8-1-2006

An examination of wetland change in Douglas and Sarpy Counties, Nebraska from 1981 to 2003.

Michelle Rerucha

AN EXAMINATION OF WETLAND CHANGE IN DOUGLAS AND SARPY COUNTIES, NEBRASKA FROM 1981 TO 2003

A Thesis

Presented to the

Department of Geography – Geology

And the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

Of the Requirements for the Degree

Master of Arts

University of Nebraska at Omaha

by

Michelle Rerucha

August 2006

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College,

University of Nebraska, in partial fulfillment of the

requirements for the degree Master of Arts,

University of Nebraska at Omaha.

Committee

Charles M. Goldwater - Geography

Joan L. Sample - Crim. Justice

Chairperson Libby A. Peek

Date July 20, 2006

ABSTRACT

AN EXAMINATION OF WETLAND CHANGE IN

DOUGLAS AND SARPY COUNTIES, NEBRASKA FROM 1981 TO 2003

Michelle Rerucha

University of Nebraska at Omaha, 2006

Advisor: Dr. Jeffrey Peake

This study focuses on wetland change in Douglas and Sarpy Counties, Nebraska, between 1981 and 2003. Because previous studies have indicated that urban development generally has a negative effect on wetlands, these two counties were selected because they are among the most rapidly urbanizing counties in Nebraska, a predominantly rural state, in terms of land use. The study examined wetlands over one acre in size in 1981, 1993, and 2003, including freshwater emergent wetlands, freshwater ponds, and lakes. The National Wetlands Inventory (NWI) data were utilized as base data for wetlands present in 1981. Aerial imagery from 1993 and 2003 was used to determine if NWI wetlands were still present in subsequent years and to detect new wetlands that emerged by 1993 and 2003. The results were somewhat surprising. According to many previous studies (Frayer et. al., 1983; Tiner, 1984; Dahl, 2000; Mitsch & Gosselink, 2000; Tiner et. al., 2002), wetlands are often lost to urban development. It was hypothesized that due to Omaha's urban expansion over the past 25 years, that the total number and acres of wetlands in the study area would have decreased.

Rather than finding wetland losses in Douglas and Sarpy Counties, the total number of wetlands present increased from 288 to 395 by 1993, but decreased to 362 in 2003. The area covered by wetlands in the study area increased from 2,650 to 3,507 acres between 1981 and 1993, and to 4,244 acres by 2003. This increase resulted, in part, from some of the large reservoir projects and sand pit lakes that had been dredged since 1981, increasing the total acres of wetlands present, but not necessarily increasing the total number present. Instead of the total number and acres of wetlands being adversely affected, it appears that in Douglas and Sarpy Counties, wetlands tend to be maintained and utilized as ponds or lakes in urban developments, rather than being drained or filled for residential or commercial developments.

ACKNOWLEDGEMENTS

I would like to recognize those people who provided inspiration, assistance, and support for me on my journey through graduate school and the completion of this thesis.

I would like to express extreme gratitude to my thesis advisor, Dr. Jeffrey Peake for his ideas and guidance throughout this process. He has been a wonderful advisor and mentor through his assistance and direction with this thesis as well as his support throughout my graduate program.

I would also like to thank the members of my committee who took time out of their busy schedules to offer assistance and support. My appreciation goes out to committee members Dr. Charles Gildersleeve for his land use expertise and Dr. Lisa Sample for stepping in at the last minute to offer suggestions in the critique of this thesis. I would also like to thank Dr. Michael Peterson for his knowledge of GIS and Dr. Dennis Roncek for his statistical advice.

I would also like to recognize my friends and family for their love, support, and encouragement. Jill, you were there with me every step of the way, through the triumphs and frustrations, with patience, understanding, and love and I can't thank you enough. A special thank you also goes out to the "Florida" crowd for your unending support over the past two years and then some.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

Introduction

Wetlands occupy about five percent of Earth's surface and are considered to be one of the most important ecosystems on Earth. They occur in almost every climatic zone from polar to tropical regions and have varying water sources including precipitation, surface flow, and groundwater. In their most basic form, wetlands are lands which are periodically flooded or are saturated with water at least part of the year (Williams, 1990).

Wetlands are characterized by three main factors: the presence of water on the landscape for at least a part of the growing season, unique soil conditions, and vegetation adapted to wet conditions (Figure 1). Although these characteristics seem clear-cut,

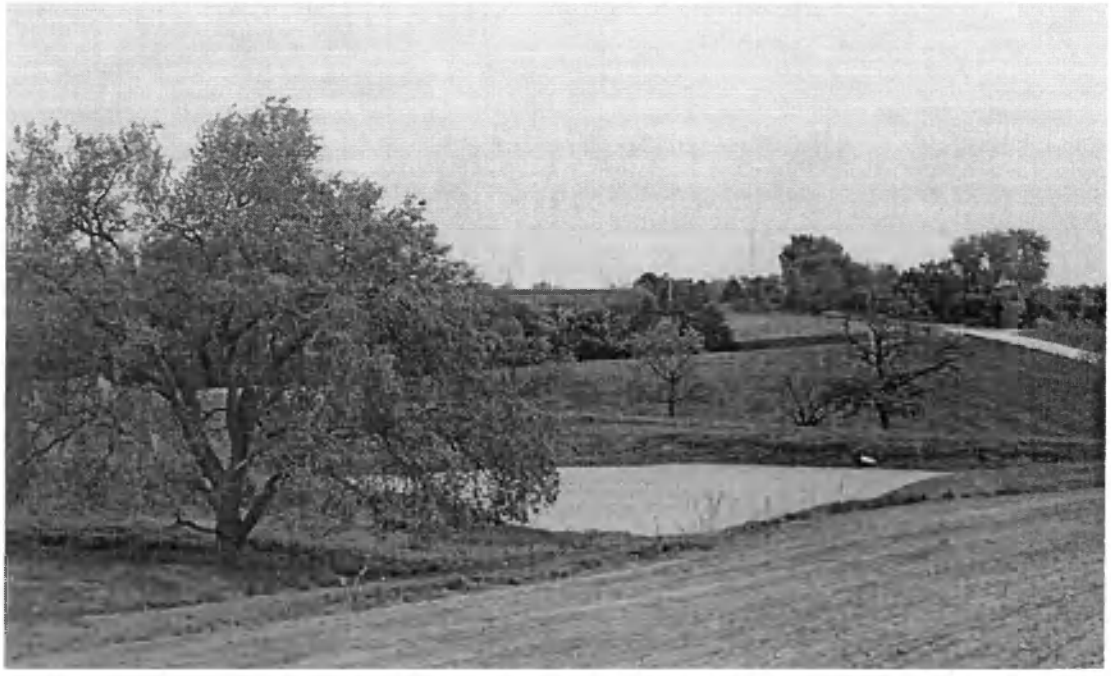


Figure 1: Rural wetland in Southern Sarpy County, near 99th Street and Mitchell Road

wetlands are transitional environments at the interface of the aquatic and terrestrial worlds, so it is difficult to combine these factors to create a universally accepted definition of wetlands. Cowardin (1979, p 3) defined wetlands as

> lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water....wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly undrained hydric soil; and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season each year.

Cowardin's definition is considered to be one of the most comprehensive scientific definitions of wetlands and was adopted for use by the U.S. Fish and Wildlife Service (USFWS). Although there are many wetland definitions, most are similar, with variations depending on what the definition will be used for: wetland science, or policy making (Mitsch & Gosselink, 2000).

Wetlands serve a variety of important functions, although most of these functions were not recognized by society until the mid-1970's when views of wetlands shifted from wetlands as wastelands to wetlands as important ecosystems. Mitsch and Gosselink (2000, p.4) refer to wetlands as "biological supermarkets because of the extensive food chain and rich biodiversity they support" (Figure 2). According to the Environmental Protection Agency (EPA) (2005), one-third of the threatened and endangered species in the U.S. live only in wetlands, while half of all threatened and endangered species in the U.S. use wetlands at some point during their lifespan. Because wetlands offer wildlife habitat, they are also valuable in terms of aesthetics. Many people are attracted to natural environments for outdoor recreation, scenic landscapes, and wildlife interaction.

Figure 2: Rural wetland in Northern Douglas County, near 180th Street and Bennington Road.

Wetlands, sometimes called the "kidneys of the landscape," also perform a variety of hydrologic functions (Mitsch & Gosselink, 2000, p.3). Wetlands provide a means to control and store floodwaters and may serve as a source of fresh water for domestic, agricultural, and industrial uses. Wetlands also help to recharge groundwater supplies where the water accumulated on the surface percolates through the soil. They also act as nutrient and chemical sinks. Wetlands accumulate, break down, and recycle nutrients and chemicals in runoff from surrounding areas, providing a natural means for improved water quality. In addition to trapping and processing chemicals and nutrients, wetlands can also serve as sediment traps and reduce sediment in rivers and lakes (Murkin, 1998).

Wetlands in urban areas provide many of the same functions as wetlands located in rural settings. However, their importance is often enhanced in urban areas. Wetlands can protect other aquatic habitats from harmful chemical and biological contamination as

a result of urban runoff (Graham & Lei, 2000). They also provide a location to store excess stormwater runoff, thus protecting homes and businesses from flood damage that may occur as a result of impermeable surfaces in urbanized areas. Wetlands in urban areas may increase property values in developments. They also provide natural open spaces, especially in city parks, for humans and wildlife, in addition to opportunities for education and recreation in an otherwise man-made environment (Hammer, 1997).

Nature of the Problem

Despite their environmental, economic, and social values, wetlands are continually threatened and are disappearing all across the U.S. (Wolfson, et al., 2002). According to the EPA (2005), there were only 105.5 million acres of wetlands in the 48 contiguous states in 1997, a decrease of over 50% from the 1600's, when about 220 million acres were estimated to have existed. Until recently, most federal policies promoted the draining and filling of wetlands in order for the land to be used for agriculture, urban development, and other land uses not compatible with wetlands (National Research Council (NRC), 1995). During the 1980's, wetland policy shifted from destruction to protection and the "no net loss" concept became a national goal (Mitsch & Gosselink, 2000). Before wetlands can be filled, drained, or otherwise degraded, the owner or developer must obtain a permit from the United States Army Corps of Engineers (USACE). However, the permit is, more often than not, contingent upon compensatory mitigation, or the restoration, enhancement, or creation of another wetland to compensate for the wetland being degraded (Brinson, 1996).

Destruction of wetlands for development is a major concern. According to Tiner (1984, p.33), inland wetlands "continue to be vulnerable to development pressures in many areas...." Dahl (2000) attributes 30% of wetland loss between 1986 and 1997 to urban development, 26% to agriculture, 23% to silviculture, and 21% to rural development. The USFWS (2002) states that increasing populations and the developmental stresses which accompany population growth require improved information regarding both wetland values and functions in order to make effective management decisions. According to Silence (2005), there is a difference between "wetland values" and "wetland functions." Wetland values are wetland services deemed beneficial to society, while wetland functions are wetland services provided regardless of whether or not society views them as beneficial. Politics and economics play a key role in the value that society places on wetlands, especially those in urban areas, and in the creation of regulations intended to protect wetlands. Oftentimes, the fate of a wetland is determined by the economic considerations of its development value, rather than the wetland functions it provides to the surrounding area. The monetary value urban development will generate is a much simpler concept for most to comprehend than trying to calculate the more intangible values of wetland preservation, thus wetlands have often been undervalued in an economic sense in the past.

As land uses change around wetlands, they can fall victim to a number of destructive forces. In addition to urban development, wetland sedimentation is another serious problem facing wetlands today. Sedimentation can fill in wetlands, thus decreasing the duration and depth of water in wetlands and affecting wetland vegetation

(Luo, et. al., 1997). On the other hand, sedimentation can also be a positive factor in the creation of wetlands. Sedimentation may produce an environment of shallow, standing water, allowing wetland plants the opportunity take root. Increased runoff in urban areas can also contribute to accelerated sedimentation in reservoirs, streams, and other waterways. Lake Cunningham, located in northern Douglas County, is currently undergoing rehabilitation, at a cost of $3 million, because of sedimentation. The lake is being drained in order to clean out sediment that has accumulated in the lake as a result of construction, neighborhood runoff, agriculture, and shoreline erosion (Ruggles, 2006). In some areas, such as Wehrspann Lake in northern Sarpy County, sedimentation basins have been created to help prevent accelerated sedimentation of lakes. Oftentimes, these sedimentation basins produce shallow, emergent wetlands.

Sedimentation is not the only way wetlands are created. Wetlands may be created in an area intentionally or unintentionally, with intentional wetlands often the result of mitigation efforts. Oftentimes, wetlands are created unintentionally through other actions. Poorly planned drainage systems associated with urban development can result in wetland creation. Construction of farm ponds, reservoirs, or irrigation projects can also increase wetland acreages, both in rural and urban settings (Tiner, 1984).

Nebraska has a wide variety of wetland types including marshes, lakes, river and stream backwaters, wet meadows, forested swamps, and seep areas. It is estimated that while Nebraska had around 2,910,000 acres of wetlands, covering about six percent of the state in 1867, only 65 percent, or 1,905,000 acres, remained in 1990 (LaGrange, 1997). LaGrange (1997, p.8) also stated that "destruction of wetlands was much higher

in some regions of the state, but the statewide figure is buffered by the large wetland resource still remaining in the Sandhills." Much of Nebraska's wetland loss over the past 50 years has been associated with increases in irrigation (Tiner, 1984). The majority of Nebraska is considered to be rural in terms of land use, so only since the "no net loss" concept came about has wetland loss to urban expansion become a concern. Many of Nebraska's wetlands tend to be farm ponds or are associated with gravel pits or lakes created along rivers. The land surrounding the numerous gravel pits and reservoir lakes has increasingly become attractive locations for homes and businesses, which is evident in both Douglas and Sarpy Counties.

Research Objectives

This study focuses on wetland changes that have taken place in Douglas and Sarpy Counties over the past 25 years. Previous studies (Tiner, 1981; Frayer et. al., 1983; Dahl, 2000; Mitsch & Gosselink, 2000; Tiner et. al., 2002) have indicated that urban development has greatly reduced the number and acres of wetlands in much of the U.S. The primary objective of this research is to examine changes in wetlands in Douglas and Sarpy Counties since the National Wetlands Inventory (NWI), which was based on 1981 aerial imagery. The secondary objective of this study is to examine the effects of land use change, particularly urbanization, on wetlands in the study area. Because extensive urban development has occurred in Douglas and Sarpy Counties, it is expected that changes in wetlands have also taken place. No attempt was made in this study to measure wetland quality, nor to include all wetland types, particularly those under one acre in size.

Hypotheses/Rationale

It is hypothesized that there should be an overall decrease in the total number and acres of wetlands present today in comparison to the total number and acres present when the NWI data were collected. The overall decrease is expected because urban development has historically been one of the primary reasons for wetland destruction (Tiner, 1984; Dahl & Johnson, 1991). Wetlands have often been destroyed in order to utilize the land more profitably, such as for commercial or residential developments (Figure 3).

Figure 3: Wetland in the process of being drained for development (USFWS)

Douglas and Sarpy Counties have seen an overall decrease in agriculture as a result of rapid urban growth since the NWI in 1981. According to the U.S. Census Bureau (2005), Douglas County experienced an 11.3 percent increase and Sarpy County saw a 19.5 percent increase in population between 1990 and 2000. It is expected that the changes, particularly wetland loss, will be greater in urban areas than in rural areas due to changes in land use from wetlands, with little value, to more profitable residential and commercial land uses. Until the late 1980's, developers were able to drain wetlands without consequences. Even after the "no net loss" concept came about, developers were still able to destroy wetlands, provided they were able to mitigate their actions elsewhere. However, development may also play a role in wetland creation in urban areas through disturbances in drainage patterns,

sedimentation of lakes and reservoirs, and mitigation efforts. This research is important because by collecting information about where wetland changes have occurred during the last 25 years, this study can assist with future effective wetland management in a growing urban area.

CHAPTER II

Literature Review

Wetlands are essential for a wide variety of species, in addition to the numerous benefits they provide for humans. Because there has already been over a 50 percent decrease in the number of wetlands in the U.S., "determining what caused wetland loss or gains is an important part of assessing the effectiveness of policy or management actions" (Dahl, 2000, p.9). The first national wetlands inventory was conducted in 1906, after Congress requested the U.S. Department of Agriculture (USDA) to gather information on the extent, character, and agricultural potential of wetlands, but the inventory excluded eight western states. The second inventory, also done by the USDA, was conducted in 1922, and was considered to be one of the most complete wetland surveys until the 1950's (Shaw & Fredine, 1956).

The USFWS conducted their first wetlands survey in 1954, focusing on the importance of wetlands to waterfowl. Shaw and Fredine's inventory (1956) documented the location, classification, and evaluation of almost 75,000,000 acres of wetlands as habitat for waterfowl. According to Tiner (1984), the USFWS "recognized the need for sound ecological information to make decisions regarding policy, planning, and management of the country's wetland resources" and created the NWI in 1974, to provide scientific information about wetlands in order to make knowledgeable resource decisions. When the NWI began, its principal focus was to produce maps in high-priority areas for wetland protection and management (USFWS, 2002). In 1984, Tiner published a report outlining the status of wetlands in the U.S. and highlighting areas in greatest jeopardy

from a national standpoint, stating that Nebraska was among the states with the most extensive wetland losses. According to Tiner's 1984 report, the wetlands of Nebraska are of particular importance because of their strategic location as a resting spot and food source along the Central Flyway for migrating sandhill cranes and other waterfowl.

Frayer et. al completed the first technical report on the status and trends of wetlands for the USFWS in 1983, covering the period between the 1950's and the 1970's, providing a "statistically valid effort to estimate the Nation's wetland resources and provide indications of wetland gains or losses..." (Dahl & Johnson, 1991, p.1). Three years later, in 1986, the Emergency Wetlands Resources Act was enacted to promote wetland conservation in the U.S. This act requires the USFWS to complete status and trends studies for wetlands in the U.S. every 10 years (Dahl, 2000). This act and its subsequent amendments set up specific goals for producing both hard copy and digital wetland maps (USFWS, 2002). Dahl published the first update to Frayer's report in 1991, covering the period from the mid-1970's to the mid-1980's, using the same statistical procedures as Frayer's original study, and found a net decrease of 2.6 million acres of wetlands during the study period (Dahl & Johnson, 1991). In 2000, Dahl published the most recent wetlands status and trends report, spanning the period 1986-1997, and cited a net loss of 644,000 acres.

Over time, society's views on wetlands have shifted from destruction to preservation and the national status and trends reports illustrate that overall change. However, these reports provide only general information about where wetlands are decreasing and increasing (Frayer et. al., 1983). Few studies have been completed on a

localized basis regarding wetland trends and most localized studies focus on the qualitative analysis of wetland functions rather than on wetland trends. Nebraska has not yet published a state report on the status and trends of its wetlands. Rundquist and Turner (1980) undertook a wetlands inventory of the Omaha District of the USACE using Landsat imagery. However, their study utilized only one time period and a classification system that differed from Cowardin's (1979) USFWS classification scheme. Dinville (1993) and Fraser (1995) assessed wetland changes in the Nebraska Sandhills region using Landsat imagery, however, neither found significant changes in wetlands in the rural Sandhills. A study published by Ekstein and Hygnstrom (1996) traced the fate of wetlands near the Phelps and E65 canals in South-central Nebraska between 1938 and 1981. Ekstein and Hygnstrom did not find an overall decrease in the number of wetlands in the Rainwater Basin in the vicinity of the Platte River canal system because the canal system was feeding new wetlands (Ekstein & Hygnstrom, 1996). Although the results of Dinville (1993), Fraser (1995), and Ekstein and Hygnstrom (1996) were similar in that none of the studies found large changes in wetlands in Nebraska, none of their study areas have been affected by urban development, a primary cause of wetland destruction.

Urbanization is one of the main causes of wetland loss in the U.S., although the majority of the literature addressing urban wetlands focuses primarily on the qualitative analysis of wetlands and their functions. Few wetland trend studies have been undertaken in urban areas. Tiner, Swords, and McClain (2002) did complete an assessment of wetland status and trends for the Hackensack Meadowlands in New Jersey for the USFWS. The Hackensack Meadowlands is a large urban wetland complex which

has been greatly impacted by urban development. In the early 1900's, portions of the Meadowlands were used as a garbage dump and other parts were drained to aid in mosquito control. The purpose of the study was to update NWI maps by interpreting aerial photography from 1995, to aid in preserving and restoring wetlands within the New York-Newark urban area (Tiner et. al., 2002). The study found that 33 percent of wetlands lost between 1966 and 1985 had been converted to industrial development, 25 percent had been filled for development that had not yet taken place, 12 percent were lost to recreational development, and 11 percent had been transformed into transportation or communication facilities.

Loss of natural wetlands was part of a larger study on urban sprawl undertaken by Hasse and Lathrop (2003) using five land resource impact indicators to compare and contrast urban development patterns in New Jersey. Between 1986 and 1995, the state of New Jersey gained over 38,000 acres of impervious surfaces due to urban development and lost over 25,000 acres of wetlands. They found that the highest wetland losses occurred in the expanding suburban areas and the rural areas located along the outer fringes of sprawling suburban areas. According to Hasse and Lathrop (2003), "the phenomenon of sprawling urban development is one of the major forces driving land use/land cover change...." Changes in land use, particularly urban areas, often affect the presence of wetlands in numerous ways: changes in drainage patterns, increases in runoff and sedimentation, or drainage for a greater economic value. Shapard (1997) states that taking inventory of wetlands within city or county boundaries is the first step in managing wetlands because one needs to know what is present before it is possible to

create a management plan and the key to dealing with wetlands issues is knowledge.

CHAPTER III

Study Area

The study area for this project is Douglas and Sarpy Counties (Figure 4), located in eastern Nebraska. The counties are both bordered on the west by the Platte River and on the east by the Missouri River, while the Platte River also makes up the southern border of Sarpy County. The mean high temperature ranges from 32°F in January to 87°F in July and the area receives an annual average of about 30 inches of precipitation (High Plains Regional Climate Center, 2005). The majority of the precipitation falls during the growing season from April to September (Bartlett, 1975).

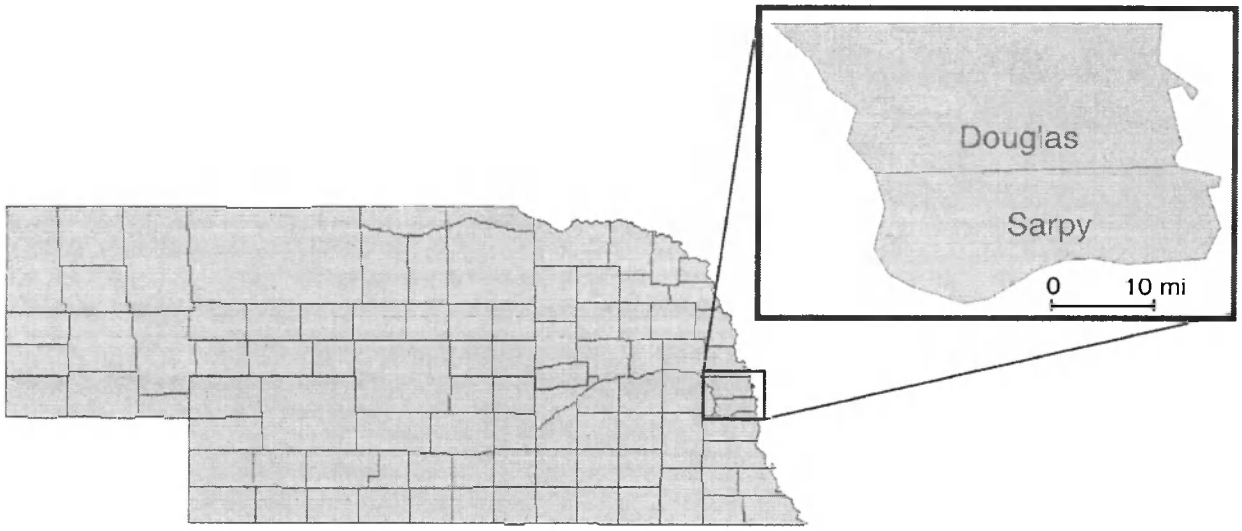


Figure 4: Study Area - Douglas and Sarpy Counties in Eastern Nebraska

According to the U.S. Department of Agriculture (1997), both counties are within two Major Land Resource Areas; the Loess-Drift Hills in the western section and the Deep Loess Hills in the eastern portion, with thick loess covering both. The soils in Douglas and Sarpy Counties are primarily Mollisols. Most of the upland soils are deep,

well-drained, and range from moderately fine to medium textured particles, while the lowland soils vary in drainage and texture (Bartlett, 1975) (Figure 5).

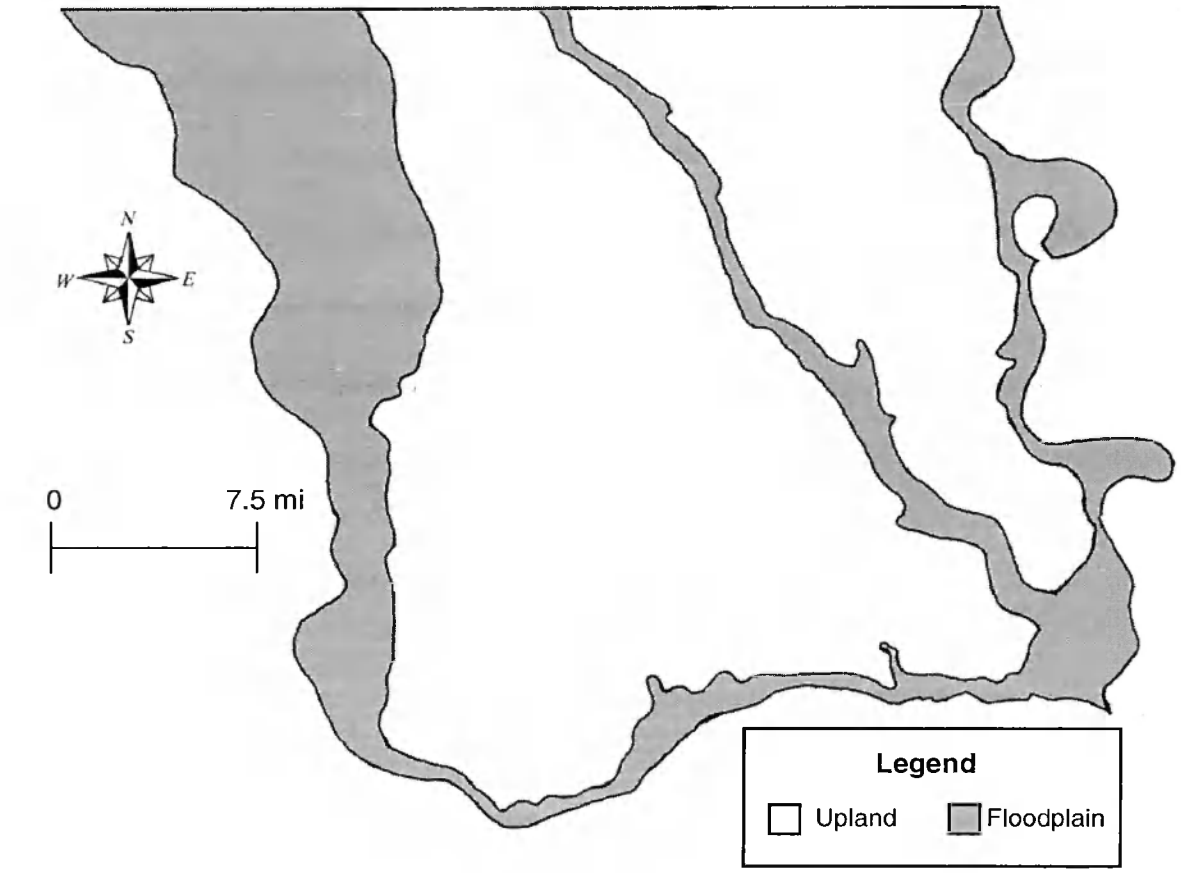


Figure 5: Location of the floodplains and uplands in Douglas and Sarpy Counties

The poorly drained lowland or floodplain soils, particularly those with fine textured clay soils, or where sandy loam soils intersect with the water table are where natural wetlands are often found.

Douglas and Sarpy Counties are suitable for this study because they contain the largest urban-rural interface in Nebraska, offering a range of both rural and urban land uses. The most recent wetland information available is the 1981 NWI, which is also the only comprehensive classification map available. According to the USFWS (2002), the

NWI maps in heavily populated areas are most in need of updating. Overall, Nebraska's wetlands are considered to have a low development risk, on a national scale; however knowledge of the number and distribution of wetlands in Nebraska is limited (LaGrange, 1997). In addition, a significant amount of urban development has taken place as the Omaha metropolitan area has expanded. The urban growth which has occurred in Douglas and Sarpy Counties over the past 20 years provides a chance to examine wetland changes as a result of urban development and to see how changes in land use affect wetlands.

CHAPTER IV

Methodology

NWI data, compiled by the USFWS, provided a basis for this research. Although the wetland data for the study area were interpreted from aerial photographs taken in 1981, it provided a solid base to examine wetland changes in this study. The data available from the USFWS provides one of the "most recent and comprehensive estimates" of wetlands in the U.S. (Dahl, 2000, p.9). The USFWS used a combination of aerial photograph interpretation and field work to collect information about wetland type, size, and location. Wetlands were identified on aerial photographs based on vegetation, visible hydrology, and geography (USFWS, 2005). Figure 6 is an example of the work done by the NWI, as displayed by the Wetlands Interactive Mapper. The NWI used aerial photographs to delineate the various types of wetlands, as indicated by the various colors in Figure 6.

Figure 6: An example of the NWI's wetland delineation and classification at 132nd Street and West Dodge Road in Douglas County (Courtesy of the Wetlands Interactive Mapper)

The wetlands were classified using Cowardin's (1979) classification scheme (Appendix 1). Cowardin's system is a hierarchical structure which progresses from systems to subsystems to classes to subclasses, and finally, to dominant types. This scheme is widely used to classify wetlands and "is the national standard for wetland mapping, monitoring, and data reporting..." (Dahl, 2000, p.15). However, for the ease of viewing digital map information, Cowardin's hierarchical scheme was simplified to only eight groups when the USFWS introduced the "Wetlands Interactive Mapper" in 1998, allowing access to digital wetlands data (Table 1). The classes used in this study were

"freshwater emergent wetlands," "freshwater ponds," and "lakes" over one acre in size because they are easily identified on aerial imagery.

Table 1: Wetlands Interactive Mapper Classification Scheme (modified from USFWS, 2005)

Wetland Type	Map Code	Cowardin Classification	General Description
Freshwater Forested and Shrub wetland	PFO, PSS	Palustrine forested and/or Palustrine shrub	Forested swamp or wetland shrub bog or wetland
Freshwater Emergent wetland	PEM	Palustrine emergent	Herbaceous march, fen, swale and wet meadow
Freshwater pond	PUB, PAB	Palustrine unconsolidated bottom, Palustrine aquatic bed	Pond
Estuarine and Marine wetland	E2, M2	Estuarine intertidal and Marine intertidal wetland	Vegetated and non-vegetated brackish and saltwater marsh, shrubs, beach, bar, shoal or flat
Riverine	R	Riverine wetland and deepwater	River or stream channel
Lakes	L	Lacustrine wetland and deepwater	Lake or reservoir basin
Estuarine and Marine Deepwater	E1, M1	Estuarine and Marine subtidal water and wetland	Open water estuary, bay, sound, open ocean
Other Freshwater wetland	Misc. types	Palustrine wetland	Farmed wetland, saline seep and other miscellaneous wetland

Using the NWI digital wetlands data available through the USFWS's Wetlands Interactive Mapper website, a map of wetland locations in Douglas and Sarpy Counties in 1981 was created using ArcGIS v.9.0. The USFWS allows users to connect directly to their NWI GIS Server, through ArcGIS, by adding the URL http://wetlandswms.er.usgs.gov to the ArcIMS Servers in ArcCatalog. Once connected to the NWI GIS Server, the user can download digital wetland information for all of the 48 conterminous states directly into ArcMap.

The Nebraska Department of Natural Resources (DNR) provided a county boundaries shapefile for the state of Nebraska. The county boundaries shapefile was

clipped to only show Douglas and Sarpy Counties and a new layer, titled Douglas and Sarpy Counties, was created in ArcMap showing only these two counties. Using ArcMap's "Select by Location" function, which performs a query in ArcMap, a data layer, Douglas and Sarpy Wetlands, was created displaying only the wetlands located in the study area. The Douglas and Sarpy Wetlands layer consisted of wetlands from the comprehensive NWI database for all 48 conterminous states, which were "contained by" the Douglas and Sarpy Counties layer. In order for ArcMap to select wetlands for the Douglas and Sarpy Wetlands layer, they had to lie within the boundaries of Douglas and/or Sarpy Counties.

From the new data layer, it was determined that in Douglas and Sarpy Counties, there were a total of 1,043 wetlands in 1981 (Table 2).

Table 2: Type and Number of Wetlands in Douglas and Sarpy Counties in 1981, per NWI data

Class	Total Number of Wetlands	Number of Wetlands > 1 Acre	Number of Wetlands included in study
Freshwater Emergent Wetlands	271	78	78
Freshwater Forested/Shrub Wetlands	142	105	Not included
Freshwater Pond Wetlands	355	167	167
Lakes	43	43	43
Other Wetlands	38	3	Not included
Riverine Wetlands	194	96	Not included
Total	1043	492	288

In order to have a manageable wetland population, the types of wetlands examined in this study were limited to "freshwater emergent wetlands," "freshwater pond

wetlands" and "lakes." According to Cowardin's classification scheme, these three categories would include palustrine emergent wetlands, palustrine unconsolidated bottom/palustrine aquatic bed wetlands, and lacustrine wetlands, respectively (Appendix 2). The wetlands classified as "other" were discarded because there were very few within the study area and the majority of "other" wetlands were less than one acre in size which makes them difficult to accurately identify on aerial photographs. Riverine wetlands were excluded because they are also difficult to accurately identify and would be difficult to identify in the future because they change frequently. Riverine wetlands also tend to remain outside of the development process. They may be affected by development, but are not typically destroyed for development. Forested wetlands were removed from the study because they are often associated with riverine wetlands and it is extremely difficult to identify wetlands through the trees. This removal decreased the total wetland population in the study area to 669.

The NWI data also provide a list of attributes associated with each wetland, which can be viewed by opening the attribute table linked with that particular layer in ArcMap. Limiting the types of wetlands that appeared in ArcMap was accomplished using ArcMap's "Select by Attribute" function. In the "Select by Attribute" function, ArcMap allows the user to select certain objects from the attribute table by choosing a particular attribute and then performing a query to see which objects do, or do not, contain that attribute. For this study, wetlands were selected from the Douglas and Sarpy Wetlands layer if the "wetland type" was "freshwater emergent," "freshwater pond," or "lake" (Figure 7).

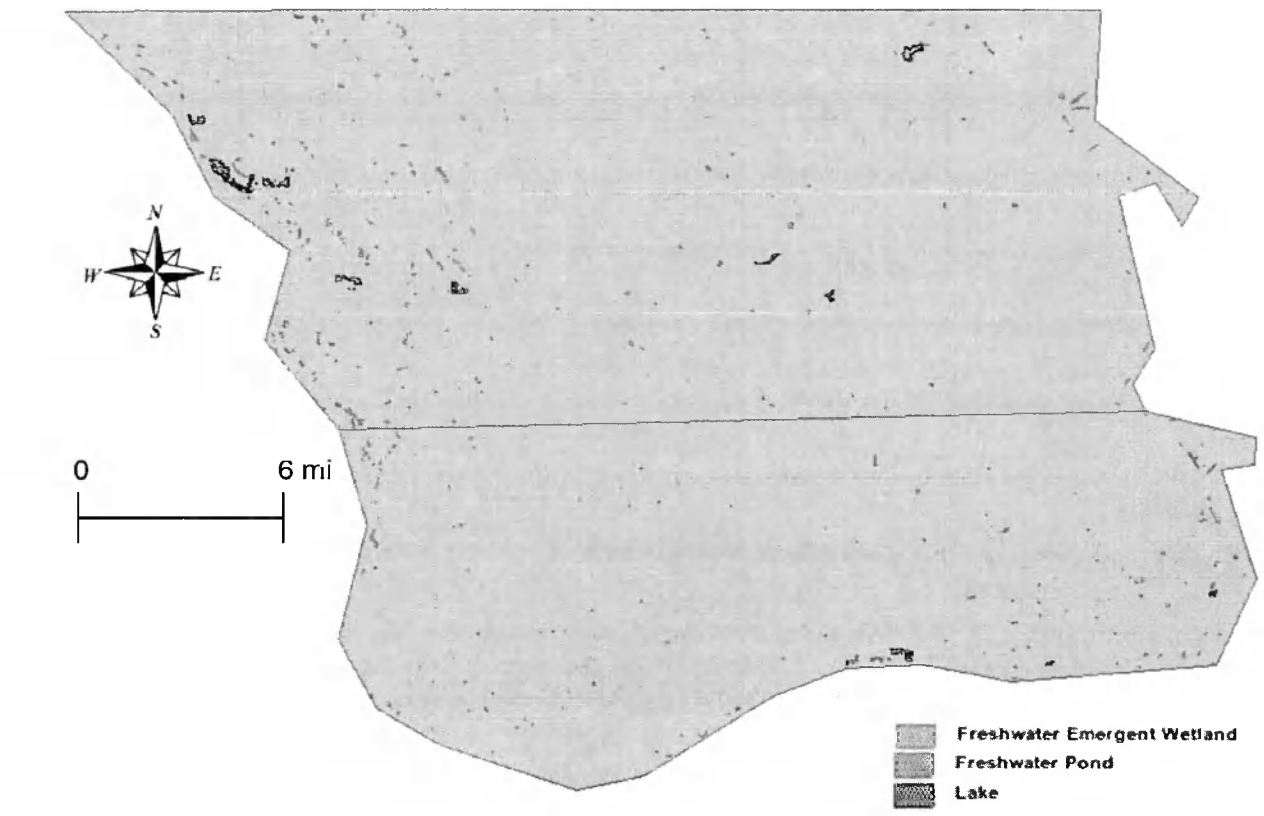


Figure 7: General distribution of the NWI freshwater emergent wetlands, freshwater pond wetlands, and lakes in 1981.

The size of wetlands examined in the study was also limited to those wetlands with an area greater than one acre. Small wetlands, less than one acre in size, and those with little or no standing water can be difficult to identify on aerial photographs. Also, wetlands with an area over one acre should experience less vulnerability to environmental fluctuations. Wetland size limitations were performed in ArcMap in a similar fashion to limiting wetland types. Instead of using "wetland types" for the "Select by Attributes" query, the attribute "wetland acres" was selected, where ArcMap would select wetlands with "wetland acres" greater than 1.0 acre. Limiting the size of wetlands to those with an

area greater than one acre decreased the population of wetlands in 1981 in Douglas and Sarpy Counties to 288 (Table 2).

Using the NWI data compiled by the USFWS as a base, wetlands present in 1981 were compared to wetlands present in 1993 and 2003. Digital aerial photographs for the study area from both 1993 and 2003 were provided by the DNR in the form of Compressed Orthophoto Quadrangles (COQ's). The black and white aerial photographs from 1993 were taken between March and April. The 2003 aerial photographs were color digital imagery taken between July and August (Nebraska DNR, 2005). The aerial photographs were loaded into ArcCatalog, projected into the Universal Transverse Mercator projection, and added to ArcMap. The final layer added to ArcMap was a "Sections" layer, provided by the DNR, which outlined each township and range section, one mile by one mile sections, for Douglas and Sarpy Counties.

The layer of wetlands present in 1981 was first placed on top of the color aerial photographs from 2003. After downloading the attribute table for the NWI wetlands, the 1981 wetlands were located using the "Find" feature in ArcMap and each wetland's Object ID number, assigned by the NWI. The 1981 wetlands were given a designation of "1" if they were still visibly present in the 2003 aerial imagery and a designation of "0" if they were not detected in the 2003 aerial photos. ArcMap provided the advantage that areas in the digital imagery could be easily enlarged to determine whether or not a wetland was present, whereas using hard copies of aerial photos cannot easily be magnified.

The land use surrounding the 1981 wetlands in 2003 was also determined, assigning the value "1" to developed land and "0" to undeveloped land. In order to determine whether or not a wetland was located in a developed area, there had to be visible evidence of urban development near the wetland. Visible urban development was defined as evidence of land clearing, streets, placement of structures or subdivisions, or industrial or commercial development. Land uses considered rural in nature, including cropland, pastureland, other agricultural lands, forests, and farms were referred to as undeveloped for the purposes of this study. Rather than looking at development on a one mile by one mile section basis, determination of development was narrowed down to whether or not quarter sections were developed because developers do not often develop entire sections at time. Instead, developers tend to develop one quarter section, or a smaller unit, at one time. Wetlands were considered to be located in a particular quarter section if 51 percent or more of the wetland lay in that quarter section. The same process was undertaken using 1993 aerial imagery in place of the 2003 aerial photos and all of the data collected were compiled in a Microsoft Excel spreadsheet (Appendix 3).

Once the fate of all of the 1981 NWI wetlands was determined, the locations of "new" wetlands present in 1993 and 2003 were identified based on visible standing water, wetland vegetation, hydrology patterns, and topography. The aerial photographs for both 1993 and 2003 were scanned on a section by section basis to determine whether or not any new wetlands were visible. Each new wetland was outlined using ArcMap in order to determine its area and to confirm that it was larger than one acre in order to be included in the dataset. The "new" wetlands that were identified in 1993 were also

compared to the 2003 aerial photographs to see if the wetlands were still present in 2003, again assigning a "1" if the wetland had persisted and a "0" if the wetland had disappeared. Designations of "1" and "0" were also used to specify whether or not the land around each "new" wetland from 1993 and 2003 was developed or undeveloped. All of the data collected were again input into the Excel spreadsheet. A sample of the "new" wetlands from 1993 and 2003 were field checked May 10, 2006, while the NWI conducted their own ground-truthing for the wetlands present in 1981 (USFWS, 2005).

CHAPTER V

Results and Discussion

After all of the wetlands in Douglas and Sarpy Counties over one acre were identified for 1981, 1993, and 2003, the data compiled were analyzed using Microsoft Excel. For the analysis, the total number and acres of freshwater emergent wetlands, freshwater pond wetlands, and lakes present in each year were combined. To determine the total acres of wetlands present in each of the three time periods, and the change between each, the data were organized according to year. Descriptive statistics were used to examine the data, using Excel, including the total number and acres present and the minimum, maximum, and mean sizes of wetlands present in 1981, 1993, and 2003. The change in acres of wetlands between 1981-1993 and 1993-2003, was also examined with respect to whether or not the area was developed to see if urban development was related to the total number acres of wetlands present through time. For this chapter, the graphs, which give a brief summary of the data, appear first, followed by the maps, which provide more detailed locational data. Following the graphs and maps is a discussion of the results.

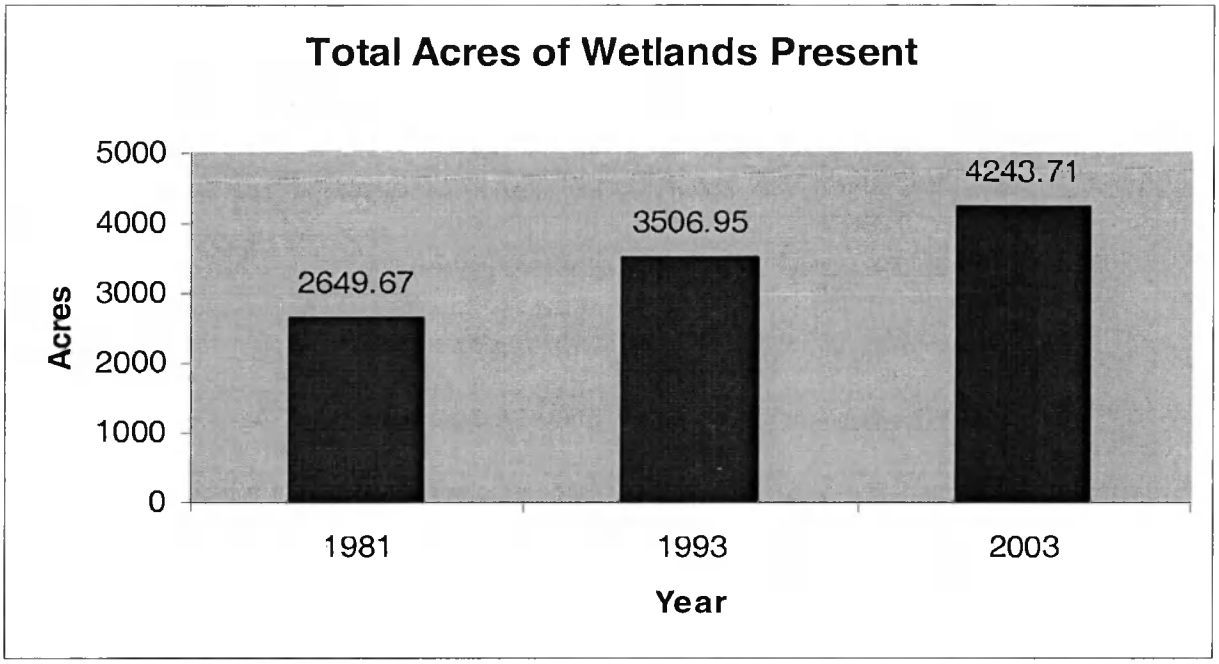


Figure 8: Total Acres of Wetlands Present

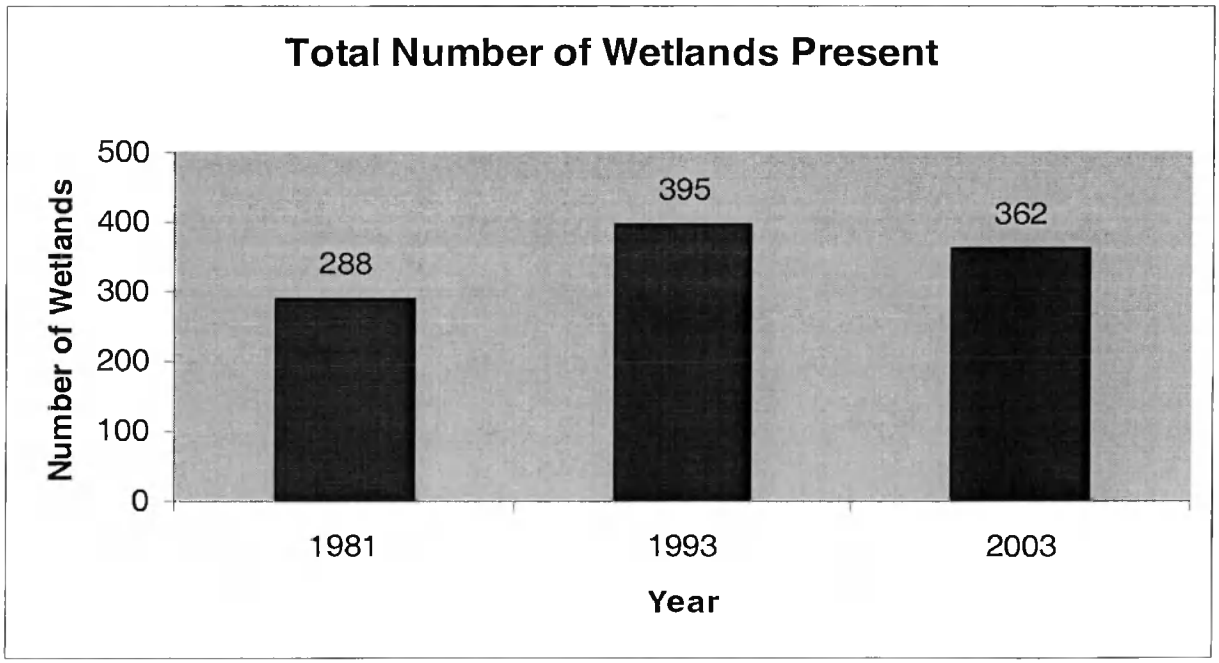


Figure 9: Total Number of Wetlands Present

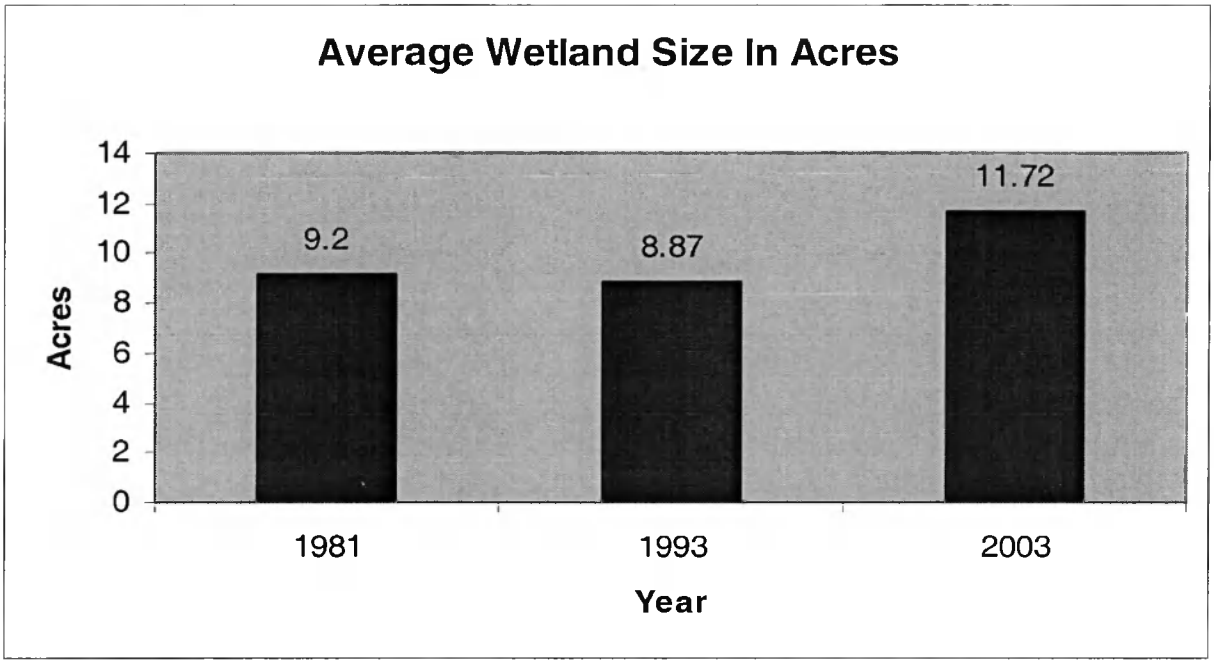


Figure 10: Average Wetland Size in Acres

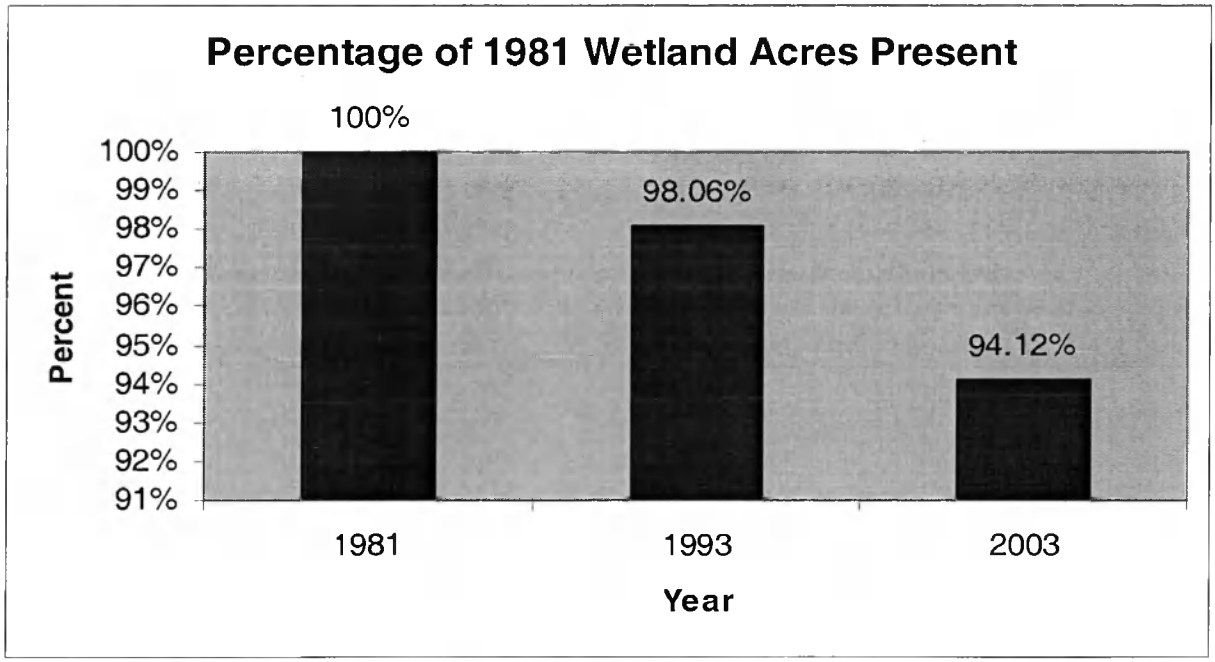


Figure 11: Percentage of 1981 Wetland Acres Present in 1993 and 2003

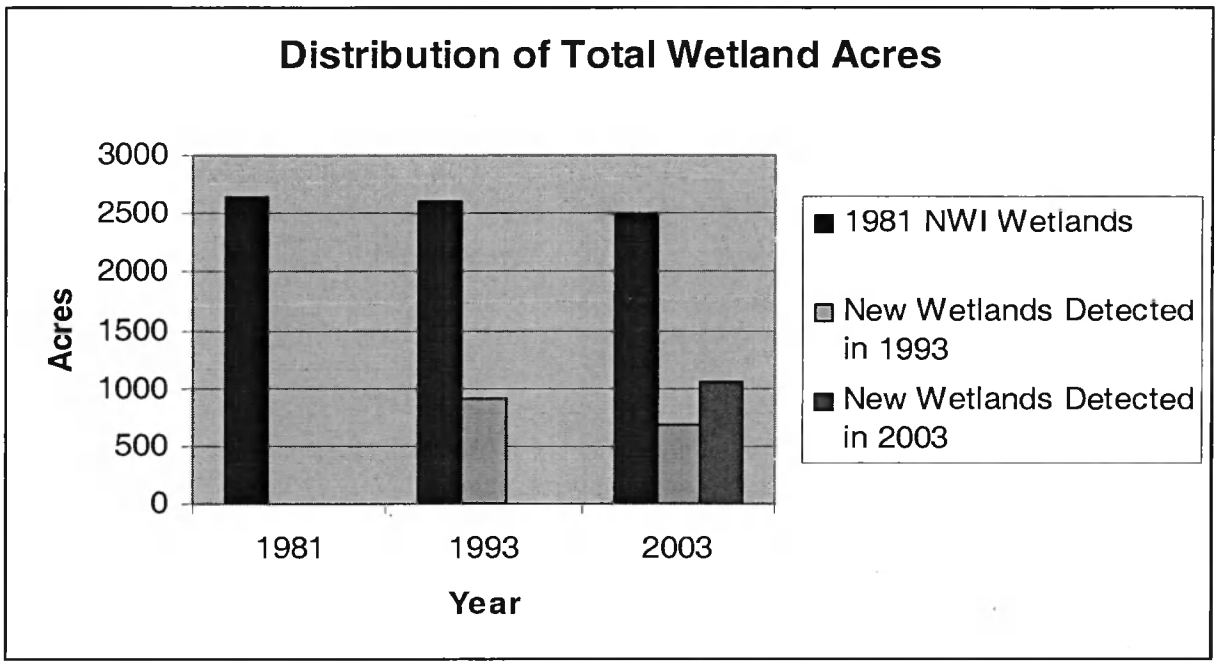


Figure 12: Distribution of Total Wetland Acres

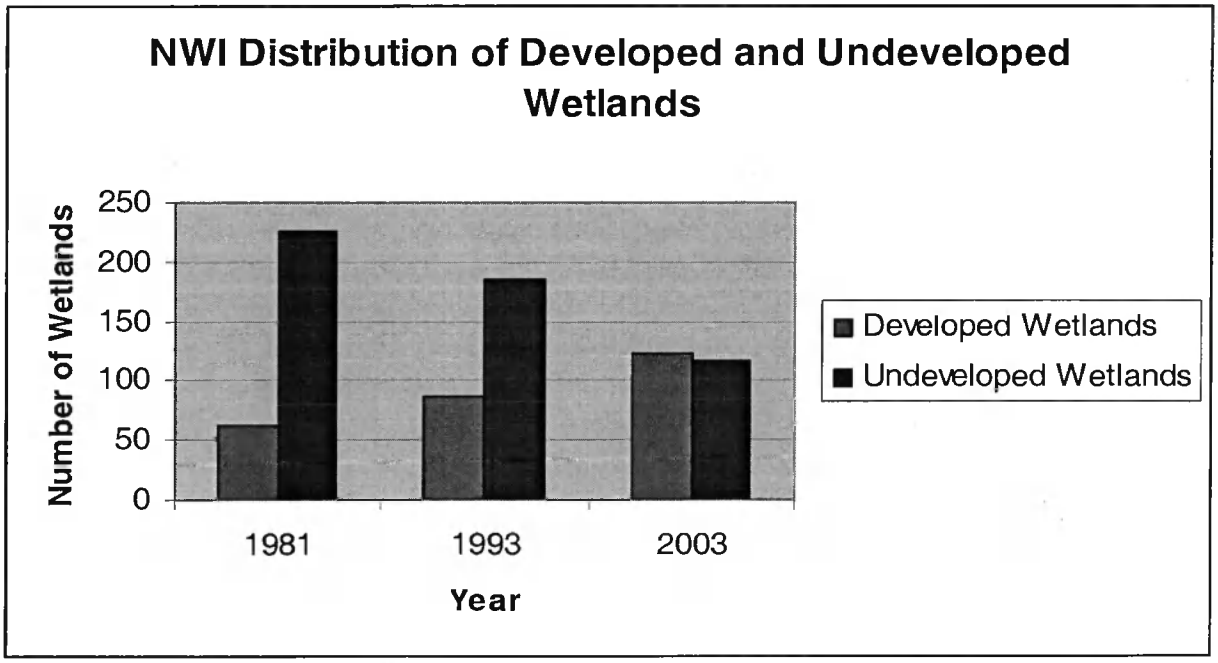


Figure 13: NWI Distribution of Developed and Undeveloped Wetlands

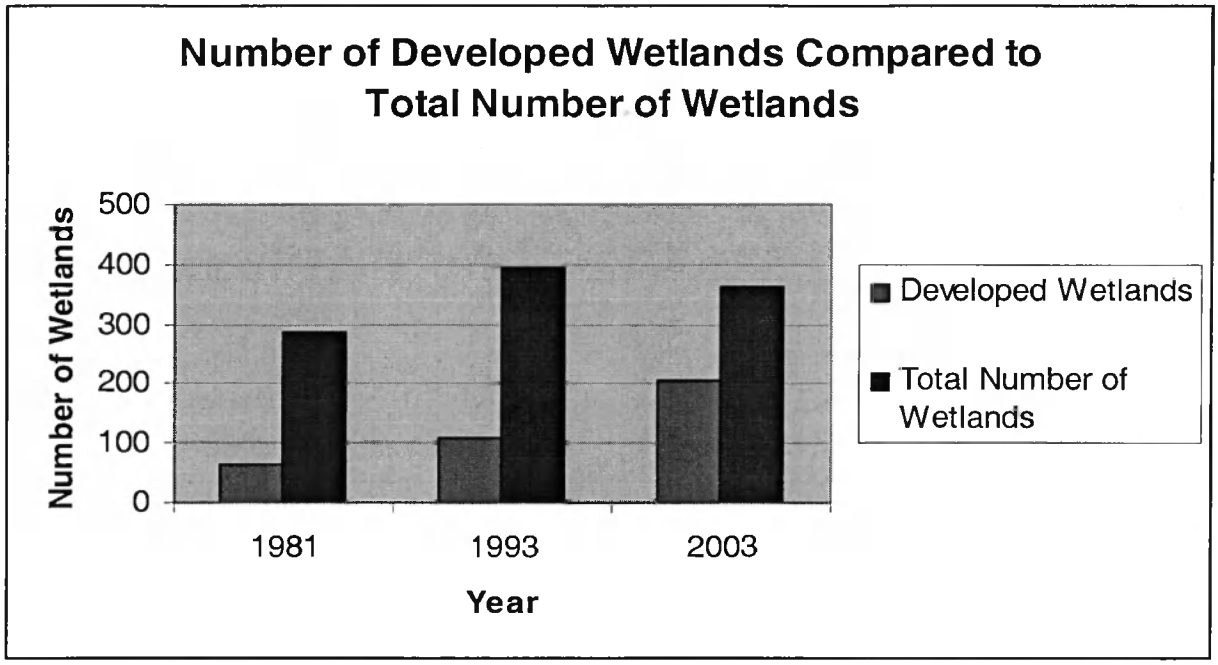


Figure 14: Number of Developed Wetlands Compared to the Total Number of Wetlands

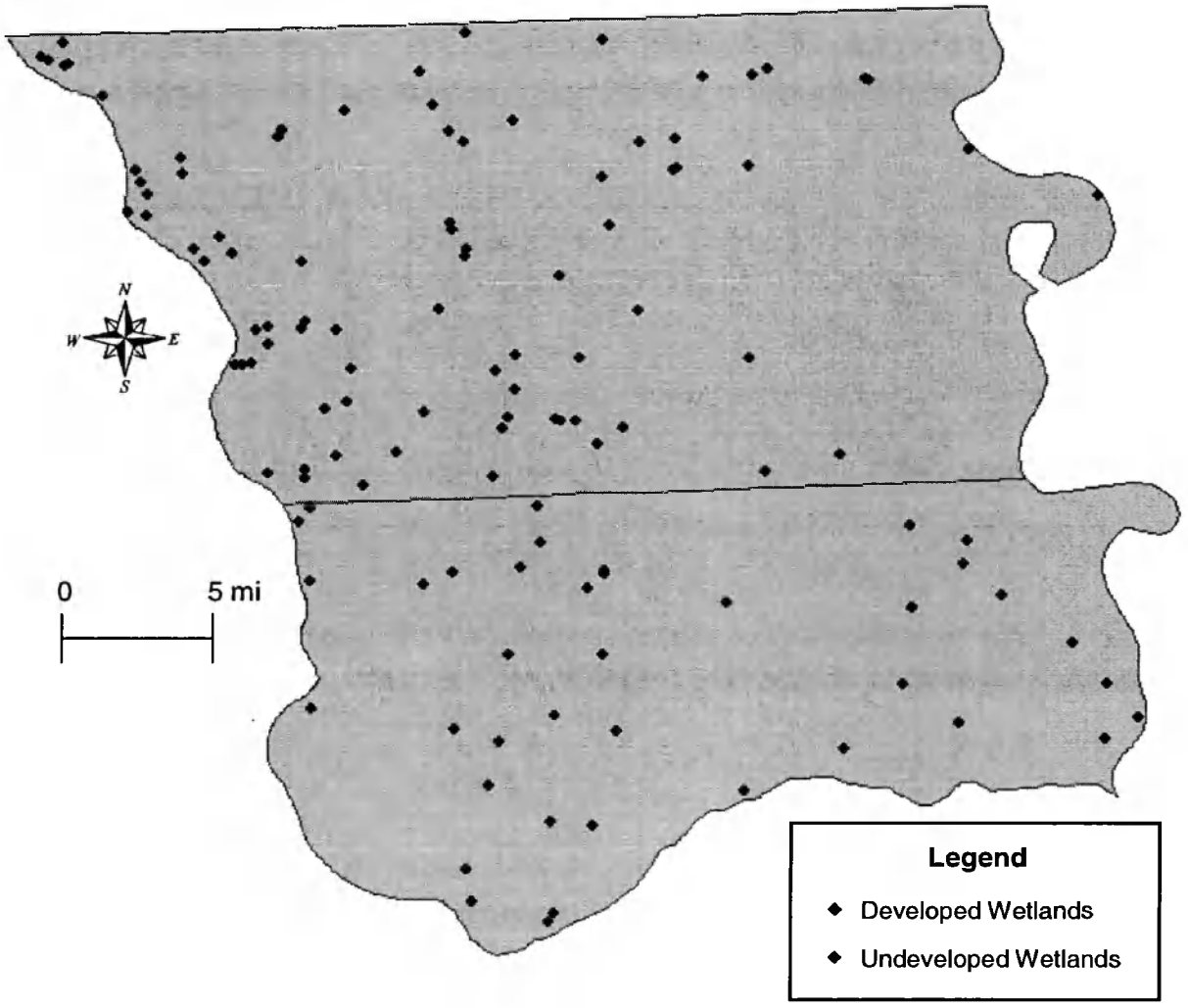


Figure 15: Locations of New 1993 Wetlands

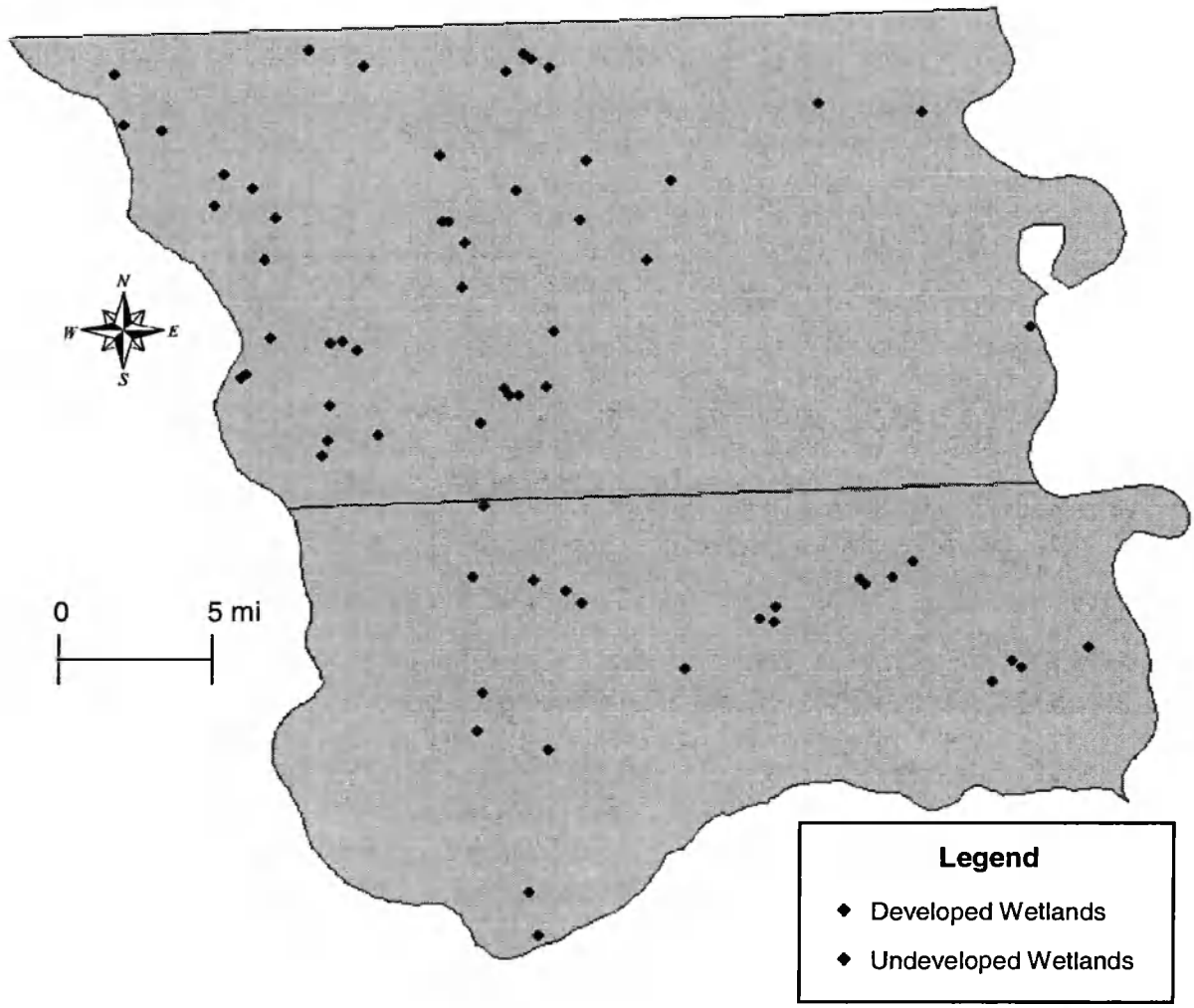


Figure 16: Locations of New 2003 Wetlands

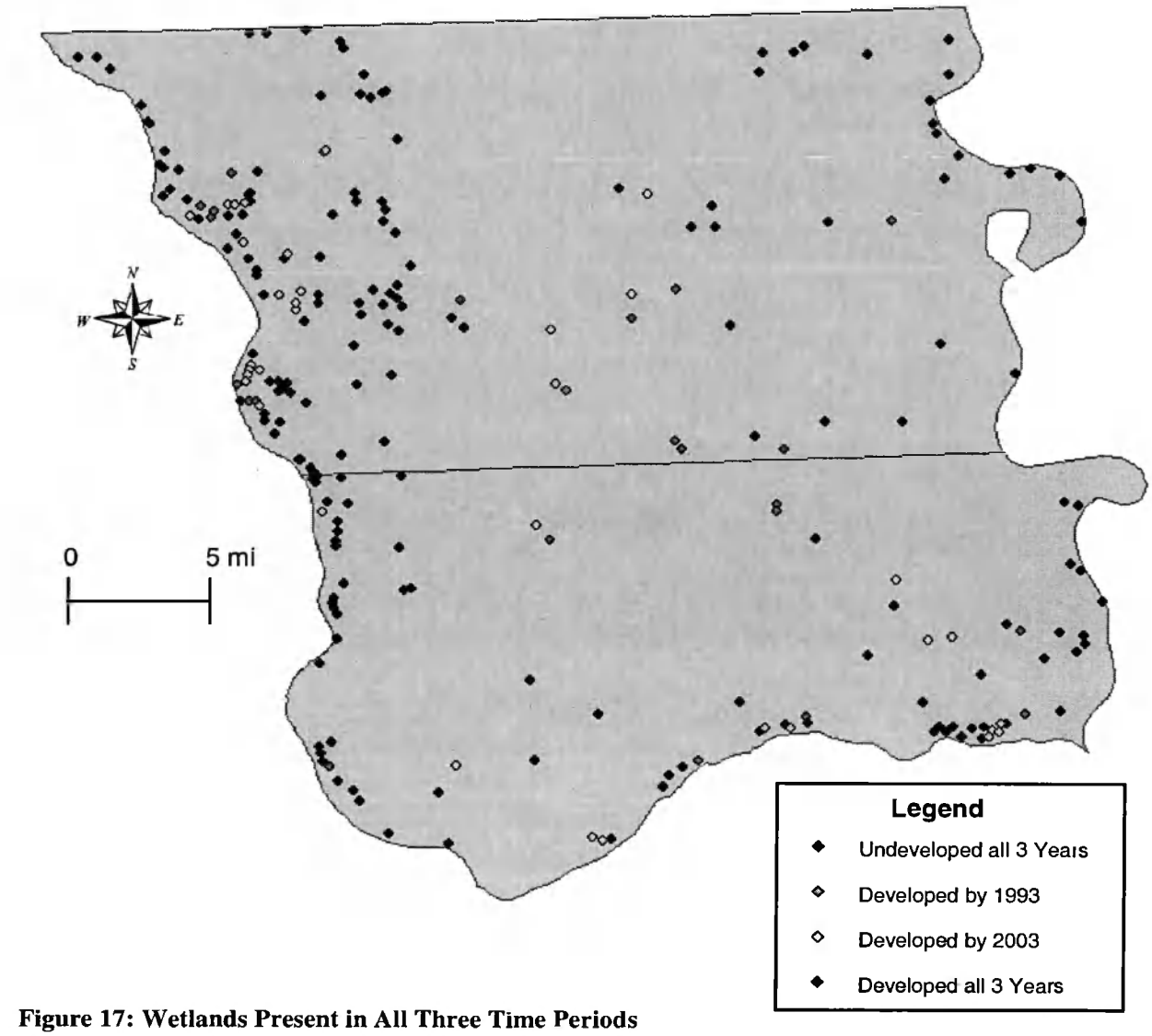


Figure 17: Wetlands Present in All Three Time Periods

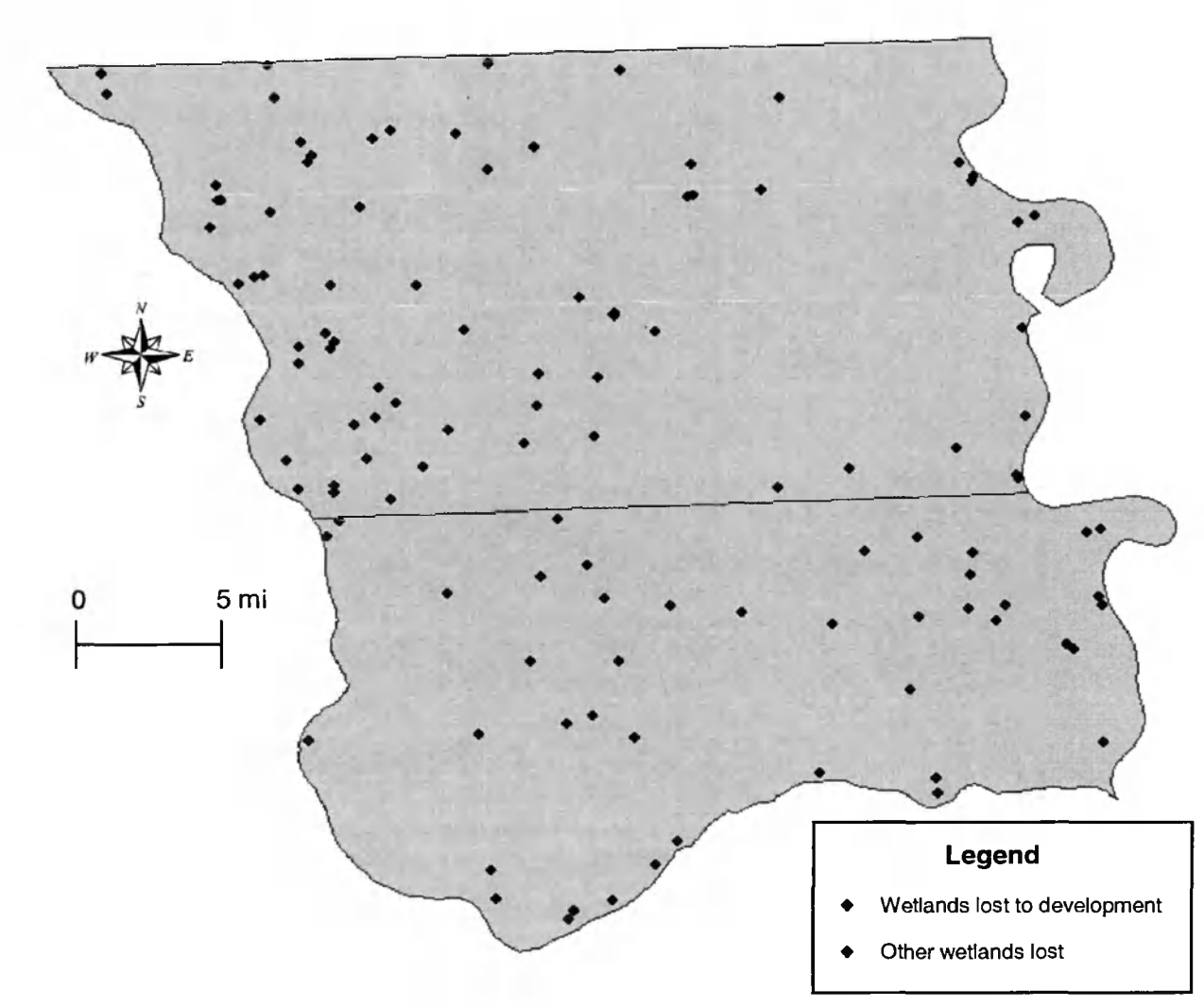


Figure 18: Locations of Wetlands Lost Between 1981 and 2003

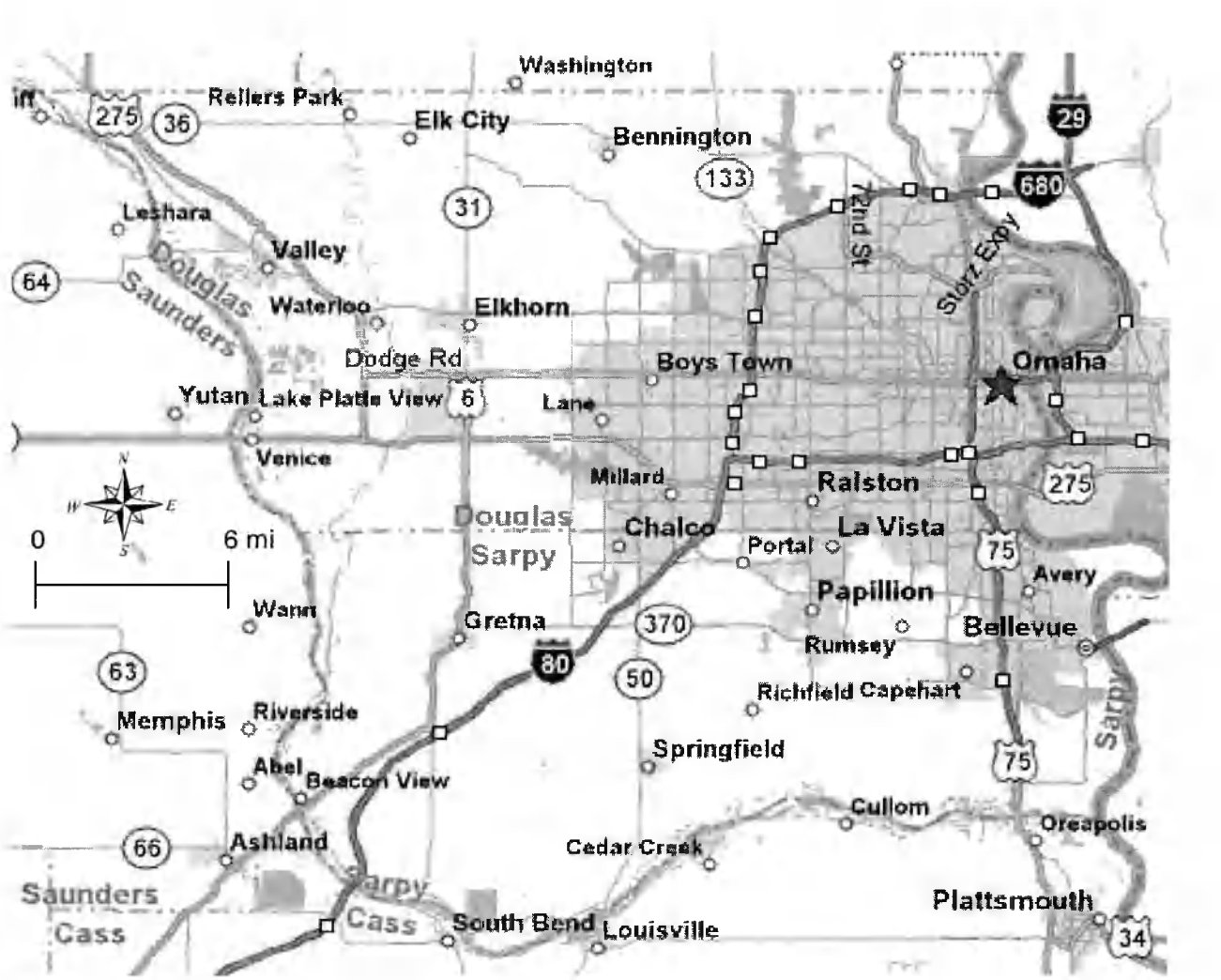


Figure 19: Map of Omaha's Developed Areas Shaded in Brown (courtesy of MapQuest, 2006)

The total number acres of wetlands present in 1981, 1993, and 2003, were 2,649.67, 3,506.95, and 4,243.71 acres, respectively (Figure 8). The general trend for the total number of acres present in each time period depicts an increase between each period. However, the same trend did not hold true for the total number of wetlands present in each year. The highest total number of wetlands present, 395, occurred in 1993 and dropped again in 2003 to 362 (Figure 9). The increase in the total number of acres in 2003, without an increase in the total number of wetlands in 2003, indicates that

wetlands in 2003 were larger in size than in previous years. In 1981, the average wetland size was 9.20 acres, which decreased to 8.87 acres in 1993, but increased to 11.72 acres in 2003, the largest mean among the three years studied (Figure 10). This could be explained by the increase in large sandpits as a result of dredging in western Douglas County and also western and southern Sarpy County and through the addition of flood control lakes along the Papillion Creek System.

Many of the wetlands that were detected by the NWI in the 1981 aerial imagery remained in 2003; however, not all persisted through 1993 and 2003. Of the 288 wetlands covering 2,649.67 acres in Douglas and Sarpy County; 272 wetlands spanning 2,598.38 acres, 98.06%, remained in 1993. In 2003, there were still 239 wetlands stretching over 2,493.88 acres, 94.12%, in the study area (Figure 11).

Although some of the wetlands that were originally present in 1981 disappeared, new wetlands had emerged by 1993 and 2003, which helped to balance out the losses (Figure 12). In 1993, a total 123 new wetlands were detected (Figure 15). These new wetlands covered 908.57 acres in Douglas and Sarpy Counties. There were 22 developed wetlands and 101 undeveloped wetlands and the average size of the new 1993 wetlands was 7.39 acres. In 2003, there was an increase of 1,058.98 wetland acres as a result of 66 wetlands, having appeared in the study area since 1993 (Figure 16). Flood control projects like the Walnut Creek Lake, located near Highway 370 and 96th Street, and opened for public recreation in 1999, provides just one example of the new wetlands that have recently appeared in the study area. Figure 20 depicts another example of a new wetland that appeared between 1993 and 2003.

Figure 20: Wetland ID# 634 is an example of a new wetland that appeared near Highway 36 and 180th Street between 1993 and 2003. The image on the top left is from 1993, the image on the top right is from 2003, and the lower image was taken May 10, 2006. (Note the waterfowl utilizing the wetland)

Of the 66 new wetlands in 2003, 31 were developed and 35 were undeveloped, and the mean size of new 2003 wetlands was 16.05 acres. In Figures 15 and 16, there is an obvious void, in the central and eastern portion of the study area, where no new wetlands appeared, which illustrates where the city of Omaha exists (Figure 19).

Development, whether for urban or agricultural purposes, often has an adverse affect on wetlands. Numerous wetlands across the country have been drained or

destroyed due to development. However, that did not appear to be the case in Douglas and Sarpy Counties between 1981 and 2003. Of the 288 wetlands detected in Douglas and Sarpy Counties in 1981, only 63, or 21.88%, were considered developed. In 1993, of the 272 NWI wetlands that remained, 86, or 31.62% were to be in a developed area. There were 239 remaining NWI wetlands in 2003, and the number of developed NWI wetlands outnumbered the undeveloped wetlands with 122, or 51.05%, classified as developed (Figure 13).

The majority of the wetlands that remained undeveloped throughout all three time periods were located in the western portion of Douglas County, partly as a result of the sand and gravel operations located there (Figure 17). A few others were scattered about in the northern part of Douglas County and also the western and southern sections of Sarpy County such as the wetland in Figure 21. These wetlands were primarily in rural areas that have not yet been threatened by urban development.

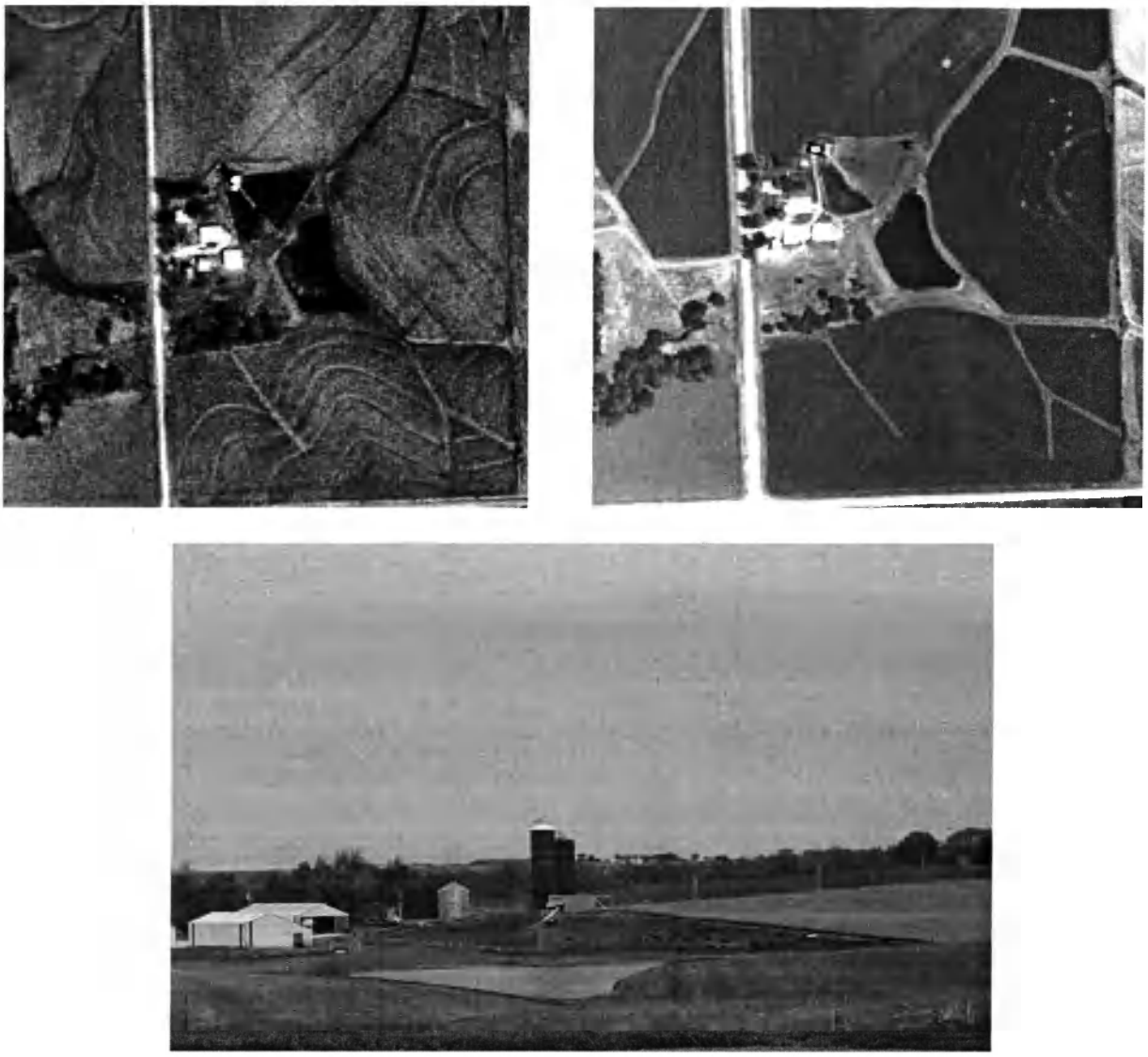


Figure 21: Wetland ID# 253727, near 108th Street and Mitchell Road in Southern Sarpy County, remained undeveloped during all three time periods. The image on the top left is from 1993, the image on the top right is from 2003, and the lower image was taken May 10, 2006.

As expected, most of the wetlands that were developed occurred near the outer fringes of the Omaha metropolitan area, as development has taken place in those areas. There appears to be a concentric ring pattern which surrounds the city of Omaha that generally reflects the Omaha's expansion throughout the study (Figure 17). There is a

cluster of red dots (representing wetlands that were in developed areas in all three years) that generally indicate where wetlands had been developed due to Omaha's growth before 1981. One example of a developed wetland that was in existence throughout the study period was a freshwater pond (ID# 209800) located in Hanscom Park (Figure 22).

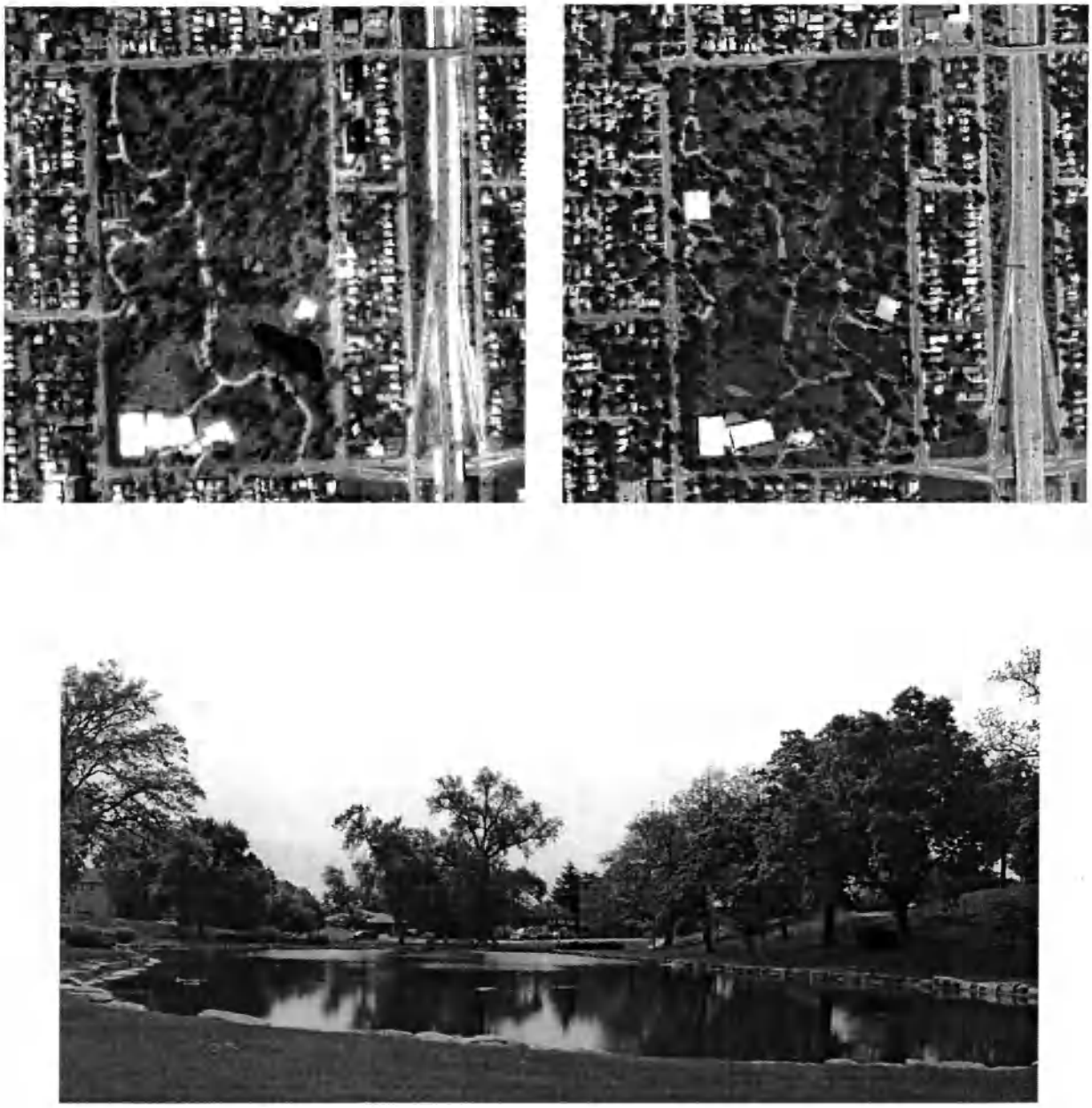


Figure 22: Wetland ID# 209800, located near 32nd Avenue and Center Street (in Hanscom Park), is an example of a wetland that was developed all three time periods. The image on the top left is from 1993, the image on the top right is from 2003, and the lower image was taken May 10, 2006.

The next ring is the green dots, those wetlands that were developed between 1981 and 1993, which surrounds the group of red dots indicating where development took place during this time period. The yellow dots form another ring surrounding the other two, illustrating the locations of those wetlands developed between 1993 and 2003 again illustrating where the outer suburbs of Omaha were located by 2003 (Figure 23).

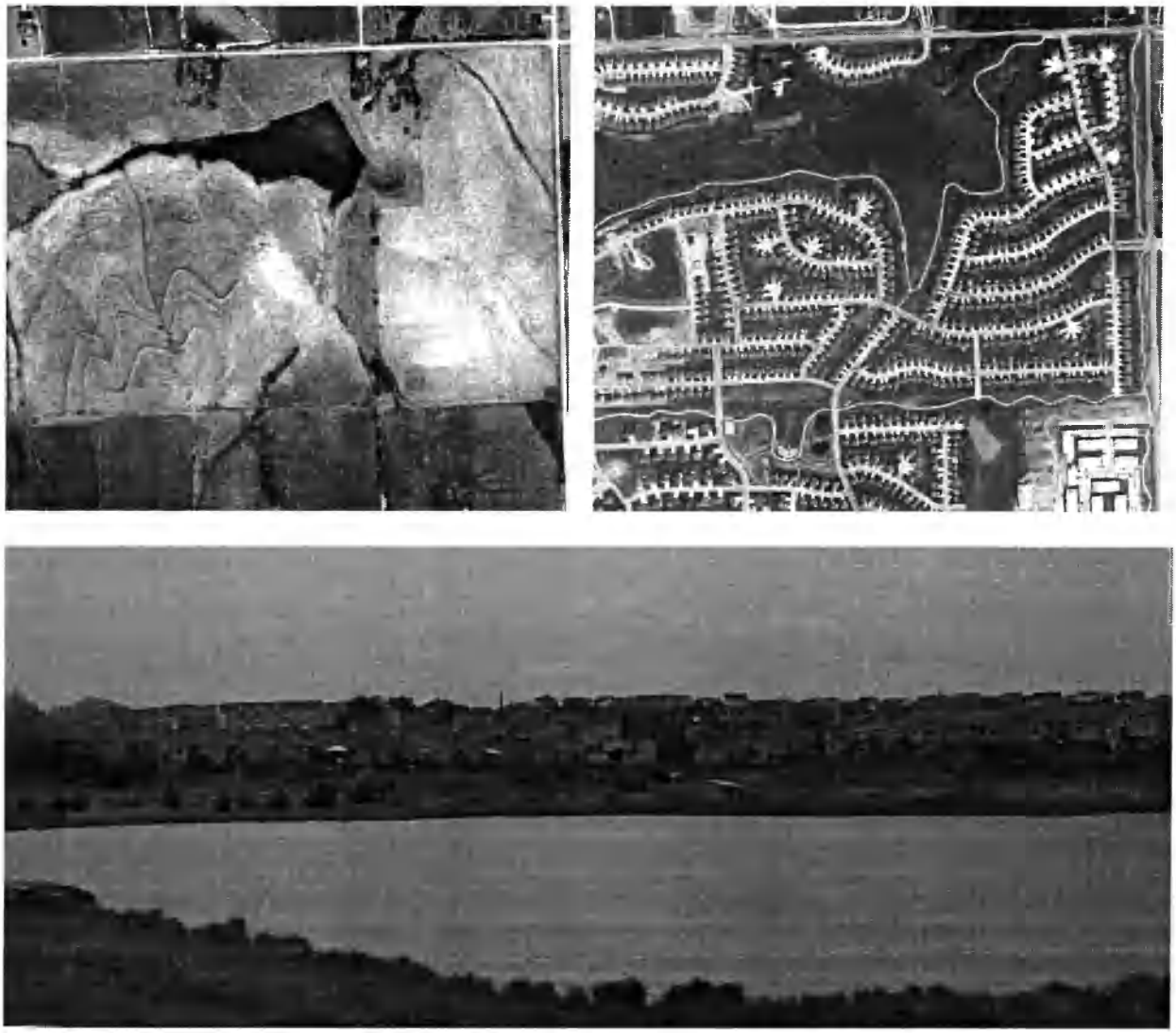


Figure 23: Wetland ID# 811, located near 144th and Fort Streets, is an example of a wetland that was developed between 1993 and 2003. The image on the top left is from 1993, the image on the top right is from 2003, and the lower image was taken May 10, 2006.

There appears to also be substantial urban development around some wetlands, especially the dredged sand pits, in western Douglas and southern Sarpy Counties. Figure 24 is an example of a newly dredged sand pit in western Douglas County. Development has taken place around much of this new sand pit lake.

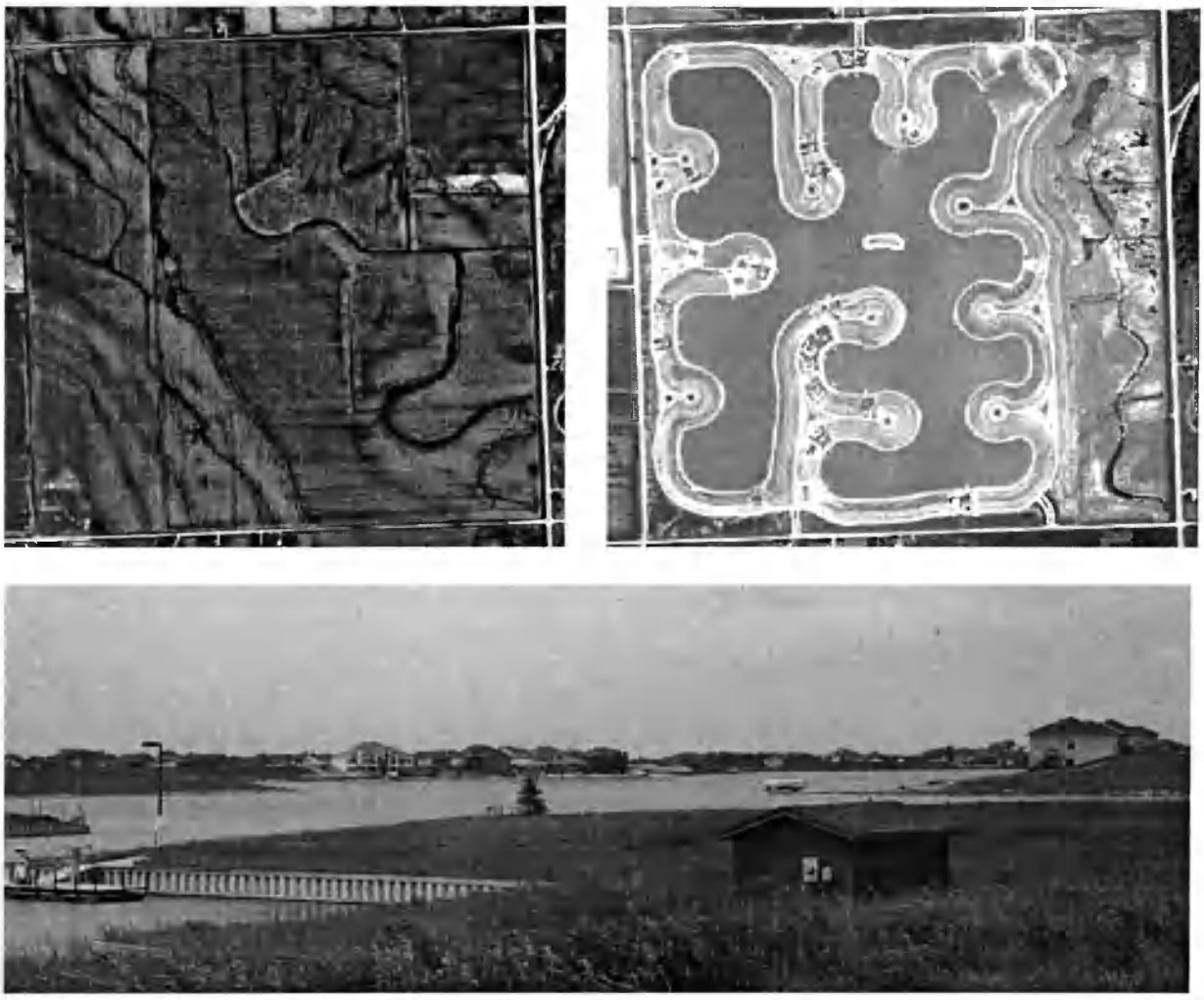


Figure 24: Wetland ID# 833, also known as Westshore near the junction of Highways 6 and 275, is an example of a new wetland created by dredging and developed between 1993 and 2003. The image on the top left is from 1993, the image on the top right is from 2003, and the lower image was taken May 10, 2006.

As Omaha has expanded, more and more of the 1981 NWI wetlands have been surrounded by urban development. The trend of wetlands becoming increasingly developed also held true when the new wetlands detected in 1993 and 2003 were factored in. In 1981, 21.88%, or 63, of the wetlands were developed, while in 1993, 27.34%, or 108, of the wetlands were classified as developed. In 2003, the percentage of wetlands in

developed areas surpassed 50%, with 56.91%, or 206, located in developed areas (Figure 14).

The total number of wetlands does not appear to be adversely affected by development. Only seven of the NWI wetlands, 22.17 acres, were lost to development by 1993. However, 50 wetlands including both NWI wetlands and new wetlands identified in 1993, totaling 145.96 acres, were lost to development between 1993 and 2003 (Figure 25).

Figure 25: Wetland ID# 833, previously a sewage lagoon near 156th and Blondo Streets, is an example of a wetland lost to development between 1993 and 2003. The image on the top left is from 1993, the image on the top right is from 2003, and the lower image was taken May 10, 2006.

However, each of these losses was offset by the large increases in wetland acres of 908.57 and 1,058.98 acres by 1993 and 2003, respectively.

The wetlands that were lost between 1981 and 2003 appear to be concentrated in the western half of Douglas County and also the central portion of Sarpy County (Figure 18). According to Figure 18, the distribution of red dots, which represent wetlands lost to

development, appear to be consistent with the outer city limits of Omaha where the majority of development is taking place. Only a handful of wetlands were lost to agricultural development. Most of the wetlands that disappeared were small wetlands. The mean size of the wetlands that disappeared between 1981 and 2003 was 3.39 acres. Many of the larger wetlands that disappeared were sandpits that were filled due to changes in dredging patterns. One example is wetland ID# 1157, a 14.01 acre wetland that appeared in 1993 and disappeared by 2003, as a result of changing dredging patterns along the Platte River in southern Sarpy County.

Many wetlands have been utilized in development rather than being destroyed by development. Numerous subdivisions in the Omaha metropolitan area have names associated with water and have some type of lake or pond within them. One example of commercial development that has used a term associated with water is the Lakeside development located on 168th St between West Center Road and Pacific Street. In the Lakeside area, there are numerous shops and restaurants, a hospital, and several office buildings. There are also many housing subdivisions that have been named for a water feature that exists within the subdivision such as Lake Shore and Bay Shore (located near Lake Zorinsky on 168th St between West Center Road and Q Street), Westshore (located near the junction of Highway 6 and Highway 275), and Lake Cunningham Hills (located by Lake Cunningham on Lake Cunningham Road).

CHAPTER VI

Conclusions

By only examining the total acres of wetlands present in each of the three time periods, the data indicate that urban development does not appear to adversely affect wetlands over one acre in Douglas and Sarpy Counties, as the number of acres of wetlands present increased with each time period. When looking at the total number of wetlands present in each of the three time periods, the data indicate an increase in the total number of wetlands between 1981 and 1993 and a slight decrease between 1993 and 2003. However, there is little evidence that urban development drastically decreased the total number of wetlands in Douglas and Sarpy Counties. Although it was hypothesized that wetlands would have disappeared in urban areas, it appears that, at least wetlands larger than one acre, have found a place in urban development in the study area. Rather than being drained, they tend to be left alone and development occurs around, instead of on top, of wetlands. Many developers kept wetlands and it seems that they were utilized as a "natural" asset for developments. People tend to be attracted to natural environments and wetlands can provide a natural environment in the midst of an urban environment.

In addition to providing a natural setting in the midst of an urban area, wetlands provide a host of other important functions, particularly in urban areas. They serve as important ecosystems for wildlife, where natural habitat is limited. Wetlands protect homes and businesses by acting like sponges to absorb stormwater and also help to recharge the groundwater supply as the standing water percolates down through the soil. By breaking down and recycling nutrients and chemicals and acting as sediment traps,

they provide a natural means to improve water quality. It is encouraging that in Douglas and Sarpy Counties, which have seen substantial urban development due to the growth of the Omaha metropolitan area, wetlands have managed to remain on the landscape and continue to fulfill these important functions, while urban development continues around, rather than in place of wetlands.

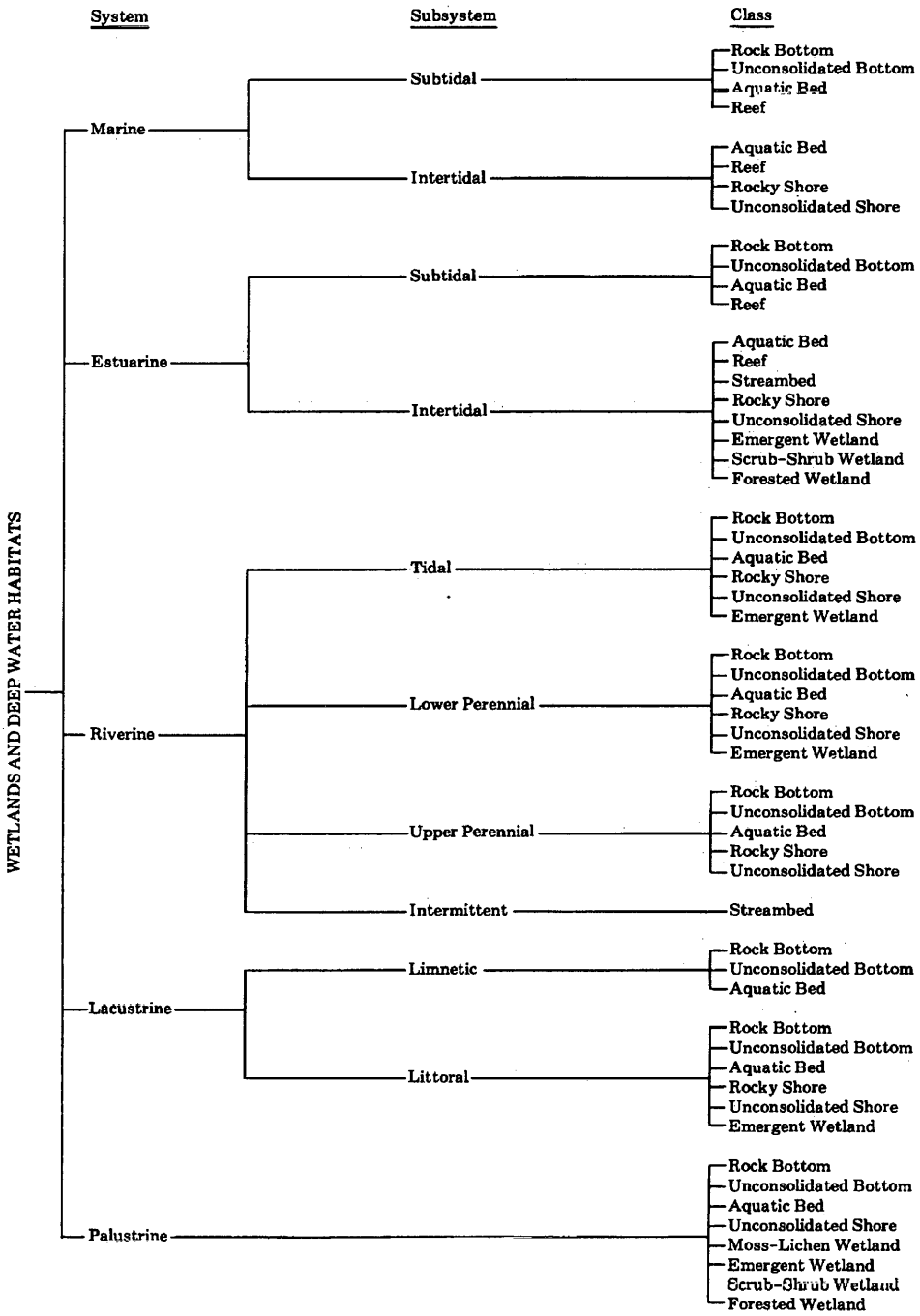
There are two factors that should be taken into consideration and may have affected the results of this study. According to climatic data published by the National Climatic Data center, 1981 and 2003 were drier than average, while 1993 was a very wet year. This may have played a minor role in the number of new wetlands that were detected in 1993 by pushing some just over the threshold of one acre, whereas during a dry year, they may have been thrown out for being less than one acre. Since 2003 was a dry year, this may have again played a minor role in the slight decrease in total number of wetlands that were detected in 2003. If a wetland was slightly less than one acre, it may have been excluded from the study, whereas in a wet year, it may have been included. However, most of the wetlands in this study are believed to be associated with the height of water table rather than being fed solely by runoff. If that is the case, then most of the wetlands in the study were not greatly affected by the amount of precipitation received. Generally, the area receives adequate precipitation and the soils are impermeable enough to sustain wetlands. Also, because the wetlands examined in the study were over one acre, only those right on the threshold of one acre may have been slightly affected by varying precipitation, while the majority of the wetlands in the study were not greatly impacted.

Another reason that the study may have detected increases in wetland acres in 1993 and 2003 is because this study did not measure each wetland again in successive years. Many wetlands change size and it is the nature of a wetland to fill in over time, without human intervention. For this study, it was only determined if each wetland was still present and whether or not it was developed, but not changes in wetland sizes. Some of the 1981 NWI wetlands and the wetlands detected in 1993 may have shrunk in size over time. However, this study only used the original size (in acres) of each wetland, regardless of whether the wetland had increased or decreased in size, to determine how many acres of wetlands were present in each time period. This may have had a slight impact on the total acres of wetlands present in 1993 and 2003.

Several recommendations for future studies on wetlands in Douglas and Sarpy Counties have emerged from this research. The first would be to complete a study on the quality of wetlands in Douglas and Sarpy County. Just because a wetland is present does not mean that it provides a quality habitat for wildlife. Additional studies on wetland quality in the area would be helpful to see which wetlands are healthy and productive, with respect to vegetation and wildlife, and those that may benefit from improvements. The second recommendation would be to examine artificial wetlands to see if they provide the same types of benefits for wildlife as natural wetlands do. The final recommendation is to continue this research in future years. It is important to continue monitoring the total number and acres of wetlands in Douglas and Sarpy Counties as urban development continues as the Omaha metropolitan area continues to expand.

APPENDIX I

(Cowardin Classification Scheme)



APPENDIX 2

Wetlands Definitions (modified from Dahl, 2000)

Freshwater Emergent	**Emergent**	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens; vegetation is present for most of the growing season in most years; usually dominated by perennial plants
Freshwater Pond	**Palustrine**	Includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, farmed wetlands, and tidal wetlands where salinity is less than 0.5 parts per thousand
Lakes	**Lacustrine**	Includes deepwater habitats with the following characteristics: 1) situated in a topographic depression or dammed river channel; 2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% coverage

APPENDIX 3

Wetlands Data

1981 NWI Wetlands Data

OBJECT ID	AREA	LATITUDE	LONGITUDE	Pres 1981	Dev 1981	Pres 1993	Dev 1993	Pres 2003	Dev 2003
170534	3.816261	724286.362603	4585653.505679	1	0	1	0	1	0
170617	5.353003	721514.489823	4585546.122852	1	0	1	0	1	0
170762	2.337096	721944.889646	4585621.901650	1	0	1	0	0	0
170788	5.251236	722392.745580	4585544.000549	1	0	1	0	1	0
171838	9.334002	714165.204417	4584303.705984	1	0	1	0	1	0
171874	2.041763	725944.681372	4585118.064942	1	0	1	0	1	0
171979	4.618073	726114.908195	4584808.561626	1	0	1	0	1	0
172477	1.762884	713315.474324	4584298.958132	1	0	1	0	1	0
173183	1.799255	755312.526754	4585310.481161	1	0	1	0	1	0
173250	5.382339	748332.256594	4584968.415927	1	0	1	0	1	0
173305	5.594815	722291.332332	4584035.828885	1	0	0	0	0	0
173410	21.846316	746295.316348	4584641.614378	1	0	1	0	1	0
173523	81.827894	747825.559397	4584586.266368	1	0	1	0	1	0
173548	3.021627	714876.624951	4583740.845356	1	0	1	0	1	0
174403	1.079444	751323.762905	4584560.942823	1	0	1	0	1	0
174565	3.263981	727082.680270	4583472.714463	1	0	1	0	1	0
176110	321.814403	746142.779592	4583610.293627	1	0	1	0	1	0
176478	23.650345	755343.604059	4583507.350056	1	1	1	1	1	1
176523	1.210919	728165.206377	4582644.631134	1	0	1	0	1	0
176553	1.626726	727987.492401	4582565.763130	1	0	1	0	1	0
176716	1.746551	726936.754174	4582460.355156	1	0	1	0	1	0
176878	1.497068	725035.823621	4582431.166203	1	0	1	0	1	0
177035	2.630716	727741.130659	4582424.500227	1	0	1	0	0	0
177296	1.569433	727378.007022	4582313.691037	1	0	1	0	1	0
177363	3.058132	716359.890253	4581863.248223	1	0	1	0	1	0
177949	4.536274	723555.213989	4581795.211894	1	0	1	0	0	0
179228	3.589006	716776.573523	4580973.172813	1	0	1	0	1	0
179250	1.455743	716663.907794	4581051.271834	1	0	1	0	1	0
179254	10.605924	754385.727231	4582266.347890	1	1	1	1	1	1
181357	41.183214	717498.352827	4579608.830022	1	0	1	0	1	0
181540	2.389165	728737.004501	4580207.651844	1	0	1	0	1	0
181714	5.953476	754541.064973	4581089.436541	1	1	1	1	1	1
182302	1.773835	754680.945284	4580859.304734	1	1	1	1	0	1
182731	2.379484	754752.038573	4580612.117086	1	1	1	1	1	1
182920	9.312613	717211.724817	4578913.532526	1	0	1	0	1	0
182932	1.202289	725277.606833	4579682.575547	1	0	1	0	1	1
182943	1.117727	725157.829779	4579553.086779	1	0	1	0	1	1
183381	7.257845	717375.912676	4578771.236381	1	0	1	0	1	0
183558	6.344470	718153.782218	4578662.851493	1	0	1	0	1	0
183659	2.248916	719732.091119	4578950.528421	1	0	1	1	0	1
184315	1.370662	755242.279097	4579901.735289	1	1	1	1	0	1
184496	2.475496	721927.929869	4578621.642998	1	0	1	0	1	0
184615	1.487572	720755.683182	4578542.072269	1	0	1	1	1	1
184937	3.950277	755845.923911	4579496.264129	1	1	1	1	1	1

184961	2.500349	726316.488926	4578604.494488	1	0	0	0	0	0
185088	1.637121	722111.977753	4578359.908043	1	0	1	0	0	0
186122	1.913537	717748.071825	4577683.947888	1	0	1	0	1	0
186565	3.397640	719252.032619	4577635.056392	1	0	1	0	0	1
186717	86.105888	718601.034850	4577187.235119	1	1	1	1	1	1
186910	18.139708	721646.094312	4577539.860146	1	1	1	1	1	1
186939	18.146889	759261.286758	4578801.728198	1	1	1	1	1	1
187044	1.108988	717387.532428	4577355.338650	1	0	1	0	1	0
187147	14.537623	719266.627096	4576898.035333	1	0	1	1	1	1
187249	2.051508	721565.163831	4577439.506350	1	1	1	1	1	1
187319	1.284741	726638.297131	4577527.786991	1	0	1	0	1	0
187320	3.664273	758254.511581	4578607.495044	1	1	1	1	1	1
187660	98.332860	740820.791195	4577544.392253	1	0	1	0	1	1
187716	5.856161	739366.869734	4577734.298832	1	0	1	0	1	0
187719	4.169962	755125.415483	4578380.565977	1	1	1	1	1	1
187840	12.566150	727999.232057	4577100.898556	1	0	1	0	1	0
187866	13.493732	760685.339493	4578539.513441	1	1	1	1	1	1
188280	2.918333	721630.007889	4577065.719673	1	1	1	1	1	1
188342	1.257866	721357.285842	4577022.088383	1	0	1	0	1	1
188403	2.523353	726773.296038	4577119.141651	1	0	1	0	1	0
188646	1.593322	758268.385041	4578197.085883	1	1	1	1	0	1
188747	9.282829	720545.739777	4576905.365179	1	0	1	0	1	1
188788	26.525921	720898.296672	4576908.602398	1	0	1	0	1	1
188935	12.145634	719864.597289	4576621.037602	1	0	1	1	1	1
189378	31.760548	721281.502385	4576404.738385	1	0	1	0	1	0
189464	27.389998	720590.574418	4576363.116219	1	0	1	0	1	0
189465	1.287939	757451.615180	4577860.541053	1	1	0	1	0	1
189494	51.767477	719185.309679	4576205.115243	1	1	1	1	1	1
189792	2.972484	728134.230964	4576684.955978	1	0	1	0	1	0
189815	1.990708	718746.084900	4576365.586949	1	0	1	0	1	1
189953	2.449928	725612.098055	4576442.194032	1	0	1	0	1	0
190037	11.116950	719764.036390	4576249.897667	1	0	1	1	1	1
190658	1.237305	743958.809362	4576955.620686	1	1	1	1	1	1
191214	2.012757	728038.954827	4576154.977764	1	0	1	0	1	0
192443	1.165466	720977.715948	4575465.830658	1	0	1	0	1	0
192865	1.474765	721348.398481	4575244.810339	1	0	1	0	0	0
192932	10.778988	721278.993652	4575060.473945	1	0	1	0	1	1
192995	1.841220	728639.782714	4575517.569299	1	0	1	0	1	0
193282	1.744221	742923.041356	4575903.445830	1	1	1	1	1	1
193375	3.617989	749543.391171	4576079.065459	1	1	1	1	1	1
193522	5.976558	752576.985745	4576158.877815	1	0	1	1	1	1
193696	1.282856	744076.866567	4575884.300786	1	1	1	1	1	1
194345	12.518162	761785.994028	4576218.750982	1	1	1	1	1	1
194602	2.063206	720576.878527	4574708.746498	1	0	1	0	1	0
195169	6.952046	729024.390683	4574821.303911	1	0	1	0	0	0
195811	2.435616	723440.161203	4574491.370806	1	0	1	0	1	1
196049	8.831390	723237.421481	4574204.327151	1	1	1	1	1	1
196113	2.020194	724986.932123	4574312.988699	1	0	1	0	1	0
196262	1.589943	721523.331017	4574190.087378	1	0	1	0	1	0
196785	8.588310	743029.662849	4574646.450938	1	1	1	1	0	1
197414	2.408407	721993.409529	4573661.765414	1	0	1	0	1	0
197757	1.730724	729403.220688	4573875.154407	1	0	1	0	1	0
198139	1.755797	721995.684124	4573417.822539	1	0	1	0	1	0
199690	96.263266	724104.230416	4572596.808958	1	0	1	0	1	1

199705	1.042411	738341.081272	4573437.008507	1	1	1	1	0	1
199774	1.022220	738266.473753	4573360.646595	1	1	1	1	0	1
199794	152.860794	723012.647070	4572430.698449	1	0	1	0	1	1
199918	1.022232	738365.248046	4573312.693198	1	1	1	1	0	1
200214	1.000872	728705.604715	4572889.662387	1	0	1	0	1	0
200217	6.093756	727589.127270	4572634.259050	1	0	1	0	1	0
200395	8.954572	724716.345190	4572442.887636	1	1	0	1	0	1
200760	2.784534	722280.265557	4572387.178314	1	0	1	0	1	0
200858	27.770733	742225.185347	4572721.451001	1	0	1	1	1	1
200862	2.075054	724966.287518	4572362.708560	1	0	1	0	1	0
201092	1.043247	728417.363806	4572459.125333	1	0	1	0	1	0
201236	23.323613	723783.874434	4571979.827067	1	0	1	0	1	1
201412	3.122199	728715.494223	4572249.112632	1	0	1	0	1	0
201772	7.335028	740062.333689	4572486.067641	1	0	1	0	1	1
201912	6.404880	728104.422533	4571941.974547	1	0	1	0	1	0
201949	3.237673	724936.676285	4571974.321719	1	0	1	0	1	0
202080	1.247875	726884.943783	4571959.264516	1	0	1	0	1	0
202197	1.195381	731798.174267	4572112.506518	1	0	1	1	1	1
202310	3.654696	728993.845624	4571857.103181	1	0	1	0	1	0
202510	11.897767	723866.929689	4571635.741012	1	0	1	0	1	1
202927	1.576641	757624.411080	4572645.558367	1	1	1	1	0	1
203439	2.065057	726974.699813	4571436.052536	1	0	1	0	1	0
203529	45.452062	724237.803895	4571071.996075	1	1	1	1	1	1
204164	1.012414	731328.864708	4571271.084161	1	1	1	1	1	1
204509	49.555774	728793.318673	4570617.813787	1	1	1	1	1	1
204598	13.888258	728328.986686	4570895.791419	1	1	1	1	1	1
204675	22.323211	740000.975709	4571263.819181	1	0	1	1	1	1
205515	1.699203	731941.422597	4570746.879335	1	0	1	0	1	0
205535	23.035416	744821.255262	4570881.777694	1	1	1	1	1	1
205796	4.704120	736156.871413	4570678.190453	1	0	1	0	1	1
207454	2.764133	726684.269732	4569803.660305	1	0	1	0	1	0
208110	9.105824	721760.691872	4569461.379583	1	1	1	1	1	1
209800	1.083909	754992.042051	4570003.937524	1	1	1	1	1	1
209835	3.131412	721708.896365	4568856.019589	1	0	1	0	1	1
209981	1.181623	728038.307383	4569034.390368	1	0	1	0	0	0
210147	21.234524	722100.599890	4568613.228147	1	0	1	0	1	1
210309	3.646908	721587.163798	4568632.982211	1	0	1	0	1	1
210905	4.430800	721535.609132	4568372.085260	1	0	1	0	1	1
211395	3.153345	721637.677542	4568169.729114	1	0	1	0	0	1
211710	1.155627	728471.363369	4568355.158566	1	0	1	0	1	0
211944	1.731465	721430.640003	4568018.228800	1	0	1	0	1	1
211987	2.089771	723028.488423	4568030.076527	1	0	1	0	1	0
212051	1.655492	723416.853225	4567953.159148	1	0	1	0	1	0
212082	2.301866	721066.470237	4567865.407649	1	0	1	1	1	1
212133	2.096725	722592.980934	4567988.768560	1	0	1	0	1	0
212259	6.184268	726788.620238	4567846.541063	1	0	1	0	1	0
213098	3.780432	723177.299003	4567597.065034	1	0	1	0	1	0
213267	7.262419	736393.842066	4567914.798730	1	0	1	0	1	1
213378	3.286052	723026.003153	4567509.157105	1	0	1	0	1	0
213390	6.161314	758581.957378	4568486.873715	1	1	1	1	1	1
213598	7.026447	723627.345025	4567478.513493	1	0	1	0	1	0
214289	2.363519	721203.314115	4567062.087956	1	0	1	0	1	0
214345	7.577790	721658.218221	4567014.671725	1	0	1	1	1	1
214377	1.687251	736890.613109	4567622.715401	1	0	1	1	1	1

214437	1.488580	757840.794965	4568301.807658	1	1	1	1	0	1
214513	2.914975	721927.548620	4567032.793513	1	0	1	1	1	1
214792	3.434053	724316.800168	4566907.537340	1	0	1	0	1	0
215554	5.747387	722136.533024	4566752.150818	1	0	1	0	1	1
216373	8.026704	722866.202236	4566170.098802	1	0	1	0	0	0
216427	4.006113	722336.826593	4566331.799315	1	0	1	0	1	0
217130	7.522935	722400.042668	4566033.811873	1	0	1	0	1	0
217149	7.584484	723108.993677	4565962.593050	1	0	1	0	1	0
217189	4.991288	726633.189065	4566210.500257	1	0	1	0	0	0
218367	1.173098	754534.154388	4566725.037826	1	1	0	1	0	1
218855	1.079226	722894.813932	4565404.155435	1	0	1	0	1	0
219593	1.112169	749420.368084	4566029.828393	1	1	1	1	1	1
219877	1.785071	753204.773320	4566051.940300	1	1	1	1	1	1
220506	1.425743	728126.231901	4564946.041084	1	0	1	0	1	0
221047	1.301387	746090.356441	4565325.232459	1	1	1	1	1	1
221228	1.616058	742195.948070	4565059.069970	1	0	1	1	1	1
221705	3.010164	726098.301504	4564286.218542	1	0	1	0	1	0
221774	1.359523	757433.372085	4565369.128692	1	1	0	1	0	1
222019	4.025647	723989.081945	4564078.054852	1	0	1	0	1	0
222140	1.196770	757480.804133	4565262.372880	1	1	0	1	0	1
222209	1.494050	742556.305970	4564675.072916	1	0	1	1	1	1
222267	1.737892	724072.471785	4564020.428062	1	0	1	0	1	0
222719	1.019061	747486.147327	4564668.366753	1	0	1	1	1	1
222761	7.570321	724576.714688	4563618.167392	1	0	1	0	1	0
223511	5.685306	724653.448339	4563457.982006	1	0	1	0	1	0
224293	6.415441	724661.160173	4563082.739221	1	0	1	0	1	0
224303	4.380418	724953.124399	4563248.220440	1	0	1	0	1	0
224336	10.575278	724841.229682	4562933.527026	1	0	1	0	1	0
224460	3.167234	726097.612078	4563175.424214	1	0	1	0	1	0
224588	1.034918	728946.549822	4563266.784886	1	0	1	0	1	0
226377	3.964179	724812.094709	4562350.827566	1	0	1	0	0	0
227283	2.632708	725387.899751	4561878.727336	1	0	1	0	1	0
227636	2.490722	726450.810871	4561803.288269	1	0	1	0	1	0
228547	6.331809	761417.922203	4562683.613702	1	0	1	0	0	0
228607	1.050687	725147.852817	4561434.204136	1	0	1	0	1	1
228702	6.974535	760740.614391	4562523.206291	1	0	0	0	0	0
229070	3.267735	747162.916544	4561829.591648	1	0	1	1	1	1
229310	9.106326	760989.297863	4562032.385083	1	0	1	0	1	0
229865	3.147047	725914.451520	4560891.499810	1	0	1	0	1	0
229949	3.808144	747176.979045	4561512.495091	1	0	1	1	1	1
230251	2.819799	750158.873756	4561624.395573	1	0	1	0	0	0
230327	7.334336	761695.024756	4561831.859634	1	0	1	0	1	0
230902	1.098580	737081.459068	4560938.064860	1	0	1	0	0	1
231023	1.831924	725906.783737	4560438.947250	1	0	1	0	1	0
231098	1.005497	735472.257600	4560791.459068	1	0	1	0	1	1
232237	1.508080	725816.303895	4559951.122886	1	0	1	0	1	0
232749	4.588957	725794.834103	4559642.878004	1	0	1	0	1	0
233157	2.039943	736141.714534	4559992.189643	1	0	1	1	1	1
233415	1.131727	728879.081026	4559633.697142	1	0	1	0	1	0
234111	3.399053	749041.270635	4560052.514984	1	0	1	0	1	0
236242	1.134366	741049.783876	4558970.542443	1	0	0	0	0	0
236996	2.921152	761375.069617	4559323.705808	1	1	0	1	0	1
237608	16.351769	726211.868300	4557777.607975	1	0	1	0	1	0
238082	1.194652	755117.890059	4558797.928201	1	0	0	0	0	0

238256	2.515854	761524.709328	4558928.144992	1	1	1	1	0	1
238487	2.207043	761346.327688	4558851.359318	1	1	1	1	1	1
239231	1.689723	729483.597071	4557516.146858	1	0	1	0	1	0
239410	1.234728	729135.244896	4557421.392116	1	0	1	0	1	0
239505	1.350951	761875.017557	4558521.197229	1	1	1	1	1	1
239675	2.027311	748703.172443	4557993.881484	1	0	1	1	0	1
239782	6.883097	752885.104516	4558015.799815	1	0	1	0	1	1
239925	1.141141	756487.387980	4558170.672549	1	0	1	0	0	1
240054	1.352934	725747.317461	4557024.211534	1	0	1	0	1	0
240483	6.348183	725690.355215	4556755.514454	1	0	1	0	1	0
241127	2.021969	725781.368991	4556521.111052	1	0	1	0	1	0
241578	4.830695	725908.236917	4556183.192656	1	0	1	0	1	0
242902	5.276413	759807.072525	4556979.817228	1	1	0	1	0	1
243177	5.976470	752827.637281	4556678.895771	1	0	1	0	1	0
243361	1.211219	762900.929259	4556945.289403	1	0	1	0	1	0
245003	1.134288	725900.650308	4554958.471091	1	0	1	0	1	0
245785	1.277394	758285.588886	4555808.731245	1	1	1	1	1	1
246480	4.110085	758918.407850	4555428.911008	1	0	1	1	1	1
246962	1.057018	760833.212566	4555351.166411	1	1	1	1	1	1
247024	6.777143	761995.400143	4555239.395103	1	0	1	0	1	0
247149	1.515287	755630.421682	4555122.117048	1	0	1	0	1	1
247229	1.696801	754463.902506	4555001.910735	1	0	1	0	1	1
247785	1.954223	725104.739326	4553767.340805	1	0	1	0	1	0
248057	15.802426	762058.807968	4554848.271483	1	0	1	0	1	0
248895	5.093304	751579.066213	4554198.969833	1	0	1	0	1	0
249017	2.549269	761700.207719	4554372.053355	1	0	1	0	1	0
249399	2.022697	737377.143059	4553483.863859	1	0	0	0	0	0
250079	3.193341	760086.928368	4554041.261604	1	0	1	0	1	0
250395	2.212861	736156.605473	4553049.325582	1	0	1	0	0	0
250782	2.073754	735229.303585	4552880.618560	1	0	1	0	1	0
251107	8.883856	723965.238161	4552190.815045	1	0	1	0	0	0
251590	1.218863	757037.606964	4553274.131535	1	0	1	0	1	0
253727	1.296671	745390.817531	4551819.882026	1	0	1	0	1	0
254440	2.720382	754217.051770	4551801.377573	1	0	1	0	1	0
254441	3.295213	738564.212439	4551207.554341	1	0	1	0	1	0
255315	57.231873	748633.941984	4551093.657087	1	0	1	1	1	1
255441	2.395760	760897.222333	4551414.772232	1	0	1	0	1	0
255749	1.584913	759233.989808	4551265.680999	1	0	1	1	1	1
256082	5.649877	748743.561513	4550791.365176	1	1	1	1	1	1
256215	12.124802	747600.021959	4550648.677810	1	0	1	0	1	0
256322	2.917324	725675.137353	4549795.920266	1	0	1	0	1	0
256408	13.727020	758290.768436	4550756.079487	1	0	1	0	1	0
256446	2.584528	748143.925459	4550589.628332	1	0	1	0	0	1
256521	9.199326	746656.301623	4550473.288965	1	0	1	0	1	1
256604	2.726458	747848.155672	4550491.214358	1	0	1	0	1	1
256741	33.952878	755764.442557	4550613.965563	1	1	1	1	1	1
256758	12.197300	755077.149048	4550604.350523	1	0	1	0	1	0
256764	2.115620	746371.851738	4550321.387662	1	0	1	0	1	0
256785	1.830921	758045.496940	4550740.156305	1	0	1	0	1	1
256984	38.039193	756638.491747	4550533.035082	1	1	1	1	1	1
256990	1.932304	757198.530672	4550581.593371	1	1	1	1	1	1
257050	25.983763	757967.046514	4550322.292111	1	0	1	0	1	1
257100	9.093865	757594.766304	4550467.966976	1	0	1	0	1	1
257112	1.146695	725073.662022	4549485.147221	1	1	1	1	1	1

257263	19.779748	754783.565134	4550319.054892	1	0	1	0	1	0
257277	8.751789	755405.111224	4550377.324838	1	1	1	1	1	1
257289	3.298109	753621.161057	4550345.307445	1	0	0	0	0	0
257376	27.031665	725137.758962	4549167.899737	1	1	1	1	1	1
257487	56.409400	756172.332179	4550128.382680	1	1	1	1	1	1
257967	11.458566	757504.124166	4550134.533397	1	0	1	0	1	1
258273	3.180726	757157.741709	4549995.656692	1	1	1	1	1	1
258520	1.366728	725272.427282	4548793.029752	1	1	1	1	1	1
258546	14.369215	725622.046958	4548550.238310	1	0	1	1	1	1
258614	4.386072	753740.789485	4549662.244477	1	0	0	0	0	0
259044	3.711428	735464.679674	4548822.916322	1	0	1	0	1	0
259274	1.773016	731694.422770	4548595.883101	1	0	1	0	1	1
259415	10.558417	743446.175982	4548900.829152	1	0	1	1	1	1
259457	45.756254	742656.294492	4548522.074503	1	1	1	1	1	1
260373	1.273381	725974.526225	4547756.441862	1	0	1	0	1	0
260772	5.181864	742007.555761	4548113.861159	1	0	1	0	1	0
261150	2.676814	726728.264642	4547299.689920	1	0	1	0	1	0
261716	2.644616	730870.190555	4547215.363149	1	0	1	0	1	0
261776	3.993963	741716.805052	4547574.492951	1	0	1	0	1	0
262241	1.083552	727106.524952	4546830.574040	1	0	1	0	1	0
262335	2.015437	741360.593646	4547247.196723	1	0	0	0	0	0
263994	5.786645	740351.607760	4546090.297096	1	0	1	0	0	0
264710	14.182146	728506.409283	4545161.517231	1	0	1	0	1	0
265636	16.065331	739244.912878	4544874.052164	1	0	1	0	1	0
265669	2.561063	738316.907688	4544994.555443	1	0	1	0	1	1
265773	1.501892	731342.860763	4544682.408786	1	0	1	0	1	0
265961	3.940602	738838.820926	4544791.578977	1	0	1	0	1	1
266536	3.090967	738387.697229	4544349.946373	1	0	1	0	0	0

New Wetlands in 1993

OBJECT ID	AREA	LATITUDE	LONGITUDE	Pres 1993	Dev 1993	Pres 2003	Dev 2003
621	4.240741	713440.067312	4584316.654861	1	0	1	0
622	3.016380	713093.684885	4584497.939917	1	0	1	0
623	2.455224	714161.967918	4584054.440104	1	0	1	0
647	22.806557	745424.116925	4583675.038011	1	0	1	0
648	1.519068	743212.125032	4583597.021028	1	0	1	0
656	6.029292	730291.411960	4583819.417988	1	0	1	0
659	14.547615	715902.943694	4582701.929914	1	0	1	1
670	2.037949	750624.062158	4583481.128580	1	0	1	1
671	1.982966	750760.025365	4583384.012003	1	0	1	1
683	1.302003	740312.547777	4580466.953764	1	0	1	0
686	1.215879	731610.578792	4581016.957310	1	0	1	0
694	6.837102	717396.272920	4579141.959938	1	0	1	0
695	7.397521	717622.878265	4578611.055986	1	0	1	0
696	3.774892	717959.549064	4578018.644686	1	0	1	0
702	20.744644	738605.885804	4578835.718999	1	0	1	1
773	6.320765	761209.769007	4577992.423393	1	1	1	1
781	2.750888	731703.163262	4576653.509523	1	0	1	0
790	12.200663	717876.352530	4576996.007317	1	0	1	0
794	1.626424	717044.387191	4577174.054374	1	0	1	1
795	5.802289	720052.735012	4575426.279717	1	0	1	0
797	4.332729	721204.537610	4576004.588588	1	0	1	0
805	3.186802	731777.619304	4576317.162446	1	0	1	1
809	1.353978	732470.384217	4575407.503846	1	1	1	1
810	1.335815	732386.216517	4575116.154116	1	1	1	1
811	7.998379	738916.658850	4576557.364113	1	0	1	1
820	70.860927	722917.997743	4571632.906235	1	0	1	1
822	2.163065	726561.487975	4571636.467177	1	0	1	0
835	21.027939	722696.248227	4570034.043663	1	0	1	1
836	7.752354	722268.935290	4569927.215428	1	0	1	1
837	10.681567	721967.873902	4569953.113182	1	0	1	1
846	1.446445	733817.714856	4569688.632372	1	1	1	1
855	3.274315	745358.725097	4570246.405244	1	1	1	1
857	168.226835	736782.360218	4567309.923689	1	1	1	1
858	59.170498	736539.568776	4567332.584224	1	0	1	1
859	7.638421	734362.215129	4567439.412458	1	0	1	1
873	6.304256	726572.494521	4565600.348219	1	0	1	0
875	1.413419	738420.716865	4566186.932342	1	0	1	1
876	7.176085	739637.587570	4566947.678859	1	1	1	1
880	1.439841	746126.593496	4564837.983093	1	1	1	1
882	1.519097	733703.441018	4564623.355459	1	0	1	1
886	1.779986	724899.499628	4562490.027993	1	0	1	0
895	1.387002	735825.114495	4561493.935639	1	0	1	0
903	12.707581	725416.807259	4559596.601454	1	0	1	0
904	3.843978	731906.136907	4560072.796401	1	0	1	0
911	1.494450	738771.631429	4560089.306219	1	1	1	1
912	1.208671	738797.529182	4559930.682478	1	1	1	1
946	80.553442	725464.070660	4553547.209898	1	0	1	1
948	2.493302	736490.039322	4553259.744831	1	0	1	0
956	4.433453	761732.579911	4554779.942977	1	0	1	0
958	10.841735	763179.616902	4553109.861581	1	0	1	0

961	1.111254	755040.600340	4552908.506546	1	0	1	0
969	2.014455	749771.054894	4551629.481232	1	0	1	0
977	2.029053	734009.034512	4551939.283112	1	0	1	0
982	1.368840	733513.092528	4549919.582040	1	0	1	0
985	39.212527	745168.376607	4549612.693658	1	1	1	1
1004	4.374041	738293.817872	4547990.846829	1	0	1	0
1006	3.089383	736341.127238	4548123.249095	1	0	1	0
1030	1.138922	714294.693186	4584196.877749	1	0	0	0
1031	1.062088	714077.799498	4585191.027772	1	0	0	0
1033	1.733470	732347.693609	4585645.209628	1	0	0	0
1034	1.246636	738650.672233	4585312.833580	1	0	0	0
1035	1.566020	746123.356277	4583975.775677	1	0	0	0
1037	2.103122	724066.563123	4581129.288817	1	0	0	0
1039	1.355058	726896.216443	4581990.389129	1	0	0	0
1042	4.766645	730844.976447	4582236.741512	1	0	0	0
1043	1.283877	734536.053801	4581544.300321	1	0	0	0
1046	6.235596	741968.709130	4580706.831709	1	0	0	0
1048	1.916751	732322.767021	4580482.492417	1	0	0	0
1051	1.166102	723895.637948	4580796.178959	1	0	0	0
1052	1.608727	719465.179723	4579763.182306	1	0	0	0
1053	1.232107	719582.367059	4579012.471169	1	1	0	1
1055	1.065799	741826.086416	4579169.278308	1	0	0	1
1056	2.464458	742039.178869	4579246.266549	1	0	0	1
1057	1.611315	745231.502382	4579457.588812	1	1	0	1
1059	9.318449	755326.446797	4580157.475607	1	1	0	1
1064	4.052829	720579.968196	4574838.882793	1	0	0	0
1066	1.366707	724975.574279	4574824.480664	1	0	0	0
1069	2.129341	736688.903285	4574188.888803	1	0	0	1
1071	2.359378	721790.474289	4575264.765461	1	0	0	0
1072	4.390028	723487.748326	4571752.683346	1	0	0	1
1073	3.979759	725100.530941	4571992.561291	1	0	0	1
1074	2.448681	724974.279392	4571652.653273	1	0	0	1
1075	11.116436	731213.531211	4572623.596370	1	0	0	0
1078	7.263211	740277.909532	4572492.064216	1	0	0	1
1080	1.680324	737598.093392	4570264.242445	1	1	0	1
1081	2.554134	734736.910035	4570435.425357	1	0	0	1
1083	1.166730	723479.277260	4570901.680937	1	0	0	1
1087	2.497862	727205.370878	4569759.527473	1	0	0	0
1090	2.921077	734664.247682	4568789.009151	1	1	0	1
1093	1.448242	737483.865623	4567287.263155	1	1	0	1
1094	2.078533	734096.763153	4566953.505853	1	0	0	1
1095	2.748941	730526.434076	4567672.168520	1	0	0	0
1097	1.613904	727085.593767	4568231.883723	1	0	0	0
1098	1.478010	726010.836986	4567882.264047	1	0	0	0
1102	3.469548	729303.899706	4565777.620341	1	0	0	0
1103	1.325290	749473.945036	4565709.118785	1	1	0	1
1104	1.617788	746126.593496	4564837.983093	1	1	0	1
1106	3.466435	727808.800291	4564239.289068	1	0	0	0
1107	4.524663	725160.051124	4564928.857888	1	0	0	0
1109	2.862600	725131.603546	4564543.235164	1	0	0	0
1110	2.284313	723430.449546	4564742.808848	1	0	0	0
1112	2.456447	725414.217484	4563140.709056	1	0	0	0
1114	7.430174	735680.087074	4563235.235857	1	0	0	1
1118	3.274399	755312.526754	4561532.469159	1	0	0	1

1119	1.589314	752733.757924	4562268.602198	1	1	0	1
1125	1.524603	730507.010760	4559486.859723	1	0	0	1
1126	1.446997	734941.920014	4560332.691053	1	0	0	0
1127	1.966308	737991.182526	4559298.196819	1	0	0	1
1128	2.022880	755197.929194	4560449.608719	1	0	0	0
1129	2.702693	756894.497623	4558926.800822	1	1	0	1
1131	3.339113	752824.400062	4558368.400482	1	0	0	1
1133	9.084726	744392.091438	4558594.358384	1	0	0	0
1136	4.039290	734412.392027	4556143.783434	1	0	0	0
1137	1.504172	738662.860863	4556150.257873	1	0	0	0
1140	13.623045	760161.881145	4556734.252220	1	1	0	1
1142	2.257136	752388.022911	4554704.192047	1	0	0	0
1144	4.881832	731983.182725	4552544.319384	1	0	0	0
1147	4.503920	761625.104233	4552125.746939	1	0	0	0
1150	9.073567	739342.609922	4552432.445553	1	0	0	0
1154	1.648663	732554.228195	4545870.144518	1	0	0	0
1155	1.559546	732819.680171	4544391.059057	1	0	0	0
1156	2.051352	736505.577975	4543841.379233	1	0	0	0
1157	14.013913	736298.395945	4543378.456885	1	0	0	0

New Wetlands in 2003

OBJECTID	AREA	LATITUDE	LONGITUDE	Pres 2003	Dev 2003
629	3.693361	725022.513958	4584900.001764	1	0
631	4.609490	727528.769078	4584159.303023	1	0
634	6.194208	734721.546463	4584742.025466	1	0
652	5.944667	735919.317574	4584065.770371	1	1
653	257.833296	735064.691700	4584476.897212	1	1
654	36.762896	733943.966406	4583874.774437	1	0
658	15.345589	716246.088931	4583705.467872	1	0
660	1.215299	716656.568328	4581329.672686	1	0
663	14.618808	718398.515991	4581116.016218	1	0
669	1.190489	748071.191081	4582448.131927	1	0
672	2.016692	752801.415805	4582056.752123	1	1
687	14.356579	730967.667055	4579987.197876	1	0
698	41.245375	721201.624113	4579044.843361	1	1
699	1.829097	722519.172335	4578390.925079	1	0
700	2.139458	734439.908391	4578291.218727	1	0
701	1.527581	737577.744980	4579738.579440	1	1
704	9.467174	741407.051595	4578796.872369	1	1
780	1.322605	737295.783186	4576883.675810	1	1
782	1.347375	731156.073214	4576870.403211	1	0
783	1.314349	731372.966902	4576834.793800	1	0
784	11.645865	723568.678807	4576986.619381	1	0
785	5.909621	720739.672930	4577572.232338	1	0
799	40.658970	723102.519239	4574998.966780	1	1
807	4.334378	732117.527322	4575886.612290	1	1
815	2.087106	740326.114098	4575062.092555	1	1
816	2.475135	732067.997868	4573698.575820	1	0
825	13.505107	757725.226239	4571917.134083	1	1
827	1.137673	736176.352780	4571685.996631	1	1
831	3.660141	727291.804631	4570782.488746	1	0
832	1.604960	726641.123568	4571183.903930	1	1
833	202.645943	726045.475232	4571051.177942	1	1
834	28.714245	723292.867729	4571326.017853	1	1
840	2.820237	721985.252658	4569416.058514	1	1
841	1.646240	722074.702137	4569539.072844	1	1
842	55.164705	722262.460851	4569603.817228	1	1
850	1.685867	733948.822235	4568924.972358	1	1
851	3.596298	734214.274211	4568617.436532	1	1
853	1.017135	734628.638271	4568620.673751	1	1
854	7.042339	735798.245575	4569038.275031	1	1
860	21.477064	732885.071999	4567296.651090	1	1
861	1.203720	728291.781648	4566752.474540	1	0
862	2.559350	726020.548644	4568138.004366	1	0
871	2.544488	725972.637799	4566464.685751	1	0
872	2.222506	725707.185823	4565755.734742	1	0
887	3.209920	733005.496554	4563312.605397	1	0
905	1.494332	732505.022463	4560011.289236	1	0
908	3.071766	736763.260625	4559325.322484	1	1
910	1.221882	735344.063719	4559775.295955	1	1
914	2.418998	750033.269650	4559895.720510	1	0
915	5.995485	750308.433284	4559639.980192	1	0

916	1.266812	751567.711561	4559976.650991	1	1
920	1.074845	752452.761990	4560724.772352	1	1
925	3.081126	745558.137801	4558018.457084	1	0
926	3.867094	746205.581645	4557837.172808	1	0
927	84.577406	746289.749345	4558578.496009	1	0
928	14.492512	737462.499976	4558707.337334	1	0
934	12.780227	760466.179752	4556653.321739	1	1
938	2.805376	756987.463978	4555990.015521	1	1
939	1.169043	757350.032531	4555708.377449	1	1
940	2.973798	756064.209057	4555018.526033	1	1
942	2.234064	742159.057620	4555590.866392	1	0
944	1.129418	732989.957902	4554424.820029	1	0
947	1.499284	732779.538653	4552631.724303	1	0
976	8.680319	735951.366044	4551725.626643	1	0
1023	4.482990	735183.497645	4545016.166088	1	0
1029	50.117341	735593.329599	4542909.060098	1	0

BIBLIOGRAPHY

Bartlett, P.A. (1975). *Soil Survey of Douglas and Sarpy Counties, Nebraska.* Washington, D.C.: U.S. Department of Agriculture.

Brinson, M. & Rheinhardt, R. (1996). "The Role of Reference Wetlands in Functional Assessment and Mitigation." *Ecological Applications.* 6(1), 69-76.

Cowardin, L.M., Carter, V., Golet, F.C., & LaRoe, E.T. (1979). *Classification of Wetlands and Deepwater Habitats of the United States.* Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Dahl, T. E. (2000). *Status and Trends of Wetlands in the Conterminous United States 1986 to 1997.* Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Dahl, T. E. (1990). *Wetland Losses in the United States 1780's to 1980's.* Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Dahl, T. E. & Johnson, C.E. (1991). *Status and Trends of Wetlands in the Conterminous United States, Mid- 1970's to Mid-1980's.* Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Dinville, A.P. (1993). *Sandhill Wetlands Change Detection Based on Landsat Imagery.* Thesis. University of Nebraska – Omaha.

Ekstein, J. & Hygnstrom, S. (1996). "Fate of Wetlands Associated with the Central Nebraska Irrigation Canal System." *Great Plains Research.* 6, 41-60.

Fraser, R.L. (1995). *Change Detection of Wetlands in the Sandhills of Nebraska Using Landsat MSS Imagery.* Thesis. University of Nebraska – Omaha.

Frayer, W.E., Monahan, T.J., Bowden, D.C., & Graybill, F.A. (1983). *Status and Trends of Wetlands and Deepwater Habitats in the Conterminous Unites States 1950's to 1970's.* Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Graham, E.I. & Lei, J.H. (2000). "Stormwater Management Ponds and Wetlands Sediment Maintenance." *Water Quality Research Journal of Canada.* 35(2), 525-539.

Hammer, D.A. (1997). *Creating Freshwater Wetlands.* Boca Raton, FL: CRC Press, Inc.

Hasse, J.E. & Lathrop, R.G. (2003). "Land Resource Impact Indicators of Urban Sprawl." *Applied Geography.* 23, 159-175.

High Plains Regional Climate Center. (1998). "Omaha Eppley Airfield, NE (256255)." www.hprcc.unl.edu/cgi-bin/cli_perl_lib/cliMAIN.pl?ne6255. [2005, March 28]

LaGrange, T. (1997). "Guide to Nebraska's Wetlands and Their Conservation Needs." Lincoln: Nebraska Game and Parks Commission.

Luo, H.R., Smith, L.M., Allen, B.L., & Haukos, D.A. (1997). "Effects of Sedimentation on Playa Wetland Volume." *Ecological Applications.* 7(1), 247-252.

Mitch, W. J. & Gosselink, J. G. (2000). *Wetlands.* New York: John Wiley.

Murkin, H. R. (1998). "Freshwater Functions and Values of Prairie Wetlands." *Great Plains Research.* 8, 3-15.

National Climatic Data Center. (2003). "Annual Publication for 2003 for Omaha Eppley Airfield, NE." http://www7.ncdc.noaa.gov/IPS/LCDPubs?action=getstate. [2005, May 15]

National Research Council. (1995). *Wetlands: Characteristics and Boundaries.* Washington, D.C.: National Academy Press.

Nebraska Department of Natural Resources (2005). "Data Bank: Spatial/GIS Databases." http://www.dnr.state.ne.us/databank/spat.html. [2005, April 4]

Ruggles, R. (2006). "Cunningham Lake being Drained to Restore its Health." *Omaha World-Herald.* www.omaha.com/index.php?u_pg1636&usid=217658&u_rnd=4700437.

Rundquist, D.C. & Turner, J.K. (1980). "Wetlands Inventory of the Omaha District." Omaha, NE: University of Nebraska – Omaha.

Shapard, R. (1997). "Swamp Things: Handing Local Wetland Issues." *American City & County.* 112 (12), 28-35.

Shaw, S.P. & Fredine, C.G. (1956). *Wetlands of the United States – Their Extent and Their Value to Waterfowl and Other Wildlife.* Circular 39. Washington, D.C.: U.S. Department of the Interior.

Silence, T. (2005). *An Evaluation of Wetland No Net Loss and Mitigation Under Section 404 of the Clean Water Act on the Santa Rosa Plain, Sonoma County, California.* Thesis. University of Nebraska – Omaha.

Tiner, R.W. (1984). *Wetlands of the United States: Current Status and Trends.* Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

Tiner, R.W., Swords, J.Q., & McClain, B.J. (2002). *Wetland Status and Trends for the Hackensack Meadowlands: An Assessment Report from the U.S. Fish and Wildlife*

Service's National Wetlands Inventory Program. Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region.

U.S. Army Corps of Engineers. (1987). *Corps of Engineers Wetlands Delineation Manual.* Washington, D.C.: U.S. Army Corps of Engineers.

U.S. Census Bureau. (2005, February 1). State and County QuickFacts. http://quickfacts.census.gov/qfd/. [2005, March 25].

U.S. Department of Agriculture. (1997). "Major Land Resource Area." http://www.soils.usda.gov/survey/geography/mlra/. [2005, February 23].

U.S. Environmental Protection Agency. (2005). "Wetlands." www.epa.gov/owow/wetlands. [2005, February 1].

U.S. Fish & Wildlife Service. (2005). "National Wetlands Inventory." http://wetlandsfws.er.usgs.gov/ [2005, January 25].

U.S. Fish and Wildlife Service. (2002). "National Wetlands Inventory: A Strategy for the 21st Century." Washington, D.C.

Williams, M. (1990). *Wetlands: A Threatened Landscape.* Cambridge: Blackwell.

Wolfson, L., Mokma, D., Schultink, G., and Dersch, E. (2002). "Development and Use of a Wetlands Information System for Assessing Wetland Functions." *Lakes and Reservoirs: Research and Management.* 7, 207-216.