological processes, particularly hydrological processes.
	Mesic Prairie that is well managed with prescribed burns.
	Sedge Meadow with natural hydrologic and fire regimes, and no history of grazing by domestic livestock.
MEDIUM Processes are disrupted to the point that the functioning of the ecosystem is significantly altered, and the health of the community will not be maintained without active management.	Wet-mesic Floodplain Forest that has been damaged by excessive flood scouring, which was caused by farming upstream in the watershed.
	Mesic Prairie that has not burned in decades.
	Sedge Meadow that is being damaged by excessive runoff of polluted water from an adjacent residential subdivision.
LOW Processes are substantially disrupted, to the pont that the original community has been replaced or cannot persist in the long term.	Wet-mesic Floodplain Forest that has been drained by stream entrenchment.
	Mesic Prairie that is so overwhelmed by shrubs that it no longer has the fine fuels (grassy duff) needed to carry a fire.
	Sedge Meadow where the controlling processes are grazing by cattle and wallowing by hogs.

Table 4. Condition Ratings for Environment.	
Description	**Examples**
HIGH The environment is substantially unaltered from natural conditions.	Wet-mesic Floodplain Forest with no evidence of unnatural disturbance to the soil and water, and no significant artificial intrusions.
	Mesic Prairie that shows no evidence of disturbance to its soil or other abiotic features.
	Sedge Meadow that has a natural substrate and unpolluted water.
MEDIUM The environment has suffered significant damage or alteration, but not enough to transform the community or to prevent it from returning to natural conditions.	Wet-mesic Floodplain Forest that received excessive siltation from the Great Flood of 1993 (damaging its vegetation), but that is now recovering.
	Mesic Prairie that lost about half of its topsoil long ago during construction of an adjacent railroad line.
	Sedge Meadow with a ditch that has lowered its water table, but not so much as to immediately destroy it.
LOW The environment is dominated by unnatural conditions, and it will not revert to natural conditions without major rehabilitation (if ever).	Wet-mesic Floodplain Forest with an entrenched, gullying stream channel that has drained wet depressions that formerly held water.
	Mesic Prairie that has reestablished in an abandoned industrial site where all of the topsoil was scraped away.
	Sedge Meadow that has been diked and partially excavated to create and maintain permanent areas of open water.

Grading Model

Grading Components and Condition Ratings

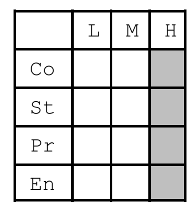
The process for evaluating Natural Quality is organized around a matrix of four variables, each of which has three possible values. The variables are the four Grading Components: Composition, Structure, Processes, and Environment (designated as `Co`, `St`, `Pr`, and `En`). The three values are the Condition Ratings that are defined on page 17: Low, Medium, and High (`L`, `M`, `H`).

Grading Components:

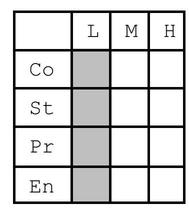
- `Co` = Composition
- `St` = Structure
- `Pr` = Processes
- `En` = Environment

Condition Ratings:

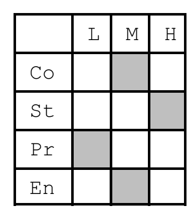
- `L` = Low
- `M` = Medium
- `H` = High



In the highest possible quality example of a Natural Community, all four Grading Components are rated High, designated as `Co` = `H`, `St` = `H`, `Pr` = `H`, and `En` = `H`, or `HHHH`. This is illustrated by the top matrix in the right margin. A High rating for each of the four Grading Components does not indicate a "perfect score." A Grading Component does not have to be scored as 100% to be rated as High: it only needs to be estimated to fall in the upper 25%.



The opposite extreme is `LLLL` (*i.e.* all four of the Grading Components are rated Low).



An intermediate case is `MHLM`: Composition = Medium, Structure = High, Processes = Low, and Environment = Medium.

Here are all 81 possible arrangements of the ratings:

LLLL	LMLH	LHML	MLMM	MMMH	MHHL	HLHM	HMHH
LLLM	LMML	LHMM	MLMH	MMHL	MHHM	HLHH	HHLL
LLLH	LMMM	LHMH	MLHL	MMHM	MHHH	HMLL	HHLM
LLML	LMMH	LHHL	MLHM	MMHH	HLLL	HMLM	HHLH
LLMM	LMHL	LHHM	MLHH	MHLL	HLLM	HMLH	HHML
LLMH	LMHM	LHHH	MMLL	MHLM	HLLH	HMML	HHMM
LLHL	LMHH	MLLL	MMLM	MHLH	HLML	HMMM	HHMH
LLHM	LHLL	MLLM	MMLH	MHML	HLMM	HMMH	HHHL
LLHH	LHLM	MLLH	MMML	MHMM	HLMH	HMHL	HHHM
LMLL	LHLH	MLML	MMMM	MHMH	HLHL	HMHM	HHHH
LMLM							

These combinations are displayed in Appendix 9. [*] Many of them are unlikely to occur in nature. For instance if Environment is in Low condition, it is not likely to support Composition and Structure in High condition: a natural glade flora will not colonize an abandoned asphalt parking lot, and a natural sedge meadow will not become established on an alluvial fan that is forming at the head of a flood-control reservoir.

If an unlikely combination of Condition Ratings actually does occur in a Survey Site, it is probably an unstable condition. For instance a community that is rated High in Composition and Low in Process is likely to be a temporary circumstance because the species composition probably cannot remain in very good condition (High) in the long term if the ecological processes that control the community are in poor condition (Low).

Relative Importance of the Grading Components

Composition is the single most important indication of the quality of a Natural Community. The species that occur in a community are an integrated expression of the condition of the community's Structure, Processes, and Environment.

Structure is the second most important indicator of the quality of a community. This is not to say that a community's structure is more important than a community's ecological processes. But Structure is a more important Grading Component than Processes because Structure is more readily observable, and it is a good indicator of the history of disturbance, recovery, and development of a community. In part, Structure is determined by Composition, but it is also controlled by Processes, especially disturbances.

Processes are key to the long-term condition and viability of a community. If ecological processes are disrupted, the community will change in response.

Environment is a basic component of an ecosystem, but in terms of evaluating Natural Quality, it usually is decidedly less important than the other three components. If the condition of Environment is not High, the environmental degradation can usually be seen in the Composition and Structure, which are often easier to assess.

Long-term Interactions among Components

`Pr < Co` or `St.` If the condition of Processes is lower than the condition of Composition or Structure, the condition of Composition or Structure is likely to decline in the long term.

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[*] These 81 possible arrangements are not *combinations* in the mathematical sense. Nor are they *permutations*.

`Pr > Co` or `St`. If the condition of Processes is higher than the condition of Composition or Structure, the condition of Composition or Structure may improve in the long term.

`En < Co` or `St`. If the condition of Environment is rated lower than the condition of Composition or Structure, the future of the community may be difficult or impossible to ascertain or predict. The Composition and Structure may or may not have already adjusted and adapted to the degraded Environment. As a general rule, Environment is not likely to improve quickly without some sort of effort to rehabilitate it.

If the condition of Composition or Structure is Low, this is often a consequence of Processes or Environment that are in Low condition.

`Co` or `St > Pr` or `En`. If the Composition or Structure are rated higher than Processes or Environment, either of two circumstances is likely. (1) The condition of the Composition or Structure may be mistakenly overrated. (2) Or the condition of Processes or Environment may have declined recently, and the Composition and Structure have not yet adjusted to the changed conditions.

To guard against the first circumstance (*i.e.* mistakenly overrating a Grading Component), the Surveyor needs to review the analysis of the Grading Components to determine whether one of them has been mis-evaluated. But if Processes and Environment are truly in lower condition than Composition and Structure, the long-term implications for the community should be examined, and the Natural Quality Grade should be assigned accordingly.

Grading Rules

The above discussion suggests that Composition and Structure can be employed as the principal basis for determining the grade of a community. The following Grading Rules are prescribed:

(1) Composition is the primary component for determining a grade:

   (a) If Composition is Low, the grade is D.

   (b) If Composition is Medium, the grade is C.

   (c) If Composition is High, the grade is either A or B, depending on (a) how much the community's composition has been altered from natural conditions, and (b) the community's Structure.

(2) Structure is the primary consideration for separating Grade A and Grade B, after the Composition has been considered:

(a) If Composition and Structure are both High, the grade may be either A or B.

(b) If Composition is High but the Structure is Medium or Low, the grade is B.

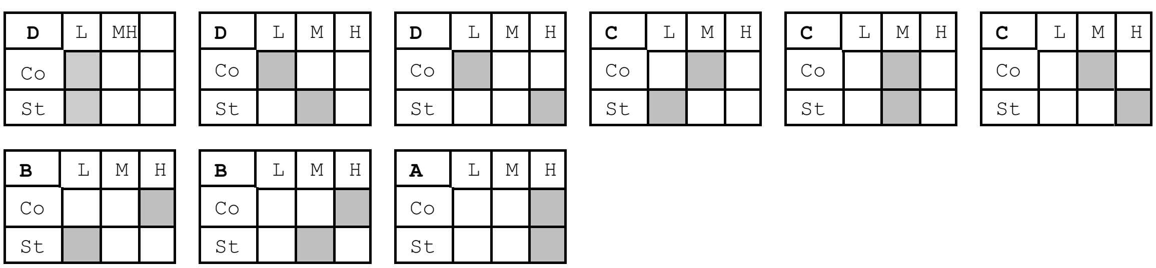
(3) If Composition or Structure is rated High, and Processes or Environment is rated Low:

(a) Reexamine the analysis and rating of Composition or Structure to determine whether that component should be rated Medium instead of High.

(b) If the rating of Composition or Structure remains High, consider whether the grade should be lowered from Grade A or B to Grade C.

(4) If the results of applying the above rules do not make sense, then do something else, document the departure from the rules on the Grading Form, and consult with the Field Survey Director or Survey Instructor. The current draft rules may prove to be oversimplified or otherwise inadequate.

When only Composition and Structure are considered, there are nine possible Grading Models, shown here with the grades that are derived from applying the Rules 1 and 2:



Appendix 9 shows all possible combinations of the four Grading Components and their three Condition Ratings. In that appendix, Natural Quality Grades are assigned to each of these 81 Grading Models, based on the above set of rules. Most of the assigned grades are obvious choices, but some are tentative. Using the Grading Models will show how well they work and which ones need to be modified or applied cautiously.

NOTE FOR THE FOURTH EDITION: Further field testing of the Grading Rules and Grading Models since the third edition of the *Grading Handbook* has indicated that the rules and models may need to be modified by splitting the High rating for Composition into two levels: Moderately High (MH) and Very High (VH) to help distinguish Grade B patches and Grade A patches (*i.e.* MH corresponds to a potentially Grade B patch, and VH corresponds to a potentially Grade A patch). Rules 1 and 2 (above) have been reworded to suggest this change, but the Grading Models have not been revised to reflect any such change, pending further testing and analysis.

The Illinois Natural Areas Inventory's grading system has five grades (A, B, C, D, and E), but Grade E is not included in the Grading Model because it can be recognized without any in-depth analysis. Grade E communities are in the Cultural Community Class, such as Developed Land and Cropland. A community is Grade E if the rating of one or more of its Grading Components would be effectively "No" instead of High, Medium, or Low. That is, a Grade E area can be considered as having no (or essentially no) natural species composition, natural vegetation structure, natural expressions of ecological processes operating at the community level, or natural physical environment.

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Notes

1. In the Supplemental Materials for the *Survey Standards and Guidelines* is an essay titled *Recognizing Disturbances within Natural Communities* by Max Hutchison (1993). This is the single best short piece of writing that analyzes the role of disturbances in Illinois' natural areas.

   See also the *Conceptual Foundation and Philosophical Framework for the Illinois Natural Areas Inventory* by John White (2008), particularly the section about the Presettlement Paradigm and the appendix, "Mission and Goals for an Ecological Reserve Program for Illinois."

2. The role of humans in wild areas and natural systems is the subject of much debate and philosophical discussion. See "Natural Disturbances in General" in the *Survey Standards and Guidelines* (White 2009) for an entry into the literature on this topic.

3. The formerly immense population of passenger pigeons must have had a big impact on the ecology of eastern North America; see Ellsworth and McComb (2003 for an introduction to the topic. However, it has been suggested that the estimated billions of passenger pigeons were a relatively recent, unnatural consequence of ecological disruptions that attended the arrival of European colonists on the continent (see Neumann 1985).

4. This quotation is from Short (1845).

5. See "Why Natural Areas Exist" in the INAI *Technical Report* (White 1978). See also the Survey Standards and Guidelines titled "Small or Isolated Piece of Idle Property" in White (2009).

6. For a detailed, local analysis of the phenomenon of snaps growing in a woods, see "Distribution Patterns of Prairie Plant Species in a Closed-canopy Forest Situation" by McCarty and Hassien (1986).

Appendix 1
Natural Quality Grades

This appendix consists of the "Natural Community Grading" section of the Illinois Department of Natural Resources' *Standards and Guidelines* (2006):

Natural Quality and Community Grading

Natural quality is defined as a measure of the effects of disturbance and/or degradation to a natural community. These disturbances may or may not be natural, but are typically anthropogenic in origin.

For the purposes of the INAI, natural quality is expressed by a system of grades which are affected by the amount of artificial or natural disturbance. Several environmental indicators are used to evaluate and subsequently rate natural community quality. These include species lists, presence of conservative or indicator species, community structure, observations of community function, and evidence of degradation (*e.g.* grazing, logging).

Grades used by the INAI are summarized below:

Grade A — Very high quality natural community

A Grade A natural community exhibits native species composition, structure, and function with no or very minimal signs of degradation. Sites experiencing minimal degradation will show near complete recovery — the composition, structure, and functional integrity are intact. Generally, Grade A communities need minimal or no restoration though may require management to maintain their present condition (*e.g.* periodic fire).

Examples of Grade A Natural Communities: old-growth, ungrazed forest, prairie with undisturbed soil and natural plant species composition, wetlands with unpolluted waters, unaltered hydrology, and natural vegetation.

Grade B — High quality natural community

A Grade B natural community is a former Grade A community that has (1) experienced some degradation, but whose composition and structural integrity is intact, or (2) historically experienced moderate to heavy degradation, but has recovered significantly to where it possesses the structure of a complete and functional community. A Grade B community can be restored to Grade A or maintained at its present condition with management.

Examples of Grade B Natural Communities: old-growth forest selectively logged 5 years ago, old second-growth forest recovered from moderate past grazing, prairie with some weedy species due to soil grading 15 years ago, wetlands where original hydrology has been altered which may have changed species composition locally, but not the structure and diversity of the community as whole.

Grade C — Medium quality natural community

A Grade C community either (1) has experienced moderate to heavy degradation and may or may not be in the process of recovering its composition, structure, and function, but possesses restoration potential appropriate for a complete and functional community of that type, or (2) has experienced severe degradation and has recovered the structure and function of the community. Degradation of Grade C communities can be so great that its species composition, structure, and function have been significantly altered, but it possesses restoration potential for improvement or maintenance at this grade. A Grade C community may be restored to a Grade B community with intensive, specifically prescribed management and/or a significant interval of time. A Grade C community can be maintained in its present condition with routine management.

Examples of Grade C Natural Communities: heavily grazed old-growth forest, young to mature second-growth forest, grazed prairie where many native species have been replaced by weedy species, wetland with artificial water levels that has changed the structure and composition of the vegetation.

Grade D — Low quality natural community

A Grade D community (1) has experienced severe degradation and has not recovered the species composition and structure characteristic for a natural community of that type, or (2) has experienced very severe degradation, but has just begun to recover the structure appropriate for a such a community. A Grade D community has been so severely degraded that its structure and function have been significantly altered. The community may be undergoing rapid succession, or if the disturbance is unnatural and constant (*e.g.* continual grazing), the community may be held in a constant degraded state. A Grade D community typically can only be rehabilitated through replacing and supplementing species composition and structure and significant management efforts.

Examples of Grade D Natural Communities: recently cut forest, severely grazed, mature second growth forest, prairie with graded soil and dominated by weedy species with many native species missing, wetland that has been artificially flooded or drained, greatly changing the vegetation.

Grade E — Very severely disturbed natural community

In Grade E communities, the original community has been destroyed or removed. Grade E communities experienced such a severe level of degradation that the functional community has been removed and there are few or no higher plants or animal species of a functional community. The land surface is often physically altered. Either (1) the site is going through the first stages of secondary succession, or (2) the natural biota is nearly or completely gone. A Grade E community can only be reclaimed through total reconstruction of a community starting from scratch.

Examples of Grade E Communities: newly cleared land, cropland, improved pasture, residential/commercial development, parking lot, road or railroad embankments and rights of way.

Appendix 2
Definitions of Disturbance Regimes

Clearing is defined as removal of vegetation, usually with substantial disturbance of the soil surface. Clearing usually transforms a "natural" Natural Community to another Natural Community in the Cultural Community Class (*e.g.* from Mesic Upland Forest to Pastureland, or from Mesic Savanna to Developed Land). Clearing is a severe disturbance — so when evaluating a vegetated area, clearing is usually considered in the context of *recovery* from past clearing. A Successional Field community is an old clearing or cultivated area that is reverting to wild conditions. Removal of vegetation that is carried out as part of natural area management usually is not classified as clearing because not all of the plants are removed, and the soil usually is not severely disturbed.

Cultivation is defined as plowing and other tilling of the soil to prepare a seedbed, kill weeds, and raise a crop. As with *clearing*, cultivation is such a severely disturbing activity that a Natural Community is usually evaluated in the context of *recovery* after past cultivation. If an area is currently cultivated, it is Grade E (Cropland). If the cultivated field has been abandoned and wild vegetation is recovering in the area, then the Natural Community is graded according to the degree to which it has reverted after cultivation has ceased.

Deer Overabundance is defined as the effects of foraging and other activities by white-tailed deer that are serious enough to significantly alter the ecology of a Natural Community. Although the effects of overly abundant deer can be similar to pasturage by domestic stock, Deer Overabundance is treated as a Disturbance Regime separate from Grazing.

Drainage is artificial removal of surface water, soil water, and shallow groundwater by ditching, stream channelization, underdraining (*i.e.* subsurface drainage tile lines), and drawdown from wells. Levees and pumping stations may also be employed as part of an artificial drainage system.

Earthmoving consists of major soil disturbances other than cultivation. Example: bulldozing to scrape and re-deposit soil in order to re-contour the land surface, commonly along a grass waterway or on a road right-of-way. A small area where earth has been moved (such as to make a single-car pull-off parking spot in the edge of a woods) may be treated as an *intrusion* instead of being classified and evaluated as an occurrence of the Earthmoving Disturbance Regime. If the earthmoving is more extensive, it usually results in the conversion of an area to Developed Land (Grade E) — rather than lowering the grade of the community that was disturbed. As with cultivation and clearing, an area that has been affected by earthmoving may have recovered to the point that it is at least Grade D (not Grade E, or bare earth).

Faunal Exploitation and Disturbance is defined as killing or otherwise interfering with the life of wild animals: hunting, fishing, trapping, roadkills, harassment by humans and human environs, etc. Destruction or disturbance of animal habitats is not addressed here; instead it is covered by other Disturbance Regimes.

Fire is wildland fire in any form and from any origin (either a prescribed burn or a wildfire).

Fire Suppression is defined as the effects of fire being reduced in frequency or completely excluded from a Natural Community whose character was naturally maintained by periodic burning.

Flooding is disturbance by water either flowing over or standing on land that usually is not covered by water.

Grazing is pasturage by domestic livestock. Although this Disturbance Regime is traditionally termed Grazing, it might be more aptly called *pasturage*, for two reasons. (1) Strictly speaking, according to some definitions, *grazing* refers to eating *herbaceous* vegetation, and *browsing* refers to eating *woody* plants. (2) The impact of domestic livestock in a pastured Natural Community extends beyond the vegetation to the soil, water, and fauna.

Insects and Pathogens include insect pests and diseases that have a significant impact on a community's composition and structure.

Intrusions are either manmade objects (such as a structure), or focal points of very localized, intense disturbance (an ORV trail or a household dump, for instance). An intrusion does not just *damage* a Natural Community: it actually *replaces* the community in the limited area that it occupies. If an intrusive feature is large enough, it is not treated as an intrusion within a Natural Community; instead it is mapped and classified as a separate Natural Community (*i.e.* as some kind of Developed Land). Intrusions are further discussed on page 3.

Invasive Species are highly competitive, non-indigenous plants and animals that have the proven potential to become so abundant in a Natural Community that they significantly change the character of the community. This Disturbance Regime does not include fire-sensitive, native plants that encroach into formerly fire-maintained communities.

Logging is the act of cutting trees. Logging usually carries the connotation of large-scale or commercial tree-cutting, but this Disturbance Regime is defined broadly so that it also includes lesser disturbances such as removing a dead tree for firewood.

Mowing is cutting of herbaceous vegetation or small woody plants. This Disturbance Regime includes haying, which involves removal of the cut herbage.

Soil Movement, Erosion, and Deposition is defined as the natural removal, transport, and deposition of soil, including water-caused erosion and sedimentation, wind erosion and deposition (sand blowouts and dune formation), mass wasting (downslope movement via gravity), and bioturbation (primarily mixing or sorting of soil by burrowing animals).

Water Impoundment is the artificial retention of surface water by means of a dam (across a stream channel or between valley walls) or a dike (across a broad lowland).

Water Pollution is defined as an unnatural increase in dissolved or suspended solids (organic materials as well as inorganic fertilizers, biocides, and other industrial chemicals) from sewage, farm runoff, and other sources. Both surface water and groundwater are included in this Disturbance Regime. Sedimentation (siltation) in a body of water is not classified as water pollution; it is included in the Soil Movement, Erosion, and Deposition regime.

Weather and Climatic Extremes include storms (wind, rain, snow, ice, lightning), drought, and temperature extremes that injure or kill plants and animals or significantly alter their habitats.

Other Hydrological Disruptions include unnatural changes in the frequency, duration, and impact of moving surface or subsurface waters (other than artificial drainage and water impoundment, which are addressed with their own Disturbance Regimes). Example: increased flooding as a result of removal of vegetation farther upstream in a watershed.

Other Natural Biotic Processes are other activities by organisms that shift the condition of a community from the norm — such as strong interspecific competition and dominance, hemiparasitism, and unusually heavy herbivory (other than foraging by deer and domestic livestock). The activity of a beaver colony (damming and cutting) is an obvious example of this kind of disturbance.

Other Natural Abiotic Processes include disturbances by non-living natural agents that do not fit into another Disturbance Regime.

Other Artificial Disturbances are ones that do not fit into any other category. Examples: littering, soil contamination.

Artificial Disturbances in General: This category is applied where the Natural Community has been disturbed by an unnatural agent, but the Disturbance Regime either cannot be identified or is not being specified for some reason (*e.g.* the community appears to have possibly been affected by several different artificial disturbances, but the disturbances cannot be sorted out and named).

Natural Disturbances in General: This category is applied where the Natural Community has been disturbed by a natural agent, but the Disturbance Regime either cannot be identified or is not being specified for some reason (*e.g.* the community appears to have possibly been affected by several different natural disturbances, but the disturbances cannot be sorted out and named).

Two additional categories are not actually Disturbance Regimes, but they are needed to cover all of the possibilities that arise when a Quality Indicator is interpreted and translated to a corresponding Disturbance Factor:

Unknown disturbance: A Quality Indicator is annotated with "Unknown disturbance" if the Quality Indicator shows that the community evidently is disturbed, but the kind of Disturbance Factor cannot be identified. That is, the disturbance cannot even be categorized with *Artificial Disturbances in General*, or *Natural Disturbances in General*, or with one of the "other other" Disturbance Factors in Table 5 (*i.e.* numbers 21.99, 22.99, or 23.99).

No evident disturbance: The Quality Indicator does not show any evidence of disturbance. In addition, the Quality Indicator may or may not clearly indicate that the area is undisturbed.

After a 400-mile, late summer and early autumn sojourn across central Illinois in the early 1840s, Dr. Charles W. Short wrote,

> The Flora of the prairies — the theme of so much admiration to those who view them with an ordinary eye, — does not, when closely examined by the Botanist, present that deep interest and attraction which he has been led to expect. Its leading feature is rather the unbounded profusion with which a few species occur in certain localities, than the mixed variety of many different species occurring any where. Thus from some elevated position in a large prairie the eye takes in at one glance thousands of acres, literally empurpled with the flowering spikes of several species of Liatris. . . . In other situations, where a depressed or flattened surface and clayey soil favor the continuance of moisture, a few species of yellow-flowered Coreopsis occur in such profuse abundance as to tinge the entire surface with a golden burnish. . . . This peculiarity of an aggregation of individuals of one or more species, to something like an exclusive monopoly of certain localities, obtains even in regard to those plants which are the rarest and least frequently met with; for whenever one specimen was found there generally occurred many more in the same immediate neighborhood. [NOTE 4]

Appendix 3
Disturbance Regimes and Disturbance Factors

Disturbance Regimes

A **Disturbance Factor** is an *intrusion* (a physical thing), an *activity*, or a *condition* of a Natural Community that affects or may affect the Natural Quality of the community.

A **Disturbance Regime** is a group of related Disturbance Factors. *

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* In this context, a Disturbance Regime is defined differently than it is traditionally defined in ecology. Ecologists use the term *disturbance regime* to refer to a characteristic set of behaviors by a natural phenomenon, such as a *flooding regime* or a *fire regime* (*i.e.* fire season, intensity, rate of spread, distribution pattern, etc.).

In Table 5, about a hundred Disturbance Factors are arranged according to the above-listed Disturbance Regimes. The regimes are numbered with whole numbers, and the factors have numbers with decimals. Nos. 26 and 27 are not actually Disturbance Regimes but are needed to cover all of the possibilities that are encountered when evaluating a site.

Table 5. Disturbance Regimes and Disturbance Factors.

1. Clearing

1.01. Recent or active clearing
1.02. Former clearing
1.99. Other clearing effect

2. Cultivation

2.01. Plowing or other tilling
2.99. Other cultivation effect

3. Deer Overabundance

3.01. Damage to the native herbaceous flora and woody vegetation (including prevention of recruitment)
3.02. Encouragement of weedy and unpalatable plants
3.03. Damage to the soil (trampling, erosion)
3.99. Other effect of deer

4. Drainage

4.01. Ditching for surface drainage (including stream channelization)
4.02. Subsurface drainage tile line
4.03. Groundwater drawdown from wells (including irrigation systems)
4.04. Depletion of soil water by trees encroaching on a herbaceous wetland
4.05. Change in vegetation composition or structure in response to drainage
4.99. Other drainage effect

5. Earthmoving

5.01. Excavation (digging a hole)
5.02. Filling (raising a mound or filling a low area)
5.03. Re-contouring the land surface (scraping and redepositing soil)
5.99. Other earthmoving effect

6. Farming

6.01. Deposition of soil at the edge of a field
6.02. Herbicide application and herbicide drift

Table 5. Disturbance Regimes and Disturbance Factors, *continued*.

6.03. Planting
6.99. Other farming effect

7. Faunal Exploitation and Disturbance

7.01. Hunting, trapping, fishing
7.02. Disturbance by human visitation
7.03. Disturbance by urbanized and residential environs (roadkill, noise, lights, pets)
7.99. Other disturbance to animals

8. Fire

8.01. Reduction of invasive species (not including native woody encroachment)
8.02. Reduction of encroachment by fire-sensitive native species
8.03. Stimulation of fire-adapted native species
8.04. Thinning of the structure of a fire-adapted woody community that has grown up because of fire suppression
8.05. Accelerated soil erosion
8.06. Stimulation of invasive vegetation
8.07. Consumption of leaf litter and woody debris
8.08. Death or injury to woody plants (including resprouting and coppice growth)
8.99. Other fire effect

9. Fire Suppression

9.01. Exotic cool-season grasses and other exotics fostered by a lack of fire
9.02. Fire-adapted, native species declining or not reproducing
9.03. Fire-sensitive, native species spreading into formerly fire-maintained habitat
9.04. Increase in the density and canopy closure of woody vegetation
9.05. Shade-pruning of major lateral crown limbs on overstory trees
9.06. Suppression of vegetative growth, flowering, and fruiting
9.99. Other fire suppression effect

10. Flooding

10.01. Death of vegetation caused by unusually prolonged inundation
10.02. Decrease in flooding (volume, velocity, duration, impact)
10.03. Increase in flooding (volume, velocity, duration, impact)
10.04. Mechanical injury of floodplain vegetation and scouring of the soil surface, promoting early successional vegetation
10.05. Seasonal water level fluctuation
10.99. Other flooding effect

11. Grazing

11.01. Enhancement of snap diversity

Table 5. Disturbance Regimes and Disturbance Factors, *continued*.

11.02. Maintenance of habitat for native species that require bare soil and sparse vegetation
11.03. Reduction or control of woody growth in a formerly fire-maintained community
11.04. Browsing and hedging of woody plants; creation of a browse line; suppression of woody reproduction; coppice growth
11.05. Decrease in favored forage species; reduction in the diversity and abundance of conservative native species
11.06. Increase or persistence of unpalatable or grazing-adapted species
11.07. Soil erosion and compaction (trails, terracettes), root damage and injury or death of trees
11.99. Other grazing effect

12. Insects and Pathogens

12.01. Disease damage
12.02. Insect damage
12.99. Other insect or pathogen effect

13. Intrusions

13.01. Building or group of buildings (homesite, farmstead), abandoned
13.02. Building or group of buildings (homesite, farmstead), active
13.03. Road, active
13.04. Road, abandoned
13.05. Footpath or horse trail
13.06. Fence
13.07. Utility line, aboveground
13.08. Utility line, belowground
13.09. Other building, structure, or other intrusion
13.10. Dump, active
13.11. Dump, inactive
13.12. Cemetery
13.99. Other intrusion

14. Invasive Species

14.01. Exotic invasive species
14.02. Native invasive species
14.99. Other invasive species effect

15. Logging

15.01. Selective timber harvest
15.02. Clearcutting
15.03. Other tree-cutting (removal of firewood or hazardous trees)
15.99. Other tree-cutting effect

Table 5. Disturbance Regimes and Disturbance Factors, *continued*.

16. Mowing

16.01. Mowing of herbaceous vegetation (other than haying)
16.02. Mowing of woody vegetation, not maintaining desirable native vegetation
16.03. Infrequent cutting of native vegetation (*e.g.* under a powerline) inadvertently maintaining desirable native vegetation
16.04. Haying
16.99. Other mowing effect

17. Soil Movement, Erosion, and Deposition

17.01. Sheet, rill, or gully erosion and deposition
17.02. Mass wasting (soil creep, slumping, rockfall)
17.03. Stream entrenchment
17.04. Stream meandering
17.05. Floodplain scouring or sedimentation
17.06. Wind erosion and deposition
17.07. Bioturbation
17.99. Other soil movement, erosion, or deposition effect

18. Water Impoundment

18.01. Dam or dike
18.02. Inhibition of migration by aquatic life
18.03. Raising and stabilization of wetland water level (reduction or elimination of seasonal water-level fluctuations)
18.99. Other water impoundment effect

19. Water Pollution

19.01. Oil or other chemical spill
19.02. Nutrient enrichment from cropland runoff and sewage effluent (including livestock containment operations and septic tanks)
19.03. Sedimentation
19.99. Other water pollution effect

20. Weather and Climatic Extremes

20.01. Storm damage (windthrow, broken limbs)
20.02. Drought
20.03. Temperature extremes (heat, cold)
20.99. Other effect from weather or extreme climate

Table 5. Disturbance Regimes and Disturbance Factors, *continued*.

21. Other Natural Biotic Processes

21.01. Interspecific competition
21.02. Succession
21.03. Beaver disturbance
21.99. Other effect of a natural biotic process

22. Other Natural Abiotic Processes

22.99. Other effect of a natural abiotic process

23. Other Artificial Disturbances

23.01. Herb gathering (root digging), flower-picking, mushroom hunting, plant poaching (orchids)
23.02. Seed gathering for off-site restoration
23.03. Damage from road salt runoff and spray
23.04. Soil contamination (petroleum or other chemicals other than road salt)
23.05. Mine subsidence
23.06. Damage to vegetation and soil by recreational visitors
23.07. Vegetation restoration and management (planting, killing plants)
23.99. Other artificial disturbance

24. Artificial Disturbances in General

25. Natural Disturbances in General

26. Unknown disturbance

27. No evident disturbance

Appendix 4
Quality Indicators and Disturbance Factors

This appendix has a set of tables with Quality Indicators and Disturbance Factors for the following Survey Features:

Organization of Table 7

Table 7 consists of a series of smaller tables for individual Survey Features, as listed above. Information in each of the smaller tables is organized according to the four Grading Components:

Composition
Structure
Processes
Environment

The Grading Components are broken into a number of Sub-components, such as *Structure: Overstory Layer* and *Structure: Understory Layer*. The four Grading Components and their Sub-components are defined beginning on page 13.

For each Component and Sub-component, the table provides a list of Quality Indicators and the Disturbance Factors that are indicated by each Quality Indicator, plus brief notes about how to interpret the Quality Indicators and Disturbance Factors.

Quality Indicators

A *Quality Indicator* is a feature that (a) can be observed in the field (or can be identified from some source other than fieldwork), and (b) can be interpreted as an *indication* of some kind of disturbance or lack of disturbance to a Natural Community. The indicator may be (a) a kind of *intrusion* (a physical thing), (b) evidence of an *activity*, or (c) a *condition* of a Natural Community. A Quality Indicator is *evidence* of either a disturbance or the lack of disturbance in a community.

Within each section of a table (that is, beneath a particular heading), Quality Indicators in the first column are generally arranged alphabetically. Or in some parts of the tables, Quality Indicators that have positive (+) Disturbance Factors are listed ahead of Quality Indicators that have more-or-less neutral (±) or negative (–) Disturbance Factors. However, it is not possible or even desirable to arrange all entries alphabetically or in a strict order from positive to negative.

Wherever a group of plant species is listed for a Quality Indicator, the list is usually intended to be illustrative and not exhaustive. Many of the Quality Indicators refer to the *presence of*, *abundance of*, or *lack of* certain plants. In this context, the term "presence" has no indication of the number of plants. An "abundance of" a species is defined as "being substantially more common than usual, especially relative to other species." The "lack of" a species means "reduced below the usual or expected level" — not necessarily the complete absence of a species.

Disturbances and their effects on a community are expressed to various degrees, denoted as Low, Medium, or High (see page 17). Most Quality Indicators are listed on the chart in negative terms: an "Abundance of weeds" and a "Lack of conservative species." If a Quality Indicator were instead stated in the opposite terms (a "Lack of weeds" or an "Abundance of conservative species"), then the ratings Low and High would have opposite meanings.

Disturbance Factors

A Disturbance Factor is an *intrusion*, an *activity*, or a *condition* of a Natural Community that affects or may affect the Natural Quality of the community. The factor may or may not be directly observable in the field, and it can be either an *explanation for* or a *consequence of* a Quality Indicator.

The second and third columns of Table 7 list Disturbance Factors for each Quality Indicator. Entries in the third column are often descriptive and detailed, and they are not standardized according to a formal set of terminology. The numbers in the second column are part of a formally defined list of Disturbance Factors that is in Appendix 3, "Disturbance Regimes and Disturbance Factors." Appendix 3 provides a hierarchical framework and standard terminology for Disturbance Factors.

In the third column, each Disturbance Factor is preceded by a symbol that indicates its probable or potential Effect on the Survey Feature:

- – Negative effect
- \+ Positive effect
- ± Positive, negative, approximately neutral, or variable effect — depending on the community or individual circumstances
- ? Uncertain or unknown effect

Notes

The fourth column provides further information, especially cautions about how to interpret information in the other columns (*i.e.* important "exceptions to the rule").

The ecological impacts of disturbances are often complex, variable, and cryptic. A Quality Indicator is only an *indicator*, and a Disturbance Factor is only a *factor* — not necessarily "the answer." It would be impossible to spell out all of the mitigating circumstances and situations in which a statement in the table is not applicable. To make a statement always true, it would often be necessary to water it down with qualifiers such as *probably*, *generally*, and *usually* to the point that the statement would be almost meaningless.

Which Subdivisions of Table 7 to Consult

Table 7 consists of 14 subdivisions (smaller tables), each of which treats a different Survey Feature, as listed here:

7.1. Floodplain Forest
7.2. Forest
7.3. Herbaceous Communities in General
7.4. Prairie
7.5. Sand Prairie
7.6. Sand Savanna
7.7. Savanna
7.8. Seep
7.9. Standing Water
7.10. Stream
7.11. Vegetated Communities in General
7.12. Wet Prairie
7.13. Wetland
7.14. Wooded Communities in General

Table 6 shows which parts of Table 7 pertain to various units of the Natural Community Classification System. For instance, Table 6 shows that Floodplain Forest is treated by Tables 7.1, 7.2, 7.11, and 7.14. Floodplain Forest is a Community Subclass; when evaluating any of the Community Types that are in the Floodplain Forest Subclass, those four tables need to be consulted.

Table 6. Natural Communities treated by Table 7.

Community Class, Subclass, or Type	**Subdivision of Table 7**													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Floodplain Forest	X	X									X			X
Forest		X									X			X
Open Water *									X					
Prairie			X	X							X			
Sand Prairie			X	X	X						X			
Sand Savanna			X	X	X	X	X				X			X
Savanna			X	X			X				X			X
Seep			X					X			X		X	X
Stream									X					
Wet Prairie			X	X							X	X		
Wetland			X								X		X	X

* The *Open Water* Community Class is defined by the Illinois Department of Natural Resources to include the two Subclasses: *Lake* and *Pond*. Streams are placed in their own Community Class even though they are also open-water communities.

Table 7.1. Quality Indicators and Disturbance Factors for Floodplain Forest.

Floodplain Forest (a Community Subclass) is also covered by the following other tables:

Forest
Vegetated Communities in General
Wooded Communities in General

Quality Indicators	Disturbance Factors		Notes
STRUCTURE: GROUND LAYER			
Lack of stumps or other evidence of logging	26	± Possibly a long-term absence of logging	Tree stumps rot away much faster in floodplain forests than in upland forests because biological decomposition is more rapid in moist conditions, and because "softwoods" such as Acer saccharinum decay faster than upland oaks. Flood scouring may obliterate or obscure logging trails and other damage from tree-cutting, so the evidence of logging does not last as long on floodplains as on uplands.

Table 7.2. Quality Indicators and Disturbance Factors for Forest.

Forest (a Community Class) is also covered by the following other tables:

Vegetated Communities in General
Wooded Communities in General

Quality Indicators	Disturbance Factors		Notes
COMPOSITION: INDIVIDUAL SPECIES			
Abundance of Asimina triloba	11.06	– Grazing	Pawpaw may have a competitive advantage over other understory plants because it is not eaten by livestock or deer, but may be abundant in areas that are not browsed heavily, simply because it spread well by root suckers.
	3.01	– Deer overabundance	
	21.01	± Highly competitive, clonal growth	
STRUCTURE: OVERSTORY LAYER			
Oldest trees with a tall trunk, major lateral crown limbs that are ascending to spreading, a lack of large, shade-pruned, lateral limbs and limb stubs on the middle and lower trunk.	27	Old-growth conditions	Several characteristics of old trees and old-growth forests need to be added to the table.
Oldest trees with large, shade-pruned, lateral limbs and limb stubs on the middle and lower trunk.	9.05	± Fire suppression and shade pruning	This growth form indicates that the stand was formerly more open (usually because of a history of recurrent fire or prolonged grazing). The community may have once been an open wood-land that has developed into a closed-canopy forest.
	27	+ Protection and recovery from a long period of disturbance in the past	
Small gaps in the tree canopy	15.01	– Selective logging	
	11.07 11.04	– Grazing	Pasturage over a period of many years may kill some overstory trees. Continual grazing by livestock will help maintain any canopy gaps that develop because young trees are eaten and prevented from growing up. Fire can have the same effect as grazing: killing overstory trees and preventing new trees from growing up and into the canopy gaps. When immigrant farmers first occupied the land in the 1800s, grazing replaced fires as the mechanism that kept the woods relatively open.
	8.08	± Fire	
	21, 22	± Death of single trees from any of a number of other natural causes	

Quality Indicators	Disturbance Factors		Notes
	27	± Extreme environment inhibiting the growth of trees that would otherwise close the canopy gaps	Canopy gaps may persist for a long time (often for several decades or longer) on wet sites or dry sites.
STRUCTURE: UNDERSTORY LAYER			
Euonymus atropurpureus not browsed very much	27	+ Deer not abundant	Wahoo is highly favored by deer, and it is likely to escape browsing only where it is inaccessible (*e.g.* on a steep bank).
Aesculus glabra severely hedged	3.01	– Deer overabundance	In a forest that is overpopulated by deer, young buckeyes have only stubs for branches.
Lindera benzoin browsed	3.01	– Deer overabundance	Apparently deer like to eat spicebush, but they seem to be selective, favoring new growth. Consequently deer may repeatedly browse on tender, young shoots that are produced by a bush that has recently been browsed — while the deer ignore nearby bushes that have hardened shoots because they were not browsed earlier in the season.
ENVIRONMENT: GEOMORPHOLOGY			
Pit-and-mound microtopography	20.01	± Windthrow	
	27	+ Big, old trees	
	27	+ Lack of cultivation	Clearing and farming obliterates pit-and-mound microtopography.

Table 7.3. Quality Indicators and Disturbance Factors for Herbaceous Communities in General.			
Quality Indicators	**Disturbance Factors**		**Notes**
COMPOSITION: GROUPS OF SPECIES			
Abundance of annual and biennial species	2.01	– Cultivation	
	5	– Earthmoving	
	10.04 10.05	± Flooding (soil scouring and deposition; inundation followed by drawdown)	
	6.02	– Herbiciding	
	24, 25	– Other disturbances that remove vegetation and creates bare soil	
Abundance of rhizomatous, clone-forming composites: Aster, Solidago, Euthamia, Eupatorium, Helianthus	2.01	– Cultivation	
	11.06	– Grazing	
	16	– Mowing	
	5	– Earthmoving	
	6.01 6.02	– Other disturbances, especially edge effects next to farm fields (herbicide drift, sedimentation)	
Lack of broadleaf herbs	6.02	– Application of broadleaf herbicide	Herbiciding to get rid of broadleafs (cemetery prairies, perhaps some prairies that were managed as haymeadows or pastureland (get rid of thistles)).
STRUCTURE: HORIZONTAL PATTERN			
Distinctly patchy vegetation pattern, not obviously related to environmental patchiness	2.01 5, 24, 25	– Usually soil disturbance, but possibly also other kinds of disturbances	A recently abandoned field that is colonized by annuals and biennials may exhibit a patchy vegetation pattern because of the way in which various species seeded into different parts of the field. Once a field is colonized by rhizomatous perennials, a patchy pattern may develop and persist for decades as clones expand. Over the long term, the patches will break up and become less distinct as clones senesce and as adjacent clones merge and pass through each other.
Patches of shrubs and young trees growing up in a matrix of herbaceous vegetation	21.02	± Vegetation succession	Woody vegetation naturally succeeds herbaceous vegetation in most situations. Exclusion of disturbances usually speeds up the process of succession.

Table 7.3. Herbaceous Communities in General.

Quality Indicators	Disturbance Factors		Notes
	9.01 9.03	± Fire suppression	Woody growth in prairies is usually blamed on fire suppression, but the dramatic present-day increase of woody invasion may be due (in part) to the fact that "the woodies never got there before" — but now seed sources, dispersers, and disturbances are so ubiquitous and close-by that the prairie vegetation is being overwhelmed by a floodtide of trees and shrubs.
	11.06	– Grazing	Grazing generally retards woody growth, but grazing may actually foster the establishment of woody plants by creating a seed bed of bare soil and by reducing competition from herbaceous vegetation. This situation is especially true if heavy grazing is followed by a period without grazing — which allows the newly established woody plants to grow up above the herbaceous plants.
	4	– Drainage	Drainage may foster the spread of woody plants into an area that was too wet for most trees and shrubs before it was drained.
Streaked appearance of the vegetation (certain plants growing in more or less faint or discontinuous rows)	2.01	– Cultivation	Streaks appear because some species are concentrated in the traces of moist furrows.
	16	– Mowing	Ruts and gouges from the mowing machine cause weedy streaks.
	6.03 23.07	– Planting	If grasses or other plants are seeded (drilled) into a matrix of wild vegetation, the pattern of planting rows may persist for years.
STRUCTURE: GROUND LAYER			
Exceptionally vigorous growth, flowering, or fruiting of fire-adapted species	8.03	± Fire, especially since the previous growing season	The Disturbance Factor has a ± value instead of a + value because the vigorous growth and flowering is a short-term response, and it is not (in itself) a true reflection of higher Natural Quality.
Lack of vigor in the growth, flowering, or fruiting of fire-adapted species	9.06	– Long-term fire suppression	

Table 7.4. Quality Indicators and Disturbance Factors for Prairie.

Prairie (a Community Class) is also treated by the following other tables:

Herbaceous Communities in General
Vegetated Communities in General

Quality Indicators	Disturbance Factors		Notes
COMPOSITION: GROUPS OF SPECIES			
Presence of heavy-seeded, deep-rooted legumes: Dalea, Baptisia, Amorpha	27	+ Lack of soil disturbance	Dalea purpurea may spread onto a roadcut if there is an immediately adjacent seed source. This species also appears to recover well in grazed hill prairies after the livestock are removed for many years.
	27	+ Lack of grazing	
Presence of shrubby snaps: Ceanothus, Amorpha, Salix humilis	27	+ Lack of cultivation	Rosa carolina is a woody snap, but it is much less conservative than Ceanothus, Amorpha, or Salix humilis.
Species that are most typical of dry or dry-mesic prairie, growing in mesic prairie: Stipa spartea, Echinacea pallida, Dalea candida	16.01 16.02	± Mowing	These species are likely to decline and even die out in mesic prairie unless some kind of periodic light disturbance (other than fire) reduces competition from typical mesic prairie species.
	11.01	± Grazing	
Abundance of weedier or less conservative snaps on eroded earth (“thin, poor” soil): Oligoneuron rigidum, Sporobolus asper, Ratibida pinnata, Aster ericoides, Silphium terebinthinaceum, Schizachyrium	11.07 2.01 5.01 5.03 17.01 17.02 17.04	± Soil erosion (often initiated by overgrazing or cultivation); or slumping above an active stream meander; or earthmoving that has exposed unweathered, calcareous glacial drift	A number of the weedier snaps are calciphilic and thrive on exposures of raw, unleached glacial drift where even the common exotic grasses and weeds do not thrive.
Concentration of a single species that is not strongly rhizomatous (also, the high density does not appear to be related to a localized edaphic condition or an obvious disturbance history). Representative snaps: Parthenium, Liatris, Eryngium, Ratibida, Tephrosia	24	± Some sort of long-ago or undetectable physical disturbance (light disturbance to the soil is the usual suspect)	
	27	± No evident reason	
	21.01	± Competitive exclusion of other species, especially via allelopathy in some species	
Abundance of snaps with large, deep taproots: Silphium terebinthinaceum, S. laciniatum, Eryngium	5.03	– Earthmoving (scraping and removal of the soil surface), typically along a road or railroad	Scraping of the soil surface does not kill forbs that have deep taproots, and the bare soil may be an ideal seedbed for these species.

Table 7.4. Prairie.

Quality Indicators	Disturbance Factors		Notes
Lack of especially palatable and favored forage species: legumes, Silphium, showy and nectar-laden flowers	11.05	– Grazing	
	3.01	– Deer overabundance	
Lack of early spring-blooming flora: Phlox, Lithospermum	6.02	– Early-season application of broadleaf herbicide	
Lack of midsummer-flowering forbs	16.04	– Haying	A long history of removing hay will deplete species that flower and set seed during the haying season.
Lack of broadleaf herbs	6.02	– Application of broadleaf herbicide	
Gentiana puberulenta in a Poa pratensis sod	11.06	– Grazing	Downy gentian can be naturally common in Grade A prairie. It may also be common in prairie that has been grazed so heavily that it is a bluegrass turf.
Helianthus mollis in a dense patch, with relatively little else growing with it	21.01	± Allelopathy	
Pedicularis and Comandra growing among sparse, stunted grasses; small perennials such as Hypoxis, Gentiana, and Sisyrinchium may be conspicuous	21.01	± Hemiparasitism	Pedicularis and Comandra are hemiparasites that reduce the vigor of grasses, improving the habitat for diminutive species. The smaller plants may or may not be more abundant, but they are more visible where the vegetation is sparser and lower.
Abundance or dominance of exotic cool-season grasses: Poa pratensis, P. compressa, Festuca elatior, F. pratensis, Bromus inermis, Phalaris arundinacea, Dactylis, Phleum	11.06	– Grazing	Phalaris arundinacea and Bromus inermis may strongly dominate a prairie that has not been significantly disturbed other than by fire suppression and perhaps long-ago grazing.
	2.01	– Cultivation (followed by long-term abandonment and often grazing)	
	9.01	– Fire suppression	
	14.01	– Invasive species	
	6.03	– Seeding of cool-season grasses	
COMPOSITION: INDIVIDUAL SPECIES			
Corylus americana thriving	8.03	+ Fire	Hazel may increase in a prairie that is burned, creating a patch of Shrub Prairie.

Table 7.4. Prairie.

Quality Indicators	Disturbance Factors		Notes
Poa pratensis in suppressed condition	14.01	± Invasive species	Kentucky bluegrass is nearly ubiquitous in well drained prairies. It has insinuated itself into the fabric of prairie communities to the extent that it has been characterized as "acting like a native" in situations where it does not dominate. The species may even be found in half or more of the vegetation sampling plots in many Grade A and Grade B prairies, but in such situations, it grows as a low grass beneath and among other species. For this Quality Indicator, the Disturbance Factor is annotated as ± even though the species is an invasive exotic because it can be considered almost innocuous in this condition.
Poa pratensis not in a suppressed condition	14.01	– Invasive species	
	11.06	– Grazing	Pasturage causes Kentucky bluegrass to increase dramatically and form a sod. After livestock are removed, this grass can persist as a dense turf for many years.
	9.01	– Fire suppression	A sward of Poa pratensis will stop the spread of a fire.
	24	– Other disturbance	
Sporobolus heterolepis	27	+ Lack of cultivation	Dominance by prairie dropseed is a hallmark indicator of virgin mesic prairie. This grass may also withstand considerable grazing pressure, and it may spread onto roadcuts.

Table 7.4. Prairie.

Quality Indicators	Disturbance Factors		Notes
STRUCTURE: GROUND LAYER			
Vigorous vegetative growth and abundant flowering of grasses and forbs	8.03	± Recent fire	In the first growing season after a prairie has burned, herbaceous plants may grow about 50% to 100% taller than they grew before the fire. Flowering of snaps (including woody snaps) after a burn is likely to be spectacular in contrast to a flowering in a prairie that has not been burned in more than a few years. If half of a Grade A prairie is viewed in the first growing season after a fire and it is compared with half of the prairie that has not burned for more than a year or two, the superficial appearance of the vegetation may give the first impression that the unburned part must be Grade B. Closer inspection (especially vegetation sampling) will reveal that the species richness on both sides of the fire line is approximately the same, but the plants in the unburned part are smaller, flowering less, and flowering later. Snaps respond positively to fire, and fire is necessary for the long-term maintenance of a prairie, but in this case, the Disturbance Factor has a ± value instead of a + value because the vigorous growth and flowering is a short-term response, and it is not (in itself) a true reflection of higher Natural Quality.
Prairie grass growing short (perhaps even seeming dwarfed), not flowering well	27, 21	+ Long-term stability and lack of disturbance, resulting in strong competition between individual plants for below-ground resources	Sporobolus heterolepis never grows tall.
Prairie grass growing especially tall and robust, flowering well	8.03	+ Fire	
	21.99 22.99 23.99	± Light soil disturbance that reduces competition from other plants but does not cause long-term damage to the prairie grass	
	23.07	± Prairie restoration	Prairie grasses often grow more vigorously in a restoration than in a natural prairie.0

Table 7.4. Prairie.

Quality Indicators	Disturbance Factors		Notes
Presence of the following low shrubs, which rarely grow taller than the ground layer: Amorpha canescens, Ceanothus americanus, C. herbaceus, Salix humilis	27	+ Lack of disturbance	The presence of shrubs is generally considered to be a negative characteristic (or at least a "red flag") in prairie communities, but these particular low, prairie-adapted species are indicators of high quality.
STRUCTURE: SHRUB LAYER			
Presence of Corylus americana	—	See the entry for Corylus americana above, under the heading *Composition: Individual Species*.	
Presence of the shrubs other than Amorpha, Ceanothus, Corylus, Rosa carolina, and Salix humilis	9.01 9.03	– Fire suppression	
	21.02	– Vegetation succession	
ENVIRONMENT: SOIL			
Terracettes	11.07	– Grazing	Terracettes are best developed in Loess Hill Prairies. But if grazing is heavy enough, terracettes may develop on a steep slope of any kind of parent material.

Table 7.5. Quality Indicators and Disturbance Factors for Sand Prairie.			
Sand Prairie (a Community Subclass) is also treated by the following other tables: Herbaceous Communities in General Prairie Vegetated Communities in General			
Quality Indicators	**Disturbance Factors**		**Notes**
COMPOSITION: GROUPS OF SPECIES			
Lack of shallow-rooted perennial species such as Viola pedata	17.06	± Blowing sand	
COMPOSITION: INDIVIDUAL SPECIES			
Abundance of Opuntia	11.06	– Grazing	
STRUCTURE: GROUND LAYER			
Bare soil between clumps of perennial bunch grasses	27	+ Long-term stability and lack of disturbance	

Table 7.6. Quality Indicators and Disturbance Factors for Sand Savanna.			
Sand Savanna (a Community Subclass) is also treated by the following other tables: Herbaceous Communities in General Prairie Sand Prairie Savanna Vegetated Communities in General Wooded Communities in General			
Quality Indicators	**Disturbance Factors**		**Notes**
COMPOSITION: GROUPS OF SPECIES			
Presence of earth star mushrooms (Geaster) and British soldier lichens (Cladonia)	27	+ Lack of soil disturbance (trampling)	

Table 7.7. Quality Indicators and Disturbance Factors for Savanna.

Savanna (a Community Class) is also treated by the following other tables:

- Herbaceous Communities in General
- Prairie
- Vegetated Communities in General
- Wooded Communities in General

Quality Indicators	Disturbance Factors		Notes

Table 7.8. Quality Indicators and Disturbance Factors for Seep.

Seep (a Community Subclass) is also treated by the following other tables:

Herbaceous Communities in General
Vegetated Communities in General
Wetland
Wooded Communities in General

Quality Indicators	Disturbance Factors		Notes
ENVIRONMENT: WATER			
Oily (opaque, iridescent) film on the surface of the water	27	± Natural conditions, not polluted water	Water that collects in shallow pools in seepage areas often has an oily surface sheen. This is a natural condition (the product of bacterial action?), not unnatural pollution.

Table 7.9. Quality Indicators and Disturbance Factors for Standing Water.			
Quality Indicators	**Disturbance Factors**		**Notes**
COMPOSITION: GROUPS OF SPECIES			
Algal bloom	19.01	– Fertilizer runoff, sewage effluent	
ENVIRONMENT: WATER			
Standing water that is clear (neither turbid nor with an algal bloom) but that has a blue or green tint	19.01	– Chemical dye (Aquashade or Aquashadow)	These dyes prevent the growth of aquatic plants. They are most commonly used in ponds that are landscaping features near residences.
	5.01	– Excavation into glacial drift	Water may have a turquoise cast because of dissolved calcium; this is most common in roadside borrow pits that are excavated into calcareous glacial drift

Table 7.10. Quality Indicators and Disturbance Factors for Stream.			
Quality Indicators	**Disturbance Factors**		**Notes**
PROCESSES			
Decrease in the frequency and duration of over-bank flooding	17.03	– Stream entrenchment	
Sudden drainage of a wetland adjacent to a stream channel	17.04	± Stream meandering	
	17.03	– Stream entrenchment	
Trees being undermined and uprooted, toppling into a stream channel	17.04	± Stream meandering	The rate at which a stream channel is widening or moving laterally can be judged in part by determining the age of trees that are falling into the channel.
	17.03	– Stream entrenchment	
ENVIRONMENT: WATER			
Algal bloom	19.02	– Fertilizer runoff, sewage effluent	
ENVIRONMENT: GEOMORPHOLOGY			
Ancient, long-buried geologic material freshly exposed in a streambank	17.03	– Stream entrenchment	
	17.04	± Stream meandering	
Gullies newly branching from a stream channel	17.03	– Stream entrenchment	
Rapid lowering of the streambed, evidenced by a "nickpoint"	17.03	– Stream entrenchment	A nickpoint marks the upstream limit of entrenchment, where the streambed drops abruptly.
Natural levees being destroyed instead of maintained by floodwaters	17.03	– Stream entrenchment	
"Perched" tributaries	17.03	– Stream entrenchment	A perched tributary has a bed that is abruptly higher than the bed of the stream that it joins, at the point where the two streams come together.
Soil pipes draining into a stream channel	17.03	– Stream entrenchment	
Soil pipes collapsing to form small sinkholes and open gullies on the surface adjacent to a stream channel	17.03	– Stream entrenchment	
Stream channel and an incipient new floodplain newly forming within the widened and deepened cross-section of the old channel	17.03	– Stream entrenchment	

Table 7.10. Stream.

Quality Indicators	Disturbance Factors		Notes
Streambanks failing and sloughing into the channel, making the channel wider	17.03	– Stream entrenchment	Channel *widening* must be distinguished from channel *meandering*. When a channel meanders, the streambank erodes away on one side of the channel while it accretes on the opposite side. When a channel widens, both banks retreat at the same time.
Surface water diverted into a new void that has developed beneath the streambed (in the very upper reaches of a stream channel)	17.03	– Stream entrenchment	
V-shaped cross-section in a stream channel	17.03	– Stream entrenchment	
ENVIRONMENT: INTRUSIONS			
Dam	18.01	– Impoundment	
	18.02	– Interference with upstream and downstream movements by aquatic life	

Table 7.11. Quality Indicators and Disturbance Factors for Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
COMPOSITION: GROUPS OF SPECIES			
Presence of conservative species in general	27	+ Absence of degrading disturbances	This is the single most important indicator of the Natural Quality and history of development, disturbance, and recovery of a Natural Community. Conservative species may sometimes occur in anomalous degraded habitats, though.
	21.99 22.99	+ Occurrence of beneficial disturbances	
Depauperate native species diversity (with fewer species than normal)	2.01	– Cultivation and earthmoving	Some Community Types have a higher species diversity than others. Different occurrences of a Community Type can naturally be noticeably more or less diverse than others.
	11.05	– Grazing	
	14.01 14.02	– Native or non-native invasive species out-competing the indigenous flora	
Dominance by one or a few plant species	15	– Logging	If a forest is clearcut, a few early successional tree species such as Liriodendron may dominate the patch that was cut.
	1.02	– Clearing	Old clearings of formerly cultivated patches may be colonized and dominated by a few weedy colonizers.
	2.01	– Cultivation	
	16.01	– Mowing	Mowing and grazing can foster the dominance of a few grasses such as Poa pratensis.
	11.06	– Grazing	
	14.01 14.02	– Invasive species	Bromus inermis, Phragmites australis, and Phalaris arundinacea are so strongly competitive and such successful invaders because they are rhizomatous or stoloniferous and allelopathic.
	21.01	± Allelopathy	
	27	+ Natural conditions	Local dominance by one or a few species may be a natural occurrence, especially in extreme environments (*e.g.* a tupelo swamp).
Weedy herbaceous plants (native and non-native)	2.01	– Cultivation	In this context, weedy herbs are annuals and early successional species.
	11.02 11.06	– Grazing	
	3.02	– Overabundant deer	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
	24, 25	± Other disturbances, most notably natural flooding	
Exotic species	2.01	– Cultivation	
	11.06	– Grazing	
	16.01 16.04	– Mowing	
	9.01	– Fire suppression	
	14.01	– Invasive species	
	24, 25, 27	± Any of a number of other disturbances, or no disturbance in particular	The majority of exotic species inhabit disturbed areas, and they do not appear to have a significant impact when they occur in low numbers in native vegetation.
Abundance of woody plants that are thorny or otherwise unpalatable: Rosa, Rubus, Ribes, Crataegus, Maclura, Gleditsia, Zanthoxylum, Symphoricarpos	11.06	– Grazing	Unpalatable woody plants can be locally common to abundant even in the absence of any history of grazing.
	3.02	– Deer overabundance	
Presence of old shade trees (notably sugar maples on hilltops) and specimen trees (*e.g.* conifers) growing untended	13.01	– Old homesite	
	13.04	– Abandoned driveway	
Abundance of invasive, exotic shrubs that were commonly planted for wildlife food and cover: Lonicera maackii (and other bush honey-suckles), Rosa multiflora, Elaeagnus umbellatus	14.01	– Invasive species	These species are well naturalized, but some of the heaviest infestations are still in and around the sites where they were first introduced for conservation purposes.
	23.02	– Proximity to long-established plantings in State Parks, conservation areas, Interstate highway rights-of-way	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Abundance and wide variety of invasive, exotic shrubs and trees that are commonly planted as hedges, landscape ornamentals, and shade trees: Berberis, Euonymus, Ligustrum, Malus, Pyrus calleryana, Crataegus, Ulmus pumila, Acer platanoides	14.01	– Invasive species	Some of these species are well naturalized, but the greatest diversity is found in wildlands close to residential areas, office parks, and similar areas that have plenty of landscape plantings that serve as seed sources.
	23.02	– Proximity to Developed Land, especially a residential area	
Presence of a wide variety of horticultural herbs (garden vegetables and flowers): Lycopersicum, Citrullus, Ajuga, Papaver, Petunia, Cleome	23.02	– Proximity to a residential area	These plants are not invasives because they rarely become naturalized — even locally. Such species usually do not spread from where they were initially established in the wild, and they tend to die out rather than reproducing. A cultivated population (most often upstream or upslope) must act as a source for continual reestablishment if such a species is to persist in the wild.
Presence of rare, unusual, especially showy, peripheral, or disjunct North American wild-flowers: Asclepias tuberosa, Coreopsis lanceolata, Penstemon grandiflorus, Salvia azurea var. grandiflora, Echinacea purpurea, Gaillardia pulchella, Ratibida columnifera, Cosmos bipinnatus, Eschscholzia californica	27	+ A natural occurrence, not the result of human manipulation	Some showy American wildflowers that are not indigenous to the local area are spreading from restorations and other plant-ings, making it more difficult to evaluate native remnants. Restorations may be enhanced with rare species. Adequately detailed and complete records of restoration efforts are likely to be impossible to obtain, sometimes making it impossible to determine whether a species was artificially introduced to a site.
	23.07	– Enhancement of the indigenous flora during restoration activities	
	23.07	– Inclusion of showy non-native wildflowers in seed mixes	
	6.03	– Wildlife food plot (legumes seeded to attract and nourish trophy bucks)	
Presence of non-invasive horticultural species growing untended: Syringa, Narcissus, fruit trees, Yucca	13.01	– Former homesite	
	13.12	– Abandoned cemetery	
Abundance of annual warm-season grasses: Setaria, Bromus, Hordeum jubatum, H. pusillum, Sporobolus, Digitaria, Echinochloa, Panicum	20.15	– Soil disturbance (cultivation, earthmoving)	A number of annual warm-season grasses are a natural component of sand prairies and streambanks.
	11.07	– Overgrazing (trampling)	
	6.02	– Herbiciding	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
	23.04	– Road salt	
	16.01	– Mowing (close enough to scalp the soil)	
	10.05	± Ponding of water in a ditch or shallow basin, followed by drawdown and exposure of a mudflat	
Abundance of herbaceous plants that are spiny, prickly, extra hairy, poisonous, or otherwise unpalatable: Verbascum thapsus, Hieracium, Cirsium, Vernonia, Eupatorium, Asclepias, resinous composites other than Silphium	11.06	– Grazing	Many unpalatable herbs are naturally common on dry sites, particularly sand deposits.
Abundance of native "hitchhiker" herbs with stickery fruits: Circaea, Bidens, Hackelia, Agrimonia, Desmodium, Geum, Galium, umbellifers	11.06	– Grazing	This Quality Indicator is found more often in shaded habitats and somewhat more often in lowland areas.
	3.02	– Deer overabundance	
	10.99 23.06 24, 25	± Disturbed conditions in general, particularly flooding as well as visitation by animals, hikers, hunters, and equestrians	
Assemblage of nitrogen-loving exotic species: Nepeta, Arctium, and Leonurus are the Big Three	13.01	– Old homesite or farmyard	Food waste, manure, and urine from people, pets, and farm animals elevate the nitrogen levels in dooryards and farmyards.
	23.04	– Nitrogen enrichment	
COMPOSITION: INDIVIDUAL SPECIES			
Ambrosia trifida	24 , 25	– Disturbances that create bare soil	Giant ragweed is an annual, but it is allelopathic, and a dense stand can persist for many years after it becomes established from a single disturbance event.
Equisetum arvense Equisetum hyemale	5.1	– Artificial deposit of sand, gravel, or cinders mixed in the soil	
	27	± Naturally sandy soil	Horsetails also grow in loamy soil, but a large, dense colony of Equisetum often indicates a sand deposit.

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Juniperus virginiana growing anywhere except on or near a bedrock outcrop or other natural firebreak	2.01	– Cultivation	Red cedars commonly colonize old fields.
	11.06	– Grazing	Grazing can stimulate the invasion of cedars into a prairie.
	9.03	– Fire suppression	Red cedars are highly vulnerable to fire.
	13.12	– Cemetery	Cedars and other conifers are commonly planted in graveyards. A single old cedar in a woods may mark a gravesite.
STRUCTURE: HORIZONTAL PATTERN			
Boundary between communities or vegetation types that is extra sharp or rectilinear	1.02	– Clearing	
	15	– Logging	
	11	– Grazing (if attended by fencing)	
	16	– Mowing	
	2.01	– Cultivation	
	24	– Other human activities	
STRUCTURE: GROUND LAYER			
Lack of a buildup of leaf litter and duff	8.07	± Fire	Consumption of leaf litter and duff by fire is accompanied by a dramatic increase in vegetative growth and flowering in most herbaceous communities.
	11.02	± Grazing	
	16.01 16.04	– Mowing	
	21.01	± High rate of biological decomposition	Moist and flood-prone habitats are most likely to exhibit rapid rotting of dead plants. The fallen leaves of oaks last much longer than those of elms, ashes, and maples because oak leaves have a lower mineral content and higher concentrations of tannins, thus inhibiting microbial action and feeding by detritivores.

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Plants and plant parts broken off or dug up, evidently by people instead of animals	23.01	– Herb gathering, flower-picking, mushroom hunting, plant poaching	
STRUCTURE: UNDERSTORY LAYER			
Young trees growing in a dense stand	15, 21	– Logging, followed by release of advance regeneration and growth of new trees	
	1.02 21.02	– Recovery after clearing	
	12.01 12.02 20.01 21.03 21.02	± Recovery after disease, insect, storm, or beaver damage	
	10.04 21.02	± Recovery after flood damage	
	9.03 21.02	± Afforestation because of fire suppression	
	4.05 21.02	– Afforestation after drainage of a wetland	
	17.04 17.05 21.02	± Afforestation on newly exposed or newly created land in a floodplain	
STRUCTURE IN GENERAL			
Deformed, discolored, chlorotic, tattered, skeletonized, or otherwise damaged or dying leaves or entire plants	6.02	– Herbicide damage	
	12.02	± Insect damage	
	12.01	± Disease damage	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
	23.99	– Death ray from flying saucer	
PROCESSES			
Flowers blooming later in the season than normal	16.01 16.04	– Mowing	
ENVIRONMENT: SOIL			
A horizon increased (deeper than expected)	2.01	– Cultivation (lowering the adjacent soil surface, creating the illusion that the deeper A horizon has been thickened)	
	5.02	– Earthmoving	
	10.04	±Sedimentation	Sedimentation and wind deposition are annotated as ± because they are commonly natural occurrences.
	17.06	±Wind deposition	
A horizon truncated (less depth than expected)	2.01	– Cultivation	
	17.01 11.07	– Sheet erosion on an uncultivated slope, often caused by grazing	
	5.03	– Earthmoving (reshaping a ditch)	
	17.06	±Wind erosion	
Gullies	2.01	– Cultivation	
	11.07	– Grazing	
	17.03	– Stream entrenchment	
	23.06	– Driving ORVs, and other activities that destroy vegetation	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Light-colored soil mixed with or on top of darker soil at the surface	17.01	– Soil erosion stripping away the topsoil	
	5.01	– Excavation and refilling of a trench for a tile line or buried utility line, bringing subsoil and regolith to the surface	
	17.07	+ Bioturbation (mammal burrows, treefalls)	Pocket gopher mounds in sand prairies are conspicuous displays of this disturbance as a result of bioturbation.
Plow sole	2.01	– Cultivation	A soil probe or soil pit is necessary to detect a plow sole (unless it is exposed by rill erosion), and it should not be confused with a natural hardpan.
Ridged and furrowed surface (plow lines and deadfurrows)	2.01	– Cultivation	
Rock piles (glacial erratics or fragments of local bedrock)	2.01	– Cultivation of the adjacent land	Loose rocks are gathered and piled in fencerows, in field corners, and beneath shade trees.
Rutted surface	2.01	– Cultivation (tractors turning around in uncultivated idle land next to a field)	
	16	– Mowing on moist ground	Ruts from mowing in a wet meadow might be mistaken for plow lines.
	23.02	– Other off-road traffic (fire engine or utility maintenance truck stuck in a prairie)	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Soil horizons intermixed with layers of cinders etc. (railroad ballast, road asphalt)	5.03	– Earthmoving (road and railroad maintenance)	
Subtle terrace (bench-like in profile) running across a slope (just one terrace, not a series of terracettes)	17.01	– Sheet erosion depositing soil on the upslope side of an old fenceline (or unfenced field border) and stripping away soil on the downslope side of the line	
Terracettes	11.07	– Grazing	
ENVIRONMENT: INTRUSIONS			
Abandoned buildings or farmsteads (including old foundations, basements, cellars, cisterns, wells, chimneys, silos, driveways, farm equipment, scattered bricks and other artifacts)	13.01	– Formerly intense local human activity, usually including a concentration of domestic livestock (especially before World War II), often including the introduction of persistent or invasive non-native plants	
Clearing and maintenance of open conditions along a utility corridor or other right-of-way by infrequent mowing (brushing)	1.01	– Clearing	Powerline and pipeline rights-of-way that cut through wooded hill country provide some of the best refuges for savanna and woodland snaps. Herbicide can wreck these refuges, though.
	16.02	– Removal of woody growth, not maintaining desirable native vegetation	
	16.03	+ Suppression of undesired woody growth and promotion of desired native vegetation	
Ditches	4.01	– Surface drainage	
	4.02	– Subsurface drainage tile line (a ditch often serves as an outlet for drainage tiles)	
	10.03 17.05	– Increased flooding, flood scouring, erosion, and sedimentation (caused by a straighter channel, steeper gradient, and faster runoff from upstream)	

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Drainage tiles or tile fragments on the surface or exposed in a hole	4.02	– Drainage tile line	
Fences	11	± Grazing	One or both or neither side of a fence may have been grazed at one time or another. The makeup of a fence may indicate the kind of animals that it was built to contain. Grazing is not always bad. See the discussion under the heading *Is grazing harmful to prairies? Or is it beneficial?* in the Grazing in Grassland SS&G and *Not all grazing is not always all bad. Not!* in the Prairie SS&G.
Hay bales and residual patches of uneaten hay ("hay dots" on aerial photography)	11	– Supplemental feeding of grazing animals	Supplemental feeding may indicate heavy grazing pressure or dormant-season pasturage.
Linear (especially rectilinear) features, boundaries, and patterns	6	– Farming	Lines that are long, straight, sharp, parallel, or at right angles are usually the expression of artificial disturbances.
	4.01 13.99	– Stream channelization, levee, dike, spoil bank	
	13.08	– Buried utility line (pipe or cable)	
	4.02	– Drainage tile line (sometimes visible from traces on the surface)	
	24	– Many other human activities, land uses, and intrusions (mowing, earthmoving)	
Livestock	11	± Grazing	The kind of livestock can be inferred by examining the kind of fencing, feeding and watering equipment, hoofprints, droppings, and hair caught on barbed wire. Grazing is not always bad. See the discussion under the heading *Is grazing harmful to prairies? Or is it beneficial?* in the Grazing in Grassland SS&G and *Not all grazing is not always all bad. Not!* in the Prairie SS&G.
Livestock shelters; feeding, watering, and handling facilities, etc. (barns, sheds, feed bunks, watering tanks, ponds, corrals)			
Livestock trails, trampled areas, dung			

Table 7.11. Vegetated Communities in General.

Quality Indicators	Disturbance Factors		Notes
Surface depressions, large (a closed basin — that is, a low spot with a center that is lower than its lowest side)	23.05	– Subsidence of an underground mine	Closed depressions (except for stream oxbows) are rarely created by surface erosion. They are usually the result of human activities. Karst sinkholes are a major exception.
	23.05	– Collapsed and partially filled entrance of a mine shaft	
	23.02	– Open-pit mine (gravel pit)	
	13.01	– Old basement	
	23.02	– Other artificial excavation	
	8.99 20.02 4	– Burned-out peat deposit (fire during a drought or after artificial drainage)	
	17.02	+ Collapse or subsidence above a cave system	
Surface depressions, small (a closed basin — that is, a low spot with a center that is lower than its lowest side)	13.01	– Abandoned well, cellar, or cistern	Surface erosion does not commonly create small closed depressions.
	4.02	– Break in a drainage tile line (“tile hole” or “blowout”)	
	23.02	– Collapsed or looted grave (most Indian mounds have been dug into)	
	15.01	– Cutting of valuable walnut or pecan below ground level	
	23.01	– Digging and removal of a plant	
	23.02	– Other artificial excavation	
	21.99 20.01 17.07	+ Tree stump or snag that has rotted away (“stump hole”), treefall pit, animal burrow	

Table 7.12. Quality Indicators and Disturbance Factors for Wet Prairie.			
Wet Prairie (a Community Type) is also treated by the following other tables: Herbaceous Communities in General Prairie Vegetated Communities in General			
Quality Indicators	**Disturbance Factors**		**Notes**
COMPOSITION			
Lower plant species diversity than in the adjacent wet-mesic and mesic prairie (often substantially lower)	26, 27	? Unknown	Most Wet Prairies exhibit significantly lower diversity than better drained prairie communities on the same site. Is this a natural condition, or is it a reflection of the fact that Wet Prairies have been almost universally degraded by unnatural hydrologic disturbances? Unless there is strong off-site evidence or direct on-site indication that the lower diversity is a consequence of unnatural disturbance, the Disturbance Factor should not be valued as negative, and the Natural Quality should not be downgraded on the basis of relative low species diversity. Even though a Wet Prairie may have lower species diversity, a high quality example should have some relatively conservative plants.

Table 7.13. Quality Indicators and Disturbance Factors for Wetland.			
Wetland (a Community Class) is also covered by the following other tables: Herbaceous Communities in General Vegetated Communities in General Wooded Communities in General			
Quality Indicators	**Disturbance Factors**		**Notes**
COMPOSITION: GROUPS OF SPECIES			
Wetland species growing on well-drained soil	4	– Drainage	Wetland species can sometimes persist for several years after their habitat has been drained.
	27	+ A natural condition: The soil only appears to be well drained.	A hardpan or bedrock near the surface can cause a shallow, perched water table and wet soil early in the growing season. The site may dry out during the summer and appear to be mesic, dry-mesic, or even dry.
STRUCTURE: HORIZONTAL PATTERN			
Wet spot in a lowland or along a shallow drainageway	4.02	– Subsurface drainage system that is failing (water is forced to the surface where a tile line has broken and clogged)	
ENVIRONMENT: INTRUSIONS			
Tile outlet discharging into a stream channel	4.02	– Drainage tile line	The tile outlet indicates that the font of water probably is artificial, not a natural spring. However, a naturally springy area may have a tile outlet.

Table 7.14. Quality Indicators and Disturbance Factors for Wooded Communities in General.

Quality Indicators	Disturbance Factors		Notes
COMPOSITION: GROUPS OF SPECIES			
Presence of relatively conservative understory trees and shrubs: Cercis, Cornus florida, Amelanchier, Viburnum, Carpinus, Ostrya, Staphylea	27	+ Lack of degrading disturbances (grazing in particular)	
Abundance of non-conservative (but not weedy) spring ephemerals: Podophyllum, Claytonia	11.06	± Grazing	Spring ephemerals can thrive in a pastured woods if they complete their active life cycle before the woods is pastured each year. Grazing can abet some species by spreading propagules and reducing competition.
Lack of especially palatable and favored forage species: Geum, Anemone, and showy and nectar-laden flowers (Lilium, Campanula americana)	11.05	– Grazing	
	3.01	– Deer overabundance	
Floodplain trees growing in abundance on an upland: Ulmus americana, Celtis, Fraxinus lanceolata, Acer negundo, A. saccharinum, Populus deltoides	1.02	– Old clearing, grown back up in trees	
	9.03	– Fire suppression	
COMPOSITION: INDIVIDUAL SPECIES			
Corylus americana thriving	8.03	± Fire	
Erechtites hieracifolia	8.03	± Fire	
Mertensia virginica	10.04	± Floodplain scouring	Bluebells thrive in forests that receive a lot of flood scouring. They are also surprisingly good dispersers and colonizers of young forest in former clearings.
	1.02	– Reforested clearing	
Phytolacca americana	8.03	± Fire	Pokeweeds are common in canopy gaps and on tree tip-up mounds (root wads). They may increase dramatically for several years after a fire.
	20.01	± Treefall	

Table 7.14. Wooded Communities in General.

Quality Indicators	Disturbance Factors		Notes
STRUCTURE: HORIZONTAL PATTERN			
Opening in a wooded tract	1	– Clearing	Many other artificial disturbances can create an opening (especially a small one) in a wooded tract. Many openings are a natural consequence of an environmental extreme (wetness or dryness), but they are maintained in part (and in the long term) by fire or some other, unarguably artificial disturbance.
	11.03 11.04	± Grazing (maintaining or creating an opening)	
	25	+ Natural disturbances	
STRUCTURE: GROUND LAYER			
Dead trees, downed	20.01	± Windthrow	
	27	+ Long-term stability and lack of disturbance	
Lack of leaf litter and duff	8.02	± Fire	Consumption of leaf litter and duff by fire may be attended by a dramatic increase in the growth and flowering of herbaceous plants.
	21.01	± High rate of biological decomposition	Moist and flood-prone habitats are most likely to exhibit rapid rotting of fallen leaves. Replacement of oaks and hickories by maples, ashes, and elms greatly increases the rate of litter decomposition. Non-native earthworms can substantially speed up litter cycling.
STRUCTURE: UNDERSTORY LAYER			
Browse line	11.04	– Grazing	
	3.01	– Deer overabundance	
Dead Juniperus virginiana trees standing beneath the overstory layer	1.02 21.02	– Clearing, followed by long-term abandonment	A red cedar must start out life in a sunny, open area. A cedar standing dead or nearly dead beneath a tree canopy is testimony to formerly open conditions.

Table 7.14. Wooded Communities in General.

Quality Indicators	Disturbance Factors		Notes
	9.04	– Loss of a hill prairie, glade, or open woodland because of plant succession, usually from fire suppression or cessation of grazing	
Hedging (twigs bitten off, resulting in clusters of short shoots and sometimes dwarfed leaves)	11.04	– Grazing	
	3.01	– Deer overabundance	
Lack of understory	11.04	– Grazing	
	23.02	– Clearing of understory	
	8.08	± Fire	
	21.01	± Overstory trees creating such dense shade that trees cannot grow well beneath them	A dense tree canopy may result in a very thin shrub layer, especially on wet or wet-mesic soil.
	27	± Wet or wet-mesic soil	
STRUCTURE: OVERSTORY LAYER			
Big, old trees with relatively few, large-diameter limbs	27	+ Old age of trees	A crown that has its wood concentrated into relatively few, large-diameter limbs is an indicator of an old tree.
Cull trees	15.01	– "High-grade" logging	In the strict sense, a "cull" can be defined as a defective, non-merchantable tree that was left uncut when a stand was logged. Fires and floods can damage trees and make them defective. Xeric environments also foster gnarled trees. (*Xeric* is used here in the sense that it is defined by the Illinois Natural Areas Inventory: excessively drained and extremely dry, not simply dry.)
	8.08	± Fire	
	10.04	± Flood damage	
	27	± Xeric environment	

Table 7.14. Wooded Communities in General.

Quality Indicators	Disturance Factors		Notes
Dead trees, standing (termed a "deadening" if the dead trees are concentrated in a patch)	21.03	± Girdling by beaver	The bivalent ± symbol indicates that the Disturbance Factor may be considered positive (or at least neutral) if it is the result of a natural agent, or negative if it is judged to be a consequence of unnatural conditions.
	12.01	± Mortality from disease	
	12.02	± Mortality from insects	
	8.08	± Fire	
	27	+ Old age of trees (natural mortality)	
	10.01 18.03	± Prolonged inundation by an extra-ordinary flood or by impounded water	
	17.05	± Sedimentation (smothering roots)	
	21.01	± Shading of shade-intolerant species by trees that overtop them	
	11.07	– Grazing damage to roots	
Lack of old trees in a mature stand of trees	15	– Logging	
	20.01	± Windthrow	
	27	+ Trees that have died of old age	An old-growth forest may have very few old trees if they have died out and have not yet been replaced.
Lack of large, well-formed, high-value hard-woods: Juglans nigra, Quercus alba, Carya illinoiensis	15.01	– Logging	Veneer-quality hardwoods are quite valuable. White oaks were once heavily cut to make staves for whisky barrels.
STRUCTURE IN GENERAL			
Coppice growth (plants top-killed and re-sprouted)	15.01	– Logging	Tilias naturally form large basal sprouts that are not caused by injury. Gleditsias sprout from their roots and commonly fork near the ground, but they do not usually have a true coppice growth form unless they have been severely injured.
	8.08	± Fire	
	16	– Mowing	
	23.02	– Clearing of understory	

Table 7.14. Wooded Communities in General.

Quality Indicators	Disturbance Factors		Notes
	11.04	– Grazing	
	23.07	+ Natural area vegetation management	
Fire scars	8.08	± Fire	
Charred tree trunks and charred woody debris			
Gap in tree size classes	11.04	– Grazing	
	8.04 8.08	± Fire	
	23.02	– Clearing of understory	
	3.01	– Overabundant deer	
Open, discontinuous tree canopy and subcanopy	8.04 8.08	± Fire	
	11.04	± Grazing	
	24, 25	± Other disturbances	Any disturbances that kill trees can result in an open, discontinuous tree canopy and subcanopy, especially if the disturbance is continuous or intermittent and continual.
Strip of trees with trunks that are all growing at a slant in the same direction	1.02	– Edge of an old clearing or roadway	Young trees lean outward as they grow toward the center of a road or clearing.
Trees broken (limbs broken), scraped, knocked down, or partially pushed over	15.01	– Logging	
	20.01	± Storm damage (wind, ice, snow, lightning)	
	10.04	± Flood damage	
ENVIRONMENT: INTRUSIONS			
Logging skid trails, haul roads, yarding areas, discarded cables	15	– Logging	

Table 7.14. Wooded Communities in General.

Quality Indicators	Disturbance Factors		Notes
Tree-cutting stumps, tops, logs	15	– Commercial timber harvest	
	15.03	– Firewood removal	
	23.07	± Natural area vegetation management	
	15.03	– Hazard reduction along a trail	
	23.07	– Removal of a “chimney” tree at a prescribed burn	
	15.03	– Cutting other trees (bee trees, coon trees)	

Appendix 5
Guidelines for Assessing Natural Quality

This appendix consists of advice and instructions about how to look at and think about an area when determining its Natural Quality. The guidelines under the first heading address Quality Indicators and Disturbance Factors in general terms. The second set of guidelines consists of tips that are good to keep in mind when conducting fieldwork and filling out the Grading Form.

Interpreting Quality Indicators and Evaluating Disturbance Factors

Different kinds of disturbances can have the same apparent effect on the quality of a Natural Community. For instance, consider the Quality Indicator that is termed *Abundance of rhizomatous, clone-forming composites* (commonly exemplified by dense Canada goldenrod with a scattering of asters and other goldenrods). In a prairie, this condition may be the result of at least four major Disturbance Regimes: Cultivation, Grazing, Mowing, and Earthmoving. The same weedy character may also be the consequence of other disturbances, perhaps especially herbicide drift, chemical-laden runoff, and sedimentation from adjacent farmland.

It is often impossible to determine what Disturbance Factor was the cause of a community's condition. You may be able to infer the kind of disturbance by examining the vegetation and its context, and by knowing or surmising the land use history. In the case of part of a prairie that is overrun by Canada goldenrod, you might presume that it was caused by long-ago farming — but later learn that the goldenrods dominate where a baseball diamond was once graded and mowed.

The character of a patch of a Natural Community is often the condition that has developed during a significant period of recovery or other change long after a disturbance event. Consider the case of a prairie that is overrun by Canada goldenrod: plowing, heavy grazing, prolonged mowing, or bulldozing may have created the conditions that initiated the establishment of the goldenrod clones, but the area did not have a dense stand of goldenrod while it was being plowed, grazed, mowed, or bulldozed. The disturbance may have ceased two or three decades ago, and the clones may have spread well beyond the area of disturbance that fostered their establishment and initial growth.

Some Disturbance Factors are stated in terms of severe disturbance, but the condition of a community is often the result of partial* recovery *from the disturbance. For instance if *cultivation* is listed for a Grading Patch, it usually does not mean that the patch is being cultivated — but that the patch is recovering from cultivation in the distant past.

A certain condition may indicate degradation and lower Natural Quality in one community — but not in another community, and sometimes not even in a different part of the same community. For instance the Quality Indicator *Abundance of rhizomatous, clone-forming composites* does not have the same relevance throughout a savanna community because this suite of plants commonly occupies shady spots in savannas that have obviously high quality vegetation in the adjacent sunny spots. Presumably all of the savanna has suffered the same disturbances, and all is the same Natural Quality — even though shaded parts appear to be weedier than sunny parts.

The occurrence of a disturbance in a community is not a significant consideration in grading the community if it does not have a significant effect on the community. If a disturbance is a small *intrusion* (*i.e.* an artificial feature or a very localized site of intense activity), it might significantly affect a community only within the space that the intrusion actually occupies; or, it might have a widely pervasive effect. A big patch of a community is likely to have more Quality Indicators and Disturbance Factors than a small patch — simply because it is bigger. In such a circumstance, a greater number of disturbances does not necessarily translate into a lower Natural Quality Grade. In fact, a larger example of a community is more likely to be higher quality simply because it can better resist or absorb the impacts of a number of degrading disturbances.

A characteristic of a community that is tentatively judged to be a negative condition may simply be natural variation. Unusual conditions may exist because of random processes and for no apparent reason. For example, it may be natural for a prairie remnant to have a large clone of Canada goldenrod or gray dogwood. But aggressive native plants and large-scale natural disturbances such as storm damage can overwhelm a small natural area, making the disturbances "negative" even though they are "natural."

A high quality example of a Natural Community might not fit a predetermined model. Nature is complex and diverse, and we don't know everything. Illustrative examples and word-pictures of "representative," "ideal," or "high quality" conditions cannot adequately portray the full scope of natural variation. An area should not necessarily be downgraded or rejected because it does not match a preconceived idea of what it would look like if it were high quality.

The Quality Indicators and Disturbance Factors in Table 7 do not cover all of the possibilities, and cannot always be used to tell the whole story of a site's disturbance, recovery, and protection from disturbance. Table 7 will be expanded as more Quality Indicators and Disturbance Factors are identified during all of the Survey Stages.

Many Quality Indicators are stated as extremes or anomalies. They are conditions that are well above or below average, or features that "catch your eye." In contrast, most natural areas have plenty of more-or-less average characteristics that are not as clearly expressed in nature as they are stated in Table 7. Consequently Grading Patches are often difficult to evaluate.

Pointers for Evaluating Natural Quality in the Field

It is safe to assume that almost any area has been severely disturbed at some time in the past two centuries. If all of the disturbances that have affected Illinois in the past two centuries were telescoped into an instant, there would be few trees and wisps of herbage standing above a landscape almost completely denuded by logging, farming, and grazing "down to the nub." The scattered areas with vegetation still standing in this scene might comprise the majority of our present-day natural areas, which have survived on sites that escaped logging, farming, and overgrazing for some reason. OTE 5N

If the quality of a community is unclear, consider its context. Consider this example: Community 1 occurs inside or adjacent to Community 2; the quality of Community 1 is unclear, but the grade of Community 2 is known. If both of the communities appear to have had the same history of land use and disturbance, then they will often have the same Natural Quality. However, this guideline must be applied with caution because different Natural Communities respond to and recover from disturbances in different ways, especially if the communities are in different Community Classes or Subclasses.

Make comparisons. Observe differences between patches, and consider why the patches differ. For instance, if part of a community looks more disturbed that the rest (*e.g.* more weeds or smaller trees) figure out why.

Land use and the history of disturbances often change at a property line. Look particularly for differences in Natural Quality on either side of a fence or road.

Don't combine a lack of knowledge with certitude. If some aspect of the quality of a community is uncertain, discuss the uncertainty. Make frank conjectures instead of unsupported assumptions. For instance, say that the flooding regime *may* be unnatural or *presumably* has changed — rather then assuming and stating that the flooding regime has changed — unless you have some evidence to support your hypothesis. Sometimes the right thing to write is, "I don't know. . . ."

***Ask the question,* "What's wrong with this area?"** If the answer is, "I don't see anything wrong," then maybe the area is high quality. But if you cannot also say why the area is high quality, then the best evaluation may be Grade C.

***If the quality of a small part of an area is unclear, ask,* "What if all of the area looked like this?** Answering this question will sometimes clear up the uncertainty.

Do not focus only on the negative indicators of a community's quality. Observe, document, and analyze what is good or average about a Grading Patch too. Be sure to photograph the average condition and representative areas, not just disturbances.

It is not necessary (and usually is not desirable) to record every possible Quality Indicator that can be identified in an area. Many disturbances have a very limited extent or level of development, and they do not have a role in determining an area's quality. For instance, a cluster of groundhog burrows or scattered windthrown or beaver-gnawed trees are local disturbances that have no effect on the grade of a community. Minor human disturbances may be common: littering, vandalism, trampling, old structures, etc. When an area is examined closely, the effects of many disturbing natural processes and artificial intrusions may be identified, but they do not need to be documented and evaluated unless they are important considerations when grading the community.

Page 1 of the Grading Form is a tool, not an end in itself. Usually at least a few Quality Indicators and Disturbance Factors are recorded on page 1 of the Grading Form. However, not all such observations need to be formally recorded on page 1. Observations can be incorporated into the discussion of Grading Components on page 2 without being entered on page 1 if this approach is efficient and the "bottom line" is the same: the *observations* and *analysis* are well stated, and the *decision* (*i.e.* the Natural Quality Grade) is clearly supported and explained.

If a Grading Patch is highly disturbed, it may not need to be documented in detail. It may suffice to list and discuss only one or two overriding disturbances without recording others. For instance if a patch of woods is clearcut, there is no need to list other Disturbance Factors such as intrusions and past grazing.

Quality Indicators and Disturbance Factors can be identified from a variety of sources. Most of them are found during the on-site inspection, but they can also be identified during the Map & Aerial Photo Stage, Existing Information Stage, and even Aerial Survey. One of the most useful tools to have at hand when investigating a site is an old aerial photo of the area. Much information about a site's history of disturbance may be gained by talking with a landowner, tenant, site manager, neighbor, former resident, or whoever has used the site. Written documentation and old on-the-ground photography may be available, especially for public lands and nature preserves. Ideally all of this sort of information will be gathered and available for use during the Final Field Survey

Help add to and improve the guidelines in this appendix as well as the information and instructions in the rest of the Grading Handbook. Routinely contribute to Table 7 and use the latest updated version. Issues that still need to be worked out better include: (1) how to grade naturally disturbed areas (such as an old-growth forest that has been blown down by a storm), (2) how to treat early successional communities that become established on naturally disturbed land (such as young riparian forest), and (3) how to grade cliff communities (where a lack of disturbance is the common condition).

Appendix 6
Terminology for Describing Nativity

The following definitions are from *Suggestions for a standardized terminology for alien plants* in an article by Pyšek *et al*. (2004).

Native plants
Synonym: indigenous plants.
Definition: Taxa that have originated in a given area without human involvement or that have arrived there without intentional or unintentional intervention of humans from an area in which they are native.

Alien plants [*]
Synonyms: exotic plants; introduced plants; non-native plants; non-indigenous plants.
Definition: Plant taxa in a given area whose presence there is due to intentional or unintentional human involvement, or which have arrived there without the help of people from an area in which they are alien.

Casual alien plants
Synonyms: Given the difficulties associated with definitions of casual plants, there are no consistently used synonyms in the literature. [†]
Definition: Alien plants that may flourish and even reproduce occasionally outside cultivation in an area, but that eventually die out because they do not form self-replacing populations, and rely on introductions for their persistence.

Naturalized plants
Synonym: established plants.
Definition: Alien plants that sustain self-replacing populations for at least 10 years without direct intervention by people (or in spite of human intervention) by recruitment from seed or ramets (tillers, tubers, bulbs, fragments, etc.) capable of independent growth.

Invasive plants
Definition: Invasive plants are a subset of naturalized plants that produce reproductive offspring, often in very large numbers, at considerable distances from the parent plants, and thus have the potential to spread over a large area.

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[*] EDITOR'S NOTE: In keeping with the majority of natural area workers in the state, the Illinois Natural Areas Inventory uses the term *exotic* instead of *alien*.

[†] EDITOR'S NOTE: The full article by Pyšek *et al*. includes a brief review of other terms that have been defined and used more or less in the same way that *casual alien plants* is defined here. These other terms include *subspontaneous taxa*, *waifs*, *occasional escapes*, *ephemeral taxa*, and *adventives*.

Transformers
Synonym: Transformers are essentially equivalent with edificators, a term used in European, especially Russian literature. Edificators are defined as "environment forming plants."
Definition: A subset of invasive plants (not necessarily alien) that change the character, condition, form, or nature of ecosystems over a substantial area. (Substantial means relative to the extent of that ecosystem.)

Weeds
Synonym: pests; harmful species; problem plants; noxious plants. The last term is often used, particularly in U.S.A., for a subset of weedy taxa, whose control or eradication is mandatory.
Definition: Plants (not necessarily alien) that grow in sites where they are not wanted and which have detectable economic or environmental impact or both.

Appendix 7
Terminology for Rating Relative Abundance

Definitions

A five-level Relative Abundance scale provides an estimate of how common a plant species is within a given area. The estimate is based primarily on the amount of effort that must be spent to find a species:

> **1. Rare**.—A plant is rated as *rare* if it is known to have very few (say, up to three of four) individuals or small populations in an area. If the area is extensive, a rare species is likely to be found only with luck, or after prolonged diligent searching, or by returning to a previously known location for the species.
>
> **2. Occasional**.—An *occasional* species is common enough that it is apt to be located before an area is thoroughly searched, but the plant is widely scattered or is not so frequent that it is likely to be discovered immediately unless the area is quite small.
>
> **3. Common**.—A species is *common* if it can be located with essentially no effort. It is found throughout most or all of the area, but it does not generally dominate the area.
>
> **4. Very common**.—A *very common* species occurs in large numbers throughout most or all of an area, but it does not generally dominate the area.
>
> **5. Abundant**.—An *abundant* species is dominant and ubiquitous in an area. Or, if it dominates only part of the area, it is annotated as "locally abundant."

If a species is present in an area but its abundance is not estimated, it can be simply annotated as *present*:

> **P. Present**

Application and Interpretation of the Relative Abundance Scale

The abundance rating provides a subjective, relative estimate of the number of plants of a certain species in an area. Only five classes (*rare* through *abundant*) characterize the entire range of possible population levels for all species, so each of the five classes must embrace a broad range of numbers. Despite the wide latitude of each class, it can difficult to confidently estimate the abundance of a species.

Ideally different Regional Ecologists examining the same area will assign the same abundance rating to a particular species. But in practice, different people are quite likely to assign different ratings to the same species. It will be satisfactory if the ratings differ by only one abundance class: for instance a species is rated 3 by one person but is rated 4 by another person.

The species that a Surveyor finds within the first few minutes in an area are likely to be rated as 3, 4, or 5. However, a rare species might be encountered immediately by chance.

Relative Abundance ratings can be assigned to species growing in any given area, but the ratings are usually used to estimate how common a species is within a Grading Patch or a specific Natural Community (instead of in an entire Survey Site, for instance).

The Relative Abundance scale must be adjusted to accommodate all growth forms of plants (*i.e.* trees, shrubs, and herbs). An acre of forest can support hundreds of thousands of herbs but only a few hundred trees. Consequently a herbaceous species can be a few orders of magnitude more numerous than a tree species but still be assigned to the same abundance class as the tree.

Many plant species have a spotty and patchy distribution, even within habitat that appears to be well suited for its growth. This uneven distribution can make it difficult to assign an overall abundance rating. In such instances, the Relative Abundance can be qualified by adding an L (for "locally"). For instance 3L means *locally common*. *

* The annotation needs to be recorded as 3L instead of L3 to meet the format requirements of the information system.

Appendix 8: Snaps

Introduction

A *snap* is loosely defined as a native, sun-loving, relatively conservative, non-aquatic plant that has traditionally been called a "prairie plant." Most snaps are perennial, although relatively few are annuals or biennials. All are herbaceous except for a few low shrubs that are morphologically and ecologically so well adapted to the prairie environment that they are sometimes mistaken for herbs — especially when they have recently re-sprouted after being top-killed by a fire.

The purpose of introducing a new term to substitute for "prairie plant" is to address two facts: (1) so-called prairie plant species are elements of many natural communities other than prairies, and (2) continuing to refer to those species as "prairie plants" has substantial, negative impacts on the identification, protection, and management of a wide range of non-prairie communities.

Background

Many Midwesterners who care for natural areas tend to focus on prairies to the neglect and detriment of other natural communities. A prairie enthusiast who finds an assemblage of sun-loving flora growing in a house-sized opening (or even a room-sized opening) in a woods is apt to call it a prairie even though this sunny, open area is actually the last remaining gap in the canopy of a savanna that has not yet completely closed over. Such a bias for prairies is ironic and unfortunate because natural remnants of savannas are even rarer than prairies.

Fixation on prairies has resulted in some tragic incidents of savannas and woodlands being managed to their detriment — to "restore the prairie vegetation." See the discussion in the section titled *Classification, entitation, and identification of savannas* in the Savanna Survey Standards and Guidelines (in White 2009), including the footnote in that discussion..

For lack of a better term, we have all spoken of "prairie plants in the woods." Words matter: when we say "prairie plant," we're apt to think *prairie*. But those native, sun-loving, relatively conservative, herbaceous plants belong in woodlands, savannas, glades, and fens too. Community classification matters: see "Why Savanna Classification Matters: The Implications for Land Management Planning, Review and Implementation" by Heidorn (1984).

A new word for "prairie plant" is needed for two reasons. (1) They're not just prairie plants. (2) Because they are called prairie plants, the communities in which they occur are sometimes treated as if they are (or should be) prairies even though they are not prairies.

At the Hill Prairie Conference at Principia College in October 2006, I vowed, “There is no such thing as a prairie plant,” and I introduced a term: [*]

nasunnonaquaperherb

Short for: **na**tive, **sun**-loving, **non-aqua**tic, **per**ennial **herb**

I constructed this concatenation to make a point — but not as a serious attempt to coin a term that would gain acceptance by ecologists and natural area workers.

Early in the series of training sessions for the INAI Update’s Regional Ecologists in 2008, I used the term *nasunnonaquaperherb* as a serious-minded but tongue-in-cheek way to assert that we truly do need to abandon the “prairie plant” paradigm. I asserted that it is not right to say that an open woodland or savanna is characterized by the presence of prairie plants. The Regional Ecologists took me seriously and rearranged and further abridged the adjectives to make a “snappier” term:

sun-loving, **na**tive, non-aquatic, **p**erennial **herb**

Subsequent brainstorming and debate among the INAI Update staff focused on the appropriate form for the term: snap-herb, snap herb, or snapherb?

Eventually I realized that “perennial herb” can be shortened to “perennial,” particularly in the sense used by horticulturists. Consequently I dropped “herb” and settled on *snap*.

Definition

A *snap* is defined as: a member of a group of sun-loving, native, non-aquatic plant species that are (a) principally perennial and usually herbaceous and (b) adapted to the ecological conditions exhibited by herbaceous vegetation that develops in a stable, little-disturbed natural community.

In this definition, a *sun-loving* plant is a species with two characteristics: (a) it is well adapted to the physical environment of full exposure to high light intensities, and (b) it can compete successfully in the dense ground-layer vegetation that typically develops in undisturbed sunny situations. *Non-aquatic* means not inhabiting the *hydric* soil moisture class as defined by the Illinois Natural Areas inventory. Although the definition states that snaps are principally perennial and usually herbaceous, a few snaps are annuals, biennials, or low shrubs that commonly associate with sun-loving, native, non-aquatic, perennial, herbaceous plants.

[*] This appendix is written in the first person of John White.

Interpretation

One might suppose that there are "degrees of snap," but the term *snap* is intended for species that are truly adapted to exposure to full sun. Some snaps, though, can also grow in semi-shade. For instance Aster oolentangiensis (sky-blue aster) is a denizen of both open woods and prairies. Parthenium integrifolium (feverfew) is a snap even though it can also persist for many years in a suppressed condition in a woodland that has developed a closed canopy. OTE 6N

A species that thrives in semi-shaded habitats with snaps is not a snap if it does not normally also grow in full sun. For instance, Lespedeza capitata (prairie bush clover) is a snap; but its congener L. virginica (slender bush clover) is not, because L. virginica can thrive only in the thinner vegetation that develops in partial shade and on poor soils. Helianthus mollis (downy sunflower) is a snap; but H. divaricatus (woodland sunflower) is not, because H. divaricatus is rarely found in open areas far from shady borders. Asclepias sullivantii (Sullivant's milkweed) is a snap; but A. purpurascens (purple milkweed) is not, because A. purpurascens usually grows beneath a tree canopy and is rarely found far out in a prairie.

Appendix 9
Grading Models

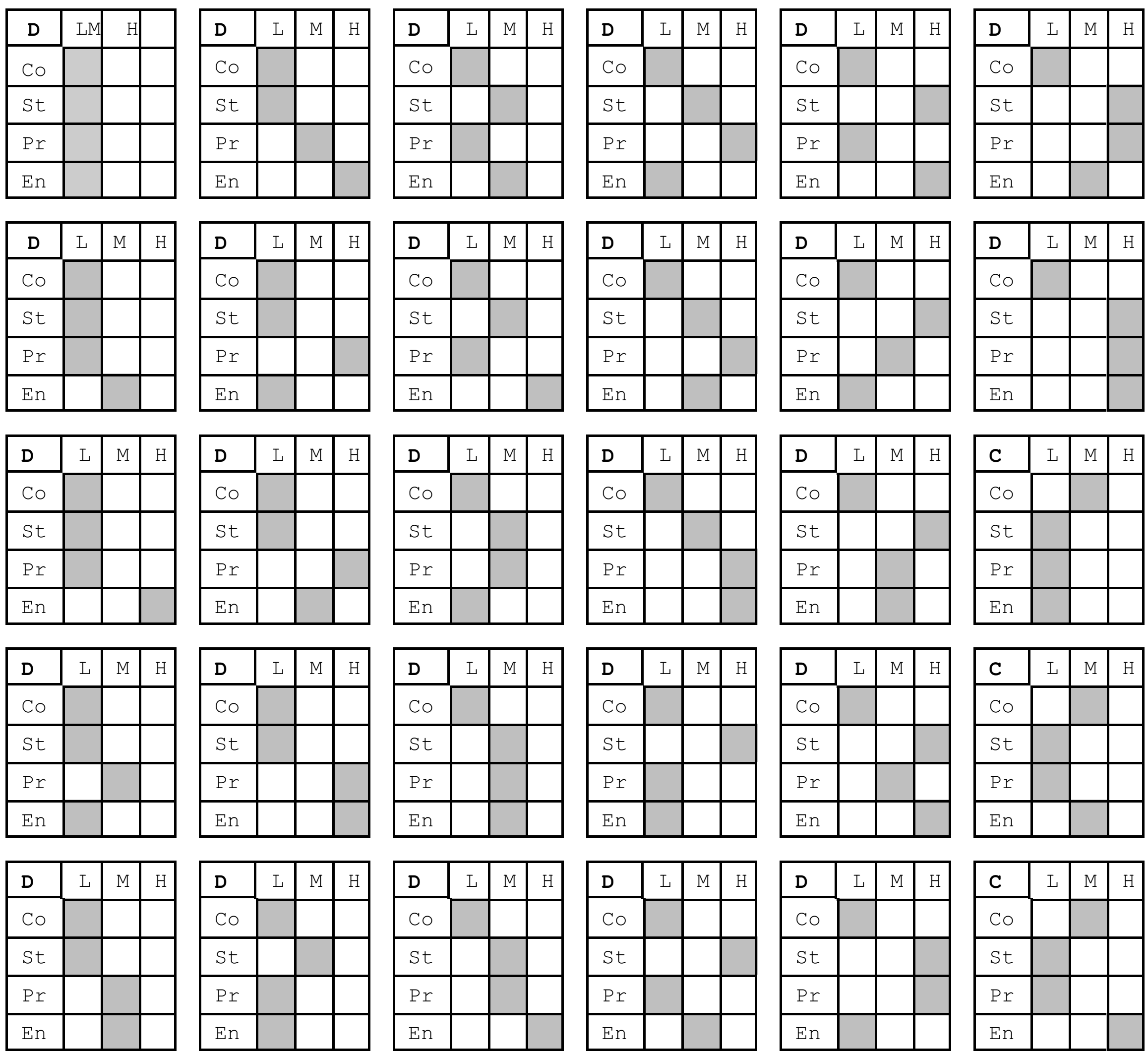
This appendix displays the 81 possible combinations of Grading Components and Condition Ratings, as discussed on page 23. The upper left cell of each matrix shows the Natural Quality Grade that is indicated by the ratings of the Grading Components. This is a provisional set of Grading Models; they need to be applied and tested to see whether the grades in the models correctly indicate the quality of a community.

Grading Components:

- Co = Composition
- St = Structure
- Pr = Processes
- En = Environment

Condition Ratings:

- L = Low
- M = Medium
- H = High



C	L	M	H
Co		■	
St	■		
Pr		■	
En	■		

C	L	M	H
Co		■	
St		■	
Pr	■		
En			■

C	L	M	H
Co		■	
St			■
Pr	■		
En		■	

C?	L	M	H
Co			■
St	■		
Pr	■		
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Appendix 10

Grading Form and Instructions

A Grading Form is used to document the Natural Quality of a Grading Patch and to determine its grade.

Page 1

The first page is for recording basic information about the Grading Patch, and to document Quality Indicators and Disturbance Features.

Site Code.—Enter the Site Code from the Survey Site Record.

Site Name.—Enter the Site Name from the Survey Site Record.

Surveyor.—Enter the name of the Regional Ecologist or other person who is evaluating the area and filling out the Grading Form.

Date.—Record the date when the area is graded.

NC/NQ polygon.—A Grading Patch can have only one grade, but it may have more than one Natural Community. A mapped area that consists of a single Natural Community (NC) and that has a single Natural Quality (NQ) grade is termed an NC/NQ polygon. If a Grading Patch has more than one Natural Community, it must have more than one NC/NQ polygon.

Enter the location code for the NC/NQ polygon or polygons that comprise the Grading Patch. These codes are the same as the codes in the Location (Loc) column of the Natural Quality table of the Survey Site Record.

Natural Community.—Record the name of every Community Type in the Grading Patch.

Grade.—Record the Natural Quality Grade of the Grading Patch here. This grade is tentative until page 2 is completed.

Notes.—Record any general information or comments about the Grading Patch that do not belong elsewhere on the form. For instance, if someone other than the Surveyor assisted with completing the form, record that person's name here. If there is not enough room in this blank, assign a number to the notes, turn to page 2 or 3, write the number in the No. column, and write the notes in the Notes column.

Description of Quality Indicators.—Describe each Quality Indicator in specific terms. That is, spell out how the Quality Indicator is actually expressed in the Grading Patch — which is not necessarily exactly the same way as it is characterized in Table 7 of the Grading Handbook. For instance, one of the Quality Indicators in Table 7 is stated as *Dominance by one or a few plant species*; in an actual Grading Patch, the specific expression of this indicator might be *Dominance by only two tree species: Quercus stellata and Q. marilandica*.

If you identify and use a Quality Indicator that is not listed in Table 7, record it on the Grading Form and email it to the other Regional Ecologists, Field Survey Director, and Survey Instructor. The Survey Instructor will add the newly identified Quality Indicator to the master list that is continually updated and re-distributed.

Photo.—Photograph the Quality Indicator (QI), and record an identifying code for the photo. More than one QI may be illustrated with a single photo; if so, record the same identifying code for each QI. More than one photo may show the same QI; if so, record only the photo or photos that best illustrate the QI (*e.g.* the photos that were taken specifically to document the QI).

Disturbance Factor (DF).—Identify the Disturbance Factor that is indicated by the Quality Indicator (consult Tables 5 and 7). Record the number of the Disturbance Factor from Table 5. It is all right to record the number of a Disturbance Regime instead of a Disturbance Factor if a specific Disturbance Factor cannot be identified, or if several Disturbance Factors in the same regime are associated with the Quality Indicator.

If there is more than one Disturbance Factor for a particular Quality Indicator, list each Disturbance Factor on its own line, and use ditto marks to show that the Quality Indicator is repeated for more than one Disturbance Factor.

If you identify a Disturbance Factor that is not listed in Table 5, select and record the number of one of the "other" categories that is listed for each of Disturbance Regimes 1 through 23. If you determine that a new Disturbance Factor should be added to Table 5, consult with the Field Survey Director or Survey Instructor.

Effect.—Decide whether the Disturbance Factor has a positive or negative effect on the quality of the Natural Community or communities in the Grading Patch. Write one of the following symbols in the column:

- – Negative effect
- \+ Positive effect
- ± Approximately neutral or variable effect
- ? Uncertain or unknown effect

Consult Table 7 to see how the Effect of the Disturbance Factor has been evaluated (*i.e.* positive, negative, etc.) for the Quality Indicator. If you determine that the Effect of the Disturbance Factor is different from how it was annotated for the Quality Indicator in Table 7, report this to the Field Survey Director or Survey Instructor.

Extent.—The *Extent* of a Disturbance Factor is an estimate of the proportion of a Grading Patch that is occupied or affected by the factor. Enter a code that best describes the Extent:

– Not seen: The factor or its effect is not found in the Grading Patch. *

L Low (Localized): The factor is localized, and it occupies or affects less than about one-tenth of the Grading Patch, often in several scattered spots.

M Medium (Moderate): The factor occupies or affects roughly one-tenth to one-half of the Grading Patch.

H High (Widespread): The factor occupies or affects more than half of the Grading Patch.

Level.—The *Level* of a Disturbance Factor is the degree of development of the factor and its effects. Enter a number that best describes this level:

– None or N/A: If a Disturbance Factor is present in a Grading Patch but it is having no apparent, active effect on the community, then the *Level* is None. Or if the *Extent* of the Disturbance Factor is recorded as Not seen, then the *Level* must be N/A (not applicable).

L Low: In the parts of a Grading Patch that the Disturbance Factor occupies or effects, it is poorly developed and has a minor effect on the community.

M Medium: The level of development is judged to be between Low and High.

H High: In the parts of a Grading Patch that the Disturbance Factor occupies or effects, it is well developed and has a major effect on the community.

Trend.—The *Trend* describes whether the *Extent* or *Level* of a Disturbance Factor appears to be increasing or decreasing. Enter a number that best describes the Trend:

---

* A Disturbance Feature is not usually recorded on the Grading Form unless it occurs in a Grading Patch, so the "Not seen" option is rarely applicable.

– Unknown or N/A: If a trend cannot be determined, it is Unknown. If the *Extent* of a disturbance is recorded as Not seen or if the *Level* is None or N/A, then the Trend is N/A (not applicable).

L Low (Decreasing): The Disturbance Factor is judged to be declining, either by shrinking in area or dropping toward a lower level of development.

M Medium (Stable): The factor appears to be in a steady state, neither increasing nor decreasing overall — although it may be increasing or decreasing locally within the Grading Patch.

H High (Increasing): The factor is judged to be increasing, either in its extent or its level of development, or both.

Notes.—As appropriate, record more observations or analysis about each Quality Indicator or Disturbance Factor. *Copious notes are encouraged*. In the Notes column on page 1, assign a number (1, 2, 3 . . .) to each set of notes. This number is used as a key to the notes, which are written on page 2 or 3.

Page 2

Page 2 addresses the four Grading Components and their Sub-components. The Natural Quality Grade is derived from an analysis of the Condition Ratings of these components and sub-components.

Site Code.—Copy the Site Code from page 1. This duplication is a precaution in case the different pages of the form become separated from each other.

NC/NQ polygon.—Copy the NC/NQ polygon code or codes from page 1.

The next section of the form has blanks for evaluating each of the Grading Components:

Composition
Structure
Processes
Environment

For each Grading Component, the names of a number of the most important Sub-components serve as headings on the form. Each of these Sub-components is defined in the Grading Handbook beginning on page 13. There are blanks for entering other Sub-components, as needed.

There are two boxes to the right of each heading. The first box is for recording a Condition Rating. The second box is for entering a number that keys to notes that are recorded elsewhere on the form.

Condition Rating.—For each Grading Component and for each relevant Sub-component, record a Condition Rating in the first box to the right of the heading:

L = Low
M = Medium
H = High

Guidelines for determining a Condition Rating are under the heading *Rating the Condition of Grading Components and Sub-components* on page 17. A Grading Component should not be rated until its Sub-components are considered. However, it is usually not necessary to formally rate, analyze, and discuss each Sub-component.

A Grading Component or Sub-component is rated High if it is judged to have more than 75% of the characteristics that it would have if it were in a theoretical, pristine natural area (*i.e.* without any degradation). A component or sub-component is rated Low if it is judged on the same basis to be in the bottom quartile. Any case in the middle half is Medium.

It may prove problematic to distinguish a potential Grade A patch from a potential Grade B patch if the Composition of the patch is rated simply as High. To address this issue, a modification of the "High" rating for Composition is provisionally introduced:

MH = Moderately High
VH = Very High

Sub-components are worded and defined so that a High rating indicates high Natural Quality. For instance, if a Grading Patch has many conservative species, then the Conservatives sub-component is rated High. But if there are many ruderal species, the Ruderals sub-component is rated Low because the Ruderals Sub-component is stated as "Lack of ruderals."

Notes.—As appropriate, for each component and sub-component, write notes that support the Condition Rating. *Copious note-taking is encouraged.* Record a number for each set of notes. This number is used as a key to the notes, which are written farther down on page 2 or on page 3.

Grade.—Consult the Grading Model (pages 23 and 95) and follow the Grading Rules (page 25) to assign a Natural Quality Grade (A, B, C, D, or E) for the Grading Patch. Write the letter grade in the box. Do not use plus or minus signs (*e.g.* B+ and C–); the grading system is not so precise, and the information system cannot accommodate pluses and minuses.

Discussion.—Enter a note number in the second box and write more notes to support the grade assignment if the documentation is not covered sufficiently in the notes for Quality Indicators, Disturbance Factors, Grading Components, and Sub-components.

In particular, it may be useful to summarize the reasons why a higher or lower grade was not assigned to the Grading Patch. This summary may be in the form of a *comparative statement*, briefly spelling out the salient differences between this Grading Patch and an adjacent patch that has a higher or lower grade.

Boundaries.—Enter a note number in the box and write an explanation if you used a certain feature or set of features to draw the line between this Grading Patch and another, and if this information would be especially edifying.

Inclusions.—Enter a note number in the box and write an explanation if a significant part of the Grading Patch consists of areas that would be graded higher or lower if those areas were larger and more distinct (as discussed on page 6 of the Grading Handbook.

No. and **Notes**.—Use this section of the form to record notes from page 1 or the top of page 2. Repeat the note number that was written earlier on the form, then write the notes.

Page 3

Site Code.—Copy the Site Code from page 1.

NC/NQ polygon.—Copy the NC/NQ polygon code or codes from page 1.

No. and **Notes**.—Use this section of the form to continue to record notes that do not fit on page 2.

If additional pages are needed, use another blank page 3 and change the number of the page.

Site Code:	Page 1
Site Name:	
Surveyor:	Date:
NC/NQ polygon:	
Natural Community:	Grade:
Notes:	

Description of Quality Indicators	Photo	DF	Effect	Extent	Level	Trend	Notes

GRADING FORM	Page 2
Site Code:	
NC/NQ polygon:	

Composition			Richness			Conservatives			Increasers		
			Lack of ruderals			Lack of exotics					
Structure			Ground layer			Shrub layer			Subcanopy		
			Overstory			Horiz. pattern					
Processes			Repr. & Growth			Succession			Fire		
			Hydrology								
Environment			Soil			Water			Lack of intrusions		
Grade			**Discussion**			**Boundaries**			**Inclusions**		

No.	Notes

GRADING FORM	Page 3
Site Code:	
NC/NQ polygon:	

No.	Notes

Appendix II

Restorability Index
Pilot Project
Grading Patch Forms
And
Photographs

Grading Patch Restorability Form

Page 1 of 1 Pages

Survey Site Identifier: Daniel-Wright Woods

NC/NQ polygon:

Community: Dry-Mesic Upland Forest

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Low**	Rating: **Low**	Rating: **Medium**	Rating: **Low**	**D**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Exotic invasive understory	**Logged, young second growth**	**Lack of fire**	**Lack of fire resulting in shift to mesic soils**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Brush hog understory seeding of native forms	**plant native saplings and shrubs, allow over-story to mature**	**Reintroduce fire once fuel established**	**Brush hog and burning**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **____Manual** **__7__Mechanical** **____Capital**	**____Passive** **____Manual** **____Mechanical** **__9__Capital** *Buy Trees*	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **____Manual** **__7__Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
7	**9**	**3**	**7**	**26**

Daniel-Wright Woods, Dry-Mesic Upland Forest, Grade D

Grading Patch Restorability Form

Page 1 of 1 Pages

Survey Site Identifier: Kettle Moraine			Community : Grade D Savanna restored as Woodland	
NC/NQ polygon: 634 (northern parts)				
Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	**C**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
27, 11.05				
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Some exotic grasses present, not enough sun-loving forbs	**Up to 80% canopy cover some places, too many trees for woodland**	**Deer gazing, more frequent burn regime is required**	**soils may be modified by number of oaks**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Supplemental planting of forbs	**Removal of Oaks**	**Increase amount of prescribed burning**	**Plant woodland grasses**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **____Manual** **____Mechanical** **__5__Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
3	**5**	**3**	**3**	**14**

Kettle Moraine, Grade D Savanna

Grading Patch Restorability Form

Page 1 of 1 Pages

Survey Site Identifier: Kettle Moraine

Community : Grade D Savanna restored as Forest

NC/NQ polygon: 634 (northern parts)

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Low**	Rating: **Low**	Rating: **Medium**	Rating: **High**	**C**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Lack of forest herbs and sedges	**No understory (sub-canopy); only shrubs present are exotic; not a multi-layered structure**	**Current burning regime adequate; Deer grazing should be reduced**		
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Planting of forest herbs and sedges	**Long-term sub-canopy replacement by removing exotic shrubs and planting native shrubs**	**Annual Deer Hunting Program**		
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__5__Manual** **____Mechanical** **____Capital**	**____Passive** **__5__Manual** **____Mechanical** **____Capital**	**__2__Passive** **____Manual** **____Mechanical** **____Capital**	**__1__Passive** **____Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
5	**5**	**2**	**1**	**13**

Kettle Moraine, Grade D Savanna

Grading Patch Restorability Form				Page 1 of 1 Pages
Survey Site Identifier: Kettle Moraine		Community : Grade D Savanna Restored to Grade B Savanna		
NC/NQ polygon:				
Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Low**	Rating: **Low**	Rating: **Low**	Rating: **Medium**	**D**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Too many forest species present, some exotic grasses	**Canopy cover very high, trees too dense, exotic shrubs**	**Much more frequent burning needed**	**soils may be modified by number of oaks**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Significant planting of savanna grasses and forb species	**Near clear cutting, leave a few oaks that show some lower branch spreading**	**Annual intensive burning, followed by cattle grazing**	**Planting savanna grasses**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive ____Manual ____Mechanical __9__Capital	**____Passive ____Manual ____Mechanical __9__Capital**	**____Passive ____Manual ____Mechanical __9__Capital**	**____Passive ____Manual ____Mechanical __5__Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
9	**9**	**9**	**5**	**32**

Kettle Moraine, Grade D Savanna

Grading Patch Restorability Form				Page 1 of 1 Pages
Survey Site Identifier: McCormick Woods				
NC/NQ polygon:		Community: Dry-Mesic Upland Forest		
Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **High**	Rating: **High**	Rating: **High**	Rating: **Medium**	**A**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Shrub layer needs to be reduced	**Shrub layer should be reduced**	**Infrequent burning**	**Soil erosion and trampling**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Hand thinning of over-abundant mature shrubs to increase diversity	**Hand thinning of over-abundant mature shrubs to increase diversity**	**Increase burning**	**Educate neighbors**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__1__Manual** **____Mechanical** **____Capital**	**____Passive** **__1__Manual** **____Mechanical** **____Capital**	**____Passive** **__1__Manual** **____Mechanical** **____Capital**	**__2__Passive** **____Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
1	**1**	**1**	**2**	**5**

McCormick Woods, Dry-Mesic Upland Forest, Grade A

Grading Patch Restorability Form

Survey Site Identifier: Middlefork Savanna | Community : Mesic Savanna

NC/NQ polygon:

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **High**	Rating: **Medium**	Rating: **Medium**	Rating: **High**	**B**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Invasive forbs (tall goldenrod)	**Invasive forbs, deer browsing reducing shrubs, dense oaks some places**	**Lack of fire**	**None (hydrology has been restored)**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Continue prescribed burning	**Plant native shrubs and thin oaks in some places**	**Continue prescribed burning**	**None**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__1__Manual** **____Mechanical** **____Capital**	**____Passive** **____Manual** **____Mechanical** **__5__Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**__1__Passive** **____Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
1	**5**	**3**	**1**	**10**

Middlefork Savanna, Mesic Savanna, Grade B

Grading Patch Restorability Form

Survey Site Identifier: Middlefork Savanna | Community : Mesic Savanna

NC/NQ polygon:

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	**C**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Invasive native tall goldenrod; exotic reed canary	**Over-dominant forbs; aspen invasion; too much tall goldenrod**	**Lack of fire**	**Forb litter too thick**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Tall goldenrod control	**Aspen removal**	**Continued burning**	**Continued burning**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive ____Manual ____Mechanical __5__Capital	**____Passive ____Manual __3__Mechanical ____Capital**	**____Passive __3__Manual ____Mechanical ____Capital**	**____Passive __3__Manual ____Mechanical ____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
5	**3**	**3**	**3**	**14**

Middlefork Savanna, Mesic Savanna, Grade C

Grading Patch Restorability Form

Page 1 of 1 Pages

Survey Site Identifier: Middlefork Savanna | Community : Reconstructed Savanna

NC/NQ polygon: Along Entrance Road to Park

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: Low	Rating: Low	Rating: Low	Rating: Medium	**D**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Low species richness	**No shrubs at all**	**Lack of fire**	**May be compacted**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Planting more forbs and grasses	**Plant savanna shrubs, hazelnut, New Jersey tea, etc.**	**Establish burning regime**	**May not be able to address**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive __5__Manual ____Mechanical ____Capital	**____Passive __5__Manual ____Mechanical ____Capital**	**____Passive __5__Manual ____Mechanical ____Capital**	**____Passive ____Manual ____Mechanical __5__Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
5	**5**	**5**	**5**	**20**

Middlefork Savanna, Savanna Reconstruction

Grading Patch Restorability Form

Page 1 of 1 Pages

Survey Site Identifier: Pike Marsh	Community : Freshwater Marsh
NC/NQ polygon:	

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Low**	Rating: **Low**	Rating: **Medium**	Rating: **Medium**	**D**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Cattail dominance	**Missing Hemi-Marsh**	**Lack of fire**	**Gravel mining (contributing sediment)**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Bushhog when soils are frozen; herbicide w/roundup	**Dynamite to create holes for muskrats who eat cattails**	**Lots of burning**	**Eliminate mining to slow sediment inputs**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **____Manual** **__7__Mechanical** **____Capital**	**____Passive** **____Manual** **____Mechanical** **__9__Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **____Manual** **____Mechanical** **__5__Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
7	**9**	**3**	**5**	**24**

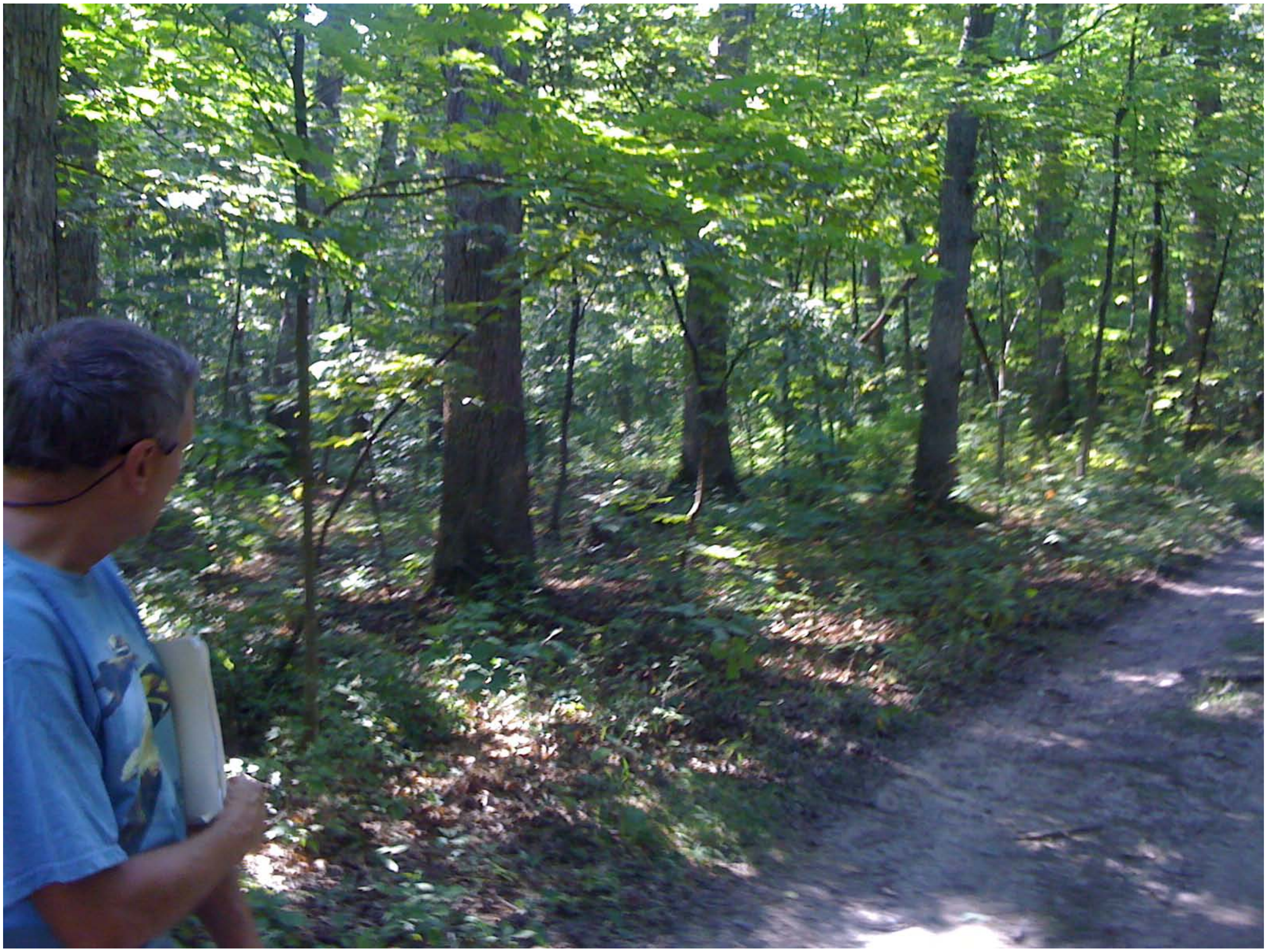
Pike Marsh, Freshwater Marsh, Grade D

Grading Patch Restorability Form				Page 1 of 1 Pages
Survey Site Identifier: Ryerson Woods				
NC/NQ polygon: 3		Community: Dry-Mesic Upland Forest		
Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **High**	Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	**B**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
27, 11.06	**9.04, No oak reproduction**	**9.04, 9.06, 9.01**	**Development of mesic soils**	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Shading	**Shading**	**Lack of Fire**	**Thinning of sapling layer (not ironwood)**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Hand thinning of invasive shrub saplings	**Hand thinning of invasive shrub saplings**	**Prescribed burning**	**Hand thinning of invasive shrub saplings**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__1__Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
1	**3**	**3**	**3**	**10**

Ryerson Woods, Dry-Mesic Upland Forest, Grade B

Grading Patch Restorability Form				Page 1 of 1 Pages
Survey Site Identifier: Ryerson Woods				
NC/NQ polygon: 3		Community: Dry-Mesic Forest		
Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	Rating: **Medium**	**C**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Low species richness, over-story trees not mature	**Buckthorn and brush honeysuckle**	**Not recovered from grazing (or deer)**	**Development of mesic soils**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Allow time for over-story trees to mature	**Could brush hog to remove invasive shrubs**	**Allow time**	**Could use brush hog to remove invasive shrubs**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
None		None		
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
__2__Passive ____Manual ____Mechanical ____Capital	**____Passive ____Manual __4__Mechanical ____Capital**	**__2__Passive ____Manual ____Mechanical ____Capital**	**____Passive ____Manual __4__Mechanical ____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
2	**4**	**2**	**4**	**12**

Ryerson Woods, Dry-Mesic Forest, Grade C



Grading Patch Restorability Form

Survey Site Identifier: Shaw Prairie

NC/NQ polygon: #1 | Community: Mesic Prairie

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Very High**	Rating: **High**	Rating: **High**	Rating**: High**	**A (7.5 acres)**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
None	**None**	**Some willows and brush in more mesic pockets as a result of recent wet springs**	**Skokie River has been ditched, but there is a natural spring which mitigates most problems**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
None	**None**	**Minor brush removal, routine prescribed fire**	**None**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
__1__Passive **____Manual** **____Mechanical** **____Capital**	**__1__Passive** **____Manual** **____Mechanical** **____Capital**	**____Passive** **__1__Manual** **____Mechanical** **____Capital**	**__1__Passive** **____Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
1	**1**	**1**	**1**	**4**

Shaw Prairie, Mesic Prairie, Grade A

Grading Patch Restorability Form

Survey Site Identifier: Shaw Prairie

NC/NQ polygon: #3 South of trail | Community: Mesic Prairie

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **High**	Rating: **High**	Rating: **Medium**	Rating: **Medium**	**B (2.5 acres)**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
			New sewer lines	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Missing some conservative species	**None**	**Lack of fire**	**Some weedy species occur along old sewer line**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Let species from adjacent grade A prairie reinvade with time, and continue routine burning	**None**	**Continue routine burning**	**Let species from adjacent grade A prairie reinvade with time, and continue routine burning**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__1__Manual** **____Mechanical** **____Capital**	**__1__Passive** **____Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
1	**1**	**3**	**3**	**8**

Shaw Prairie, Mesic Prairie, Grade B

Grading Patch Restorability Form

Page 1 of 1 Pages

Survey Site Identifier: Shaw Prairie

NC/NQ polygon:	Community: Mesic Prairie

Community Composition	Community Structure	Ecological Processes	Physical Environment	Overall Community Grade
Rating: **Medium**	Rating: **Low**	Rating: **Medium**	Rating: **Medium**	**C (5.5 acres)**
Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	Disturbance Factor Codes from Grading Form	
Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	Name of Most Problematic Disturbance Factor	
Missing conservative species, many edge effect species present, missing indicator species, some exotic species present	**Ratio of grasses to forbs too high, grasses are too tall**	**Lack of fire, resulting in some brush**	**Multiple intersecting trails; old sewer lines**	
Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	Describe Most Expensive Restoration Strategy Required to Minimally Address the Disturbance Factor	
Plant species or burn a lot	**Plant species to compete with grasses**	**Prescribed fire**	**Reduce trails by closing through spring; less mowing**	
Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Projected Cost of Implementing the Above Management if Known	Total of Known Costs for Restoration
Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	Check Corresponding Management Sequence Below	
____Passive **__3__Manual** **____Mechanical** **____Capital**	**____Passive** **__5__Manual** **____Mechanical** **____Capital**	**____Passive** **__3__Manual** **____Mechanical** **____Capital**	**__2__Passive** **____Manual** **____Mechanical** **____Capital**	
Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Restoration Score Based on Rating:	Index of Restorability for the Grading Patch
3	**5**	**3**	**2**	**13**

Shaw Prairie, Mesic Prairie, Grade C