

RESEARCH REPORT



Michigan Agricultural
Experiment Station
Michigan State University

Guidelines for Wetland Identification and Evaluation: Needs and Opportunities for Local Protection



October 2000



Research Report 572

Guidelines for Wetland Identification and Evaluation: Needs and Opportunities for Local Protection

Ger Schultink, Richard Moore, Lois Wolfson and James Dischinger-Smedes
Department of Resource Development
Michigan State University



Acknowledgements

The authors wish to thank Tom Moen for his assistance in writing Appendix I and Matta Rao and Diane Hickling for assistance in the preparation of this manuscript. In addition, the reviews by Delbert Mokma and Eckhart Dersch are gratefully acknowledged.

We thank Leslie Johnson and Ken Fettig for the editorial assistance provided and Margaret Weaver for publication design.

This research and the publication of this research report were made possible through a special grant from MSU's Agricultural Experiment Station.

TABLE OF CONTENTS

	Page
FOREWORD	1
INTRODUCTION	1
Defining Wetlands	2
LAND USE TRENDS	3
Wetland Loss and Protection.....	3
Causes of Wetland Loss	4
Estimating Environmental	
Degradation and Loss of Wetland Functions	5
Urbanization and Wetland Ecosystems	5
Changes in Michigan’s Landscape	6
Urbanization and Wetland Ecosystems in Michigan	7
Historic Wetland Trends in Michigan	8
Threats to Michigan’s Remaining Wetlands	9
WETLAND FUNCTIONS/VALUES.....	9
Classification of Wetlands	9
Functions vs. Values	11
Critical Wetland Functions	13
Physical Functions.....	13
Chemical Functions.....	13
Biological Functions	14
Functions Implicit in Michigan’s Regulatory Statute.....	14
Wetland Values	15
Economic Valuation	15
Non-market Goods	16
Socioeconomic Values.....	16
The Regulatory Concept of Value.....	18
Economic Values	19
Aesthetic and Cultural Values.....	20
Water Quality Values	21
Hydrological and Biochemical Values	21
Ecosystem Values	21
WETLAND ANALYSIS/EVALUATION STRATEGIES	22
Identification and Analysis Techniques.....	22
Wetland Inventory	24
Assessment Methods	24
Comparing Wetland Assessment Methods.....	26
WETLANDS PROTECTION.....	30
Why Protect Wetlands?	30
Federal Wetland Protection Regulations	31
Michigan Wetlands Protection Regulations	35
Policies and Procedures for Wetland Regulation.....	37
MICHIGAN’S LEGAL FRAMEWORK	37
Local Authority - Police Power/Common Law	37
Local Wetland Regulation	39
P.A. 451- Part 303 Restrictions.....	40
Section 30309 Evaluation Criteria	41
Essential Elements of Local Regulations	42
Limits on Local Authority	42
Relationship to State and Federal Jurisdictions	43
LOCAL OPPORTUNITIES FOR WETLAND	
REGULATION AND PROTECTION	44
Adoption of Local Regulatory Authority Provided for in	
the Wetland Act.....	44
Stand-alone Ordinance	45
What About Appeals and Takings Claims?	45
Local Ordinance Requirements	45
Wetland Permit Review	46
Local Zoning and Building Permits Conditioned on	
Wetland Permits	46
Setback Zones or Natural Features Buffers	47
Overlapping Jurisdiction	49
Primary Elements of an Ordinance.....	49
Regulatory Takings and Wetland Protection	49
Criteria in Wetland Takings Cases	50
Reducing the Risk of Takings Claims.....	50
INTEGRATED WETLANDS PROTECTION	
PROGRAMMING.....	51
Successful Regulatory Programs.....	51
State Zoning Authority.....	51
Local Regulations: Land use Planning and Zoning	51
Non-regulatory Protection Methods	52
Purchase of Development Rights and Transfer of	
Development Rights	52
Conservation Easements	53
Voluntary Preservation and Technical assistance	53
Fee Acquisition	54
Tax and Economic Incentives	54
REFERENCES	80
APPENDICES	
I. Using the Wetlands Information Management	
System II	56
II. Sample Wetland Ordinance: Charter Township of	
Meridian, Michigan.....	59
III. Sample Wetland Ordinance:	
City of Montezuma, Georgia	72

Foreword

This publication provides guidelines for wetland identification, evaluation and protection. Various important wetland functions and associated social and environmental values are discussed. Within this evaluation context, needs for local protection may be assessed and protection policies may be formulated using the implementation strategies and measures identified. In Michigan, the completion of a local wetland inventory is required before specific land use controls, such as zoning or wetland preservation ordinances, can be enacted.

We hope that local governments, especially those rural townships subject to significant development

pressures, may use these guidelines to direct economic development and promote sound land use planning — specifically, the allocation of land uses according to land suitability and environmental impact considerations, the protection of important natural resources and unique features in their communities — and, as a result, improve the long-term quality of life for all citizens.

Some of the evaluation methods identified were developed with the assistance of a grant from Michigan State University's Agricultural Experiment Station. The distribution of this publication has been made possible, in part, through assistance provided by MSU Extension.

Introduction

Wetlands — marshes, fens, bogs and estuaries — are among the most fragile ecosystems on earth. In addition to containing a great diversity of plant life, they may be home to about 10 percent of all animal species and 40 percent of all fish species. They provide a bounty of plant and animal products such as cranberries, blueberries, fiber and timber, fin and shellfish, waterfowl, furbearers and game animals. They also supply and purify drinking water, provide water for agriculture, help to maintain soil moisture, stabilize shorelines, filter pollutants, reduce excess nutrients and downstream sedimentation, transform chemicals, provide flood protection by detaining storm flows and reducing peak runoff, and play a vital in groundwater recharge.

In spite of their critical role in providing benefits with important societal value, wetlands are under severe threat. Since European settlement, estimated wetland losses in the United States and Michigan have exceeded 50 percent. The USDA estimates that in the northeastern United States, wetland loss is up to 59 percent. Land conversion, drainage, dam construction and irrigation, and encroachment by residential, commercial and industrial development have all contributed to wetland reduction. In addition, wetland functions may be compromised by land uses and management practices that concentrate wildlife and reduce flow throughput, resulting in elevated coliform counts and reduced oxygen content. Examples include upper watershed wetland conversion, deforestation, habitat destruction and encroachment on tributaries and streambeds.

To effectively contain this threat, preserve wetlands and potentially reverse this trend through the restoration of critical wetland areas, conservation objectives must be:

- *Integrated into state and local land use planning* to reflect environmental and socioeconomic values and preservation goals. In Michigan, the role of local protection is especially critical because current federal and state laws do not protect many isolated wetlands of less than 5 acres. In the great majority of Michigan townships, effective land use controls, such as appropriate zoning measures in combination with wetland ordinances, have not been enacted.
- *Protected through Best Management Practices (BMPs)*, measures or procedures to protect the environmental functions and societal values of wetlands. Protection includes:
 - Considering the relative importance of a wetland in relation to the total property values (socioeconomic and environmental) and the underlying watershed functions to be managed.
 - Protecting the hydrology of the wetland by not restricting the inflow or outflow of surface and groundwater, reducing residence time (hydroperiod) of water, introducing toxic substances or minimizing changes in temperature regime. Protecting wildlife habitat and biodiversity.
 - Protecting wildlife habitat and biodiversity.

Defining wetlands

According to the Conservation Foundation (1990), in the United States alone, more than 50 different non-regulatory definitions are in use. Because of the wide variety of landscape features (hydrology, sediment and climatic conditions), wetland composition and perceived functions are most important. All those regional definitions (marshes, fens, bogs, wet meadows, potholes, bottomlands, moor, etc.) fall under the common denominator of “wetlands” at the present.

In 1972, amendments to the Federal Water Pollution Control Act (later called the Clean Water Act [CWA]) gave the U.S. Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA) authority to regulate uses in areas with potential impacts on water pollution. These included 15 percent of the total wetland acreage. Between 1972 and 1977, judicial authority broadened considerably and created a need for a regulatory definition of all wetlands in the United States. This definition was finalized in 1977 and upheld until 1985, when the Food Security Act (FSA), via the U.S. Department of Agriculture (USDA), established a separate regulatory definition used concurrently with the USACE’s definition.

Given the need for greater national uniformity in the delineation and identification of wetlands, the USACE issued a national delineation manual in 1987 (USACE, 1987). After this, the USACE collaborated with the U.S. Department of the Interior’s Fish and Wildlife Service (FWS), the EPA and the USDA in preparing a revised manual, released in 1989. These revisions were not implemented because the manual was strongly criticized by various individuals and special interest groups as being *excessively inclusive*. In their opinion, land that should not be defined as wetland was regulated under these provisions, strongly restricting future development. For instance, 80 percent of Louisiana would be protected from development (Davis, 1991). In 1991, the Bush administration attempted to create a revised manual, which also was not implemented because of criticism that too many wetlands were *excluded* from regulatory control. Estimates indicated that from 30 to 80 percent of wetlands now classified as such would have lost protected status in some regions because inundation or saturation requirements were increased from 7 to 14 days (Silverberg, 1993).

As a result, three definitions are used currently in the United States: the USACE 1977 definition, the Natural Resources Conservation Service (NRCS) definition in the Food Security Act (FSA) of 1985 and the FWS 1979

definition (Cowardin et al., 1979). The USACE and the FSA definitions have direct regulatory significance through implementation of the CWA and the FSA. The FWS definition is also significant because it captures the perspective of a federal agency that interacts with regulatory agencies, comments on permits and is charged with reporting to the U.S. Congress on the status of the nation’s wetlands, and because it serves as the basis for national assessment and mapping of wetlands (National Academy of Sciences, 1995).

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers

The federal regulation used by the U.S. Army Corps of Engineers for implementing a dredge and fill permit system required by section 404 of the 1977 Clean Water Amendments defines wetlands as:

Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

U.S. Department of Agriculture

In the Food Security Act (1985), the following definition is used:

The term “wetland,” except when such a term is part of the term “converted wetland” means land that:

- (A) Has a predominance of hydric soils;*
- (B) Is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions; and*
- (C) Under normal circumstances does support a prevalence of such vegetation. For purposes of this Act and any other Act, this term will not include lands in Alaska identified as having high potential for agricultural development which have a predominance of permafrost soils.*

U.S. Fish and Wildlife Service

The non-regulatory definition that the FWS uses defines wetlands in the following way:

Wetlands are 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 non-soil and is saturated with water or covered by

shallow water at some time during the growing season of each year (Cowardin et al., 1979).

N.R.C. Reference Definition

Besides these official definitions, the National Research Council's Committee on the Characterization of Wetlands¹ developed a reference definition in 1995. This scientific definition falls outside the mandate of any particular federal agency, policy or regulation. It states:

A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features will be present except where specific physiochemical, biotic or anthropogenic factors have removed them or prevented their development (National Academy of Sciences, 1995).

Michigan

According to part 303 of Michigan's Natural Resources and Environmental Protection Act (P.A. 451,

1994), which replaced the Goemaere-Anderson Wetland Protection Act, a wetland is:

Land characterized by the presence of water at a frequency and duration sufficient to support and that under normal circumstances does support wetland vegetation or aquatic life and is commonly referred to as a bog, swamp or marsh and is any of the following:

(i) Contiguous. to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or stream.

*(ii) Not contiguous to the Great Lakes, an inland lake or a pond, or a river or stream; and **more than 5 acres** in size; except this subdivision shall not be of effect, except for the purpose of inventorying, in counties of less than 100,000 population, until the department certifies to the Commission of Natural Resources it has substantially completed its inventory of wetlands in that county.*

*(iii) Not contiguous. to the Great Lakes, an inland lake or pond, or a river or stream; and **5 acres or less** in size if the department determines that protection of the area is essential to the preservation of the natural resources of the state from pollution, impairment or destruction and the department has so notified the owner; except this subdivision may be utilized regardless of wetland size in a county in which subdivision (ii) is of no effect; except for the purpose of inventorying at the time.*

Land Use Trends

This chapter presents a summary of the current status of wetlands, trends in conversions and alterations, and linkages between wetland losses and resource degradation. Many or most environmental concerns or problems originate in land use, and the need for concerted efforts to protect wetlands is no exception. Many areas in Michigan are in the midst of significant land use change because of population growth and demographic change. Increasingly, Michigan's citizens, elected officials, planning professionals and scientists are expressing concerns about the impacts of urbanization — expansion of residential, commercial, transportation and industrial land uses — on open space, resulting in a rapid conversion of prime farmlands, wetlands and woodlands, and environmental degradation (Schultink and van Vliet, 1997). Significant declines in wetlands and other sensitive land and water resources from such change are imminently possible unless greater efforts are undertaken to appreciate and preserve wetlands' important qualities.

Wetland Loss and Protection

The EPA estimates that the lower 48 states contained about 103.3 million acres of wetlands in the mid-1980s (an area the size of California). An estimated 170 million to 200 million acres of wetland exist in Alaska — covering slightly more than half of the state — while Hawaii has 52,000 acres. Next to Alaska, Florida (11 million), Louisiana (8.8 million), Minnesota (8.7 million) and Texas (7.6 million) have the largest wetland acreages. In the 1600s, more than 220 million acres of wetlands are thought to have existed in the lower 48 states. Since then, extensive losses have occurred, and over half of our original wetlands have been drained and converted to other uses. The years from the mid-1950s to the mid-1970s were a time of major wetland loss, but since then the rate of loss has decreased.

Recent estimates of wetland trends on non-federal lands indicate a loss rate of between 70,000 and 90,000 acres annually, in spite of a federal policy objective of "no net loss". The drainage of wetlands for agricultural

¹The National Research Council is an organization founded by the National Academy of Sciences in 1916.

purposes has continued to decline because of federal farm policies that discourage drainage and encourage restoration, more effective governmental regulation, landowner stewardship, acquisition and protection of sensitive environmental areas, and an increase in state, tribal and local wetland programs.

In addition to these wetland losses, many wetlands suffered degradation of functions, though calculating the magnitude of that degradation is difficult.

The combined impacts of loss and degradation have greatly diminished our nation's wetland resources and the public benefits they represent. Consequences include reduced protection against flood and drought damage, impacts on water availability and quality, declining bird populations, chemical contamination and eutrophication.

The major causes of wetland loss and degradation by human interventions include drainage, dredging and stream channelization, deposition of fill material, diking and damming, crop management practices, logging, mining, construction, increased runoff, air and water pollution, increased nutrient and toxic chemical loadings, introduction of non-native species and overgrazing by domestic animals. In addition to these human causes, natural threats include wind and water erosion, land subsidence, sea level rise and natural disasters.

The U.S. Fish and Wildlife Service (FWS) has estimated that 53 percent of all pre-European settlement wetland acreage in the lower 48 states has been lost to other land uses (MSPO, 1995). Despite federal and state regulatory goals for no net loss in wetland acreage, in 1989 the FWS estimated that wetland losses continued at a level as high as 450,000 acres annually, predicted to result in an additional loss of 4,250,000 acres by 2000 (Salvesen, 1990). Michigan's decline in wetland acreage has kept pace with this national rate, and, when including the important stock of coastal wetlands adjacent to Michigan's Great Lake shorelines, the loss amounts to 70 percent (MSPO, 1995). The loss is approximately 20,000 acres annually in the Great Lakes Basin. Of Michigan's estimated original 11.2 million acres of wetlands, approximately 5.5 million remain (MSPO, 1995).

The importance of local involvement in jurisdiction over wetland use is borne out by the ownership in lands containing or contiguous to wetland ecosystems. In Michigan, 75 percent of all wetlands are in private ownership, as is the case for the majority of wetlands in

most states. The impetus for most land use decisions involving issues of public health and quality of life rests with local government, enabled with broad police powers with respect to the interpretation of private property (land and water) rights. A significant percentage of the accumulated acreage of wetlands drained or filled consists of incremental acreage that, because of its limited size, is excluded from protection by statutes regulating development activities including and surrounding wetlands. The erroneous notion exists that the importance of a wetland increases with size and that relatively small wetland ecosystems are not as worthy of preserving and, because of their numbers, too cumbersome to regulate.

Part 303 of the wetlands protection section of the 1994 Natural Resources and Environmental Protection Act (P.A. 451) exempts from state protection all wetlands less than 5 acres that are not contiguous to lakes or streams or deemed "not essential" to the state of Michigan. For counties of less than 100,000 people, the protection of wetlands of less than 5 acres is delegated, on a non-mandatory basis, to local authorities and subject to the presence of a wetland inventory. Therefore, local governments have a unique opportunity and responsibility in filling the regulatory gap in policing and protecting their unregulated wetlands and strengthening their role in managing all wetland resources and the public values they represent.

Causes of Wetland Loss

The vast majority of wetland drainage took place in the early settlement activity of town building in the 19th century and later as increased agricultural production and technology required larger and more tillable farm parcels. Drainage for agricultural purposes continued to account for upwards of 90 percent of all wetlands conversions until federal legislation, such as the Swampbuster provision of the 1985 Farm Bill, recognized the need to curb agriculture-related wetlands drainage and provided incentives to halt such practices. Conversions to agricultural use dropped to 54 percent after this time, and since 1985, commercial and other urban development has accounted for more than 50 percent of wetland destruction. An Environmental Protection Agency survey echoes this trend, with nearly 90 percent of reporting states listing urbanization as the leading threat to wetlands in their regions (Fig. 1).

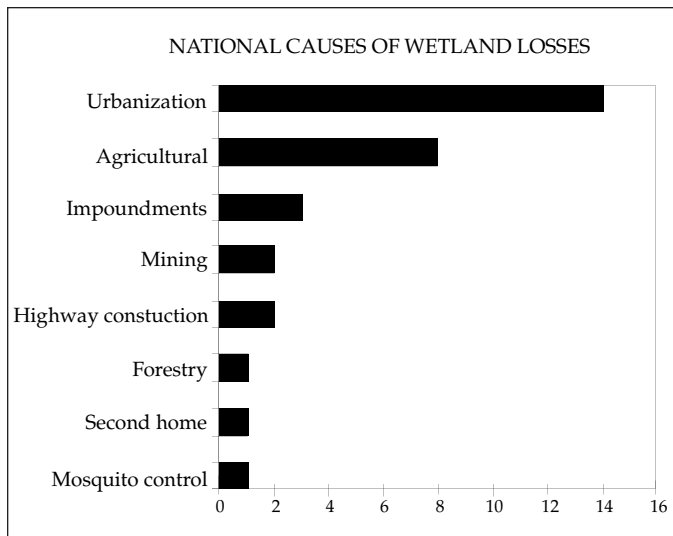


Figure 1. Causes of wetland loss (USEPA) (millions of acres).

Estimating Environmental Degradation and Loss of Wetland Functions

Increasingly, environmental impacts associated with these land use conversions are becoming a significant concern in urbanizing and rural regions alike. Impacts vary from overextraction of groundwater resources by residential wells, groundwater contamination by nitrates and phosphates from private septic systems, contaminated runoff caused by pesticide and fertilizer applications on golf courses and residential lawns, contamination from industrial and commercial acreage, and toxic substances from poorly designed landfills. In addition, land conversion reduces groundwater recharge rates, increases surface water runoff and flood risks, reduces open space and ecosystem habitat, and limits opportunities for recreation and tourism. The EPA lists sedimentation and salinity impacts as the most frequently reported water quality effects of disturbed wetlands, followed by the presence of metal, pesticides, hydrological modification, nutrients and dissolved oxygen.

Urbanization and Wetland Ecosystems

The Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA) estimated from an extensive nationwide sample of “fast growth” counties between 1970 and 1980 that 3.2 percent of new urban land area was in wetlands prior to conversion. It is unknown how representative this sample is of Michigan counties, but the results nonetheless illustrate the significant potential for urban growth to destroy

wetlands. The majority of new urban land use in areas not already platted or annexed by municipalities is for single-family residences.

As substantial as the initial conversion of wetlands into urban uses may seem, the negative secondary impacts on remaining wetlands within the new mosaic of urban land uses may be the most critical factor in considering the need for a community wetland protection strategy.

This impact on wetland ecosystems and other critical habitat is not simply a matter of conversion. The transformation of rural land to residential uses — the dominant endpoint for most land conversions in rural areas — or urban uses in general increases the likelihood that aquatic ecosystems will suffer irreversible impacts from development. In addition, the ecological viability of wetlands and their relationship to other critical habitats depend on uplands that extend far beyond the official wetland boundary. Increases in impervious surfaces in adjacent uplands, such as conversion of wooded or old-field areas to structures, lawns and parking lots, can cause important changes in local hydrology, triggering secondary impacts on wetland hydrological regimes that range from insignificant to catastrophic. Plant communities adapted to the natural hydrological regime commonly undergo substantial changes following the alteration of runoff characteristics of adjacent uplands.

Wetland-dependent wildlife species may be equally dependent on adjacent upland for a critical stage in their life cycle. The nesting activity of some waterfowl species, such as mallards and the blue-winged and green-winged teal, for example, occurs not in wetlands but in connected grassy or brushy areas. Other waterfowl species that nest in wetlands may be vulnerable to increased peak flows and high water level fluctuations that commonly follow urbanization of watersheds.

It is also important to note that ecosystems classified as wetland provide critical habitat to 30 percent of the state’s endangered plant species and 60 percent of endangered animal species as well as spawning, nesting and feeding grounds for numerous fish, reptile, mammal and migratory bird species (MSPO, 1995). Unfortunately, state wetland protection regulations ignore these critical wetland/upland interrelationships and do not extend beyond the wetland boundary. In addition, Michigan law authorizing local wetland protection ordinances has been interpreted as prohibiting local governments administering such regulations from extending their authority beyond the

land/water interface. Neither state nor local regulators are authorized to prohibit the removal of vegetation, which is so essential in determining the characteristics and values of wetlands.

Typically, a substantial portion of land converted to urban uses was formerly in agricultural use, and much of these areas consisted of drained wetlands. Urbanization of agricultural lands, then, reduces available acreage well suited for wetland restoration. Large rural tracts in Michigan may also contain small, isolated wetlands that, though viable in an agricultural setting, may be severely degraded by adjacent land uses.

The presence of relatively strong state and federal wetlands protection programs with broad goals for wetland protection may mask the nature and location of actual wetland losses. A recent study of wetland losses in Ottawa County, one of western Michigan's rapidly urbanizing counties, indicated that, though the overall change in wetland acreage was small, some townships showed significant loss. Most of the loss involved forested wetlands. From a watershed perspective, complying with a nebulous policy of "no net loss" may actually obscure critically important losses of certain vulnerable and more unique wetland types. Though the quantity of the wetland resource may appear undiminished, the quality may effectively have been substantially degraded.

The fact that roughly 5 percent of total U.S. acreage is in wetlands may not impress upon some the need for conservation or preservation. But increased urbanization pressure on open space, forestland and farmland is not simply a matter of reduced wetland acreage. Increased net conversion of rural land to residential and other urban uses increases the likelihood that aquatic ecosystems will suffer negative impacts from development, whether directly through drainage/filling or by way of effluent discharges or runoff from impervious surfaces and lawns. Many developers of commercial and residential property recognize the aesthetic, if not the functional, benefits of developing around rather than over wetlands; others are restricted from significant disturbance of wetlands by state and local regulations. But wetland ecology involves more than that area of soils saturated or covered with water permanently or periodically. Most state statutes regulating wetlands use do not prohibit the removal or alteration of rare trees and plants that may be integral, defining attributes of a wetland ecosystem.

At the national level, land for residential purposes was the component of urban land with the largest increase between 1970 and 1980 (Vesterby et al., 1994). An equal percentage of residential land (36 percent) during the decade was in prior forest and open space use as was in agricultural use. Most of the wetland portion of farmland might already have been drained for cultivation reasons before conversion to residential use, but the same cannot be assumed for forest and open space land, the location of countless smaller shrub and forested wetlands. On many large rural parcels, wetlands may remain after home construction, but the tendency toward heavy applications of fertilizers and herbicides on residential lawns and the removal of some of the wetland edge by mowing may threaten the functional quality of wetlands, if not their actual existence.

Changes in Michigan's Landscape

Beginning in the 1960s, the pattern of land development in Michigan began to change markedly. Compact urban development on small lots gave way to larger lots dispersed across the countryside. Commercial development also began to change, with the concept of the "shopping center" replacing the downtown commercial districts that had previously characterized communities. Even before the term found its way into common usage, the trend toward "urban sprawl" had begun in earnest.

The positive and negative aspects of sprawl development are the subjects of considerable debate. The decay of older urban communities is an obvious result of sprawl development, as are the losses of farmland and forestland and the increasing problems related to traffic and public services. Conversely, sprawl development is being driven by high consumer demand. A recent survey of Michigan residents indicates that nearly half of the respondents desire large-lot residences and dispersed rural development (Public Sector Consultants, 1997). Commercial and industrial development must of necessity follow the workforce to compete for business and skilled labor. Sprawl, then, creates its own spiral effect, with development following development and in turn pushing the urban boundary farther out into the countryside. In the 1980s and 1990s, urban sprawl became rural sprawl, converting rural areas on the urban periphery into large residential lots of 5 to 10 acres, converting agricultural land at an increasing rate.

Curiously, while planners and local government officials acknowledge urban sprawl as a serious problem, the issue attracted little attention from policy-makers at the state and federal levels until the late 1990s. Recent legislative initiatives to address local land use controls and growth management concerns, however, have rarely progressed beyond initial discussions.

Urbanization and Wetland Ecosystems in Michigan

The rapid and relatively uncontrolled growth commonly known as sprawl manifests itself in several ways. MUCC (1993) identifies typical indicators and discusses in detail the critical issues these phenomena present. Among the more noteworthy:

- Sprawl is primarily associated with population shifts rather than population growth.
- The number of households is increasing faster than the population.
- The population moving to rural areas tends to consist of younger, more affluent families with a high demand for services, while the population remaining in urban areas is disproportionately composed of elderly persons and minority residents.
- There is a clear correlation between sprawl and the conversion of farmland to other uses.
- New residential development in rural areas tends to occur on large lots, with many lots created in the 5- to 20-acre range.
- Rural local government frequently lacks the resources and expertise to deal effectively with increasing development pressure.
- Rural development tends to create increasing demands on transportation and public infrastructure, necessitating publicly financed improvements that in turn induce more development.
- Rural development inevitably results in decreased environmental quality and the fragmentation of habitats.

Though this particular study was limited to the Saginaw Bay watershed in east central Michigan, the results reflect trends across the state. Other similar studies have provided comparable insights. A Southeast Michigan Council of Governments study (1993) of regional growth trends indicates that, by the year 2020, a 6 percent population increase in that region will result

in a 40 percent increase in land in urban uses. A statewide analysis of growth trends by the Michigan Society of Planning Officials predicts similar results in rural areas surrounding most urbanized areas in Michigan (MSPO, 1995).

Much attention has been and is being given to reports of the present and possible future effects on the natural resource base from heightened migration from urban and suburban centers of population and commerce to more rural areas. Available data at the state and national levels regarding this phenomenon are increasing. Two of the most important trends are changes in household size and the reversal of the rural-to-urban migration trend dominant only a few decades ago. The Michigan Society of Planning Officials (MSPO) Future Trend Study and the Southeast Michigan Council of Governments (SEMCOG) both project increases in rates of urban land area that markedly outpace the rate of population growth in the next 25 years (MSPO, 1995).

According to a study by the USDA's Economic Research Service, the acreage of land conversion for urban purposes per household has not risen significantly, but rather the number of households has risen more dramatically than population because of decreasing household size (Vesterby et al., 1994). The consumption of land for urban uses in more rural counties is also double that of urban counties, nearly 1 acre per household compared with 0.5 acre in counties classed by the Census Bureau as metropolitan statistical areas (MSA).

In the early stages of growth, before rising land prices bring about a leveling off or lowering of urban area to household ratio, land consumption for new population growth and migration is even greater (Vesterby et al.).

At the core of this issue is the conversion of rural space, including wetlands, into residential lots resulting from new settlement patterns. Estimates of the proportion of additions to urban land area composed of new residences vary, depending on the extent of present development. In the most rural township sections, the proportion of new urban land use devoted to single-family homes is likely very high. The trend toward larger, more scattered rural residential lots with self-contained water and sewer service is well documented in Michigan (Bennett, 1986; Norgaard, 1995; Arthur, 1981).

A recent survey of land parcels with new residential development in rural areas of Ottawa County indicates that the average residential lot is 5 acres.

Revisions to the Subdivision Control Act (Land Division Act) may result in increases in the number of large residential parcels created in rural areas, depending on the reaction of local planning and zoning entities to the new legislation.

The management of urban growth is an issue that transcends concerns about the protection of wetlands and other environmental resources. It involves the entire breadth of public policy debate, from public investment to quality of life. It is clear, however, that the protection of wetlands has not been adequately incorporated into the decision process for a variety of reasons.

The remainder of this report is dedicated to providing communities with a clear understanding of the pervasive threats to the wetland resource, the benefits that wetlands provide to community residents, and, most importantly, the tools to develop and accomplish realistic wetland protection goals. This analysis is based on the understanding that:

- Wetlands are valuable community resources deserving of protection.
- Wetland protection and development are not inherently incompatible.

Historic Wetland Trends in Michigan

It is estimated that wetlands once covered about 31 percent of Michigan's land area (Shaw and Fredine, 1956). Estimates of wetland losses range from about 40 percent to as high as 80 percent, with the most credible estimate, that of the U.S. Fish and Wildlife Service (Tiner, 1984), being about 50 percent. Beginning in the earliest days of European settlement, wetlands were filled and drained as a matter of public policy to stem the spread of malaria and to make lands suitable for agriculture and human habitation.

Recognition of the critical need for drainage in Michigan is reflected by the fact that laws facilitating public drainage projects date back to the earliest days of statehood (MSA, 1997). Most of the state's historic wetland loss can be attributed to drainage for agricultural purposes under the Michigan Drain Code, facilitated in part by federal homesteading incentives (MDEQ, 1997). By 1910, 80 percent of Michigan's extensive network of artificial drains had been established.

As agricultural drainage slowed in the early part of the 20th century, wetland losses for other purposes began to increase. Depression-era programs under the

Works Progress Administration led to the drainage of thousands of wetland acres for malaria control. By the 1950s, when wetland conversion for agriculture and public health purposes had slowed considerably, conversion for residential, commercial and industrial development continued. Conversion for development purposes is now the dominant cause of wetland loss in Michigan (Dahl and Johnson, 1991).

The organized and publicly funded focus on wetland conversion has been remarkably effective. Since presettlement times, more than 5 million wetland acres have been altered to the point that they no longer exhibit wetland characteristics (Dahl, 1990). Wetland losses have not been uniformly distributed throughout the state. For example, Great Lakes coastal marshes have been reduced by over 70 percent (MDNR, 1990), while forested wetland types have sustained losses in the 25 to 35 percent range.

Michigan land use/cover data from recent surveys indicate that the distribution of remaining wetlands and the predominance of wetland types vary considerably throughout the various regions of the state (MDNR, 1994). The data, based on aerial surveys, are thought to be of questionable accuracy, but they nonetheless illustrate general trends in wetland losses from urban southeastern Michigan to the undeveloped counties in the Upper Peninsula. In Luce County, in the central portion of the Upper Peninsula, slightly more than 45 percent of the total land area is classified as wetland. Southeastern Michigan's Wayne County, heavily urbanized, contains only 6.1 percent wetland cover. Regionally, it is estimated that almost half of the state's remaining wetlands are found in the 15 counties of the Upper Peninsula. Detailed site-specific information is available from a review of Michigan Land Office records dating back to the original state surveys. Surveyors laying out the 1- by 1-mile section grids that would eventually become the typical 6- by 6- mile townships and 36- by 36-mile counties kept detailed notes on vegetation and hydrology, which can be correlated with modern habitat types. The Michigan Natural Features Inventory conducted a detailed analysis of these records (MNFI, 1996). Correlation of this information with current land cover data, including Michigan Resource Inventory System (MIRIS) aerial surveys, National Wetland Inventory maps and other sources, indicates former wetland areas and verifies the more recent information. The former wetlands identified in the MNFI study may also provide an inventory of wetland restoration opportunities.

Threats to Michigan's Remaining Wetlands

Current estimates indicate that Michigan retains between 5.5 million and 6.5 million acres of wetlands. Many of these wetland resources lie within heavily urbanized or rapidly urbanizing counties, making immediate and decisive action to provide for their protection imperative. For example, Livingston and Oakland counties, two of the most rapidly developing counties in Michigan, still contain an estimated combined total of nearly 120,000 acres of wetlands (MDEQ, 1997). Wayne County, one of the most populous counties in the Great Lakes region, still retains more than 24,000 acres of wetlands, some of which are globally rare habitat types (MNFI, 1995). Continued development in these areas, and in other developing areas across the state, will threaten the continued viability and perhaps even the existence of these unique resources.

Threats to wetlands in developed and developing areas come in many forms. The most obvious potential impact is the direct draining or filling of wetlands to provide building sites, roads and parking areas. Clearly, when these impacts occur, an entire range of wetland functions and values is eliminated, often without any opportunity for restoration. The issue of detrimental impacts on the function of wetlands remaining was discussed earlier in this chapter but warrants revisiting briefly here. Even under an aggressive regulatory protection program, wetlands left relatively intact while

adjacent uplands are converted to urban uses frequently undergo substantial hydrological changes that can lead to degradation of many wetland functions and values. Isolation of wetlands from other wetlands or from important upland habitats may have profound and unanticipated impacts on their habitat characteristics.

An additional threat to wetlands not previously discussed but nonetheless potentially significant is the pervasive threat of additional impacts or conversions after the "first wave" of development occurs. As the urban fringe pushes farther outward, economic development considerations may change the way a community views wetlands and open space, increasing the impetus for additional wetland conversion. In addition, infrastructural improvements such as highway expansions, utility corridors and others may trigger wetland impacts that were unforeseen at the time original land use decisions were made.

The protection of important wetland resources presents a community with a range of challenges that will require innovation, creativity and commitment. For local wetland protection to be effective, it must be carefully planned, widely supported and effectively executed. It must also involve a range of techniques from regulation to public education. This publication is designed, in part, to provide community decision makers with a concise introduction to the nature and critical importance of wetland protection and an overview of the current state of the practice of wetlands protection at the local level.

Wetland Functions/Values

Classification of Wetlands

Numerous schemes for organizing wetland types into classes have been proposed.

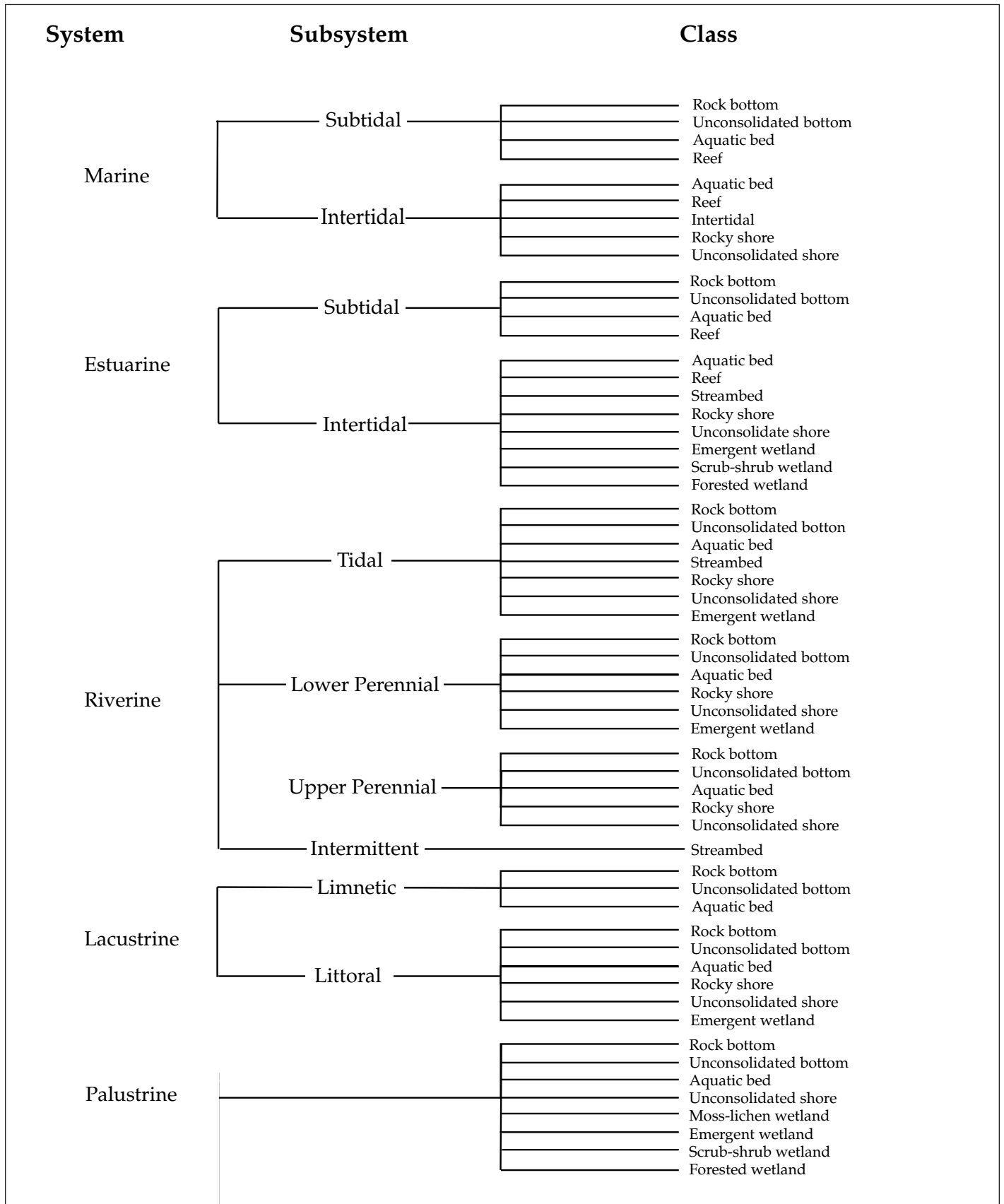
A detailed summary of these schemes would reveal a wide divergence of opinion on wetland typology and a confusing array of terms for wetland attributes, many of which prove to be interchangeable. Mitsch and Gosselink (1986), for example, list 15 terms in common usage, many of which mean different things in different regions.

It is not necessary to adopt a classification system to protect wetlands effectively, but a standardized classification system does provide a common language with which to discuss community perspectives on wetland values and to lend clarity and certainty to regulatory decisions or expressions of community priorities.

By far, the most extensively used wetland classification is that created by Cowardin et al. (1979) for the U.S. Fish and Wildlife Service. Its purpose is to classify and inventory wetlands and other aquatic habitats on a national scale. The National Wetlands Inventory is based on this system. But despite the detail and broad acceptance of this system, its creators acknowledge that there is no single, indisputable, ecologically sound classification system because of the very nature of wetland habitats and the legitimate scientific debate about the precise line of demarcation between aquatic and terrestrial habitat characteristics.

The Cowardin system is hierarchical in nature, involving the differentiation of habitats into systems, subsystems, classes, subclasses and dominance types (Figure 2). Of the five systems, two are associated with saltwater habitats and do not occur in Michigan. The remaining three — Riverine, Lacustrine and Palustrine

Figure 2. Classification hierarchy of wetlands and deepwater habitats, showing system, subsystems and classes. The Palustrine system does not include deepwater habitats (Cowardin et al., 1979).



— encompass the wide range of wetland habitats found across the state.

The basis for classifying aquatic habitats under the Cowardin system is the way in which soils, plants and animals reflect the presence of water. The soils and hydrology generally provide the foundation for most wetland delineation methodologies, including those employed by state and federal regulatory agencies. In general, soils will respond in identifiable and predictable ways to regular intervals of saturation, and the plants adapted to those soils are also markedly different from plant communities inhabiting upland sites. Detailed discussion of wetland delineation and evaluation techniques is provided in the section on wetland analysis and evaluation.

The classification of wetlands within the context of a local wetland protection strategy can be an important precursor to identifying priorities and evaluating progress. The Cowardin system was developed for use across the United States and thus involves a high level of detail and includes many wetland types not found in Michigan. It enjoys wide acceptance and is supported by a tremendous body of research, but it is by no means the only classification system available. For the purpose of community wetland protection, a simpler system aggregating wetland types into fewer, broader categories may be far more appropriate.

Michigan's wetland resources fall into four broad classes separated by differences in plant communities, hydrology, water chemistry and soil types.

Marshes are wetlands dominated by grasslike vegetation such as cattails and reeds, are typically frequently or permanently flooded, and have organic soils. This wetland type is the one most commonly recognized by the general public as a wetland and is frequently the most highly valued from an economic and recreational perspective. They serve as important breeding and feeding grounds for waterfowl, wading birds and furbearing animals. Because they are typically (though not always) associated with lakes and streams, marshes also provide important flood control benefits.

Swamps are similar to marshes except that they are dominated by woody rather than grassy plant types. The three classes of swamps common in Michigan are the conifer swamps, dominated by northern white cedar, tamarack and black spruce; hardwood swamps, characterized by elms, maples and ashes; and shrub-scrub swamps indicated by speckled alder, willows or dogwoods. Swamps are also frequently associated with lakes and streams but are more likely to occur in isolation from surface waters. Like marshes, they are

characterized by frequent flooding and rich, organic soils. The habitat value of swamps is often highly interrelated with adjacent upland and open water habitats. Most wetland habitats are high in productivity, but bogs are the exception.

Bogs exhibit low productivity, acidic peat soils, and little inflow or outflow. They support plant communities highly adapted to such conditions and are characterized by mosses and low-growing shrubs such as leather leaf, blueberry and cranberry. Many species of orchids are also adapted to bog conditions. Though bogs are relatively low in productivity and provide generally poor wildlife habitat, they are often valued for their uncommon biological characteristics and for the unusual and highly adapted plant communities found there.

Fens, the final class of Michigan wetland, are highly variable habitats characterized by mineral soils and a direct connection to groundwater or surface water. They share many characteristics with bogs and often house similar plant communities. A relatively common fen type in the Great Lakes region is the wet meadow, which is dominated by reeds, grasses or sedges. Wet meadows receive groundwater inflows that have passed through mineral soils and are therefore richer in nutrients and less acidic than bogs. Trees or shrubs dominate other fen types. Because fens do not fit the common public image of wetlands and are often similar to adjacent upland habitats, they are often overlooked. They present difficulties in identification and delineation, but they are important wetland habitats that should be considered in local wetland protection strategies.

Functions vs. Values

Functions and values are attributes of wetlands that are discrete but related. The functions performed by a particular wetland will influence the value placed upon it by society. Conversely, some functions — aesthetic quality, for example — are primarily value-related. Frequent interchangeable use of these terms is misleading.

Wetlands have *functions* irrespective of human preferences or desires. They cannot, however, have *values* independent of human preferences. The paradox facing decision makers contemplating protection of wetlands is that typically the relative values of wetland types and functions dominate the policy debate, but the functions are more easily understood and quantified.

Even when two wetlands share the same general

function, their relative value to a community can often be perceived as quite different. For example, virtually any wetland will provide some measure of flood control, but the value of this function depends highly on site-specific factors such as location and storage capacity. All wetlands provide habitat for plants and animals but may be valued differently because of the popularity or economic importance of the species found there. The highly adapted and uncommon plant community of a bog or fen, for example, may be valued less than the waterfowl production of a marsh, despite the fact that bogs and fens are far less prevalent and the species found there comparatively rare.

Value-based biases in a wetland protection program can be minimized if it includes among its objectives the preservation of biological diversity. Valuing any habitat on the basis of relative rarity of its inhabitants can serve environmental protection goals far beyond those of a local wetland protection strategy.

Functions differ from values in the sense that they represent performances or changes in wetland ecosystems via physical, chemical and biological processes and are typically verifiable by investigation. Examples of land use effects on wetlands are listed in Table 1. Values are the subjective appraisal of public,

private and intrinsic goods that are enjoyed or recognizable features of wetland resultant from the functional processes. The multiplicity of values inherent in wetland functions allows people to recognize and enjoy distinct benefits while taking care not to alter the natural processes of functions.

Understanding the diversity of functions and values and the identifying characteristics of wetlands allows for direct determination, by way of observations (presence of species, hydrologic characteristics) and surveys, etc., of the relative importance of functions and the most important preferences behind public support for wetlands protection. This is part of the critical information necessary for considering the variety of possible land use decisions that may affect wetlands in your area. This topic will be dealt with in greater detail in the discussion of relative functions and values assessment in the section on wetland analysis and evaluation.

Land use choices are listed in Table 1. Many of these activities can be (and already are in many areas) included in the zoning or drain commission ordinances with which development site plans must comply.

Table 1. Land use impacts on wetlands.

Wetland Enhancement		Harmful Wetland Impacts	
Activity	Effect	Activity	Effect
Buffers/greenbelts (50-300 feet)	Uptake of nutrients; erosion prevention; wildlife corridors	Water impounding or conveyance	Changes in vegetation/habitat; reduce flood storage and conveyance
Nest boxes or platforms	Safe nesting areas (mosquito control)	Draining	Partial or complete loss of habitat; loss of sedimentation and nutrient retention
Minimize impervious surfaces, grass-lined swale	Control stormwater runoff (water quality/quantity)	Dredging	Hydrologic changes; less aquatic flora, fauna
Install fencing	Protect wetlands from livestock or human use (e.g.: ORVs)	Filling (including landscaping and bulkheads)	Increased runoff; reduced water quality; loss of nursery habitat
Reduce or replace pesticide / fertilizer use	Reduce toxic runoff; algae blooms	Vegetation clearing	Erosion, sedimentation; habitat loss; hydrologic modification
Biotechnical erosion (shoreline) control	Avoid reduction in wetland habitat by replacing use of bulkheads and rock riprap methods	Introduction of non-native plant species (e.g.: purple loosestrife)	Outcompete native species; do not support wetland fauna
Maintain septic systems	Reduce water (including groundwater) pollution		

Critical Wetland Functions

Wetlands represent one of the most important landscape elements in preserving environmental quality. Wetlands protect surface and groundwater quality and quantity, contribute to habitat diversity, assist in flood protection, and provide erosion and sedimentation control.

Wetlands are the most productive biological ecosystems in the temperate regions. They provide tremendous economic benefits to people through their production of fisheries resources, maintenance of water tables for agriculture, timber production, water storage and reduction of natural impacts such as watershed flooding and shoreline erosion. According to Environment Canada (1997), wetlands have been estimated to provide more than \$10 billion a year in benefits to Canadian society (Schultink and van Vliet, 1997). Wetlands provide numerous ecological functions and values — serving as sinks for natural contaminants, heavy metals and other pollutants; enhancing water purification; and providing popular recreational and hunting areas.

Several wetland evaluation methods, including the New Hampshire, Oregon, Minnesota and WET II methods, concentrate heavily on wetlands' ecological and biophysical/chemical characteristics. Functions that they all share include:

- Water quality — groundwater use potential and nutrient/toxin retention and transformation.
- Hydrologic control — sediment stabilization or shoreline anchoring, flood attenuation.
- Biological — fish and wildlife habitat.
- Social functions — aesthetic, educational and recreational.

Wetland functions may be categorized into four broad categories (Williams, 1990):

- Physical functions: flood mitigation, coastal protection, sediment trapping and climatic functions.
- Chemical functions: pollution trapping, removal of toxic residues and waste processing.
- Biological functions: productivity and provision of habitats.
- Socioeconomic functions: food production (fish, fowl and fauna), and recreational and aesthetic benefits that are difficult to quantify.

Physical Functions

Wetlands in low-lying areas have an important water storage and peak-flow retention function, especially during severe rainstorms and during high water levels in the spring characterized by high soil moisture balances because of low evapotranspiration rates, high precipitation and melting snow. As seen in Figure 3, peak runoff is reduced, thus curtailing flood risk.

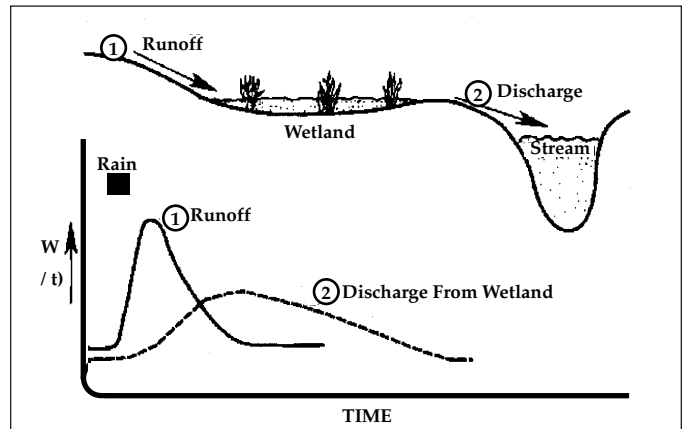


Figure 3. The general effect of wetlands on stream flow (Source: Mitsch and Gosselink, 1993).

Development in floodplains and associated wetlands reduces water storage capacity and increases flood risks. Many agricultural tile drains also direct storm runoff directly to already swollen streams instead of allowing it to infiltrate into the deeper soil profile. The large-scale (up to 85 percent) removal of wetlands in Illinois and Iowa, much of it for increasing tillable acreage, is thought to be partly behind the extent of the 1993 flooding along the Mississippi River. In general, the function of flood abatement seems undervalued — floodplain development is the most significant cause of wetland destruction (Darnay, 1994). Coastal wetlands can absorb most of the destructive power of storm surges. A 30-meter (about 100 feet) wetland buffer is enough to dissipate most wave energy. At the same time, wetland vegetation, with its complex root systems, protects against erosion (Mitsch and Gosselink, 1993; Kusler, 1983; Williams, 1990).

Chemical Functions

Wetlands perform an important function in maintaining water quality by recycling and accumulating nutrients, trapping sediments and transforming a variety of toxic chemical substances (Mitsch and Gosselink, 1993; Kusler, 1983; Williams, 1990). Some communities are using wetlands to treat tertiary wastewater as well as stormwater. In the DesPlaines, Ill., River Wetlands Demonstration Project,

experimental wetlands have been shown to trap more than 80 percent of sediments and nutrients contained in the incoming river water.

Biological Functions

The presence of wetlands is highly correlated with biodiversity. Wetlands represent a fertile breeding habitat for many species of flora and fauna, and many plants exist only within wetland ecosystems. Scientists estimate that 150 bird species and 200 fish species depend entirely on wetland ecosystems (Berhart and Margin, 1994). Of the 97 species that have become extinct since 1600, approximately one-third were wetland birds. Of species vulnerable to extinction, 16 percent are wetland birds (Buisson, 1994). Coastal wetlands are used as nursery grounds for many fish species that feed on wetland-dependent food. Nearly two-thirds of the U.S. commercial and saltwater fish catch probably depends on the coastal estuaries and their wetlands (Williams, 1990). Cwikiel (1992) points out that nearly 40 percent of Michigan's endangered plant species can be found in wetland ecosystems and that one-third of all endangered or rare animal species live in or depend on wetlands.

The most well known biological wetland function is serving as wintering and breeding grounds for migratory birds. Scholars have discovered a strong correlation between the diminution of numbers of migratory birds and the reduction of wetlands through drainage and cultivation. The breeding and wintering areas of migratory birds are linked by several flyways. The presence of small stopover wetlands along these flyways is crucial to the survival of migratory birds (IEEP, 1991), which, according to a Fish and Wildlife Service inventory, number more than 23.3 million (Williams, 1990).

Wetlands frequently provide critical habitats for many species of plants and animals. Many of these species are highly specialized and therefore comparatively rare. In fact, a preponderance of plants and animals listed as threatened or endangered by the U.S. Fish and Wildlife Service according to the provisions of the federal Endangered Species Act depend on wetland habitats for at least a portion of their life cycle. A recent report by the National Wildlife Federation indicates that almost two-thirds of species so listed are at least associated with, if not dependent on, wetland resources.

Many economically important wildlife species are also critically dependent upon wetlands. Waterfowl

and furbearing mammals produced by North American wetlands are valued in the billions of dollars annually. Wetlands also produce economically important forest resources and specialized agricultural commodities.

Functions Implicit in Michigan's Regulatory Statute

Increasingly, the public is becoming aware of the importance of wetlands in protecting both public and private interests by preserving or enhancing property values, protecting the environment and preserving recreational opportunities. In Michigan, for instance, wetlands are of great importance in replenishing the groundwater supplies of shallow aquifers in rural areas and can improve the water quality of residential wells by recycling and storing nutrients introduced by agricultural land uses and runoff from fertilized commercial and residential properties.

In allowing local governments to regulate wetlands that are not protected by the state, Michigan requires that local governments attest that one or more of the following functions exist at a wetland site (Section 30309, Part 303, Wetland Protection Act, P.A. 451 of 1994):

- (a) *Habitat for state or federal endangered or threatened plants, fish or wildlife.*
- (b) *The site represents what is identified as a locally rare or unique ecosystem.*
- (c) *The site supports plants or animals of an identified local importance. Groundwater recharge documented by a public agency. Flood and storm control by the hydrologic absorption and storage capacity of the wetland.*
- (f) *Wildlife habitat: breeding, nesting or feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.*
- (g) *Protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.*
- (h) *The site provides pollution treatment by serving as a biological and chemical oxidation basin.*
- (I) *Erosion control: sedimentation and filtering basin, absorbing silt and organic matter.*

The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

Wetland Values

It is difficult to clearly distinguish wetland values from functions. Values most typically are the goods that functions bestow for human use and enjoyment. The characteristics of wetlands that are beneficial to society are often considered “wetland values”. Values of wetlands are based on anthropogenic properties by which the wetlands are determined to be useful or impart public good. The value establishes a worth, excellence, utility or importance of a particular wetland function.

Valuation of wetlands and other resources — for instance, in activities requiring an environmental impact statement or economic valuation per Section 30311(e,i), Part 303 of the Wetland Protection Act (P.A. 451) — includes an economic valuation of market goods and services, a resource evaluation based on non-market goods and an environmental risk assessment.

Economic Valuation

This approach to quantifying wetland functions and values includes a comparison of the economic value of the wetland habitat with the economic value of some proposed activity that would have destroyed or modified it. This is commonly referred to as the opportunity cost of the foregone benefit of development — the best alternative use — in the case where a wetland permit is not issued.

Another way to quantify the values inherent in a particular wetland is to assess the replacement cost of lost functions when infrastructure has to be added. As an example, a study by Houck and Rolland (1995) indicated that a loss of 50 percent of America’s remaining wetlands would result in increased sewage treatment plant expenditures of up to \$75 billion for the removal of nitrogen alone. Additional replacement technologies for lost wetland functions and values appear in Table 2.

Table 2. Some replacement technologies for lost wetland functions and values (Mitch and Gosselink, 1993).

<i>Functions/Values to Society</i>	<i>Replacement Technologies</i>
Peat Accumulation Accumulating and storing organic matter	Artificial fertilizers Redraining ditches
Hydrologic Function Maintaining drinking water quantity	Water transport Pipeline to distant source
Maintaining groundwater level	Well drilling Saltwater filtering
Maintaining surface water level	Dams for irrigation Pumping water to dam Irrigation pipes and pumps Water transport for domestic animals
Moderation of water flows	Pumping water to streams Regulating gate
Biogeochemical Functions Processing sewage, cleansing nutrients and chemicals	Mechanical sewage treatment Sewage transport Sewage treatment plant Clear-cutting ditches and streams
Maintaining drinking water quality	Water quality inspections Water purification plant Silos for manure from farm animals Nitrogen filtering Water transport
Food Chain Functions Providing food for humans and domestic animals Species diversity: storehouse for genetic material Bird watching, sport fishing, boating and other recreation Aesthetic and spiritual values	Agricultural production and food imports Replacement not possible Replacement not possible
Sustaining fish species and wetland-dependent flora and fauna	Replacement not possible Work by non-profit organizations

Finally, valuation of socioeconomic benefits may be based on the real market price of goods and services produced by wetlands. These include food production (fish, fowl and fauna) and other animal products harvested or the revenue from local hunting or fishing expenditures that have some measurable connection to wetland habitat.

Zahniser and Kaplowitz (1994) indicate that “most wetland practitioners do not use any socioeconomic data/information or models/frameworks to make decisions concerning wetlands.” Decision makers more likely use their own personal knowledge and experience in determining the benefits particular wetlands provide to communities.

Non-market goods

The total value of an ecosystem comprises direct use values, such as recreation and research; indirect use values, which are non-consumptive values and are encompassed by functions such as groundwater recharge and flood attenuation; and non-use values, including biodiversity and intrinsic value or existence value (Zahniser and Kaplowitz, 1994). Many values, particularly the non-use values, are difficult to quantify because no market and attendant prices exist.

The second category of resource valuation involves some estimation of non-market goods and services, or societal benefits of wetlands not formally “traded” in the marketplace, such as flood protection, erosion and sedimentation control, preservation of biodiversity, and the provision of recreational opportunities or aesthetic considerations. This method of valuation often includes contingent valuation or the “willingness to pay” for a given commodity or service that typically has no directly associated cost or price. The assertion made earlier — namely, that wetland losses may not be easily compensated for by mitigation — is legitimate. This is partly due to the valuation placed on a particular wetland by individual(s), values that may not be computed in economic or biophysical terms but for which there may be a significant level of willingness to pay to continue enjoying the benefits.

Most township or municipal comprehensive plans today include some form of non-market valuation. This is usually in the form of a summary of citizen surveys on preferences for growth and preservation of essential economic, social and natural resources. Such surveys can include questions on the individual estimations on the important functions of wetlands as well as preferences on development and preservation and for expenditures and procedures warranted for preservation. A survey of citizen opinions from

Williamstown and Meridian townships in Ingham County, Mich., revealed that citizens of these townships would be willing to pay from \$11 to \$30 a year to protect wetlands and less than \$50 to replace each function lost (Ruby, 1997). Respondents from these townships felt that biodiversity and habitat for wildlife protection were the most important functions associated with wetlands.

Socioeconomic Values

Assessing the “real” public values of wetlands is one of the valuation challenges in resource economics. *Value*, in the context of assessing wetland resources, has different meanings to different users and specialists. To the general public, it may represent recreational opportunities such as hunting, fishing, boating or wildlife observation. To an ecologist, the value of a marsh may be its significance as critical breeding habitat. For a land use specialist or resource manager, it may be associated with shoreline stabilization, sediment reduction, flood control and groundwater recharge. All these values are based on the perceived use functions of wetlands, frequently well documented in the form of scientific evidence and theories, and often reflecting public perceptions and preferences based on experience, personal knowledge and *private interests*.

In this context, it is important to stress the fundamental purpose of impact assessment of land use alternatives on the sustained production capacity of renewable resources. It necessarily represents the broader, long-term *public interests* of multiple generations rather than the short-term monetary gains of narrowly defined *private interests*.

Placing an economic value on the loss of natural resources or expressing public preferences associated with impacts of policy changes or project alternatives on the natural environment is an objective of environmental valuation and resource economics. As such, it represents a fundamental distinction from other disciplines — attempting to reflect the functionality or public utility in economic terms. This economic value is a measure of the amount a user is willing to forego one set of alternative goods and services to obtain or maintain a particular set of goods and services, such as represented by a wetland. This concept is typically referred to as the *willingness to pay* (WTP) and reflects the lost value — a welfare measure or desire to maintain a habitat in its original, undisturbed functional or unpolluted state.

Economic theory and federal laws and regulations have progressed to address the challenges of economic valuation and public policy analysis. In the United

States, environmental valuation has its origin in the River and Harbor Act of 1902, requiring a systematic assessment of project benefits and costs to commerce. Other milestones of this legislative history include:

- The Flood Control Act of 1936.
- The national thrust to broaden valuation by the inclusion of intangibles and the environmental movement in the 1950s and 1960s. The National Environmental Policy Act (NEPA) of 1969, with its systematic impact assessment requirements.
- The Clean Air Act of 1970.
- The Clean Water Act of 1972.
- The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, including natural resource damage assessment.
- Executive Order 12291 of 1981 on regulatory impact analysis.
- The Oil Pollution Act of 1990.

The following legislation is specifically relevant to mandates associated with coastal and marine resource management and public policy:

- Section 404 of the Clean Water Act addressing the wetland permitting process necessary to convert wetlands for development. It charges the Army Corps of Engineers to assess public and private benefits and costs and, specifically, to take into account environmental values.
- Section 319 of the Clean Water Act, which establishes a national program on non-point pollution control.
- Section 6217b of the Coastal Zone Act Reauthorization Amendments of 1990, which requires that states with coastal management programs develop a coastal non-point pollution control program for approval by EPA and NOAA.
- The National Environmental Policy Act (NEPA) requiring federal agencies to assess environmental impacts of proposed legislation and “other major federal actions significantly affecting the quality of the human environment.” Subsequently, this authority has been extended to include any partially government-funded actions, even if carried out by the private sector, requiring an environmental impact statement (EIS). Though cost-benefit analysis is discussed under the NEPA, it is not required. When a cost-benefit analysis is conducted, discussion of the relationship between the analysis and the unquantifiable environmental impacts, values and amenities is mandatory.

- The Magnuson Fishery Conservation and Management Act of 1976 and its amendments requiring the preparation of fishery management plans under federal jurisdiction by fisheries management councils. This act requires cost-benefit analysis under the regulatory impact review component of the plan. To assist in this process, the National Marine Fisheries Service, under the auspices of NOAA and the Department of Commerce, provides guidance.
- The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) mandates the preparation of regulations to assess natural resources damage from oil spills or hazardous substances to compensate society for losses incurred prior to the full restoration of the natural resources.
- The Oil Pollution Act (OPA) of 1990 specifically mandates regulations for the assessment of damages from oil spills. Both CERCLA and OPA require the development of a systematic damage claim by which the values of lost resources and service flows, pending full restoration, are to be included. This may also include the value of wildlife and the existence value that society attaches to a natural habitat or wilderness area. These acts are rather comprehensive in the identification of valuation methods and the range and types of values that may be included.
- The Coastal Zone Management Act of 1972 identifies coastal resource uses subject to management that may require benefit-cost analysis. These include the siting of major facilities such as energy, commercial and industrial development, transportation and recreation.
- The Marine Protection, Research and Sanctuaries Act of 1972 (as amended) requires assessment of socioeconomic benefits derived from sanctuary designation in combination with an EIS, fisheries management guidelines and pollution regulations.
- The National Estuary Program (NEP), established under Sections 317 and 320 of the Water Quality Act of 1987 (amended to the Clean Water Act), directs the development of comprehensive conservation and management plans (CCMPs), which are critically dependent on the valuation of estuarine functions and services.

Valuation of socioeconomic benefits may be based on the real market price of goods and services produced by wetlands or, alternatively, on the so-called non-market goods and services and non-use value, such as aesthetic considerations. The first category is represented by socioeconomic benefits such as food production (fish,

fowl and fauna) and other animal products harvested. Another example includes forested wetlands as a source of fiber with high harvest volumes due to high productivity rates represented by bottomland hardwoods in the southeastern part of the United States. The second category, non-market goods and services, represents other societal benefits of wetlands not formally traded in the marketplace, such as flood protection, erosion and sedimentation control, preservation of biodiversity and the provision of recreational opportunities.

In assessing negative project impacts or cost, opportunity cost, representing (short-term) benefits foregone by not developing or exploiting wetlands, may be considered as well. Examples of these costs may include protection measures preventing the use of bogs for the production of cranberries or other forms of agriculture in reclaimed (drained) wetlands with excellent soils for certain specialty crops because of high organic soil content, acidity or nutrient supply. Historically, drained wetland soils have typically contributed disproportionately more to regional economies than other, less productive soil types. Another important example of wetland use is as a source of peat (partially decomposed organic matter), in dry form a clean-burning fuel source with a relatively high caloric value. Peat production is concentrated in countries with vast deposits. These include Russia, with 89 percent of the world production total; Ireland, with 6.2 percent; and Finland, with 3.4 percent (Williams, 1990, and Mitsch and Gosselink, 1993). Historically, peat mining in lowland areas of the Netherlands, northern Germany or Ireland has created wetland resources with unique ecosystems, permitting various stages of wetland succession and habitat formation varying from floating bogs to forested wetlands. The mining of peat as a non-renewable energy source, however, typically destroys more unique wetland habitat than it creates. This is especially significant when it involves the destruction of elevated bogs that represent an oligotrophic ecosystem that, by its unique nature and limited acreage worldwide, is a scarcer ecosystem than lowland bogs and increasingly subject to eutrophication.

Recreational and aesthetic benefits are also socioeconomic values of the non-market category. If hunting is seen as a form of recreation, hunter expenditures may be counted as revenues to the local community and as a contingent value of wetlands. Aesthetic values are more difficult to quantify because of the inevitable subjectivity. Here contingent values may be based on the willingness to pay to have these

values preserved. Non-market goods and services provided by wetlands have traditionally been considered secondary in importance to the economic value of quantifiable market products. As more scientific knowledge and public understanding have emerged on the functional benefits of wetland protection, however, societal willingness to endorse preservation policies has increased.

Along with the identification of wetland functions comes the task of ranking these functions according to community preferences — the incorporation of value into the regulatory scheme. In the section on the legal basis for wetland regulation, it is shown that Michigan law limits the ability of local governments to regulate wetlands according to value-based preferences. It will also be demonstrated, however, that communities retain substantial flexibility in how they might individually reflect on this concept of value in the form of a wetland protection ordinance and comply with state law.

It is implicit, then, that *community value* is an important element in any wetland protection strategy. Unfortunately, though some values can be defined in economic terms, many value judgments are based on individual ethical, moral and philosophical perspectives and are therefore poorly suited to policy discussions. Despite these difficulties, local decision makers must balance the vague with the concrete to reflect community preferences accurately. This discussion will introduce the concept of wetland value and the methods by which value is assessed.

The Regulatory Concept of Value

Wetland functions are comparatively easy to identify and categorize, but wetland values are more subjective and, thus, subject to controversy. Yet the mere idea of wetland protection presupposes wetland values, and communities with an interest in preserving their wetland resources do so with the tacit acknowledgement of those values, whether they are clearly articulated in the regulatory scheme or not.

Most wetland regulations, in fact, are built implicitly around the concept that wetland values are highly variable (MUCC, 1997). Despite the protestations of opponents of wetland regulations, the typical regulatory approach does not treat all wetlands equally.

Michigan's wetland protection law is a good example of how value is built into a regulatory framework without explicitly ranking wetlands according to relative value or imposing a mechanism to do so. Section 30311 of the state's wetlands law includes, among the criteria used to assess permit applications, several value-based elements including "...historic,

cultural, scenic, ecological, and recreational..." values provided by an individual wetland. What is not included in this statute is any further detail on how such determinations would be made in practice.

As will be discussed more extensively in the legal framework section, Michigan law also imposes on local wetland protection programs a range of value-based evaluation criteria in cases where wetlands of less than 2 acres are to be protected. But like so many constructs of political negotiation, the so-called Section 30309 criteria are extremely vague, leaving communities tremendous latitude in determining how to incorporate the concept of value into their regulatory framework.

Categorizing wetland values is both variable and subjective. Mitsch and Gosselink (1986) list 13 categories of wetland values ranging from furbearer production to global ecosystem values. Cwikel (1992), in his assessment of wetland protection in Michigan, used three broad value categories. Later, in his landowner's guide to wetland protection, he revised the list to eight narrower ones. Other authors have proposed different categories of wetland value.

It is beneficial, then, for communities contemplating the adoption of a wetland protection ordinance to have a clear concept of which wetland values are important to them and structure their ordinance accordingly. From the earliest discussions of wetland protection to the final adoption of a regulatory program, this concept is typically embodied in the reasons the community is considering the ordinance in the first place — the various answers to the question "Why protect wetlands?"

It is also critical to differentiate between the *value* of wetlands and the valuation of wetlands. The first is an abstract concept reflecting citizen preferences and attitudes toward wetlands. The second is an assessment of the economic attributes of wetland parcels in relation to certain functions. The latter is much more easily articulated in a language that is relevant to political decision making than the former, yet many of the important values held by community members with respect to wetlands do not lend themselves easily to valuation. Both will be important elements of a protection strategy that accurately reflects the wishes of the community.

Economic Values

The distinction between economic and non-economic values is somewhat artificial. Here, the distinction is made between those wetland functions for which tangible economic value can be established — goods and services that are *traded* or *valued* in the marketplace

— and those for which reliable economic estimates are more elusive.

The economic value of a wetland function can be expressed as the price an individual or the public is willing to pay for that function rather than be without it. Unfortunately, there is generally no direct transaction involved in wetland protection, so the value of many wetland functions must be established through alternative means.

Mitsch and Gosselink (1986) recognize three general approaches to establishing wetland values: weighting and scaling approaches, common denominator approaches and replacement value. These authors also point out, however, several caveats (discussed below) to quantifying wetland values and conclude that there is no universal agreement on which approach is preferable. Therefore, it may be argued that present methods for wetland valuation are clearly inadequate. Though the science and policies associated with the assessment of wetland values are rapidly developing, no "cookbook" approach exists for policy-makers to incorporate such value-based decisions into local protection initiatives.

There are some inherent problems with placing a specific or comparative value on wetlands (see also Mitch and Gosselink, 1993):

- Wetlands contain multiple values, making evaluation among alternative wetlands or alternative uses, which represent different commodities and preferences, difficult.
- The most valuable functions of wetlands are public amenities that return no significant direct commercial values to the private property owner but have high replacement costs. Because landowners are usually not compensated for these public use values, as is the case in some European countries, they may be prone to convert wetland uses to some use with a perceived greater economic potential or immediate benefit.
- There is a complex relationship between the size (area) of a wetland and the marginal value that it provides. As an example, a small strip of riparian wetlands along a stream may perform an efficient and valuable function in filtering nutrient or sediment-laden runoff from an adjacent farm. The small size of the wetland may not reflect its great environmental importance.
- Commercial values are based on finite transactions, while wetlands provide value in perpetuity. Some wetland values may not be needed at the present time and to this extent reflect future needs. However,

wetland modification and conversion result in foregone environmental benefits, a loss difficult to reverse.

- It is inappropriate to compare the long-term benefits of wetland conservation with the short-term benefits of high economic yield projects. Part of this argument reflects the notion that future generations are not represented and, therefore, do not compete in the marketplace. To fail to consider important aesthetic and irreplaceable ecological values of wetlands is to disregard their interests.
- Estimates of values carry the personal endowments, biases and socioeconomic perspectives of individuals. It's not surprising, therefore, that a wetland scientist would generally value a wetland higher than a typical developer.

One of the implicit messages is that decision makers must consider individual actions affecting wetlands not only in the context of that decision but also against the backdrop of all past and potential future decisions. Another critical consideration brought out in these observations is that balance between private rights and the public interest can be highly site-specific and subject to modification over time.

For some wetland functions, direct economic values can be established. The value of floodwater storage in a particular wetland can be reflected in the cost of providing similar storage capacity elsewhere, for increasing stormwater conveyance capacity downstream or the potential damage caused by increased flooding. For those wetlands that current technology is capable of replacing, the per-acre cost of constructing similar wetlands can be estimated. For other functions, however, value can be assessed only through secondary means. Wetland *outputs* that are not *traded* on the open market cannot be measured by discrete transactions. Their value is frequently estimated by "revealed preferences" — by linking the more nebulous wetland functions to a closely related market choice, providing an estimate of consumers' willingness to pay. Most of the currently employed models operate on the implicit assumption that wetlands values can be valued in much the same fashion as commodities traded in the marketplace.

The most common methods for estimating the value of wetlands and similar resources are the *travel cost method* and the *contingent valuation method*. The travel cost method, the older of the two, is used to measure the value of recreational resources by estimating the expenditures of people traveling to enjoy those resources. A study using this method in conjunction with others estimated the value of Michigan's coastal

wetlands at nearly \$500 per acre per year, exclusive of what the authors termed "non-economic values" such as endangered species protection (Jaworski and Rafael, 1978). This was not the real estate value of the property in question but rather the value of coastal wetlands as a public good. Statewide, the value of Michigan's coastal wetlands was estimated at more than \$51 million annually.

Contingent valuation provides estimates of non-market values through the direct questioning of consumers via a survey instrument. It is the only method that even approaches reliability in estimating non-use values of natural resources such as wetlands (Thibodeau and Ostro, 1981). In a contingent valuation study, participants are asked to express their willingness to pay for a particular resource through a series of hypothetical market transactions.

Methods of measuring the economic value of wetlands provide estimates of value that can be very useful in making comparisons between wetlands or establishing priorities in local protection programs. But it is not possible to establish with reliability the actual value of a wetland to a community through economic analysis alone. Relying solely on the estimable monetary value of a wetland resource ignores non-monetary wetland values that can often be as important to the public.

Aesthetic and Cultural Values

The value of wetlands as a scenic, recreational and cultural resource is difficult to describe, much less to quantify. But such values can be of critical importance. The enjoyment of wetlands by naturalists, artists, photographers, scientists and other *non-consumptive* users is an essential part of community character and, thus, the value of wetlands to the public. In some specific instances, wetlands can have a high level of historic, cultural or archaeological significance. These attributes are of critical importance to a successful community wetland protection strategy.

Unfortunately, the studies dealing with such non-monetary values are of little practical utility to local decision makers. Gregory, Slovic et al. (1997), for example, propose a complex multiattribute approach to establishing public preferences for environmental resources that, though well conceived, is simply too time consuming to be of value in a local decision process. Cumberland (1990) offers a similarly complicated methodology for incorporating the concepts of ecological sustainability and interest group acceptance into more traditional economic analysis.

Though establishing tangible values for the aesthetic and cultural attributes of community wetland resources is beyond the capabilities of local governments, the underlying principles of such methods can be applied. Engaging in community dialogue to establish public perceptions of and desires for managing wetland resources will assist local protection initiatives to incorporate public preferences into program objectives. Measuring alternatives against these objectives enables these preferences to be incorporated into the program, even if measurable values associated with them cannot.

Water Quality Values

The prevalence of wetlands in association with surface waters, coupled with their physical and biological characteristics, enables wetlands to serve important water quality functions that are typically highly valued by the public. Wetlands moderate the velocity of waters entering lakes and streams, trapping sediments and chemicals transported with them and minimizing erosion. The biological, physical and chemical activity of wetlands can transform or remove certain chemicals from the water column, reducing pollutant loads.

These values can sometimes be quantified by estimating the pollution control costs that would be needed if wetlands were degraded or destroyed, but this measurement does not capture the value associated with maintaining ecosystem stability or preventing degradation of water quality. As with aesthetic and cultural values, water quality values need to be incorporated into local wetland protection programs on the basis of community preferences and consensus about program objectives derived from a dialogue among stakeholders.

Hydrological and biochemical values

Hydrological values, because they represent significant aspects of the quality of life, may be viewed as part of socioeconomic values and, therefore, considered very important. Wetlands in low-lying areas have an important water storage and peak-flow retention function, especially during severe rainstorms. In the spring, during high water levels characterized by high soil moisture balances, low evapotranspiration rates, high precipitation and melting snow, wetlands reduce peak runoff, thus curtailing flood risk in downstream areas.

In 1977, the Carter administration acknowledged flood risk, specifically, by issuing an executive order to protect floodplains. The accompanying statement indicated that the federal government had invested \$10

billion between 1936 and 1977 to reduce flood hazards. Despite these efforts, annual losses from floods continued to increase. In 1975, U.S. flood damage was estimated at \$3 billion to \$4 billion. When development in floodplains displaces water storage, flood risks are increased. In general, the function of flood abatement seems undervalued since floodplain development is the most significant cause of wetland destruction (Darnay, 1994). Coastal wetlands are able to absorb most of the destructive power of storm surges. A 30-meter wetland buffer is enough to dissipate most wave energy, and at the same time, wetland plants, with their complex root systems, protect against erosion (Mitsch and Gosselink, 1993; Kusler, 1983; Williams, 1990).

In addition, biochemical studies (e.g., Houck and Rolland, 1995) indicate that a loss of 50 percent of America's remaining wetlands would result in increased sewage treatment plant expenditures (up to \$75 billion for the removal of nitrogen alone). A Swedish study concluded that the benefits of using land for wastewater treatment are greater than the value of the same land for agricultural production (Benhart and Margin, 1994).

Ecosystem values

Globally, biodiversity is threatened. Present estimates indicate that of all plant and animal life, one to six species per day become extinct. According to Darnay (1994), this number may have increased to one species per hour by the year 2000. Increasingly, biodiversity is recognized as an important socioeconomic value. For instance, the Waddensea, with almost a half million wading birds present, is a tidal wetland complex along the coastal region of the Netherlands, Germany and Denmark, and of major significance for migratory birds (Williams, 1990). Its international importance is highlighted by its recent designation as an International Biosphere Reserve by UNESCO. Some wetland waterfowl in the Netherlands are known to represent 20 to 77 percent of the total breeding population of western and central Europe (Dutch Ministry of LNV, 1990).

Many endangered species depend on wetland resources, and the increasing loss of these habitats has led to more rapid declines within these populations. Wetlands act as important buffers between terrestrial and aquatic environments, yet only relatively recently in our history have scientists, managers and public opinion come to appreciate this important habitat.

The uniqueness of coastal wetlands is emphasized in Hay and Farb (1982):

"It stands between land and sea, taking from both and giving

to both, comprising a network of complex ecological strings that tie the unity of the ocean's edge together."

Salt marshes are found along tidal shores in middle and high latitudes throughout the world and, measured in total biomass produced per square meter, are one of the most productive habitats. Even though biodiversity within a salt marsh appears to be rather low from a distance, closer inspection reveals that actual diversity — numbers of species present — is relatively high (Gadbois, 1989; Montague, 1981). This can be attributed to the fact that these wetlands serve as important feeding habitats and wintering grounds to many

migratory and local species of aquatic birds. They also provide crucial habitat for spawning and serve as nurseries for many invertebrates and fishes, including commercially and recreationally important species.

Environment Canada (1997) estimated that wetlands provide \$10 billion a year in benefits to Canadian society. Complex ecological functions and values were identified, such as sinks for natural contaminants, heavy metals and other pollutants; enhanced water purification; and popular recreational and hunting areas in wetland ecosystems worldwide.

Wetland Analysis/Evaluation Strategies

The problems encountered in defining, classifying, inventorying and evaluating wetlands depend on the purposes for which the assessments are being conducted. For Michigan communities engaged in wetlands protection, the legal requirement to conduct a wetlands inventory as a prerequisite for enacting a wetland protection ordinance is one purpose that must be served. When regulating wetlands below 2 acres in size, the additional requirements to make affirmative findings with respect to the value of those wetlands give additional structure to a local inventory and evaluation program. Incorporating community preferences, to the extent that they are known, or non-regulatory components of a comprehensive wetland management program can give further form to such endeavors. But regardless of the specific management strategy an inventory/evaluation program is designed to facilitate, the purposes the program is intended to serve must be an integral part of the decision process from its earliest stages.

In general, conducting resource inventory/evaluation projects will invariably involve four specific elements where critical decisions are made. Phase one is adopting a **definition** of the resources for which management plans are to be developed and a **delineation** process for identifying wetlands on a site-specific basis. The second phase is to develop a system for **classification** of these resources conforming to specific management objectives. Then, an **inventory** is conducted to determine the amount, location and characteristics of the resource base. Phase four involves the **evaluation** of the resource base in light of the program's objectives. These four phases must, from initial inception, be developed and integrated to ultimately support implementation of a program to achieve overall program goals.

This chapter will discuss the four elements in the context of developing and implementing a wetlands protection program at the community level. The integration of these elements into a comprehensive local program will be discussed in the legal framework section.

Identification and Analysis Techniques

The definition of wetlands is an issue that has generated a considerable amount of controversy over the past several years. At the federal level, the definition of wetland, as reflected by delineation procedures employed by federal agencies, has been the source of divisive debate in Congress since 1990. Because wetlands are often transitional habitats, much of the disagreement centers on the line of demarcation between aquatic and terrestrial habitats. In the case of isolated wetlands not found at the land/water interface, the debate is over the degree of wetness that is required to place an area in the wetland category.

Despite a great deal of scientific attention on wetlands, this debate is far from resolved. Wetlands are highly variable landscape features and are very difficult to define (Mitsch and Gosselink, 1986). Regardless of the questions surrounding the definition of wetlands, decision makers must adopt a working definition as a foundation on which to develop a protection strategy. If regulations are to be involved in community wetlands protection activities, the Michigan Legislature has required them to adopt the state's statutory definition, which describes wetlands as *"...land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as bog, swamp, or marsh..."* (MCL 13A.30301).

This broad definition is supplemented by additional language that defines regulated wetlands based on their proximity to the Great Lakes or an inland lake or stream, their size and their geographic location. Though many wetland classification systems have been proposed, none has achieved universal acceptance (Mitsch and Gosselink, 1986). The use of "... bog, swamp or marsh..." to circumscribe the universe of habitat types considered to be wetlands encompasses a wide variety of landscape features that the public may not recognize as wetlands. To ensure fair and efficient administration of an ordinance or even the planning of a non-regulatory protection program, it is critical that a community adopt well defined delineation criteria to provide for site-by-site evaluation of wetland resources.

From an administrative standpoint, the terms "bog, swamp and marsh" have limited utility for program development. Marshes are simply wetlands dominated by herbaceous vegetation on mineral soils. Swamps are those with woody vegetation and organic or mineral soils. Bogs are characterized by organic soils such as peat and mosses, typically of low biological productivity. But these simplistic definitions mask the fact that these three broad categories contain a rich diversity of individual habitat types ranging from grassy meadow to emergent marsh to floodplain forest.

Wetland delineation methods are generally based on three landscape characteristics: soils, vegetation and hydrology. Criteria for making regulatory determinations have been adopted by the federal government. Though the state uses criteria modeled after the federal guidelines, these have never been formally adopted. Because these methods have been developed and tested and have legal validity as well as practical application, communities would be well served by modeling their delineation process after the state and federal guidelines. In addition, training and certification in these methods is readily available from the U.S. Army Corps of Engineers and numerous private vendors.

The structure of the USACE procedure (USACE, 1987) and the similar procedure employed by the Michigan Department of Environmental Quality involves a three-part field investigation. Assessments are made of the soils and vegetation, and evidence of periodic flooding or saturation is sought. The results of these three independent determinations are then integrated to determine if the land in question depends sufficiently on the presence of water to meet the threshold required by law.

Though the structure of field delineation of wetlands is relatively straightforward, their execution frequently is not. Periods of saturation or inundation may be relatively brief. Soils may not show clear evidence of the physical and chemical characteristics that define wetland soils, particularly in areas that may have been historically drained or recently flooded. And the vegetation present in a wetland may also be adapted to live in upland soils nearly as well. So, though three criteria are employed to identify a wetland, all three may not be evident at the time the delineation is performed. Typical practice is to infer one of the criteria if strong evidence of the two remaining criteria is present, a fact that leads to criticism of the currently accepted methodology (Zinn and Copeland, 1996).

Despite the questions surrounding wetland delineation methods, the fact remains that these methods are scientifically based, well developed and readily available for adaptation at the community level. Literature describing or critiquing the techniques is also readily available, including Cwikiel (1992), USACE (1987) and MDNR (1987). Regardless of variation in delineation methods between regulatory agencies and, indeed, the individuals applying them, the process used in the field is remarkably consistent. Though community decision makers will rarely need to become certified wetland delineators, a basic understanding of the field methods employed and the science behind them is beneficial, particularly because the delineation is frequently a point of disagreement between property owners and regulatory officials.

The primary wetland indicator used by delineators is vegetation. Plants are typically adapted to a specific set of environmental conditions, though the adaptability of individual species varies considerably. Some plants are adapted primarily to wetland conditions and some to upland conditions. Many are adapted to either but can exhibit a preference for one or the other. The U.S. Fish and Wildlife Service publishes a list of plants and the conditions to which they are adapted in five categories, including obligate wetland plants, which typically occur only in wetlands. Three classes of facultative plants have been identified, one which shows a strong preference for wetlands, one showing no preference at all and the third showing a strong preference for uplands. Finally, there is a class that typically occurs only in uplands.

A detailed plant survey is conducted and an area is classified as wetland if the plant community is dominated by species identified by the list as showing a strong preference for wetlands. Though statistical

methods are used to analyze the data, delineation by plant community dominance remains a blend of art and science, particularly in complex communities where transitions are gradual or dominance types are mixed. This consideration explains why additional characteristics are also analyzed.

The second community attribute involved in wetland delineation is the nature of the soils present. Under conditions of prolonged or permanent saturation, some soils undergo chemical changes that are readily visible to the trained eye, while others are easily identified even by the casual observer. One of the easier wetland soils to identify is peat, an organic soil frequently purchased by gardeners as a soil conditioner. Another characteristic found in some wetland soils is a strong “rotten egg” odor indicating the presence of hydrogen sulfide, produced only in saturated conditions. Other wetland soil characteristics require specific training to identify. These involve soil colors and patterns that occur under saturated conditions or indicate alternating wet/dry periods, with saturation times long enough to trigger chemical reactions in the soil.

The third indicators of wetlands are direct indicators of either flooding or extended periods of soil saturation. Water marks on trees or stained leaves on lower branches are good indicators of flooding, as are lines of debris left by receding floodwaters. Roots of some plants growing in periodically saturated soils sometime form a rusty coating as iron in the soil forms iron oxide in the root channel.

Because wetland characteristics are highly variable and often change according to season or over time, all three categories of wetland indicators are critical to accurate field delineation. Decision makers will often be called upon to interpret field reports and settle disputes and should, therefore, develop a general understanding of the science and practice of wetland delineation. Cwikiel (1992) offers an excellent summary of the federal delineation procedures, which also form the basis of those used by the state of Michigan.

Wetland Inventory

Under Michigan law, any community wishing to adopt a wetlands protection ordinance must first complete an inventory of its wetland resources and provide this inventory for public review and comment. A community has the option of simply adopting the National Wetland Inventory (NWI) maps (developed by the U.S. Fish and Wildlife Service) or other similar existing data source and would probably be in

compliance with the legal requirements (this has not, however, been tested through administrative or legal proceedings). But an inventory can provide much more than mere compliance with the law — it is also an invaluable planning and decision-making tool that may be an integral part of the entire wetland protection strategy.

As stated previously, a community could simply adopt an existing data source identifying the general location of wetlands within its borders. The other extreme would be to contract with a wetland consultant to conduct a detailed field survey of community wetland resources on the basis of whatever characteristics are considered important in the overall wetland protection strategy. A combination of these two approaches could also be employed. Costs could run from hundreds to tens of thousands of dollars.

The Michigan Department of Environmental Quality is currently developing a system that would use digital databases from its own MIRIS system, the National Wetlands Inventory and the hydric soils maps produced by the Natural Resources Conservation Service. This system is not yet available, but it could possibly provide detailed inventory information at the community level in a digital format. By enabling decision makers to manipulate data to suit specific needs and to integrate data from a variety of sources, a digital database greatly enhances a community’s ability to make rational, supportable judgments on wetlands issues in both regulatory and non-regulatory environments.

Assessment Methods

A wetland classification system is necessary for several reasons. A classification system establishes wetland presence or absence but also assesses the range of wetland types within a community. This enables decision makers to compare the relative rarity of specific types during the regulatory process. A second requirement satisfied by the adoption of a classification system is the ability to assess and integrate a variety of existing databases into a community wetland profile. Geographically referenced information is available from a variety of existing sources, but seldom are the same classification methods used from one source to the next. For example, modern soil surveys with soil series classification produced on a county level by the U.S. Department of Agriculture are available for most counties in Michigan, though the ages of these survey documents and their accuracy may vary. Such soil surveys are an excellent source of data on the presence of hydric soils, a primary characteristic of wetlands, as

well as descriptive narratives of vegetation types typical of those soils. At the same time, the Michigan Department of Natural Resources maintains a computerized inventory of geographic data based on aerial photographs taken since 1978. In this case, wetlands and other landscape features are identified primarily through the interpretation of vegetation types and expressed as a two-, three- or four-digit numeric code on maps. These two data sources express similar information in widely differing formats, and other sources use other means of expressing wetlands information.

The most convenient means of adopting a wetlands classification system is simply to adopt the Cowardin system (described briefly in Chapter 2) used by the U.S. Fish and Wildlife Service. The many benefits of this system include both the detail and flexibility it provides and the wealth of readily available information on which it is based. The Cowardin system uses an alphanumeric code to convey highly detailed information on a wetland's type, its landscape location, its dominant vegetation and its hydrologic characteristics. Perhaps the greatest benefit of the Cowardin classification system is the fact that it forms the basis for the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI), perhaps the most detailed and accurate wetland mapping program ever undertaken in the United States. It is based on the standard topographical maps produced by the U.S. Geological Survey (which also are the basis for Michigan's MIRIS maps).

As discussed in the previous section, the standard regulatory definition of wetlands may be poorly suited to a policy-relevant classification system. The United States, however, has been a global leader in wetlands classification and inventory (Scott and Jones, 1995), and the comprehensive system developed (Cowardin et al., 1979) has seen widespread application in North America. Acknowledging that the field of wetlands classification is challenging from both an administrative and a scientific perspective, the Cowardin system has nonetheless found broad acceptance in the United States and is in many ways the "language" of wetland classification and inventory in this country.

The classification system devised by Cowardin and his colleagues, properly known by the title *Classification of Wetlands and Deepwater Habitats in the United States*, was published by the U.S. Fish and Wildlife Service after five years of development. The work was designed to support a new national wetlands inventory to replace the national inventory based on a previous classification system (Shaw and Fredine, 1956). The system was

intended to incorporate new information on wetlands ecology and management developed in the intervening decades. It also serves as the basis for the three-part delineation methodology adopted by the U.S. Army Corps of Engineers in 1987.

The Cowardin system advances a hierarchical scheme for classifying wetlands beginning with five *systems* as the highest level identified. Only three of these systems are of interest in Michigan; the remaining two are features associated with saltwater and estuarine environments. The three systems are Riverine, which concerns itself with flowing-water habitats; Lacustrine, which describes primarily open-water habitats in depressions and impoundments; and Palustrine, with which we associate most inland wetlands in the swamp and marsh category. Most wetlands regulated in Michigan are likely to fall in the latter classification.

The systems are broken down into *classes*, *subclasses* and *dominance types*, which reflect the native vegetation and animals characteristic of the type. Examples of familiar dominance types in Michigan are cattail marsh, cedar swamp and floodplain forests characterized by maples, ashes and elms. A simplified version of the Cowardin classification system is presented in Figure 2.

Classification of community wetland resources serves the same purposes at the local level as those identified by Cowardin and Golet (1995) for the national classification system:

- Describe ecological units that have homogeneous natural attributes.
- Systematically arrange those units into a system to aid in natural resource decision making.
- Furnish the basic classification units for inventory and mapping activities.
- Provide uniformity of concepts and terminology.

Each of these elements is an essential component in building community understanding of and support for the protection of wetland resources.

Perhaps the most critical activity in a local wetlands protection program involves establishing priorities and developing an assessment methodology to make decisions about individual wetlands within the framework of those priorities. The importance of establishing a uniform evaluation strategy cannot be overemphasized in light of the fact that, should a legal challenge be mounted against a local wetland protection ordinance, the uniformity with which it is administered is an important component in its defense.

Comparing Wetland Assessment Methods

As public awareness concerning the role of wetlands increases, new laws, policies and regulations at all levels of government have been enacted in an attempt to protect this natural resource from the destruction that occurred in the past. Changes in priorities from draining and filling wetlands to protecting and managing them have occurred, but development pressures also continue to grow. As conflicts and concerns about wetlands continue, the need for consistent and reliable data and information for decision making relative to wetlands is also likely to increase. Planners, resource managers and other decision makers are continually faced with decisions on the future use of these resources, and having pertinent and accurate information for evaluation will assist them in their decision-making process. State and federal agency personnel given responsibility for wetlands can also benefit from improved access to information concerning wetlands.

Assessing wetlands and comparing their importance in the landscape is challenging, however, because not all wetlands perform the same functions. Users often perceive benefits differently. Also, the emphasis for wetland assessment — such as protecting sensitive wetlands, mitigation or land use planning — may vary, as might the interpretation of results.

Several wetland evaluation methods have been developed in the United States and Canada to provide a general assessment of wetland functions and values. These include the *Wetland Evaluation Technique (WET) Volume II* by Adamus et al. (1987); the *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire* by Ammann and Stone (1991); the *Minnesota Wetland Evaluation Methodology* for the North Central United States by the U.S. Army Corps of Engineers in conjunction with the Minnesota Environmental Quality Board Wetland Evaluation Methodology Task Force (1988); the *Oregon Freshwater Wetland Assessment Methodology* (Roth et al., 1993); and *The Hydrogeomorphic Approach for Assessing Wetland Functions (HGM)*, by the U.S. Army Corps of Engineers (Smith, 1995).

Each of these assessments provides information that may enable users to target acreage best qualified for protection/land acquisition; aid in the identification of conditions for mitigation activities; identify wetlands performing functions that should not be disrupted; or identify those areas where further study and/or management is needed. Many of these methods consist

of paper forms (field sheets) that an evaluator fills out by answering certain questions on the wetland function or value of interest. The evaluator may utilize interpretation keys to perform the analysis. Any computations must be performed by hand. A few methods, such as *WET II* and the *Minnesota Wetland Evaluation Methodology*, provide a computerized program that assists with the computation, interpretation and printout of the results. Some of the methods generate a rating of high, medium or low with respect to a particular function or value; others use a numerical scoring and weighted index. Some approaches combine scores to provide an overall rating to the wetland, while others address each function or value independently of other functions or values.

The first comprehensive approach to wetland assessment was the federal *Wetland Evaluation Technique (WET), Volume I: Literature Review and Evaluation Rationale* (Adamus et al., 1991) and *Volume II: Methodology*, hereafter referred to as the *WET II* method. Functions and values evaluated in this method are flood flow alteration, groundwater discharge and recharge, sediment stabilization, sediment/toxicant retention, nutrient removal/ transformation, aquatic diversity/abundance, wildlife diversity/abundance, recreation, uniqueness/heritage and production export. The method employs features of the wetland and its watershed, including topography, soils, vegetation and others to rate an individual wetland by its opportunity to perform a particular function and for its effectiveness in performing that function. It also evaluates how valuable the wetland is to society because of its particular designation, its economic value or its location in the landscape.

The major objectives of *WET II* are to provide an evaluation technique that assesses many of the wetland functions and values, can be used with a wide variety of wetland types, can be done rapidly, is reproducible and is derived from sound scientific research.

Functions, values and social significance are evaluated by identifying variables that can directly or indirectly measure the physical, chemical and biological attributes of a particular wetland and its watershed. A series of questions concerning a particular function or value are addressed. Responses to these questions are then analyzed, reflecting the correlation between the integrated variable (termed a predictor) and the function or value of the wetland. Each predictor is then assigned a qualitative probability rating of high, moderate or low in terms of the wetland's opportunity,

effectiveness and social significance in performing the function or value being analyzed.

The WET II method is very rigorous and time consuming. In its entirety, it is time and labor intensive, particularly for broad planning purposes. However, it is excellent for identifying the criteria and parameters necessary for determining wetland functions and values. The WET II method is very comprehensive and contains an extensive list of criteria. High, moderate and low “potential importance to function” ratings are used in the WET II method for each criterion.

Other assessment methodologies are simpler models derived from the WET II method. The *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire* is designed for use by local decision makers who are not wetland experts. It is intended for broad planning and educational purposes, not as an instrument for detailed impact analysis on individual wetlands. Most of the evaluation criteria are qualitative in nature.

The functional values used in this method are ecological integrity, wetland wildlife habitat, finfish habitat, educational potential, visual/aesthetic quality, water-based recreation, flood control potential, groundwater use potential, sediment trapping, nutrient attenuation, shoreline anchoring and dissipation of erosive forces, urban quality of life, historical site potential and noteworthiness.

The framework used by this method for evaluating functions and calculating indices appears to be very useful and straightforward. A series of *evaluation questions* are asked about each potential wetland function. Possible answers for each of these questions (i.e., the *evaluation criteria*) are listed, and a score, or *functional value index*, is assigned to each answer. All of the scores for the individual criteria are then averaged to give the average *functional value index* for a particular wetland function. The average *functional value index* is then multiplied by the size (in acres) of the evaluation area to give a *wetland value unit score* to that function. Because size is used as a weighting factor, a “noteworthiness category” was included to help identify smaller wetlands that should be given equal consideration as larger ones. Though no high, medium or low value is provided for the probability of the wetland being able to perform a particular function, the functional index value could readily be converted into this format. No overall score for multiple functions is provided.

The structure of this method allows certain questions to be skipped if the data are not available without

skewing the resulting score or probability rating. Use of this method’s approach makes it relatively easy for the user to build in *weighting factors* to emphasize criteria that are more important in performing certain wetland functions.

Authors of this method recommend that this methodology could be used as a tool for educating citizens on wetland functions and values, collecting basic information about wetlands in a given study area, creating a database that provides a relative ranking of evaluated wetlands or as a decision support system for regional planning.

In New Hampshire, land use decisions are usually made at the local level. This wetland methodology was created so that local officials could be in a better position to prioritize wetlands important to the area. It has also been deemed appropriate as an educational tool for increasing awareness of wetlands and their functions and values.

Like many methods, using this assessment for other than its intended purposes could result in misleading information resulting in poor decision making. It is not designed for impact analysis or as a justification for the destruction of a wetland because the wetland received a low rating for a particular function. It is also not designed for use in legal proceedings. It is to be used for comparing various wetlands, not for evaluating a single wetland, though the information gained may be useful in other contexts.

The *Oregon Freshwater Wetland Assessment Methodology* was adapted from the New Hampshire method, so the two are similar in many aspects. Like the New Hampshire method, the Oregon method is designed for use by local decision makers who are not wetland experts. It is intended for broad planning and educational purposes, not for detailed site impact analysis. Like the New Hampshire method, it is intended for assessing several to many wetlands, not for evaluating site-specific impacts. The method is mostly qualitative in nature and evaluates nine wetland functions and conditions, include wildlife habitat, fish habitat, water quality, hydrologic control, education and recreation. It also assesses conditions of sensitivity to impacts, enhancement potential and aesthetics.

The major purposes of the Oregon method are to provide a tool to educate planners and members of the community on wetlands; to collect basic information about wetlands, particularly within the community; to create a database with information about wetland functions and conditions; and to support planning and decision making within a jurisdiction.

It has the same limitations as the New Hampshire method, plus an additional one: this method will not properly evaluate urban wetlands unless the urban criteria for specific indicators, which take increased value into account, are utilized. The method is qualitative — the assessment provides an indication whether the wetland provides, has the potential to provide or does not provide the function being assessed.

To assist in completing the evaluation, the Oregon method recommends possible additional information. Some of these resources include low altitude aerial photographs, drainage basin maps, endangered and threatened species listing, fish stocking information, flood hazard maps, a statewide assessment of non-point source pollution, lake water quality information and lake maps, zoning maps, local and national wetlands inventories, soils map and topographic maps.

The *Minnesota Wetland Evaluation Methodology for the North Central United States* is much more quantitative than the New Hampshire and Oregon methods and utilizes a computer program for some of the more advanced mathematical calculations. Evaluations using this method are detailed, take more time to complete, and require a professional familiar with wetland functions and values, plant communities, regulations and wetland delineation issues. The hydrological and physical characteristics of wetlands are heavily emphasized in this method. Much of the data required by this method may not be available without an intensive site investigation. However, it does provide some guidance in what parameters and criteria should be used to determine certain wetland functions.

Minnesota's method was developed to make less arbitrary decisions about wetlands and to add reproducibility when determining functions and values of wetlands. A basic assumption is that the user has a general understanding of wetland functions and values, plant communities and issues related to wetlands delineation. Another purpose for the method was to provide a multifunction focus so that decisions regarding wetland management could be based on the multiple functions that a wetland might provide. Functions evaluated in this method include flood flow characteristics, water quality, wildlife, fish, shoreline anchoring and visual values.

Unlike the other methods, the Minnesota method combines ratings of individual functions to obtain an overall rating for the wetland. Though the authors suggest that this procedure provides a single composite estimate of all of the functional values provided by the

wetland in question, they recognize that the procedure "adds apples and oranges" to get the overall rating.

A newer method, *The Hydrogeomorphic Approach for Assessing Wetland Functions* (HGM), is a procedure for measuring the capacity of a wetland to perform functions. Unlike the other methods, the HGM satisfies the technical and programmatic requirements of Section 404 of the Clean Water Act and other regulatory, planning and management options that require an assessment of wetland functions. It does this through the use of a hydrogeomorphic classification, functional indices and reference wetlands.

The goal of the HGM approach is to provide a standardized tool for assessing wetland functions consistently in a variety of wetland types across the nation. It uses a multistep procedure for classifying wetlands into regional wetland subclasses based on hydrogeomorphic factors. It first classifies the wetlands on the basis of their ecological characteristics, such as water source, flow and fluctuation of the water once in the wetland, and position of the wetland in the landscape. It then uses reference sites to establish the range of functioning of the wetland and, finally, a relative index of function, calibrated to reference wetlands, to assess wetland functions.

Two phases of this assessment approach are a development phase, performed by an interdisciplinary assessment team, and an application phase, performed by a regulator, manager or other end user. The development phase includes the hydrogeomorphic classification, based on geomorphic setting, water source and hydrodynamics, development of a functional profile, identifying reference wetlands, developing assessment models and calibrating models using the referenced wetlands. The application phase includes the assessment procedure, and a characterization, assessment and analysis of the wetland.

A description of the wetland and its surrounding landscape and the proposed project and associated impacts fall under the characterization of the wetland. The assessment includes the application of assessment models and calculations of the function index for a given wetland. The analysis portion involves an examination, description, determination or plan for impacts that the proposed project might incur; identifying ways for minimizing any impacts; developing design criteria for mitigation or restoration projects; and monitoring projects and comparing management alternatives.

Functions identified include dynamic surface water storage, long-term surface water storage and subsurface storage of water, energy dissipation, moderation of groundwater flow and discharge, nutrient cycling, removal of compounds, retention of particulates, organic carbon export and maintaining characteristics of plant communities, detrital biomass, spatial habitat structure, interspersion and connectivity, and distribution and abundances of invertebrates and vertebrates.

This method identifies which functions the wetland class performs in a region, identifies wetland and landscape variables that give an indication that the function is being performed, and, finally, scales the variables to indicate the degree to which the function is being performed. Reference wetlands are used for comparison. The technique is complicated and time consuming. It does not consider the opportunity for the wetland to perform a particular function nor does it consider social significance. It also allows comparisons only within wetland classes. It does, however, assist the user in understanding how a wetland operates and helps in the analysis of changes that may occur within the wetland because of alterations. Finally, it reduces variability to a level that can be addressed in Section 404 requirements and, therefore, used for regulatory purposes.

A recently developed program by Michigan State University with funding from the MSU Agricultural Experiment Station is the *Michigan Wetland Information Management System II* (WIMS II). It incorporates Wet II and New Hampshire methods but is unique in that it ties together wetland evaluation criteria with the spatial analysis capabilities of a geographic information system (GIS) to provide a consistent and systematic approach for the integration, manipulation, analysis and display of wetlands data and analytical results. Where appropriate, quantitative measures are derived using GIS techniques. Information that cannot be derived through GIS techniques is obtained through on-site evaluation. Prototypes of this system with local data were installed in the offices of Meridian and Williamstown townships, Mich.

The WIMS II, based on the WIMS I prototype (Wolfson et al., 1995) incorporates available data — including base maps such as land use, soils and elevation, and wetland inventories such as the National Wetland Inventory and the Michigan Resource Information System — to facilitate the analysis of wetlands functions in a watershed context. By increasing efficiency in the wetland evaluation process, the WIMS II serves as a valuable, timesaving tool for the

planner and resource manager. Functions and values evaluated in this method are flood control, groundwater recharge, sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, aquatic diversity/abundance, wildlife diversity/abundance, recreation and noteworthiness.

Three major design principles guided the development of the wetland evaluation component of WIMS II. Quantitative measures were incorporated where appropriate using GIS techniques to derive needed information from existing spatial databases. As in other wetland evaluation methods, some of the evaluation criteria are qualitative because either rigorous quantitative measures do not exist or the data are too time consuming and/or cost prohibitive to obtain. Second, the evaluation methodology incorporated into the WIMS is designed to utilize the spatial analysis capabilities of the GIS environment. Thus, it was designed so that the GIS provides as much of the necessary information as possible, with other information being collected during site visits and supplied by the user. Finally, much effort was put into designing a database capability within the system, allowing users to access, enter, store and manage data needed for wetland evaluation and planning.

The structure of the wetland evaluation component of the WIMS II was adapted from an approach used in the New Hampshire method. For each function or value that a wetland may perform, a set of criteria was developed to evaluate that function/value. These criteria were adapted from other evaluation methods listed above. An evaluation question (or multiple questions) was then developed to address each of these criteria. To help answer these questions, users are provided with some information derived from calculations performed by the WIMS II. In some cases, this information is sufficient to answer the question(s); in other cases, users must rely on additional information collected during a visit to the wetland site. The user is also provided with a list of possible answers from which to choose.

An indexing system is designed to allow users to compare the functions and values of similar wetlands within or between watersheds. Each answer has an associated score (i.e., a *wetlands function index* [WFI] or *wetlands value index* [WVI]). A default score is provided for each answer. The WFI score represents the probability that the wetland will perform the given function. A user can then compare the WFIs of similar wetlands for certain functions and determine which wetlands are more likely than others to perform the

functions under consideration. Wetland values receive a similar score, called a wetland value index (WVI). A database capability has also been designed to store the results of wetland evaluations, allowing users to access these results and perform their analyses later.

Algorithms and methodologies were developed to derive the wetland function index for evaluating wetland functions (flood control, groundwater recharge, sediment/toxicant retention, etc.) using a *function evaluation* utility of the GIS.

WIMS II is embedded in a user-friendly information system with multifunctional capabilities. GIS capabilities within the customized system include map overlay, query functions, graphics, data display and images. A functional analysis of a selected wetland can be performed on a function-by-function basis or for all functions simultaneously. Each function receives its own numerical and descriptive rating. Ratings are not combined to obtain any overall index value. A written report and/or graphic representation can also be generated to compare the selected wetlands.

WIMS II provides a user with a set of tools for accessing, analyzing, evaluating and displaying wetlands data and information within a landscape using a combination of GIS and on-site evaluation. The WIMS II is generic and flexible in structure, so it can be used with any spatially referenced data that reside in the relational databases. Thus, data are the limiting factor of WIMS II — the more spatially referenced data added to the system, the more powerful the analyses that can be performed. The structure of the WIMS II is also flexible enough to be adapted for use with spatial data from other watersheds or other geographic regions. The more data are added to the system, the more enriched it becomes with potentially critical information.

Databases that could prove useful include those of land ownership, well logs, P.A. 451 Part 201 sites (sites of environmental contamination within Michigan), floodplain boundaries, wildlife habitats and archaeological sites. The addition of other watersheds within WIMS II would also make the system more useful to a wider audience.

Wetlands Protection

Why Protect Wetlands?

Wetlands are one of the most important landscape elements in preserving environmental quality. They protect surface and groundwater quality and quantity; preserve biological diversity; reduce surface water runoff, thereby assisting in flood protection; and provide erosion and sedimentation control. Wetlands are of great importance in replenishing the groundwater supplies of shallow aquifers in rural areas and improve the water quality of residential wells by recycling and storing chemicals introduced by agricultural land use (e.g., nitrates, phosphates and pesticides) and runoff from residential properties (Schultink and van Vliet, 1997).

Like sand dunes, unique farmland and floodplains, wetlands are considered special environments. These resources perform vital functions that are not transferable from one area to another. Reduced crop production or mineral extraction in one region may be replaced by increases elsewhere. Such is not the case with wetlands. Protection of natural resources may sometimes be confused or debated, given less than complete information on the stocks of these resources, our future needs, future technological breakthroughs and the actual depletion rates. A good example is the concern about the preservation of farmland. There has been no shortage of conflicting opinions and data on the

extent of farmland and cropland loss. But the more important issue is not only whether the threat exists of a substantial loss in farm acreage that may affect food security or commodity prices, but the key question is one of potential loss of overall quality of life to the local community. Like wetlands, farmland functions and values cannot be expressed only in terms of food security. Local farm economies extend far beyond the farm field and are integral to the life of rural communities. Unique agricultural resources — whether productive soils, open farm fields or woodlots, historic farmsteads and barns — all contribute to open space quality that is not transferable.

Perhaps even more than farmland, wetlands may be crucial to the vitality of their surroundings and the environment. Replacing filled wetlands from one area with man-made wetlands in another watershed may do little or nothing to mitigate functions lost on site. This is certainly true for certain land-based species such as snakes, which do not thrive when habitat loss forces them to relocate (Kentula et al., 1992). Other functions of wetlands may be effectively reduced or eliminated in wetland restoration. Water depth and its fluctuation have been shown to differ significantly between natural and created wetlands. In an Oregon survey of all restored wetlands, one quarter of man-made wetlands were ponds when, in fact, no ponds were affected by earlier development (ibid.). The rationale for wetland

protection, introduced in the preceding paragraphs, is the preservation of critically important functions and values contained in fens, bogs, marshes and other wetland systems. Functions, simply stated, are the hydrologic, habitat and biogeochemical processes inherent in the water-dependent ecosystems, such as seasonal water storage; maintenance of wetland vegetation, food chains and cover; and nutrient and pollutant retention. Values are the societal benefits we enjoy. Among them are maintenance of water quality, reduced floodwater damage and habitat for game waterfowl.

The recognition of the important functions and values of wetland resources and increasing concern over their continued loss and degradation have resulted in a wide range of protection initiatives at the state and federal levels. The basis for wetland protection in Michigan is the regulation of development activities in wetlands through provisions in both state and federal law.

Federal Wetland Protection Regulations

Federal wetland protection policy is not based on a specific, comprehensive national wetland law. Rather, various federal statutes regulating or otherwise protecting wetlands have evolved piecemeal. They often reflect laws originally intended for other purposes. As a result, jurisdiction for wetland protection is a mandate of several federal agencies, and wetland protection is not as effective or cohesive as it could be.

Federal, state and local government regulatory or permitting programs are essential tools in the nationwide effort to protect wetlands. Though essential, current programs do not, in most cases, provide sufficient protection. Regulatory programs typically include thresholds of applicability, allowing destruction of small wetlands or small portions of larger wetlands. They often contain loopholes, such as allowing direct drainage or excavation of wetlands provided none of the spoil material is placed in the wetland. Programs almost universally fail to address activities in surrounding areas that may lead to wetland degradation, such as diversion of surface drainage or alteration of groundwater flows. Almost all regulatory programs contain exemption categories for many agricultural, silvicultural and sometimes mining activities. Wetland protection programs are vulnerable to economic development interests and often rely on the safety net of mitigation to offset wetland losses or

degradation. It can be argued that current regulatory programs are a reactive form of wetland protection and can provide only partial long-term protection.

Despite the efforts of regulatory programs and non-government conservation organizations, the degradation and destruction of wetlands will continue unless offset by additional and effective protection approaches. Approaches needed to achieve comprehensive wetland protection must be proactive, farsighted, planned strategies that utilize positive motivation to succeed in the long term. These can be grouped by type of approach: incentive/disincentive; acquisition/legal restriction; restoration; and others, including policy statements, educational efforts and inventories. Each has its advantages and disadvantages, and all are needed to protect wetlands effectively. For example, regulatory programs are essential for basic wetland protection and for recourse when detrimental impacts occur. Incentive/disincentive programs provide wetland property owners with a reason to protect wetlands without requiring an enforcement presence. But incentive programs tend to apply only to certain land use activities, and incentive mechanisms can become less compelling over time as economic forces change. Acquisition greatly increases the likelihood of minimizing detrimental impacts to wetlands, as do legal restrictions short of acquisition, depending on their design. But acquisition and some legal restrictions provide limited coverage because of funding constraints, and some legal restrictions require active enforcement. Restoration is important for correcting historical damages but should be coupled with legal protections and, again, is invariably limited by funding. Policy support and educational efforts are essential in the long run but are inadequate without favorable economics or enforceable authority. Therefore, a combination of these approaches is essential for the effective short- and long-term protection of wetlands.

Many opportunities exist for private citizens and corporations to assist federal, state and local government agencies in slowing the rate of wetland loss and improving the quality of the nation's remaining wetlands. Individual landowners and corporations own the majority (75 percent) of the nation's wetlands: they are in a key position to determine the fate of wetlands on their properties (USEPA, 1995).

Federal authority for regulating development activities in wetlands stems from Section 404 of the federal Water Pollution Control Act of 1972, more commonly known as the Clean Water Act. This legislation established federal standards for the discharge of pollutants into the waters of the United

States. Included among the activities regulated by the act is the discharge of “dredged and fill materials” into the nation’s waters. Ironically, this section, which forms the basis for federal regulatory authority in wetlands, does not even contain the word “wetland.”

Initially, the U.S. Army Corps of Engineers, the agency charged with implementing Section 404, interpreted the law to apply only to waters that were traditionally navigable. Based on a federal court decision in 1977, however, the scope of the law was determined to include all waters of the United States, including wetlands, not simply navigable waters. Though the federal regulatory presence in the wetlands arena is only distantly related to local wetland protection issues, the federal law in many ways sets the standard for protection initiatives at lower levels of government. Michigan’s wetland protection program, as a delegated federal program, has met the 404 consistency requirements and therefore parallels the USACE regulations. Many of the principles embodied in the Michigan law and imposed on local governments within the state were adopted directly from federal regulations. As with most regulatory programs, obtaining authorization from the USACE most frequently begins with the submission of a permit application. In the application, the applicant discloses the nature and extent of the proposed project, the purpose for which the project will be carried out, the location of the project and other information, technical or otherwise, as may be required by the agency. The project proposal is then released for a public notice and comment period lasting 20 days, after which the USACE makes a decision on the application.

Such decisions are based on the so-called *404(b)(1) guidelines* in the Code of Federal Regulations (40 CFR 230). These guidelines, adopted by the USACE in conformance with federal law, direct the decision maker to consider several factors in deciding on individual applications. Most significant of the decision criteria in the guidelines are:

- The availability of “practicable alternatives” that would minimize or eliminate resource impacts.
- The magnitude of adverse impacts to natural resources that would be caused by the project.
- The effect of the project on water quality, particularly with respect to state water quality standards.
- The extent to which the applicant would be able to avoid or minimize wetland impacts and compensate for the unavoidable loss of wetlands.

The USACE is prohibited from issuing a permit without considering these four factors. The “practicable alternatives” test is the progenitor of Michigan’s “feasible and prudent alternatives” test, which will be discussed in greater detail below. So, too, is the progression of decisions in item #4, known as “mitigation sequencing,” requiring all avoidable wetland impacts to be eliminated from a project before the USACE can issue a permit.

In determining the significance of the environmental impacts of a proposed project, the USACE has broad latitude in selecting factors to be reviewed. Kusler (1983) lists 16 factors that the agency would typically address in the analysis of a permit application:

- Conservation.
- Aesthetics.
- Economics.
- Environmental concerns.
- Fish and wildlife values.
- Flood damage prevention.
- Welfare of the general public.
- Historic values.
- Recreation.
- Land use.
- Water supply.
- Water quality.
- Navigation.
- Energy needs.
- Safety.
- Food production.

Clearly, the ability of the USACE to factor both direct and indirect impacts of a proposed project into their decision is broad indeed.

To reduce the tremendous administrative burden of individually reviewing the countless projects annually affecting the nation’s wetlands, it makes liberal use of regional and nationwide *general permits*. These permits merely require applicants to certify that they are in compliance with the guidelines and other applicable regulations. If the agency accepts the applicant’s documentation within the specified time, it issues the required authorization. This occurs without public notice, site inspection or follow-up compliance inspection. The USACE retains the option of denying general permit coverage to individual proposals if it determines that the project could have significant impacts on the environment. In those cases, an individual, public-noticed permit would be required.

Essentially, this general permit program is analogous to a “permit by rule” authorization unsuccessfully proposed for Michigan’s program several times over the

past five years. The general permit program enables the USACE to expedite the authorization of a large number of arguably minor projects without significant administrative burden. Recent data indicate that the agency processes about 70 percent of its total permit load — 35,000 of 50,000 permits annually — via statewide, regional and nationwide general permits. The utility of this program with respect to agency personnel and resources is considerable. Conversely, many argue that the general permit program is little more than a loophole through which thousands of damaging projects are authorized each year. It is not known, for example, how thoroughly the USACE analyzes applications for general permit coverage for potential upgrading to an individual permit, or how many times this has occurred in the 20-year life of the general permit program. Nor has it been demonstrated that the cumulative effect of authorizing multiple “minor” projects does not lead to significant environmental degradation.

Regardless, it is advisable from an administrative perspective to develop mechanisms for expediting the review of inconsequential projects that inevitably fall under an agency’s regulatory umbrella. The general permit program is but one example of how this could be accomplished.

The following is a synopsis of federal, state and local wetland regulatory efforts, along with a brief discussion of existing and potential non-regulatory programs that can also support wetland protection in the United States.

Significant protection of wetlands as integral and essential parts of the nation’s waters began with the 1972 Federal Water Pollution Control Act, now commonly referred to as the Clean Water Act (CWA) and continued through amendments to the act passed in 1977. Section 404 of the 1972 act establishes the major federal program regulating activities in wetlands, and the 1977 amendments significantly expand on the design of the Section 404 program, including exemption categories and the option of delegation of the 404 program to states together with enforcement powers.

Section 404, jointly administered by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency (EPA), regulates the discharge of dredged or fill material into waters of the United States, which include wetlands. Discharge of dredged or fill material requires a permit from the USACE based on regulatory guidelines developed in conjunction with the EPA (pursuant to Section 404[b][1]). Failure to obtain a permit or comply with the terms of a permit can result

in civil and/or criminal penalties. Under Section 404(c), the administrator of the EPA may prohibit or restrict the use of any defined area as a disposal site if it is determined that the discharge may cause unacceptable adverse effects on municipal water supplies, wildlife, shellfish beds and fishery areas, or recreational areas. This section is referred to as the EPA *veto authority*. Parties intending to discharge material into the nation’s waters must obtain an individual permit or be covered under a general permit issued by the USACE. As of September 1993, not only the discharge is regulated under 404 (see examples below).

General Permits

Under Section 404(e), the USACE may issue general permits on a nationwide, regional or statewide basis for particular categories of activities that, when conducted in U.S. waters, are presumed to cause only minimal adverse environmental impacts. Landowners undertaking these activities are not required to obtain individual permits. The USACE has identified and periodically updates a list of categories (40 to date that apply nationwide) of activity that merit such blanket approval. General permits that apply nationwide — or *nationwide permits* — are issued by USACE headquarters and apply throughout the country. Some of these categories require simply notifying the USACE prior to commencement of the activity in a wetland, and some do not. Information about regional or state-level general permits may be obtained from USACE division or district offices.

Of the 40 nationwide permits issued by the USACE as of March 1993, seven always require notification prior to project activity: outfall structures, hydropower projects, surface mining, temporary construction, cranberry production, emergency watershed protection and cleanup of hazardous wastes. Eight nationwide permits require notification of the USACE in certain circumstances: scientific measurement devices, temporary recreation structures, bank stabilization, road crossing, minor discharges, removal of vessels, isolated wetlands and hazardous waste cleanup. The remaining 25 permits do not require that the landowner notify the USACE prior to project initiation if the landowner complies with the conditions of the permit. All activities allowed by nationwide permits must include the use of appropriate erosion and sedimentation controls. Activities may not disrupt the movement of indigenous aquatic species, and heavy equipment must be placed on mats.

Individual Permits

An individual 404 permit is required for activities

with more significant wetland impact potential. Individual permit applications are evaluated on a case-by-case basis using the Section 404(b)(1) guidelines. The guidelines spell out a sequential review process whereby the applicant must first show that all available alternatives to the impact (the “discharge of dredged or fill material”) have been considered, and that no practicable alternative exists that would have less adverse impact on the aquatic ecosystem. Non-water-dependent activities face a more rigorous evaluation from the USACE. Next, no discharge can be permitted if it would violate other applicable laws, including state water quality standards, toxic effluent standards, the Endangered Species Act and marine sanctuary protections. Further, the discharge “cannot cause or contribute to significant degradation of wetlands by adversely impacting wildlife, ecosystem integrity, recreation, aesthetics, and economic values.” If these conditions are met, then the applicant must show that all appropriate and practicable steps will be taken to minimize adverse impacts of the discharge on wetlands. Only after avoidance and minimization criteria are satisfied can the USACE consider compensation, which is commonly known as mitigation (USEPA, 1991a). In establishing mitigation requirements, the USACE must strive to achieve a goal of no overall net loss of wetland values and functions, meaning a minimum of one-for-one functional replacement with an adequate margin of safety to reflect scientific uncertainty. An environmental assessment or environmental impact statement (EIS) must be prepared for each individual permit application.

Mitigation

Under the Section 404(b)(1) guidelines (codified at 40 CFR 230) and USACE regulations (codified at 33 CFR 320.4[r]), the USACE (or the EPA) has the right to require the developer to mitigate any unavoidable impacts on a wetland as a condition of an individual 404 permit. A developer may be required to enhance, restore or create wetlands on or near the development site. Mitigation projects are meant to replace the loss of natural wetland functions due to the permitted activity.

Section 404(f) exempts discharges of dredged or fill material associated with normal farming, ranching and forestry activities, such as plowing, seeding, cultivating or harvesting food, fiber or forest products; minor drainage; maintenance (not construction) of drainage ditches; construction and maintenance of irrigation ditches; construction and maintenance of farm or stock ponds; construction and maintenance of farm or forest roads in accordance with best management practices; and maintenance of dams, dikes and levees. These

discharges are exempt from the 404 permitting requirements if they do not convert a wetland to an upland area through the discharge of dredged or fill material. Minor drainage activities covered by this exemption are those involving the discharge of dredged or fill material incidental to:

- Connecting upland drainage facilities to waters under Section 404 jurisdiction to remove excess soil moisture from upland croplands.
- Installing ditching or other water control facilities associated with the planting, cultivating, protecting or harvesting of wetland crops (e.g., cranberries, loblolly pine).
- Manipulating the water level, flow or distribution of impoundments that are in established use for production of cranberries or other wetland crops.
- Removing sandbars, gravel bars or other similar blockages formed by flood flows on an emergency basis that, if not promptly removed, would result in damage to or loss of existing crops.

Minor drainage activities do not include enlarging or extending the affected drainage area beyond the dimensions that existed prior to development of the blockage that necessitated maintenance (USEPA, 1991a, 1995).

Section 404 is the backbone of wetland protection in the United States today. Yet, the vague language of the regulation, multiple exemptions, loopholes and activities not covered allow many wetlands to be legally degraded or destroyed. For example, Section 404 has no control over groundwater pumping that can completely dewater a wetland (USEPA, 1989). As a result of the above caveats, by most estimates, only about 20 percent of the activities that destroy wetlands are regulated under the Section 404 program (GAO, 1991). It should be noted that a large part of the remaining activities involve agriculture, which has been a major cause of past wetland losses. As discussed below, the 1985 and 1990 Farm Bills attempted to fill this gap in coverage.

A recent change in wetland regulation closed a major loophole that had enabled unregulated wetland conversion by non-discharge activities. The scope of the 404 program was clarified in August 1993 as a result of the lawsuit *North Carolina Wildlife Federation et al. v. Tulloch* (58 Federal Register 45008, August 25, 1993), and is now reflected in federal regulations at 33 CFR 332223.2(d). The COE revised the definition of “discharge of dredged material” in its guidance to include “any addition, including redeposit, of dredged material, including excavated material, into waters of

the United States which is incidental to any activity, including mechanized landclearing, ditching, canalization, or other excavation" when such activities destroy or degrade waters of the United States, including wetlands. This revision is "of great national significance to the Section 404 program" (58 Federal Register 45008, August 25, 1993), taking a clear position in favor of regulating excavation in wetlands, an area with a mixed history of enforcement (Want, 1994). This change will also help to narrow the exemption for drainage of wetlands, since most draining involves some degree of dredging (Want, 1994). As a caveat, this provision does not affect, in any manner, the existing statutory exemptions for normal farming, ranching and silvicultural activities in Section 404(f)(1)(58 Federal Register 45008, August 25, 1993).

Section 401 of the Clean Water Act

Section 401, the state water quality certification process, gives states authority to grant, deny or condition issuance of federal permits or licenses that may result in a discharge to waters of the United States, including the discharge of dredged or fill material. Through this certification process, states can prevent non-compliance with water quality standards through permit denials (such as Section 404 individual permits discussed above) or conditions of permit issuance (for example, mitigation requirements). States are encouraged by the EPA to use 401 certification as a means of protecting wetlands and of offsetting unavoidable impacts by obtaining mitigation proposals before granting 401 certification. The EPA offers guidance to the states on this process (USEPA, 1989), and some states have implemented it, resulting in essentially de facto Section 404 dredge and fill regulation at the state level. Of course, this approach to wetland protection is only as effective as the associated 404 protections.

Michigan Wetlands Protection Regulations

The Wetlands Protection Act (WPA), formerly P.A. 203 of 1979 and now Part 303 of the Natural Resources and Environmental Protection Act (NREPA), provides the statutory basis for wetland protection regulation in Michigan. In effect since October 1, 1980, the WPA is the product of several years of intense legislative debate and, for better or worse, a great deal of negotiation and compromise. As the result of a highly political process, the WPA suffers from a confusing jurisdictional scheme, vague and subjective provisions, and unfulfilled legislative requirements. In spite of these shortcomings,

it was, and remains, among the most innovative and progressive wetland protection laws in the nation.

The WPA regulates dredging, filling, draining of or construction in wetlands. It does not regulate the removal of vegetation from wetlands, nor does the jurisdiction of the act extend upland of the wetland boundary. In addition, the act is fairly generous in providing broad exemptions for many activities that can have severe impacts on wetland resources, including drainage, agriculture, forest products production and mining. These exemptions result in continued loss and degradation of wetland resources, the magnitude of which has not been quantified.

The WPA does not designate specific lands to be wetlands but rather establishes a definition of wetlands that must be employed primarily on a case-by-case basis. The statute's wetland definition is in part scientific and in part political. Generally, wetlands are defined as "*...land characterized by the presence of water at a frequency and duration sufficient to support and under normal circumstances does support wetland vegetation or aquatic life...*". This definition gives rise to the heavy emphasis on hydrology, vegetation and soil types in the wetlands delineation procedures employed by the MDEQ.

For regulatory purposes, the WPA also relies on the location of specific wetlands to determine jurisdiction. Throughout the state, all wetlands contiguous to one of the Great Lakes, Lake St. Clair, or an inland lake or stream are regulated regardless of their size. "Contiguous" is defined in the act's administrative rules as adjacent to or within 500 feet of an inland lake or stream or 1,000 feet of one of the Great Lakes or Lake St. Clair.

Non-contiguous wetlands of 5 acres or more are also regulated, except that such wetlands are exempted from regulation in counties of less than 100,000 population until the department completes a wetlands inventory as required by Section 30320 of the act. In the more than 16 years since the WPA's effective date, not a single county-level wetlands inventory has been completed, making it unlikely that the state's jurisdiction will be extended in sparsely populated counties anytime soon. This aspect of the state's jurisdictional scheme is difficult to explain on scientific grounds.

The department also has the authority to extend its jurisdiction to any wetland, regardless of size or location, upon making an affirmative finding that its protection is "*...essential to the preservation of the natural resources of the state from pollution, impairment or destruction...*". This authority has never been invoked.

Exemptions from permitting requirements are granted to a fairly wide spectrum of activities, including normal farming, ranching, horticultural, silvicultural and lumbering activities; maintenance and improvement of agricultural drains and drains constructed pursuant to the Michigan Drain Code; construction and maintenance of farm roads and ponds; construction and maintenance of temporary forest and mining roads; maintenance of public roads, pipelines and utility lines; and others.

The WPA also provides, in Section 30312, for expedited permitting for minor projects, including authorization for the department to issue *general permits* (GP's). The term "general permit" is in this instance a bit of a misnomer in that individual permits are still required, albeit without public notice and comment opportunities, for eligible projects. The GP authorized by the WPA is the functional equivalent to minor permits processed under the other statutes. It bears no resemblance to the general permit programs administered by the USACE under federal wetlands protection regulations.

Projects qualifying for a GP are those determined by the department to have, both individually and cumulatively, only minor impacts on the environment. Activities eligible for GP consideration include minor fills of less than 300 cubic yards and covering less than 10,000 square feet of wetland; construction of ponds less than 5 acres, if spoils are placed in an upland location; boardwalks and elevated platforms; driveways conforming with the 300 cubic yards/10,000 square feet restriction; utility lines and pipelines if wetland impacts are minimized; and other similar activities.

Section 30311 of the WPA lays out a framework of detailed and comprehensive permit evaluation criteria that the department applies to permit applications. According to the letter of the law, the WPA requires both an affirmative finding by the MDEQ that resource impacts have been minimized and a demonstration that there is no feasible and prudent alternative before a permit can be issued. As a practical matter, no such finding is explicitly made for permits granted by the department, though these factors are typically cited as justification for permit denials.

The specific review criteria in Section 30311 include the following:

The extent of public and private need for the proposed development.

- The magnitude and permanence of the project's detrimental impacts on wetlands.

- The contribution of the project to cumulative impacts on wetland resources.
- Impacts on historic, scenic, cultural, ecological or recreational values or on public health, fish or wildlife.
- The size of the wetland affected.
- The extent of wetland remaining in the area.
- The proximity to surface waters.
- The economic value of the proposed project.

These criteria are not ranked in the statute, nor is there any indication of how severe the impacts must be to trigger the denial of a permit. There is, however, an additional threshold in Section 30311 that an applicant must meet to qualify for a permit: the applicant must demonstrate either that the proposed activity is either wetland dependent or that there is no feasible and prudent alternative to the proposed project. Unlike the federal regulations, state law does not include any additional elaboration on what factors may make an alternative feasible or prudent.

The most innovative of the factors considered under the WPA is the issue of cumulative impacts. In other similar statutes, the aggregate impact of numerous small projects on natural resources and environmental quality is largely ignored. Section 30304(d), on the other hand, explicitly requires the department to consider "...the probable impacts of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed." Many wetlands scientists and conservation advocates recognize the incremental decline in wetlands function and value resulting from a number of seemingly inconsequential projects as a critical issue. Unfortunately, the MDEQ has never developed an evaluation strategy to deal effectively with the issue of cumulative impacts.

The WPA differs from the other statutes in the program in that there is an *automatic permitting* provision if statutory processing deadlines are not met. Section 30307 clearly states that a project will be authorized if the department fails to act on a complete application within 90 days of receipt if a public hearing is not held and within 150 days of receipt if a hearing is required. It is important to note that the administrative clock begins to run only when an application contains all information necessary for the department to make a decision, not when the department first receives an application. Though other statutes contain mandatory processing time frames, few contain the automatic issuance clause. The Inland Lakes and Streams Act (ILSA) contains similar statutory processing time frames but lacks the automatic permitting language of the WPA.

The WPA also includes a detailed treatment of mitigation in the act's administrative rules. Wetlands mitigation is among the more controversial and misunderstood aspects of the regulatory program. It is commonly understood, for example, that "mitigation" and "replacement" are interchangeable. Mitigation, as applied to this and many other permitting exercises, is a *sequence* of decisions undertaken by the department and the applicant. It begins with avoiding wetland impacts to the greatest extent practicable, continues with minimizing unavoidable impacts and concludes, in a small percentage of cases, with the construction of compensatory wetlands at the project site or another location authorized by the department.

Contrary to popular opinion, the department's authority to require mitigation is permissive. Many projects are authorized each year without any consideration of compensatory mitigation. In those cases where mitigation is deemed necessary and practical by the department, Rule 5 of the WPA requires that the sequence of decisions outlined above be followed. A clear mandate exists that on-site mitigation is preferred when practical and that the mitigation project replaces the wetland functions and values affected by the project when feasible. Another common misconception about wetlands mitigation is that the process potentially represents an exchange of wetland creation for wetland destruction as a mechanism for granting a permit. Wetland mitigation can be considered only when a proposed project is determined to be permissible in full compliance with the provisions of Section 30311. This myth is pervasive even among policy-makers.

Policies and Procedures for Wetland Regulation

Both the state and federal programs for wetland regulation contain similar elements that have been tested through years of administration and have survived numerous legal challenges. Generally, the courts have recognized wetland protection as an issue of legitimate public interest and have upheld an

overwhelming majority of agency decisions, provided certain legal standards are met.

Among the most important legal standards is that of consistency in the application of the law. Various classes of permit applications can be processed through different administrative procedures, but each application is measured against the same evaluation criteria. All applicants within permit classes are subject to the same application requirements, the same timelines and the same procedures.

Another important element common to all wetland regulations is a mechanism to appeal an agency decision. In the case of federal actions, agency decisions must be challenged in federal district court. State permit actions are subject to a prior administrative hearing process and are referred to circuit court only if the administrative process does not resolve the dispute.

State and federal regulatory programs also share the concept of feasible and prudent alternatives. If a project is necessary to the applicant and no alternative site or method can satisfy the applicant's need, a permit may be granted regardless of the magnitude of the wetland impacts involved. It is important to note that the feasible and prudent alternatives test is in two parts and both must be satisfied if a permit is to be granted. A project alternative may be feasible but not prudent, or vice versa, and a permit may be granted if this is the case. An agency retains the discretionary authority to deny an application even if a project is necessary and no feasible and prudent alternative is available if the resource impacts are unusually severe.

The cornerstone of wetland regulatory policy is the careful balancing of public and private rights, though various critics on both sides of the issue will argue that this balance does not exist. It is typical for the regulatory agency to grant modified permits minimizing wetland impacts while permitting the applicant to complete necessary portions of a project. For example, a recent Michigan study determined that the Michigan Department of Environmental Quality modified nearly 30 percent of the permits issued by the agency during the study period (MUCC, 1997).

Michigan's Legal Framework

Michigan's regulatory framework encompasses state legal authority combined with rules and regulations delegated for implementation at the local (county, township and/or municipal) level.

Local Authority — Police Power/Common Law

The concept of "home rule" is firmly embodied in Michigan law and culture. When practical, our legal system has delegated to local governmental units

decisions on critical issues such as land use, education, police and fire protection, and others that affect the general quality of life for Michigan citizens. Historically, the Michigan Legislature has been extremely cautious in altering the balance between state and local decision making.

Communities in Michigan exercise broad regulatory powers based on the delegation of substantial authority by the state. A series of planning and zoning enabling acts authorize counties, cities, villages and townships to enact and administer general land use controls. In addition, language in the Natural Resources and Environmental Protection Act, P.A. 451 of 1994 (discussed below) delegates to local units the authority for specific wetland protection ordinances to supplement the state's regulatory authority. The breadth of local land use authority allows local governments to exercise significant direct and indirect control over wetlands. Direct control, via ordinance language specifically targeted to wetland protection, is comparatively rare. More common is the indirect protection afforded by the general growth management activities routinely engaged in by local governments. However, the exercise of planning and zoning authority by Michigan communities is permissive and by no means universal. Recent surveys conducted by MUCC (1993) and by the MSPO (1995) indicate that only about half of the state's 1,800 jurisdictions have availed themselves of this opportunity. Clearly, local regulatory authority is an underutilized tool for natural resource protection.

Though planning and zoning at the local level are intimately linked, they are conducted under separate enabling statutes. There are three planning enabling acts: the Municipal Planning Act (P.A. 285 of 1931), the County Planning Act (P.A. 282 of 1945) and the Township Planning Act (P.A. 168 of 1959). These three acts authorize the creation of planning commissions and the creation of plans at the various jurisdictional levels and prescribe elements that may be included in such plans. There is no requirement that the governing body of a jurisdiction formally adopt any plan created by its planning commission.

The application of planning to the management and protection of natural resources in general and wetlands in particular is contained in general language in the enabling statutes. For example, the Township Planning Act enumerates as one of the several purposes of planning "...to encourage the use of resources in accordance with their character and adaptability "(MSA Section 5.2963[102]). And the preservation of natural

resources, including wetlands, can be included within the general "health, safety and welfare" provisions of municipal legal authority. But except to the extent that it supports the administration of regulatory authority, planning by itself does little more than articulate a community's collective vision for its future. It is the administration of regulatory programs that provides local governments with their greatest opportunity to provide for the protection of wetland resources. Like the planning laws, there are separate statutes authorizing zoning authority for the various local governments. The City-Village Zoning Act (P.A. 207 of 1921) was one of the nation's original zoning laws and served as a model for many subsequent state zoning enabling statutes (MUCC, 1993). The County Rural Zoning Enabling Act and the Township Rural Zoning Act followed more than two decades later (P.A. 183 and P.A. 184, respectively, of 1943). Each provides local government with specific legal authority to regulate the nature and intensity of land use within their jurisdictional boundaries.

The three zoning statutes are similar in that they lay out the authority for and procedures related to such functions as ordinance adoption and amendment, site plan review, appeals, and treatment of unusual issues such as non-conforming uses, variances, and conditional or special land uses. As with the planning statutes, the legislative intent to include natural resources protection among the purposes of local zoning is explicit. The statement of purpose for the Township Rural Zoning Act begins by articulating that the intent was "...to provide for the establishment in townships of zoning districts within which the proper use of land and natural resources may be encouraged or regulated by ordinance" (MSA 5.2963). The County Rural Zoning Enabling Act contains a nearly identical statement (MSA 5.2961). The protection of natural resources, then, is clearly within the regulatory authority of local government, provided that specific ordinance provisions are reasonable and related to the general health, safety and welfare of the community and its residents.

The relationship between the plan produced under the planning acts and the zoning ordinance adopted pursuant to the delegation of regulatory authority is not necessarily a direct one. Though there is a practical relationship between the two activities, few legal requirements exist to formally integrate them. All zoning enabling statutes require that a zoning ordinance be based on a plan, for example, but only the Township Rural Zoning Act requires that plan to be the master plan created and adopted by the township planning commission, if one exists. Further, most plans and

zoning ordinances focus on land use and development rather than on protection and management of specific elements of the landscape itself.

In addition to direct protection of natural features such as wetlands, the exercise of planning and zoning authority provides a wealth of underutilized tools to encourage indirect protection of wetlands. The authority to review and approve site plans can be used to protect wetland resources from encroachment, vegetation disturbance or the impacts of stormwater. General setback requirements for structures and parking areas can also insulate wetlands from the degrading influence of surrounding development. Finally, managing community growth to maximize the efficiency of land use can protect wetlands and other natural features from development pressure.

The protection of natural amenities, however, is not integrated into local land use management authorities to the maximum possible extent. Natural resource protection elements of site plan review are typically generic rather than specific. Detailed criteria for the management of stormwater, the protection of vegetation and the extent or location of impervious surfaces on developing sites could further protect wetland resources but are frequently absent from site plan review ordinances. Similarly, the inclusion of environmental impact analysis requirements for major development projects is a permissible element of a zoning ordinance that is rarely employed. Nor are mitigation measures to reduce impacts on wetlands and other natural features typically employed as a condition of special land use authorization.

Despite the leadership role that Michigan played during the early development of zoning laws in the United States, laws related to planning and zoning authority have not been adapted to include innovative land use management techniques developed across the nation. Michigan communities do not have the legal authority to transfer development rights between parcels, and the authorization for purchasing development rights is limited to agricultural lands. At the present time, the use of urban/suburban service districts, the concept of service concurrency or the imposition of impact fees on major developments are also not within the ability of Michigan's local governments. The substantial regulatory authority potentially available for direct and indirect wetland protection activities at the local level is an underutilized resource.

The application of this wealth of authority to wetland protection is one means for a community to expand its

ability to protect its critical wetlands. Methods for the effective deployment of these regulatory tools and recommendations for the integration of regulatory measures into an overall wetlands protection strategy are discussed in Chapter 7.

Local Wetland Regulation

Prior to 1993, local governments choosing to protect wetlands within their borders enjoyed wide latitude in the regulatory measures that they could adopt because of specific language in Section 8 of the Goemaere-Anderson Wetlands Protection Act. Communities were authorized to enact and enforce ordinances as long as they were no less stringent than state law. Local ordinances could and often did protect wetlands outside the jurisdiction of state law and also regulate activities that the Michigan Legislature had exempted from permitting requirements.

Local regulatory programs proved to be extremely problematic for the development community. Allegations were raised that local units employed a patchwork of regulatory strategies and a wide spectrum of wetland definitions and delineation criteria such that the presence of local regulations constituted a significant impediment to land development. Though these allegations were seldom supported by relevant factual information, they nonetheless resonated with members of the state legislature. As more communities across the state adopted wetland ordinances, opposition to their statutory authority to do so increased.

By 1993, opposition to local ordinances had become so well organized and well funded that the legislature found it difficult to ignore the development community's calls for reform. A bill to repeal the statutory authorization for local wetlands ordinances was introduced in the Michigan Senate and nearly passed by that chamber before procedural maneuvers were employed to get the legislation returned to committee for reconsideration. After several months of intensive negotiations involving wetlands protection advocates, the development community and local government officials, a compromise was reached that would authorize local ordinances but would greatly restrict the areas in which administering units could be more stringent than state law. The substance of this compromise is embodied in the language of the 1993 amendments to Michigan's wetland protection law, discussed in the next section.

In the face of the additional requirements imposed by the 1993 amendments, several communities that

formerly administered wetland protection ordinances chose to relinquish that authority rather than comply. Of the 31 communities actively engaged in wetland regulation in 1992, only a limited number continue to administer their programs. This is unfortunate, given that compliance with the new requirements would prove to be less difficult than originally anticipated. The lesson derived from the process leading to the 1993 amendments is that communities that choose to protect their wetlands will be venturing into controversial territory. A solid scientific basis for decision making, always beneficial, is now a requirement of state law. Careful program development and administration must precede regulatory decisions involving wetlands.

P.A. 451, Part 303 Restrictions

Of the several new requirements of local ordinances now contained in Sections 30308, 30309 and 30310 of the NREPA, the biggest challenge is in the protection of small wetlands. Communities wishing to regulate wetlands less than 2 acres in size are compelled by the new amendatory language to engage in a relatively complex values assessment of the wetlands they wish to regulate. This represents a significant shift in responsibilities under state law.

Prior to the amendments, applicants bore the primary responsibility to demonstrate that the wetland losses entailed in their proposals were reasonable and acceptable under the standards of the act. After the amendments, this burden was shifted to the local regulatory entity for all wetlands under 2 acres in size. New language added to Section 30309 requires that, for wetlands under 2 acres, the local unit must make a determination that the wetland is "...essential to the preservation of the natural resources of the local unit of government..." and provide the justification in a written statement. The statement must include an affirmative finding that the wetland meets one of the following criteria:

- *The site supports state or federal endangered or threatened plants, fish or wildlife appearing on a list specified in section 36505.*
- *The site represents what is identified as a locally rare or unique ecosystem.*
- *The site supports plants or animals of an identified local importance.*
- *The site provides groundwater recharge documented by a public agency.*
- *The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.*

- *The site provides wildlife habitat by providing breeding, nesting or feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.*
- *The site provides protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.*
- *The site provides pollution treatment by serving as a biological and chemical oxidation basin.*
- *The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.*
- *The site provides sources of nutrients in water food cycles and nursery areas for fish.*

For wetlands between 2 and 5 acres that are unregulated by the Michigan Department of Environmental Quality, local communities cannot regulate in a manner more stringent than state law. From a practical standpoint, this means that the state's wetland definition and delineation criteria must be substantially followed and all activities exempt from state regulations are also exempt from local ordinances.

An additional requirement imposed by the 1993 amendments is that all new ordinances adopted after the effective date of the amending act must be preceded by a published wetland inventory, made available to the public and subject to public comment. Local governments with ordinances in force at the time of the amendments were required to conduct and publish an inventory within 18 months.

Though the state law explicitly requires the inventory, the inventory itself has no presumptive regulatory effect. Lands identified as wetlands in the inventory are not presumed to be covered by regulation until such time as a site investigation verifies the wetland character of the parcel. Conversely, wetlands that the inventory fails to identify as such are not exempted from regulatory requirements. Property owners wishing to engage in activities regulated by the ordinance are still required to disclose the presence of wetlands and file a permit application.

The required inventory, then, can be thought of as little more than a mandatory public education exercise, nothing more than a generalized indication of where in a local unit regulated wetlands may occur. The provision was included in the 1993 amendments to erect a potentially costly administrative hurdle that must be cleared before an ordinance can be enacted, a hurdle that serves no clear regulatory purpose.

On the other hand, the required inventory can, with a comparatively small incremental cost increase, constitute a valuable planning tool, not only for the administration of regulatory control over development activity but also to support comprehensive non-regulatory wetlands protection programming. Strategies for wetlands inventory and evaluation are discussed in detail in the section on wetlands protection.

Section 30309 Evaluation Criteria

The incorporation of values into the regulatory protection of wetlands is both intuitively attractive and politically necessary, but no universally accepted and objective methodology to determine the value of a particular wetland exists, either within the landscape mosaic where it is found or within broader resource protection objectives. The value of a particular wetland, either to its owner or the community, is specific both to its location in relation to other habitat types and to the value-based preferences of the observer. A birder or hunter may express a preference for emergent wetlands such as cattail marshes, while a botanist may favor a wet meadow that the casual observer may not even recognize as a wetland. Obviously, developing a value-based regulatory scheme is, at best, challenging.

Section 30309 provides a list of wetland values that is a mandatory feature of a legally enforceable wetland ordinance that protects wetlands below 2 acres in size. How these values are to be applied to individual regulatory decisions involving these wetlands or the extent to which such considerations are to be applied to locally regulated wetlands above 2 acres is not dictated in statute. Some guidance on how these criteria are to be applied in a local ordinance can be derived from the decision criteria contained in NREPA Section 30311. These criteria provide value-based guidance to MDEQ field staff members on factors such as economic values, project purpose, and the balance between public wishes and private rights.

Section 30311(2) specifies nine factors to be used in determining if a project is “in the public interest” per Section 30311(1). The act’s language directs the department to “balance the benefits which reasonably may be expected to accrue from the proposal” against the activity’s “reasonably foreseeable detriments” in light of the following general criteria:

- *The relative extent of the public and private need for the proposed activity.*
- *The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits of the activity.*

- *The extent and permanence of the beneficial and detrimental effects which the proposed activity may have on the public and private uses to which the area is suited, including the benefits the wetland provides.*
- *The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.*
- *The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or fish and wildlife.*
- *The size of the wetland being considered.*
- *The amount of remaining wetland in the general area.*
- *Proximity to any waterway.*
- *Economic value, both public and private, of the proposed land change to the general area.*

The range of possible approaches to employing these nine criteria in the evaluation of project proposals is very broad. The specific balancing of these factors or the relative weight given to each in relation to the others is not specified. However, there is an implied legislative endorsement of value-based wetland protection inherent in the specific inclusion of such factors as proximity to surface waters, magnitude of previous wetland impact in the general vicinity, the amount of remaining wetland in the area and the size of the wetland in question. That these factors can and should be given special consideration by decision makers is emphasized by these statutory references. The value-based flexibility for local wetland protection efforts is delimited by the Section 30309 statutory criteria. Two of the ten criteria allow for limited local discretion. Section 30309(*) (a), for example, involves the presence of plants, fish or wildlife included on the state or federal threatened species list. Section 30309(*) (d) involves sites of groundwater recharge “...documented by a public agency.” Absent the required documentation of these factors, local governments cannot apply either of these criteria in their regulatory decisions.

The remaining eight criteria, however, provide broad latitude for the development of a sound, scientifically based regulatory structure based primarily on locally expressed values and preferences. Section 30309(*) (b) and (c) allow for the protection of specific wetland sites based on the presence of “locally rare or unique ecosystems” and “... plants or animals of an identified local importance” (emphasis added). Provided that their importance is based on some valid assessment methodology, the range of species and habitat types included within the scope of these criteria is substantial.

The remaining six criteria relate to wetland functions such as flood control, habitat, and surface and groundwater quality protection. Few wetlands in Michigan will fail to satisfy one of these six criteria. The key to employing these criteria in a regulatory framework is to provide documentation of the extent to which a particular wetland meets them as a part of the decision process.

Essential Elements of Local Regulations

To comply fully with state law regarding wetlands protection, a local ordinance must possess several features specified in NREPA Part 303. The requirement for a wetland inventory has already been discussed, as has the values assessment requirement for wetlands below 2 acres. But local ordinances must also mirror state requirements in several other critical respects. Local ordinances must contain a definition of wetland that is operationally equivalent to the one in the state's wetland law. From a practical standpoint, this also implies that the delineation criteria used to make jurisdictional determinations must also be substantially identical to state practices. Compliance with this requirement is complicated by the fact that Michigan has never formally adopted a wetland delineation manual similar to that used by federal agencies. However, wetland delineation practices are becoming increasingly standardized throughout the range of jurisdictions applying them. Conformance with federal procedures or those informally practiced by the state will all but guarantee compliance with state law.

Local ordinances must also mirror the state's statutory timeframes for processing applications. According to NREPA Section 30307(6), communities must act within 90 days of the receipt of an application for a wetland permit or the permit is considered approved by operation of law. This differs slightly from the processing time allowed state regulators in that the state's 90-day period begins when the Department of Environmental Quality makes the determination that an application is "administratively complete" while local governments' processing period begins with the receipt of an application. To protect local units from being compelled by this requirement to act on incomplete applications, the statute specifically includes insufficient information as a criterion for denial.

Local ordinances must also exempt from permitting requirements all activities exempted from state wetlands protection law. These activities are enumerated in NREPA Section 30305 and include a range of uses permitted by right, such as hunting, fishing, trapping, swimming or boating, hiking, and grazing of animals as well as a list of categorical

exemptions for wetland dredge and fill projects for specific purposes. Most of the categorical exemptions are for such activities as farming, mining and harvesting forest products or drainage. The exemptions most significant to the local administration of wetland protection regulations are for the improvement of public streets and highways and the maintenance of structures or uses predating the act or authorized by permit.

Local governments administering wetland ordinances must also use the state's standard application form. Included among the items covered by this form is an "environmental assessment" that may be required at the option of the administering agency. The environmental assessment covers the effects of a proposed project on wetland benefits as well as physical and biological impacts.

State law also requires local authorities to use the same decision-making body to act on wetland permits that will make decisions related to site plans, plats, wetland determinations and "related matters." The only exceptions to this provision are for preliminary review by a "planning department, planning consultant, or planning commission," and for acting on appeals.

The restrictions placed on local wetland ordinances by the 1993 amendments to the state's wetland protection law undoubtedly limited the regulatory authority available at the community level. But Michigan's cities, villages, townships and counties still enjoy a wide range of authority should they choose to employ it. Succeeding sections outline detailed strategies for employing that authority.

Limits on Local Authority

Michigan's Wetlands Protection Act of 1979 authorized local ordinances virtually without restriction, and it was under these provisions that most local wetlands ordinances in the state were developed. In 1992, a major legislative initiative would have expressly prohibited *all* local wetlands protection ordinances through amendments to the act. This rather draconian effort eventually gave way to the compromise that produced the provisions discussed earlier. There was, however, one issue on which the new amendments were silent: the regulation of wetland buffer areas.

Several of the communities with wetland regulations included restricted development of upland buffer areas within a certain distance from wetland boundaries. The premise on which the regulation of buffer areas was based was the protection of wetland areas not only from physical encroachment from fill but also from the more subtle impacts of human activity adjacent to wetlands.

These provisions went well beyond the state's regulatory authority, which stopped at the wetland boundary.

Following the 1992 amendments, most communities simply left their buffer provisions intact, assuming that, since they were not addressed in the amendment process, they were still within the provisions of the law. In 1996, the majority leader of the Michigan Senate requested that the Michigan attorney general (AG) conduct a review of this question to determine definitively if the 1992 amendments prohibited buffer protection provisions in local ordinances.

The AG's opinion, which has the effect of a judicial decision unless overturned in court, was that buffer regulations were prohibited by the 1992 amendments to the Wetlands Protection Act. The AG relied on the language of NREPA Section 30307, which states that communities may regulate wetlands "...only as provided under..." state law. Because the state statutory authority did not extend upland of the wetland boundary, it was concluded that local authority was similarly limited.

At least one community has apparently found an innovative way to regulate buffer areas around wetlands outside of the scope of their wetlands ordinance. The Charter Township of Meridian in Ingham County adopted, as a separate provision of its zoning ordinance, requirement for setbacks by means of natural vegetation strips adjacent to "water features," including wetlands (Charter Township of Meridian, 1994a).

This approach poses an interesting question with respect to compliance with state law. Meridian's setback/vegetation strip requirements are extended to a variety of water features besides wetlands, so it is arguable that this requirement is outside of the specific limitations of Section 30307. Conversely, it can be argued that, because the provisions relate to wetlands, they are impermissible, whether or not they occur in a specific wetland protection ordinance.

This remains an open question — Meridian's ordinance provisions have not been tested in court. This township's approach to wetland protection, however, illustrates the role of innovative, multielement wetland protection strategies blending various regulatory authorities to preserve critical wetland resources.

Relationship to State and Federal Jurisdictions

Local wetland regulations are supplemental to state and federal regulatory authorities. The range of potential conflict between agencies at various levels of government suggests that a high degree of coordination between local units and higher levels of government would be beneficial. The impact of the federal government on local wetland ordinance administration is limited by the geographic scope of federal regulatory authority in Michigan. Since 1984, when Michigan assumed Section 404 regulatory authority from the USACE, the only areas where the federal agency retained jurisdiction were Great Lakes coastal areas and the so-called "Section 10" waters, primarily harbors and navigation channels maintained by the USACE. Local governments not lying within those areas will have little need to coordinate with federal agencies.

Provisions of NREPA Part 303 dictate coordination between state and local regulatory entities. Specifically, Section 30307(6) directs the Department of Environmental Quality to forward any permit application it receives from within a local unit administering a wetland ordinance to that local unit for action. The state's consideration of the application, provided that the project occurs in state-regulated wetlands, begins only after the local unit makes its decision. Even in communities without local ordinances, the state forwards the application to that unit for its consideration. Section 30307(7) allows communities without ordinances to hold hearings on state jurisdictional issues and provides a 45-day period in which a community may provide comments to the department. The department is also required to notify the local government of its decision on the application.

Regardless of the legal requirements for intergovernmental coordination, local units administering ordinances should build a close working relationship with the local MDEQ wetlands permitting staff to exchange information informally that may facilitate the formal consultation process. Advance notification of pending issues prior to the legally required date can then allow the respective governments to fulfill their responsibilities more efficiently.

Local Opportunities for Wetland Protection

Local governments, by way of state zoning and planning enabling acts, have been granted broad powers for controlling land use within their jurisdictions. This regulatory authority is referred to as police power. Local jurisdictions may also become involved in wetland cases stemming from a common law foundation, such as the case where changed water flows (in magnitude or direction) of a property adjacent to one that has undergone wetland alteration are the impetus of a nuisance claim.

By identifying, assessing and including specific measures for wetland monitoring and protection, local governments can ensure some proactive planning and avoid future problems, among them:

- Saving personnel time and minimizing delays in obtaining building permits for landowners by prior identification of protected wetlands.
- Including a wetlands inventory in site plan review, therefore increasing the likelihood that wetlands may be designed into stormwater discharge, open space preservation and recreational plans.
- Aid land use planning and the wetland permitting process by evaluating general functions and values of wetland areas.
- Provide for the possible inventory of other sensitive lands, endangered species and natural resources during wetland assessment.
- Review state-local jurisdiction over wetlands and assess ramifications for public takings or other challenges.

Local experiences with the Wetland Act will usually occur for one of two reasons: an individual or group becomes involved in an attempt to stop a development project affecting a local wetland, a project that is either supported or not opposed by the local planning and zoning boards; or a local government and its agencies use the Wetland Act to stop a project they oppose.

Local governments are instrumental in comprehensive wetland protection. Protection strategies adopted on the local level offer advantages, such as:

- *More diverse environmental protection measures, including water management, land use planning and zoning authority.*
- *Prioritization and designation of nature protection areas.*
- *Ecosystem protection and restoration of wetland functions*

and values, allowing prioritization of protection and restoration efforts.

- *Harmonization and consolidation of environmental protection and local programs, such as open space preservation, establishing wildlife corridors, ecosystem networks or migratory pathways, riparian protection and floodplain regulation.*
- *A greater ability to respond to cumulative environmental impacts than through permitting programs.*
- *The ability to plan acceptable mitigation banking activities and to coordinate with wildlife corridor and other environmental protection efforts.*
- *A more proactive approach to wetland protection.*

Some local governments have adopted wetland protection ordinances; others have developed buffer, riparian and other land protection ordinances, zoning overlay districts, master planning efforts that include wetlands protection and development permits.

There are several limitations to wetland protection at the local level:

- *Watersheds and wetlands often cross local government boundaries — activities in one jurisdiction may affect wetlands in another jurisdiction in the same watershed.*
- *Local economic resources are generally very limited, especially in rural townships.*
- *Local politics may conflict or interfere with larger public protection goals. Therefore, states may wish to retain a proactive oversight role and work together with local governments to address the historical legacy of wetland loss and degradation.*

Adoption of Local Regulatory Authority Provided for in the Wetland Act

Local governments wishing to set standards and procedures for activities affecting wetland ecosystems and their functions can do so by way of the general zoning powers conferred in the township or municipal zoning enabling acts or in accordance with Part 303 of Michigan's Natural Resources and Environmental Protection Act (Act 451) of 1994 (NREPA). Part 303 replaced the Wetland Protection Act (Act 203) of 1979, in effect since 1980. The act prohibits draining, dredging or filling of regulated wetlands without a permit from the Michigan Department of Environmental Quality.

Because of the broad definition of wetlands, the amount of wetlands regulated by the NREPA is considerable. The NREPA covers all wetlands contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or stream, as well as wetlands not contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or stream but which are 5 acres (2 hectares) or larger.

“Contiguous to the Great Lakes” includes every wetland within 1,000 feet of those lakes or located within 500 feet of an inland lake, river, pond or stream. Wetlands of any size in counties of less than 100,000 population are not covered by the NREPA wetland provision until the MDNR has conducted an inventory of wetlands for that county (Sadewasser, 1996). Wetlands contiguous to bodies of open water and smaller than 5 acres can be protected under the NREPA if the MDEQ designates them as “essential” (Michigan Compiled Laws Annotated, 324.303). State protection does not depend on the completion of a wetland inventory (Sadewasser, 1996).

To be designated as “essential”, a wetland must meet one or more of the following criteria:

- a) *It supports state or federal endangered or threatened plants, fish, or wildlife appearing on a list specified in section 36505.*
- b) *It represents what the department has identified as a rare or unique ecosystem.*
- c) *It supports plants or animals of an identified regional importance.*
- d) *It provides groundwater recharge documented by a public agency.*

Stand-alone Ordinance

In 1995, 22 local governments had wetland protection ordinances on file with the state Department of Environmental Quality (MDEQ, 1995). The changes in the Natural Resources and Environmental Protection Act relative to wetlands came about as a result of efforts to establish a uniform definition of wetlands at the local level. The act also attempted to ensure that local protection be guided by statutes that are no more restrictive than statutes at the state level and that local communities enforce regulations on wetlands not protected under the NREPA.

There are several benefits to a local jurisdiction adopting a wetland ordinance that can streamline wetland regulatory issues and help avoid many future

problems and expense where wetland related problems surface after development has gone ahead or been completed. Among these benefits are:

- Defining and clarifying to developers and private landowners wetlands definition and preservation objectives, state and local wetland statutes, and exemptions to the state wetland provisions.
- Specifying the state and local wetland permit application, review and appeal process.
- Setting forth the course for identifying and mapping wetlands (and other sensitive natural resources) and establishing development site plan requirements for fully including these resources in the planning and implementation stage.

The latter is specifically useful in attempting to use the design with nature concept and enhance the opportunities to create quality residential developments incorporating natural features and benefits.

What About Appeals and Takings Claims?

Some communities may shy away from involvement in wetland protection for fear of increasing their workload and overburdening their budgets in contesting legal grievances involving a township’s or municipality’s denial of a building permit. This has not proven true in some cases. In one rapidly growing Michigan community with substantial acreage in wetlands, there were dire predictions that adopting such an ordinance would stop economic growth and result in “huge takings claims” (Clos in Cwikiel, ed., 1995.) In fact, development has proceeded much as it did before the ordinance, and now developers are designing projects to avoid wetlands and the permitting process (the annual number of wetland permit applications has decreased). Most permits that do make it through the review process are granted with some alteration to the development plans. In this particular case, no litigation has resulted since the ordinance was adopted in 1991, and, in the opinion of the ordinance’s principal author, wetland loss has been substantially reduced. This township was budgeting \$11,000 for its wetland program, though part of this expense was being recouped through permit and related fees.

Local Ordinance Requirements

A local unit of government is allowed to protect contiguous or non-contiguous wetlands that are smaller

than 5 acres and that meet the wetland protection provision of the NREPA. For wetlands between 5 and 2 acres, local governments have to comply with state regulation by using the same definition and completing a wetland inventory. If a local government in Michigan has adopted a wetland ordinance for a site smaller than 2 acres, a development permit cannot be denied unless the site complies with one of the following criteria (from NREPA, Part 303, Section 30309, noted as functions in Chapter 3.4):

- a) *The site supports state or federal endangered or threatened plants, fish, or wildlife appearing on a list specified in section 36505.*
- b) *The site represents what is identified as a locally rare or unique ecosystem.*
- c) *The site supports plants or animals of an identified local importance.*
- d) *The site provides groundwater recharge documented by a public agency.*
- e) *The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.*
- f) *The site provides wildlife habitat by providing breeding, nesting, or feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species*
- g) *The site provides protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.*
- h) *The site provides pollution treatment by serving as a biological and chemical oxidation basin.*
- i) *The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.*
- j) *The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.*

Wetland Permit Review

Unless an individual or party is involved in an agricultural or other exempt activity (Section 30305), permits have to be filed with the Department of Environmental Quality for all activities which:

- (a) *Deposit or permit the placing of fill material in a wetland.*
- (b) *Dredge, remove, or permit the removal of soil or minerals from a wetland.*

(c) *Construct, operate, or maintain any use or development in a wetland.*

(d) *Drain surface water from a wetland.*

Requests for wetland development that arrive at the state department regulating such permits are copied and forwarded to local governments. (Part 303 of NREPA also stipulates notification of local governments or individuals of all pending wetland permits on a biweekly basis for a \$25 annual fee.) Local government officials — or any individual, for that matter — have the opportunity to review and comment on the proposal outlined in the permit application and should do so within 45 days of receipt of the application. The Department of Environmental Quality has 90 days from the filing of the permit or the completion of a public hearing on the proposed development in which to approve or disapprove the permit.

The agency's decision on whether to issue a permit allowing one of the four otherwise prohibited activities rests on whether the benefit to be gained by issuing of the permit and the ensuing development are greater than the "reasonably foreseeable detriments" of the activity, and whether it can be proven that the proposed development does not create an unacceptable disruption to the aquatic resources. This second condition consists of the applicant's evidence that either the proposed activity is primarily dependent on being located in a wetland or that a feasible and prudent alternate site for the development does not exist.

The first of these conditions is referred to as the "public interest test" because "wetland dredging, filling and draining typically benefit the applicant, whereas the detriments are typically felt by the public at large" (Cwikiel, 1996). Section 30311(2) spells out the nine criteria considered in determining the public interest served by issuance of the permit. Some of these considerations include economic valuation, a matter that is given little attention — at least of a professional nature — in actual practice (Zahniser and Kaplowitz, 1994). The second condition, that of wetland dependence and development site alternatives, will be summarized later in this section.

Local Zoning and Building Permits Conditioned on Wetland Permits

Local units of government that have no provisions in their ordinances for regulating wetlands may nevertheless require a state wetland permit pursuant to any approval of other local building permits. This is an

inexpensive method of assuring that wetlands and other sensitive lands regulated by state or federal agencies do not slip through the regulatory cracks. The disadvantage, however, is similar to local commentary on wetland permits in that only regulated wetlands are accounted for in such measures.

Site Plan Review (SPR): A site plan review is a document specified in the zoning ordinance needed to “insure that a proposed land use or activity is in compliance with the local ordinance and state and federal statutes” (Wyckoff, 1988). Site plans enjoy statutory authority (Township, County and Village Zoning Enabling Acts) and can be an effective tool for wetland protection. The documents usually include a drawing and description of the location of parcel boundaries, size and location of structures, setbacks, parking, utility lines, natural features and topographic relief. Most local governments administer a site plan review process. Single-family homes are usually exempt from the SPR unless a sensitive natural resource, such as a wetland, is affected by the development.

Though a stand-alone wetland ordinance allows for the most explicit (and supported by parallel state regulations) protection measures for locally important wetlands, the site plan review option does not require separate wetland permits and extensive (or expensive) coordination with state agencies. The site plan review process should at a minimum facilitate the mapping of local wetlands and require that site plans locate wetlands with reference to parcel development and describe protective measures in development plans. SPRs may include conditions or requirements of the land use to conform with the zoning and building codes.² The conditions must meet the following requirements (Wyckoff, 1988):

- *Be designed to protect natural resources, the health, safety and welfare...of those who will use the land...landowners immediately adjacent to the proposed land use..and the community as a whole.*
- *Be related to the valid exercise of the police power, and purposes which are affected by the proposed use or activity.*
- *Be related to the standards established in the ordinance for the land use or activity under consideration.*

Setback Zones or Natural Features Buffers

Setbacks or buffers are not expressly provided for in Part 303 of the NREPA, though it is certainly true that areas abutting wetlands and the activities on these lands, including uplands, can have a detrimental effect on wetland functions. Buffer restrictions could be adopted as a separate article to a zoning ordinance and could apply in general to all zoning districts. Language should be included detailing the intent of the buffer, a definition of the natural feature (wetlands) being protected, authorization and prohibition, exemptions and the setback standard (e.g., 100 feet from the delineated boundary of a wetland).

Buffers may be especially important in the agricultural landscape, where sediment in runoff — the result of extensive areas with little cover at times when rains or snowmelt may be especially heavy — can reduce the capacity of wetlands to remove nutrients and residual pesticides. A buffer’s width should be commensurate with the stress brought about by the sedimentation reflective of land cover/use of the surrounding watershed area.

Wetland and buffer systems of appropriate vegetation configuration and dimension have been shown to remove 90 to 100 percent of suspended solids and 80 to 100 percent of total phosphorus and nitrogen. Maintaining appropriate buffers where wetlands make up 5 to 10 percent of the total watershed area can increase capability of reaching 50 percent reduction in peak flood period (DeLaney, 1995).

Buildable Lots

Communities can require that all new parcels conform to buildable criteria: assuring that sufficient upland area exists on the parcel for meeting ordinary setback, structural, septic and accessory use requirements. Local zoning ordinances should be amended that cover both platted and unplatted parcel creation. Where a local subdivision control ordinance exists, a requirement can be made that all lots be buildable. Preliminary plats with identified wetlands present should be submitted to the MDEQ prior to local approval. Non-conforming lots would not be eligible for building permits or variance review.

²For an in-depth discussion of the applicability of the site plan review to wetland protection, consult “The Site Plan Review Process: A Cost-Effective Tool for Environmental Management” by Lillian Dean, 1982, Southeast Michigan Council of Governments.

Soil Erosion and Stormwater Runoff Control Ordinance

Local governments may require site plans that include proposals for minimizing erosion in developments involving earth changes (cut and fill activities). This requirement may be especially designed to protect environmentally sensitive sites — for example, sites located within 100 feet of a wetland. Provisions may include maps detailing the proximity of any earth changes to any lakes, streams or wetlands; a soil survey of the land area proposed for earth changes; location of all lakes, streams or wetlands within 50 feet of the site boundary; description and location of all temporary erosion control facilities and measures; and stormwater runoff calculations (Grand Traverse Ord. VI B).

Open Space Zoning Regulations

This technique for accommodating residential development while preserving the unique rural or natural character of as much of the parcel as feasible is most often associated with cluster developments. Higher residential building densities are usually traded for permanently setting aside significant portions of natural areas as open and common space. Design standards include a maximum building envelope size to minimize impact on the remaining parcel; maximum total residential lot disturbance outside of which boundaries no disturbances (grading, lawns and landscaping) shall be permitted; maximum parcel area disturbance for roads, utilities, stormwater management facilities and other infrastructure; building envelope siting — not in wetlands or wetland transition areas; and setback restrictions for designated wetlands.

Randall Arendt (1996), in his book *Conservation Design for Subdivisions*, introduces his four-stage design for clustering residential developments so as to maximize the protection for natural areas while also maximizing the benefits in common, open and recreation space. This design creates more functional space than conventional developments. The four stages are: identifying all potential conservation areas, locating house sites, designing street alignments and trails, and drawing in lot lines. Examples of such residential development can now be seen in various areas in Michigan where communal wetlands and open space enhance subdivisions. Examples of these developments may be found in Williamstown Township, Mich.

Feasible and Prudent Alternative

In accordance with the transference of the EPA's administrative authority for Section 404 (Clean Water Act 1972) wetland regulation to the state DEQ, the wetland permit review includes Section 404 (b)(1)

guidelines for alternative analysis of development projects. The purpose of the guidelines is to steer land-based (i.e., not water-dependent) projects to upland areas so as to fully minimize any harmful development effects (filling, dredging, etc.). This is one potential major obstacle to permit approval and can be the basis for much of the public commentary opposing permit approval.

Wetland permits generally require a statement of purpose of the proposed project along with a description of alternatives considered, including alternative sites or building "footprint" and methods of construction. Purpose: The agency or local government responsible for evaluating a permit must first consider whether any components of a development depend on being located on or near water. Examples of water-dependent activities include boat landing facilities, peat harvesting and docks. If a development is not considered to be water dependent, then "practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise" (40 CFR 230.10 [a][3]). In evaluating a project's purpose, it is necessary to separate those elements of a purpose statement that are essential or basic from those that are secondary.

In the case of a nursery operation that also sells to retail customers, the nursery production site would be considered primary, whereas the site plan for the retail shop would be considered secondary and more justifiably altered to limit wetland disturbance. Site criteria may need to adhere closely to the primary purpose of the project and not to access to amenities, self-imposed restrictions or restrictions that are often open to appeal, such as variances to zoning ordinances. Though an applicant may choose and design a site on both necessary and desirable grounds, the only criteria allowed by Section 404 guidelines are criteria fundamental to the basic purpose. In the previous example, the acceptable necessary criteria for a development site could include:

- Source of irrigation water.
- Road access.
- Sufficient upland acreage and soil conditions.
- Limited parking space and market area.

The "alternative analysis", as referenced above, includes the investigation of possible site and design alternatives. This shows that the applicant is taking wetlands into consideration and avoiding them as much as possible. An alternative is practicable if it is "available and capable of being done, taking into account cost, existing technology, and logistics, in light of overall project purpose." Available sites are not

limited to ownership of the present parcel, and it is possible to evaluate a wetland permit by determining whether a selected and purchased parcel meets the “market entry test” — sites may not be limited to those included at the time of application but rather those sites that existed at the time the applicant entered the market.

Practicable also refers to the methods employed in the construction as well as the components included as primary to the purpose of the project. It could well be considered a luxury to fill a wetland area to construct foundations for a deck or porch on a home when there are practicable alternatives, such as driven pilings or cement piers, for achieving such purposes. A side yard may also not warrant filling or dredging — many would consider having a wetland area adjacent a home, so long as it does not endanger the structure, as an acceptable alternative to a lawn or other form of landscaping. Zoning may often serve as the basis for permitting a given use, but zoning does not imply that all permitted uses or densities should always be allowed. Building fewer or smaller structures than are permitted by zoning regulations under other circumstances is a practicable alternative in site design.

Overlapping Jurisdiction

Currently, Michigan is one of two states authorized to administer the federal 404 permit program of the CWA. In 1977, the MDNR and the USACE signed a Memorandum of Understanding (MOU, 1977) stating that “a considerable portion of the duplication which necessarily results from processing permit applications independently can be eliminated if application processing is done in a joint matter.” This MOU refers both to permits under the River and Harbor Act of 1899 and the Clean Water Act. This was followed in 1984 by a Memorandum of Agreement (MOA, 1984) between Michigan and the USACE, delegating administrative authority of the section 404 program and waiving the right to review MDNR permits. Two exceptions are made. The first, for major discharges (more than 10,000 cubic yards of fill), and the second, for discharges that may affect coastal waters, connecting channels and the upstream limits of navigation in major tributaries of the United States.

“All waters within the state of Michigan shall be regulated by MDNR other than those waters which are presently used, or are susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce shoreward to their ordinary high water mark, including wetlands adjacent thereto.”

Under these provisions, the EPA and the Army Corps of Engineers have retained jurisdiction and review authority over wetland activities. In places where the USACE has retained jurisdiction, dual permits are required (DEQ and USACE). Federal (Corps of Engineers) jurisdiction may be triggered by the commerce clause: if the destruction or degradation of streams, rivers or other water bodies can be construed as limiting or prohibiting interstate or foreign commerce, then by definition these could be considered U.S. waters and worthy of federal wetland regulation. This argument has been used for wetlands, albeit not always successfully, where it has been shown that commercial logging once depended on water transport and, in a more interesting case (*Hoffman Homes v. Administrator, U.S. EPA*) in Illinois, where migratory birds were argued to be the object of commerce — i.e., bird watchers or bird shooters (Salvesen, 1990).

Primary Elements of an Ordinance

The following outline could be adopted for drafting a local wetland protection ordinance:

- Purpose.
- Definitions.
- Relationship to other permit requirements.
- Determination of wetland, land to which ordinance applies (prohibited activities requiring permit).
- Exempt activities (part 303, local exceptions).
- Existing non-conforming uses.
- Permit process.
- Permit standards and criteria (part 303) for less than 2-acre wetlands.
- Mitigation.
- Approval of legitimate public need.
- Protection of wetlands during/after construction.
- Non-conforming uses guidelines.
- Penalties/enforcement.
- Appeal or variance.

Regulatory Takings and Wetland Protection

The U.S. Constitution’s Fifth Amendment just compensation clause for the taking of private property is the basis for claims for regulatory takings of properties with wetlands. A regulatory taking is not a government appropriation of land but a regulation of

land, by way of police power, that has been determined to either so severely restrict private property owners' use of their land or so severely diminish its economic value that compensation is owed the landowners by the state.

The courts generally recognize three types of regulatory takings. The first is a physical taking or invasion, the second is the loss implied when regulations limit the bundle of rights implicit in land ownership, and the third is cases where an economic taking renders the property effectively without value when the regulation is enforced. Precedent established in one or more landmark cases often sets the stage for court decisions. This is not as evident with takings cases and their court interpretations. In general, for all types of taking claims, the court usually considers seven criteria in determining the merits of a claim. Usually, existence of not a single criterion but multiple criteria warrant a finding for a plaintiff in a takings claim (Olsen, 1994). The criteria are:

- A land use regulation does not promote a legitimate state interest. A legitimate state interest is generally related to the promotion of the health, safety or welfare of a community.
- Assuming a legitimate state interest, the regulation does not substantially advance that interest.
- The regulation entails a permanent occupation (physical) of the property.
- Reasonable investments were made prior to general notice of the regulatory program. Wetland ordinances in Michigan often recognize the importance of such investments in land use and allow continuing or even restorative use of such otherwise restricted activities.
- In the advancement of a legitimate state interest, a disproportionate burden of securing a public benefit is placed upon a single landowner, rather than the general public.
- The economic effect of the regulation deprives the landowner of all, or substantially all, beneficial use of the property. A significant diminution of value sufficient to award compensation is generally determined to be 90 percent.
- The regulation abrogates an essential element of private property.

Criteria in Wetland Takings Cases

Other takings criteria have established some degree of precedent for future decisions relative to wetlands.

Two takings cases, *Loveladies Harbor, Inc., v. the United States* and *Florida Rock v. the United States*, show that, in general, three conditions most often result in courts finding that compensation is due to a landowner following denial of a 404 permit. These conditions are:

- **The majority of the parcel must consist of wetlands.** This criterion is also relevant to the issue of treating a parcel's use as a whole rather than claiming that there has been 100 percent loss of use and value on a portion of the parcel. If the vast majority of the parcel is in wetlands, it may be rightfully argued that rights are being abrogated on more than a portion of the land holdings. On the other hand, if the wetlands are known to exist on the property, the purchaser of the land is probably buying the land with full knowledge that he or she will have to obtain a wetland permit pursuant to development. In such cases, it could be that a landowner's expectations of return on the land were unreasonable.
- **It isn't necessary to prove 100 percent loss of economic value** due to restrictions on development in wetland areas. According to Salvesen (1990), these cases and others have shown that losses in excess of 90 percent will normally result in compensation in takings decisions.
- **Acquisition and use of the affected property before enactment of wetland legislation.** This would apply to cases where land was purchased before awareness of wetland values was as common as today and is quite different from a case in which someone knowingly buys land with federal or state regulated wetlands.

A Claim Must be Ripe

A claim is ripe if a landowner has exhausted all the administrative options available. These include mitigation and alternative analysis/design of the project.

Reducing the Risk of Takings Claims

The recommendations for avoiding legal problems in administering a wetland statute include:

- Apply restrictions to the smallest amount of the parcel possible. This obviously is contingent on the extent to which wetlands encompass the land cover of the parcel because the agency does not have the authority to enforce the wetland statute on only a portion of the parcel.
- Apply restrictions consistently and comprehensively.

- Have monies budgeted for compensation and, more importantly, for acquisition of wetlands.
- Undertake an inventory of wetlands to assure that both local government officials and land developers know the locations of wetlands at the time of purchase

and planning. Some wetlands, such as wet meadows that are actually inundated very rarely, may be overlooked in parcel selection and site planning, so it is important to provide a method by which these wetlands are identified.

Integrated Wetlands Protection Programming

Successful Regulatory Programs

Meridian Township, located in the eastern portion of the greater Lansing area in central lower Michigan, is an example of a successful wetland preservation program. Though the program is somewhat characterized by political controversy and court challenges by developers, it may be viewed with some success in its attempt to regulate the protection of smaller wetlands. Although detailing various local cases falls outside the immediate scope of this publication, a number of other cases at the local and regional levels (e.g., Tip of the Mitt) exist.

To assist practitioners and local officials in drafting a wetland ordinance, a generic outline is provided on page 49 and the Meridian ordinance language is provided in Appendix II.

State Zoning Authority

The state conveys authority to local units through acts of the state legislature. Such powers take two forms — *mandating* and *enabling*. A mandating statute directs a township board to exercise certain powers and may vary from very detailed instructions, as in the laws governing uniform accounting and budgeting procedures, to broad grants of power, as for the responsibility to provide for the general health and welfare of the public.

Enabling or permissive statutes do not require local units to act but allow local officials to do so if they so desire. Once a township board votes to use the power, the enabling statutes often prescribe how the township should proceed in carrying out the functions. For instance, state law does not require a township board to adopt a zoning ordinance. But if it does, it must give proper public notice and create a zoning board of so many members and a board of zoning appeals (VerBurg, 1990).

Michigan has three zoning enabling acts for three types of local government. The first is the **City or**

Village Zoning Act of 1921. This act provides a legal basis for ordinances that regulate “*the use of land and structures, the height, the area, the size, and location of buildings... the light and ventilation of those buildings*”. The density of population can also be regulated by ordinance and the designation of the use of certain state-licensed residential facilities.

The second, the **County Rural Zoning Enabling Act of 1943**, and the third, the **Township Rural Zoning Act of 1943**, serve the same purpose. The basis and considerations of both zoning ordinances are:

“The zoning ordinance shall be based upon a plan designed to promote the public health, safety and general welfare, to encourage the use of lands in accordance with their character and adaptability, and to limit the improper use of land, to conserve natural resources and energy, to meet the needs of the state’s citizens for food, fiber and other natural resources, places of residence, recreation, industry, trade, service and other uses of land, to insure that uses of land shall be situated in appropriate locations and relationships, to avoid the overcrowding of population (to provide adequate light and air) to lessen congestion on the public roads and streets, to reduce hazards to life and property, to facilitate adequate provision for a system of transportation, sewage disposal, safe and adequate water supply, education, recreation and other public needs, and to conserve the expenditure of funds for public improvements and services to conform with the most advantageous uses of land, resources and properties.”*

Local Regulations: Land Use Planning and Zoning

State and local natural resource management dates back to the 1800s, when park, wildlife and forestry programs were established for lands in the public domain. Control of the private use of land was possible only by outright acquisition. It was not until the 1920s that states authorized local units of governments to adopt zoning and subdivision regulations. In practice, however, lack of effective local control and demand for land close to urban centers resulted in construction within floodplains and destruction of wetlands (Kusler, 1980).

* Extra phrase of the Township Rural Zoning Act of 1943.

Rural land use planning is often undertaken principally for economic development with limited emphasis on resource protection. Though a significant number of federal programs have an indirect impact on land use decision making (137 federal programs in 1979, such as the Department of Housing and Urban Development [HUD] with its urban revitalization programs and the USDA/NRCS with well intended efforts to preserve prime farmland, etc.), land use planning remains largely the domain of local government. Though some states' programs assumed some responsibilities after WWII, specifically in the 1970s, most states — including Michigan — redelegated planning authority to the local level in the 1980-90 period. Oregon and New Jersey are notable exceptions because of their adoption of statewide planning strategies and growth management policies. The federal role is mostly limited to providing funding for city and regional planning activities (Held and Visser, 1984), with specific allocations to public housing assistance (HUD), transportation and economic development (U.S. Department of Commerce, Economic Development Administration).

Planning is accomplished by the development of a comprehensive plan and its implementation through local ordinances and regulations for zoning, subdivisions, housing, nuisance conditions, etc. As specifically authorized under the zoning acts, local authorities such as municipalities and townships may adopt zoning ordinances. In open space preservation and wetland protection issues, township actions are the most relevant, especially when bordering urbanizing regions.

Non-regulatory Protection Methods

Among the more successful community-based wetland protection strategies are those involving willing landowners who share a community's desire to protect important natural features. It is frequently possible to accomplish wetland protection through a variety of formal or informal negotiated agreements, avoiding the potential conflict and administrative expense of regulatory protection.

Non-regulatory wetland protection should be part of a well conceived plan to identify and protect wetland resources that a community regards as particularly important. In some cases, it could potentially replace a regulatory program; in others, it can supplement regulatory efforts. In either case, the careful identification and targeting of the most valuable or vulnerable wetlands will maximize limited community

resources while providing long-term, often permanent wetland protection.

Purchase of Development Rights/Transfer of Development Rights

A land resource protection technique that also shows potential for wetlands protection involves the acquisition of only a portion of the privately held rights in real property. These programs are well developed in other regions of the country but have only recently found their way into local growth management programs in Michigan and are not frequently employed expressly for wetlands protection. These programs are based on either the *purchase of development rights* (PDR) from a private party or the *transfer of development rights* (TDR) from one private parcel to another. In either case, the property owner is compensated for the reduction in property value and the land is permanently protected from development.

PDR and TDR programs are based on a concept that divides the rights of owners of real property into discrete components. Barlowe (1972) describes the concept as a "bundle of sticks," with each "stick" in the bundle having its own property right identity. For instance, water and mineral rights and the rights to farm a parcel of land, harvest timber from it or use it for recreation exist separately from the right to develop the land for residential or commercial purposes. Each of these rights may be viewed as having its own economic value, and the total economic value of land is the sum of the independent values of the variety of uses to which it could be put (subject to public restrictions). In the case of a property description including wetlands, the development rights for the entire property may be acquired, inclusive of its wetland values.

In either a PDR or a TDR program, the value of the land for development is calculated separately from its value for the remaining uses. The property owner is compensated for the development value but retains ownership of the land for all remaining uses. The primary difference between PDR and TDR is the disposition of the development rights after they are severed from the property.

In a PDR program, ownership of the development rights is simply retained by the purchaser and "retired." The purchaser can be a governmental body, a private party, a non-profit organization such as a local land conservancy or a number of other entities. The land is permanently barred from development and the owner can use the remaining rights unencumbered.

TDR programs are a little more complex. The development value of the property is established and

the owner compensated, but the development rights of the property are transferred to another parcel. They can either be sold directly by the owner or brokered through an administrative agency. The transfer results in higher density or more intensive use of the receiving parcel. To work properly, a jurisdiction must first establish "receiving zones" to accept the transferred rights. Theoretically, the receiving zone would be more appropriate for development because of such factors as better infrastructure or roads, proximity to other intensive uses or other appropriate factors. The "sending zone" would be an area where low density, lack of infrastructure or the presence of vulnerable natural features such as wetlands would make intensive development inappropriate or less desirable.

PDR programs were recently authorized by specific state legislation and are now developing in Michigan, but their application is limited to agricultural land or land adjacent to agricultural land. The applicability of PDR programs for wetland protection in Michigan is uncertain. TDR programs are currently not specifically authorized by Michigan law, though it is uncertain whether such direct authorization is a necessary prerequisite to their development. TDR programs seem to be a highly controversial concept and are in some cases vigorously opposed by certain interest groups whenever they are considered. Opposition apparently centers on the issue of selecting sending and receiving zones and the resulting economic impact to property owners within those zones. The economic interests of a property owner within a sending zone, for example, could be negatively affected by a perceived reduction of development value. Conversely, a property owner within a receiving zone who has no interest in intensive development may also be harmed as surrounding parcels undergo conversion to higher density uses. Some view it unlikely that TDR programs will be available in Michigan in the near future.

Conservation Easements

Easements have historically been used to transfer specific rights or privileges from a property owner to another party and are similar to PDR in that title to the land remains with the original owner. Easements have been frequently employed by public agencies and utilities to secure rights-of-way for roads, power lines and gas transmission pipelines, and by private parties to gain access to their lands across the lands of another owner. Their use to protect wetlands and other natural features is increasing. Such easements are typically known as *conservation easements*.

The Conservation and Historic Preservation Easement Act of 1980 specifically authorizes

conservation easements. They are legal instruments, voluntarily negotiated, between landowners and other parties, typically a government agency or a non-profit organization. These agreements can be structured to limit or prohibit certain activities or uses on a parcel and are thus more flexible than PDR or TDR. They can be arranged as a deed restriction or binding covenant, a simple contract or other legal instrument, and they must be recorded with the deed to be enforceable against subsequent property owners.

The flexibility of conservation easements makes them an attractive addition to local wetland protection programs. They can be applied to limited portions of a parcel of land and are therefore more acceptable to property owners. A conservation easement can include only wetlands and surface waters or may also include a buffer around these features. It can also specify limitations on development across a parcel of land to ensure protection of natural areas.

Another attractive feature of conservation easements is that a party other than a public agency can hold them, so they can lower the administrative burden on local governments by transferring some of the responsibilities to other entities. Involving a local land conservancy, for example, means that lands deemed critical in a local wetland protection strategy can be protected and the conservancy rather than a public agency can absorb the task of monitoring compliance with the agreement. In addition, the provisions of a conservation easement are enforceable by anyone, not just by parties named in the easement language. This adds neighbors and other interested citizens to the monitoring network.

Because the negotiation of a conservation easement represents a use limitation on a parcel of land, it has a determinable value. The owner is typically compensated for this value but can realize substantial tax benefits if the transaction includes a donation of all or part of the negotiated price, particularly if non-profit organizations are involved. Integrating a charitable donation component into a conservation easement program can significantly reduce the costs of acquiring easements.

Voluntary Preservation/Technical Assistance

With the growing recognition of wetlands as a valuable community resource and the increasing concern over their depletion, a number of property owners are interested in protecting or restoring wetlands on their property without compensation. Providing technical assistance to these property owners can be a valuable low-cost addition to a local wetland protection strategy. Numerous state and federal agencies, as well as a number of private organizations,

provide technical and financial assistance to landowners interested in voluntarily preserving their wetlands. These include several units of the U.S. Department of Agriculture and the U.S. Fish and Wildlife Service, divisions of the Michigan departments of Environmental Quality and Natural Resources, and organizations such as Ducks Unlimited, the Michigan Wildlife Habitat Foundation and Pheasants Forever. Programs offered by these and other organizations are described in detail by Cwikel (1996).

Additional technical assistance and a comprehensive education strategy developed at the community level can supplement the efforts of federal and state agencies and private organizations. As landowners are made aware of the benefits that wetlands provide to them and their communities and of their options to protect them, some will be willing to participate in the implementation of a local wetland protection program. Voluntary wetland protection can provide substantial benefits at a very low cost, some of which will be absorbed by other public and private service providers.

The primary drawback to voluntary programs is their lack of permanence. Non-development agreements associated with these programs, if they exist at all, are usually for a limited time. The property owner retains full rights to the land and can eventually withdraw from a program. Subsequent owners may have very different ideas about the values of wetland protection. Still, a voluntary component to a local wetland protection strategy can pay large dividends in education and public support and should not be overlooked.

Fee Acquisition

The outright purchase of wetland property is an expensive proposition, but it is the only method that ensures complete public access and control over real property. Because it does not involve regulations, it is often more politically acceptable. Despite its relatively high cost, acquisition of property may be justified for particularly critical or vulnerable community wetland resources. Financial assistance is available from state and federal agencies but is extremely limited. Generally, public funds are available only when the property slated for acquisition is a high regional or

statewide priority and typically requires a substantial match.

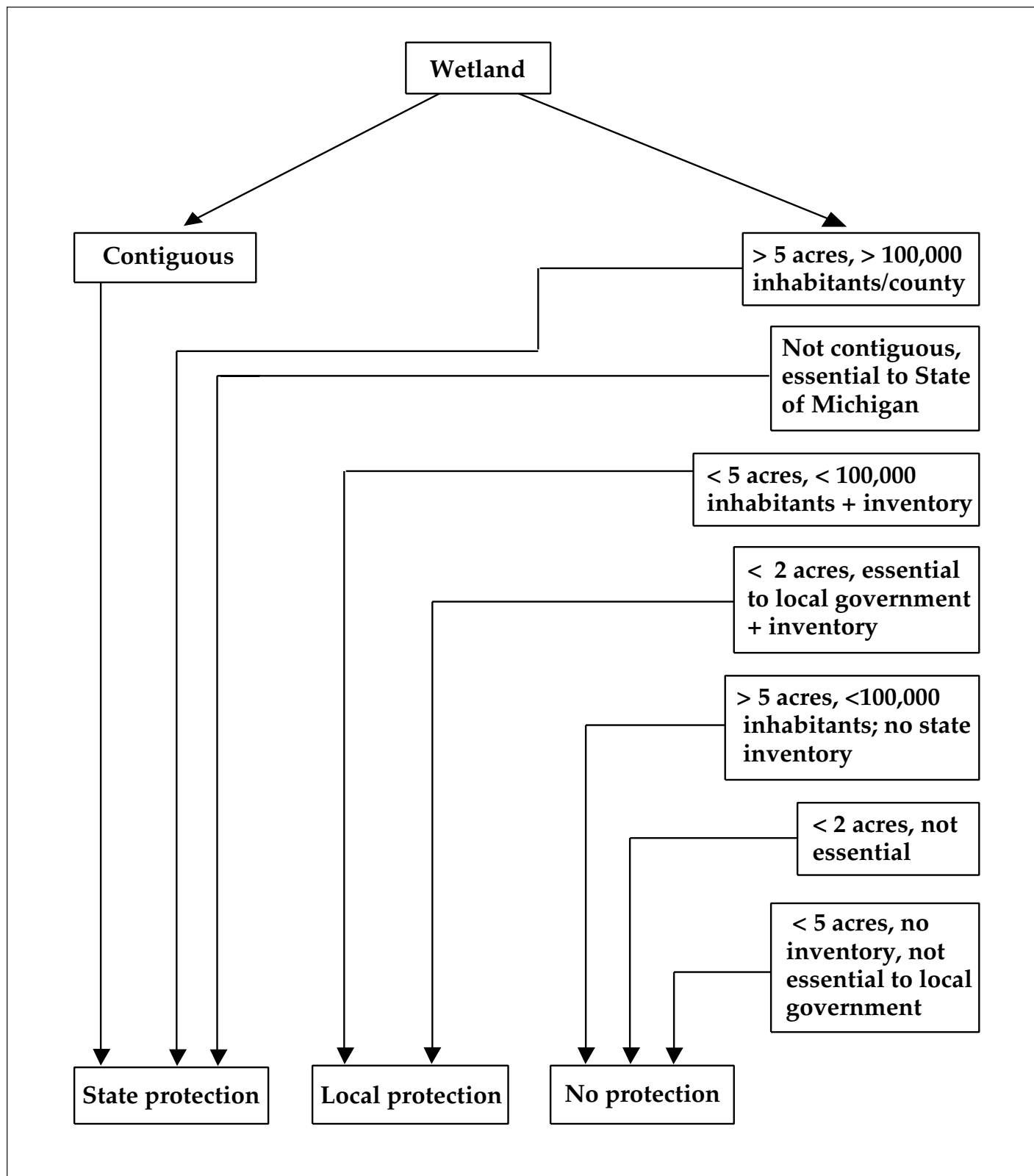
Some communities may be able to invest their general fund revenues in wetland acquisition or secure funds through special assessments or bonds, but political realities dictate that this strategy will be infrequently employed. Most acquisitions will involve corporate or private gifts or grants or other private funds, either alone or in combination with public revenues. Acquisition of land by local governments, however, does not necessarily guarantee permanent protection of wetlands unless the necessary easements or deed restrictions are recorded at the time of the transaction. A portion of today's wetlands can easily become tomorrow's industrial park as elected officials turn over and community attitudes toward growth and development change. It is in the area of fee acquisition that local land conservancies can provide their greatest benefits. Conservancies (e.g., the Nature Conservancy) are organizations that are formed specifically to acquire land or rights in land, and to preserve its natural features, including wetlands. The past decade has seen an enormous growth in local land conservancies in Michigan, which now number more than 60 and can be found in all regions of the state.

Tax/Economic Incentives

The assessment of property taxes on wetland property frequently results in pressure to develop that property. Unfortunately, the property tax structure in Michigan does not lend itself to the recognition of legitimate use restrictions resulting from the presence of wetlands and other natural features. Though changes to state law that would correct this problem have been discussed in recent years, no amendments to the General Property Tax Act have advanced much beyond the discussion stage.

A useful first step toward correcting this problem and reducing development pressure on wetlands would be for local tax assessors to recognize how wetlands can affect the development potential of a parcel of land.

Figure 4. Diagram of conditions for *potential* local wetland protection in Michigan. The numbers represent wetland size, county population and the presence of a wetland inventory (from Schultink and van Vliet, 1997).



Appendix I

Using the Wetlands Information Management System II

Authors' note: The development of the analytical interface and databases for the Wetland Information Management System II as implemented for Meridian and Williamstown townships, Michigan, was made possible in large part by Tom Moen and Frank Krist, project graduate research assistants employed under this project and Ph.D. students in the Department of Resource Development and the Department of Anthropology, Michigan State University, respectively.

The Wetlands Information Management System II (WIMS II) consists of a graphical user-friendly interface for map display, querying capabilities, graphics and analysis. Help screens are available throughout the program to assist the user.

Three folders are available for view when the program is opened: Map, Wetlands and Evaluation. The display window, called "Updating map", displays all the layers selected.

The "MAP" section of the main folder is used to add or remove map layers from the map view. A map is composed of multiple layers of data (for example, a "lakes" layer or a "roads" layer). Layers are made visible by checking the desired layer on the list (click the mouse on the layer checkbox) and can be toggled on and off. If a classification map exists for a selected layer, it is listed in the "map classifications" list below the map layer window. Clicking on the map classification displays a legend for the map layer and displays the associated color-coded map in the "Updating map" window.

The initial maps loaded are base maps depicting the National Wetlands Inventory (NWI) wetlands, lakes, rivers, streams, railroads and roads. Map layers are organized in four categories:

Base Maps:

Lakes, land cover, streams, rivers, soils, wetlands, roads and railroads.

Hydrology:

Basins: derived from the contour map (10-foot contour intervals).

Contours: contour lines of elevation at 10-foot intervals. Digital elevation model.

Flow direction (aspect): arrows pointing down the slope (derived from contour layer).

Watersheds: (from USGS).

Images:

Aerial photos.

USGS quad maps.

Other:

Census blocks and census tracks.

For any layer, the color of the layer, outline or background can be changed by clicking on the appropriate color boxes. A color palette is loaded, and the user selects the color and clicks "OK" to update the map. Changes made are set only for the current session. The user cannot change default map colors.

When the user selects "Soils" under "Base maps," an associated soils data table is opened. To obtain data on a particular soil type, the "identify" button in the "Updating Map/ Map View" window must be highlighted. The user then must select one of the soil polygons, and attributes about that soil type will be revealed. The summary button in the soils window provides information that may be particularly useful to the user when answering questions during a WIMS analysis.

The "WETLANDS" section of the main folder is used to select and view wetlands based on NWI classification or size. The user can select wetlands by type — for example, forested wetlands — or by acreage values or ranges.

In the "Query" frame, the dropdown lists are used to define a query. Clicking on the arrow on the right of the dropdown menu lists categories. When a selection is made, the query is run, and the results of the query (those wetlands matching the specified parameters) are shown in the "Result" frame. The number selected out of the total number of wetlands in the database is shown below the list of selected wetlands. When setting up a query for area (acreage), the operator should be set (less than or greater than or a range of values), a value entered and "Run" selected to run the query.

The following command buttons are available:

Run:

Runs the current query. In most cases, the query is automatically run after an item is selected from the dropdown lists. Use the command button after entering an acreage number (or press "Enter") to run the query.

Reset:

Resets the query to select all records (clears the current query).

Highlight All:

Selected wetlands are highlighted on the map.

Zoom to:

Zooms to the selected wetland on the map.

Highlight:

Highlights the selected wetland on the map.

NWI Data:

Shows NWI classification and other data for the selected wetland.

Statistics:

If wetlands are highlighted on the map, click on this command button to show acreage statistics for the selected sites.

Auto-Zoom:

If the auto-zoom box is checked, the map viewer automatically zooms to and highlights a wetland selected on the results list.

The "EVALUATION" section is used for evaluating functions and values of wetlands using the WIMS methodology. Prior to the analysis, an evaluation area (EA), which consists of one or more hydrologically connected wetlands, must be defined and data must be collected for the EA. All defined EAs are shown in a list. The number in the EA list is a unique identification (ID) number associated with the EA (assigned when the EA is defined).

The following command buttons are available in the "Evaluation Areas" frame:

Add EA:

Adds a new evaluation area. A wetland should be selected on the map first (use the map "identify" tool to highlight a wetland). When "Add EA..." is selected, the wetland selected on the map is highlighted and the user is asked for verification. Select "Yes" to proceed if the selected wetland is the correct one for the EA. Then the new EA is assigned an ID number and added to the database. The user is given the option of entering WIMS data for the EA. The user should select "YES" when ready to enter WIMS data. The first in a series of questions will appear. The user may then begin the WIMS analysis by category, by function or for all possible functions (see "WIMS Analysis" section). Note: initially the user must select one wetland to define an EA. If the EA is composed of multiple wetlands, click on "Add..." in the "Wetlands and Basins" frame to add additional wetlands to the EA.

Delete EA:

Deletes the currently selected evaluation area following confirmation by the user.

Report:

Prepares a summary report of the selected evaluation area.

WIMS Data:

Accesses WIMS data for the selected evaluation area for viewing or editing (see section below).

WIMS Analysis:

Accesses WIMS to perform wetland functional analysis (see section below).

When the user clicks on an evaluation area in the list of evaluation areas, the map extent will be set to show the selected EA (if Auto-Zoom is checked on). All wetlands that are defined as part of the EA are listed (by NWI-ID) in the "Wetlands list" box. The associated drainage basin (watershed) can be highlighted by clicking the "Show basins" box. Note: The user may identify a smaller drainage basin for the wetland by field observation. The listed basin is the basin defined using the 10-foot contour data and does not necessarily reflect the local drainage area for the wetland.

In the "Wetlands and Basins" frame, the following command buttons are available:

Highlight:

Highlights the selected wetland on the map.

Zoom to:

Zooms to the selected wetland on the map.

Add:

Adds a wetland to the evaluation area. The user should first use the "identify" tool to select the wetland to be added (make sure that wetlands are the active map layer). After selecting a wetland, click on "Add..." An input box allows the user to verify the ID of the wetland to be added and select "OK" to add the wetland to the current EA. After adding a new wetland, acreage of the EA is recalculated and WIMS data are updated with the new value.

Remove:

Removes the selected wetland from the evaluation area.

Data:

Provides wetlands data derived from the NWI.

Following the identification and selection of the wetland or systems of wetlands to be evaluated, the data are ready to be input into WIMS.

WIMS Data:

The user adds the EA to the database. The window "Edit: Evaluation Areas Data" will open. The user can

then proceed to answer the WIMS questions using existing GIS data and the user's own local knowledge. The user will likely be unable to answer all of the questions without a field visit.

The user may address all functions and values by answering a total of 55 questions or select questions by category or function. Each question provides a single or multiple-choice answer that may be selected. If no answer is provided by the user, the default will be entered as the user's choice. The user may proceed to other questions by selecting the "next>>>" key. When the last question is asked, the "next>>>" key is disabled.

The user can now either close the window and return to perform a WIMS analysis, create and print a report of the questions asked and answers given, and/or print out a blank data sheet with all questions and possible answers provided. The data sheet, the user's current responses and WIMS documentation may be taken to the wetland site to work through the WIMS questions that cannot be answered at the computer to complete the data collection process.

Following the on-site investigation, the user can return to the computer to enter the final responses to WIMS questions for the EA. With all questions answered, the user is now ready to perform a WIMS analysis.

WIMS Analysis

WIMS II uses the Wetland Information Management System (WIMS) methodology for evaluating wetland functions. WIMS was developed at the Institute of Water Research at Michigan State University. Complete documentation of WIMS can be found in the WIMS Documentation File.

The "WIMS Analysis" command buttons are: Close, Run, Experiment, About, Documentation. Below these command buttons are two frames. In the first frame, the user selects one or more EAs (by ID number) to be evaluated. In the second frame, the user selects the functions to evaluate.

The "Select All" button adds a checkmark in all boxes. Similarly, the "Clear All" button deselects all checked boxes. All selections can be toggled on and off by clicking individual boxes.

After selecting EAs and functions to be evaluated, the user can click on "Run" to perform a WIMS analysis.

Run:

Two new windows appear: the WIMS results in tabular form and a graphic representation of the data. The graph's default is a two-dimensional bar chart, but it can be changed to a line, pie or XY-graph in either a two- or three-dimensional format.

The information in the table window includes the EA number along with the wetlands function index (WFI) or wetlands value index (WVI) for each function or value selected. The selections in the table window include buttons for performing simple statistics, such as averages, sums and standard deviations; providing an evaluation report as a text file; exporting a file; and sorting the data. The graph function can also be enabled through the table window as can the documentation function, which provides a detailed description of the WIMS and its development.

Experiment:

The "Experiment" key enables a user to select one WIMS function and run a WFI for one or several EAs. The user can omit one or more of the criteria used in determining the WFI. This situation might be necessary if the user cannot answer one or more of the questions posed or feels that a question is inappropriate. A new WFI will be calculated ignoring the criteria left unselected. Caution must be taken in assessing any of the wetlands in this manner.

The results of the "Experiment" run give the EA ID number, the WFI and the function that was selected. A comparison can be readily made between the former WFI and the new one that uses only a select group of criteria. Caution must be taken in using the new WFI value, however, because not all criteria are used.

Appendix II

Charter Township of Meridian, Michigan: Wetland Protection Ordinance

(REVISED 1994)

Chapter 105 Wetland Protection

Section 105-1 Findings

The Township Board of the Charter Township of Meridian finds that wetlands are indispensable and fragile natural resources that provide many public benefits, including maintenance of water quality through nutrient cycling and sediment trapping as well as flood and storm water runoff control through temporary water storage, slow release, and groundwater recharge. In addition, wetlands provide open space; passive outdoor recreation opportunities; fish and wildlife habitat for many forms of wildlife, including migratory waterfowl, and rare, threatened or endangered wildlife and plant species; and pollution treatment by serving as biological and chemical oxidation basins.

Preservation of the remaining Township wetlands in a natural condition shall be and is necessary to maintain hydrological, economic, recreational, and aesthetic natural resource values for existing and future residents of the Charter Township of Meridian, and therefore the Township Board declares a policy of no net loss of wetlands. Furthermore, the Township Board declares a long-term goal of net gain of wetlands to be accomplished through review of degraded or destroyed wetlands in the Township, and, through cooperative work with landowners, using incentives and voluntary agreements to restore wetlands.

Pursuant to Article 4, Section 52 of the Constitution of the State of Michigan, the conservation and development of natural resources of the state is a matter of paramount public concern in the interest of the health, safety, and general welfare of the people. Therefore, with authority from Section 8 (4) of the Goemaere-Anderson Wetland Protection Act (Act 203, Public Acts of 1979, as amended), the Township Board finds that this Chapter is essential to the long term health, safety, economic, and general welfare of the people of the Charter Township of Meridian, and, to the furtherance of the policies set forth in the Michigan Environmental Protection Act (Act 127, Public Acts of 1970) and the Goemaere-Anderson Wetland Protection Act (Act 203, Public Acts of 1979, as amended).

Section 105-2 Purpose

The purposes of this ordinance are to provide for:

a. The protection, preservation, replacement, proper maintenance, restoration, and use in accordance with the character, adaptability, and stability of the Township's wetlands, in order to prevent their pollution or contamination; minimize their disturbance and disturbance to the natural habitat therein; and prevent damage from erosion, siltation, and flooding.

Adopted 8-6-91

Rev. 6-7-94

X-14

b. The encouragement of proper and reasonable economic use of wetlands, the discouragement and limitation of improper use, the reduction of financial burdens improper uses impose on the community, the maintenance of harmonious and compatible land use balance within the Township, and the prevention of nuisance conditions that arise with the indiscriminate development of wetlands.

c. The coordination with, and support for, the enforcement of applicable federal, state, and county statutes, ordinances, and regulations, including but not limited to:

1. Goemaere-Anderson Wetland Protection Act (Act 203, Public Acts of 1979, as amended), enforced by the Michigan Department of Natural Resources; and

2. Soil Erosion and Sedimentation Control Act (Act 347, Public Acts of 1972, as amended), enforced by the Ingham County Drain Commissioner.

d. Compliance with the Michigan Environmental Protection Act (Act 127, Public Acts of 1970), which imposes a duty on government agencies and private individuals and organizations to prevent or minimize the pollution, impairment or destruction of the natural resources that is likely to be caused by their activities.

e. The establishment of standards and procedures for the review and regulation of the use of wetlands.

- f. The issuance of wetland use permits for approved activities.
- g. A procedure for appealing decisions.
- h. The establishment of enforcement procedures and penalties for the violation of this Chapter.
- i. Assurance that the right to reasonable use of private property is maintained.

Section 105-3 Definition of Terms

The following definitions shall apply to the words and terms used in this Chapter:

- a. "Aggrieved Person" is any land owner whose property is located within 500 feet of the property affected by the permitted activity or any other person determined by the Township Board to be aggrieved.
- b. "Aquatic Life" means vertebrates or invertebrates that are dependent on wetlands for some vital portion of their life cycle including any of the following: breeding, spawning, nesting, rearing of young, feeding, and resting or protection.

Adopted 8-6-91 Rev. 6-7-94

X-15

- c. "Deposit" means to fill, place or dump.
- d. "Director of Planning and Development Control" shall mean the Director of Planning and Development Control for Meridian Township or his/her designee.
- e. "Fill material" means soil, rocks, sand, pilings, waste of any kind, or any other material which displaces soil or water, reduces water retention potential or reduces ability for wetland vegetation growth.
- f. "Lot" means a designated parcel, tract, building site or other interest in land established by plat, subdivision, conveyance, condominium master deed, or as otherwise permitted by law, to be used, developed or built upon as a unit.
- g. "Minor drainage" includes ditching and tiling for the removal of excess soil moisture incidental to the planting, cultivating, protecting, or harvesting of crops or improving the productivity of land in established use for agriculture, horticulture, silviculture, or lumbering.
- h. "Mitigation of wetlands" shall mean: (1) methods for eliminating or reducing potential impact to regulated wetlands; or (2) creation of new wetlands

of the same or similar function to offset unavoidable loss of existing wetlands to meet the Township goal of no net loss of wetlands.

i. "Person" means an individual, sole proprietorship, partnership, corporation, association, municipality, this state, and instrumentality or agency of this state, the federal government, or an instrumentality or agency of the federal government, or other legal entity.

j. "Remove" means to dig, dredge, suck, pump, bulldoze, drag line, or blast.

k. "Restoration" means to return from a disturbed or totally altered condition to a previously existing natural or altered condition by some action of man.

l. "Structure" shall mean any assembly of materials above or below the surface of the land or water, including but not limited to, buildings, bulkheads, piers, docks, landings, dams, waterway obstructions, paving and roadways, poles, towers, cables, pipelines, drainage tiles, and other underground installations.

m. "Township Board" shall mean the legislative body of Meridian Township, Ingham County, Michigan.

n. "Township Wetland Consultant" shall mean a person(s) professionally knowledgeable in wetland delineation and resource value assessment, wetland protection, wetland restoration and wetland mitigation, appointed pursuant to Section 3.4 of the Township Personnel Policy to carry out certain duties hereunder. Any firm or individual appointed on a contract basis shall be selected competitively under the Township Purchasing Policy.

Adopted 8-6-91

Rev. 6-7-94

X-16

o. "Township Wetland Inventory Map" refers to the Meridian Township Wetland Inventory Map created to comply with Section 8a(1) of the Goemaere-Anderson Act. The Township Wetland Inventory map is based on the National Wetland Map of the U. S. Fish and Wildlife Service; the Michigan Resource Information System Mapping (MIRIS) of the Michigan Department of Natural Resources; the soils maps of the Soil Conservation Service, aerial photography, and on-site inspections.

p. "Wetland" means land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life and is commonly referred to as a bog, swamp, or marsh.

q. "Wetland Board" shall mean the Wetland Board of the Charter Township of Meridian or any other body designated by the Township Board to assume the Wetland Board's duties.

r. "Wetland Vegetation" means plants that exhibit adaptations to allow germination and growth with at least their root systems in the water or saturated soils under normal conditions.

Section 105-4 Lands to Which This Chapter Applies;

a. This Chapter shall apply to:

1. All wetlands, as defined in this Chapter, that are equal to or greater than one-quarter (.25) acre and equal to or less than five (5) acres in area except those wetlands for which the Michigan Department of Natural Resources (MDNR) has determined to exercise State regulation under MCL 281.702 (g) (iii).

2. Notwithstanding the above, it shall be unlawful under this Chapter to conduct any activity or use within a MDNR regulated wetland without full compliance with the requirements of the Goemaere-Anderson Wetland Protection Act. A copy of all applications for Wetland Permits filed with the MDNR and for which permits are not governed by this Chapter, shall be submitted to the Township for review and comment by the Township Wetland Consultant. A copy of the comments filed by the Township Wetland Consultant shall be forwarded to the Board.

Section 105-5 Township Wetland Inventory Map

The Township Wetland Inventory Map is a guide to the location of wetlands in Meridian Township. The Map shall be used in the administration of this Ordinance and Chapter 84 of the Code of Ordinances.

a. The Township Wetland Inventory Map, together with all explanatory matter thereon and attached thereto, as may be amended through the Wetland Verification and Delineation process, is hereby

adopted by reference and declared to be part of this Chapter. The Township Wetland Inventory Map shall be on file in the Department of Development Control.

Adopted 8-6-91

Rev. 6-7-94

X-17

b. The Township Wetland Inventory Map shall serve as a general guide for the location of protected wetlands.

c. The Township Wetland Inventory Map does not create any legally enforceable presumptions regarding whether property that is or is not included on the inventory map is or is not in fact a wetland.

d. Map Amendment Process

1. Any change to the Township Wetland Inventory Map, approved by the Director of Planning and Development Control through verification or delineation, shall be added to the Township Wetland Inventory Map on an annual basis.

2. The Township shall insure that each record owner of property on the property tax roll shall be notified of any amendment to the Township Wetland Inventory Map on an annual basis. The notice shall include the following information:

- a. the maps have been amended
- b. the location to review the maps
- c. the owner's property may be designated as a wetland on the inventory map
- d. the Township has an ordinance regulating wetland
- e. the inventory map does not necessarily include all of the wetland within the Township that may be subject to the wetland ordinance

Section 105-6 Wetland Verification and Delineation

The Township Wetland Inventory Map shall be validated through the Wetland Verification Process and the Wetland Delineation Process. The Wetland Verification Process, as set forth herein, shall be used to verify wetlands on properties where wetland is shown on the Wetland Inventory Map. The Wetland Delineation Process, as set forth herein, shall be used to establish the actual boundaries of wetlands in the

Township. The identification of the precise boundaries of wetlands on a project site shall be the responsibility of the applicant.

a. Wetland Verification Process

1. The Township or property owners of wetlands may initiate a verification of the areas shown on the Township Wetland Inventory Map as wetland. The verification shall be limited to a finding of wetland or no wetland by the Township Wetland Consultant. The finding shall be based on, but not limited to, aerial photography, topographical maps, and field inspection.

Adopted 8-6-91

Rev. 6-7-94

X-18

2. In the event that there is a finding of no wetland on the property, then no further action by the applicant would be required and the finding shall be incorporated into the Wetland Inventory Map during the Map Amendment Process.

3. In the event that there is a finding of wetland, then the establishment of the precise boundary through a wetland delineation shall be required to amend the Township Wetland Inventory Map or process a wetland use permit application.

4. The applicant shall pay fees for the Wetland Verification Process as established by resolution of the Township Board. The fee shall be refunded if there is a finding of no wetland.

b. Wetland Delineation Process

Prior to the issuance of any permit or land development approval for a property which is shown to include a wetland on the Township Wetland Inventory Map, the applicant may be required to provide a wetland delineation to the Township. The Director of Planning and Development Control shall decide whether a delineation is required, based on the proximity and relationship of the project to the wetland.

1. To establish actual wetland boundaries on a property, an applicant shall provide a survey or dimensional site plan, drawn at an appropriate scale, showing property lines, buildings and any points of reference along with the determined wetland boundaries, according to one of the following:

A. Wetland delineation by the Michigan Department of Natural Resources (MDNR).

B. Wetland delineation by the applicant's wetland consultant subject to review and approval by the Township Wetland Consultant .

2. Where a wetland delineation is required by this Chapter, the Township Wetland Consultant shall establish wetland boundaries following receipt of the above required information and after conducting a field investigation.

3. The applicant shall pay fees for the Wetland Delineation Process as established by resolution of the Township Board.

Section 105-7 Activities Not Requiring A Permit

The following uses shall be allowed in a wetland without a permit subject to other laws of this state and the owner's regulation:

Adopted 8-6-91

Rev. 6-7-94

X-19

a. Fishing, trapping or hunting.

b. Swimming or boating.

c. Hiking.

d. Grazing of animals.

e. Farming, horticulture, silviculture, lumbering, and ranching activities, including plowing, irrigation, irrigation ditching, seeding, cultivating, minor drainage, harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices. Wetland altered under this subdivision shall not be used for a purpose other than a purpose described in this subsection without a permit from the Township.

f. Maintenance or operation of serviceable structures in existence on October 1, 1980 or constructed pursuant to the Goemaere-Anderson Wetland Protection Act.

g. Construction or maintenance of farm or stock ponds.

h. Maintenance, operation, or improvement which includes straightening, widening or deepening of the following which is necessary for the production or harvesting of agricultural products:

(i) An existing private agricultural drain.

(ii) That portion of a drain legally established pursuant to the drain code of 1956, Act No. 40 of the Public Acts of 1956; as amended, being section

280.1 to 280.630 of the Michigan Compiled Laws, which has been constructed or improved for drainage purposes.

(iii) A drain constructed pursuant to other provisions of the Goemaere-Anderson Wetland Protection Act.

i. Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining or forestry equipment, if the roads are constructed and maintained in a manner to assure that adverse effect on the wetland will be otherwise minimized.

j. Drainage necessary for the production and harvesting of agricultural products if the wetland is owned by a person who is engaged in commercial farming and the land is to be used for the production and harvesting of agricultural products. Except as otherwise provided in the Goemaere-Anderson Wetland Protection Act, wetland improved under this subdivision after October 1, 1980, shall not be used for nonfarming purposes without a permit from the MDNR. This subdivision shall not apply to a wetland which is contiguous to a lake or stream, or to a tributary of a lake or stream, or to a wetland which the MDNR has determined by clear and convincing evidence to be a wetland which is necessary to be preserved for the public interest, in which case a permit shall be required.

Adopted 8-6-91

Rev. 6-7-94

X-20

k. Maintenance or improvement of public streets, highways or roads, within the right of way and in such a manner as to assure that any adverse effect on the wetland will be otherwise minimized. Maintenance or improvement does not include adding extra lanes; increasing the right-of-way; or deviating from the existing location of the street, highway, or road.

l. Maintenance, repair, or operation of gas or oil pipelines and construction of gas or oil pipelines having a diameter of 6 inches or less, if the pipelines are constructed, maintained, or repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

m. Maintenance, repair, or operation of electric transmission and distribution power lines and construction of distribution power lines if the distribution power lines are constructed, maintained,

or repaired in a manner to assure that any adverse effect on the wetland will be otherwise minimized.

n. Operation or maintenance, including reconstruction of recently damaged parts, of serviceable dikes and levees in existence on October 1, 1980, or constructed pursuant to the Goemaere-Anderson Wetland Protection Act.

o. Construction of iron and copper mining tailings basins and water storage areas.

Section 105-8 Activities Requiring a Wetland Use Permit

It shall be unlawful for any person to conduct any activity, listed below, within a wetland without first obtaining a wetland use permit in accordance with the requirements of this Chapter. Activities governed by this Section include but are not limited to the following:

- a. Depositing or permitting fill material to be deposited in a wetland.
- b. Grading in a wetland.
- c. Dredging, removing, or permitting the removal of soil or minerals from a wetland.
- d. Draining, or causing to be drained through artificial means, excluding storm runoff, any water into or from a wetland.
- e. Constructing, operating, or maintaining any use or development in a wetland that requires a building permit under the Building Code.

Section 105-9 Existing Nonconforming Lots, Uses and Structures

Building sites or lots, uses and structures lawfully existing on September 2, 1991, shall be subject to the requirements of this Chapter, except as follows:

Adopted 8-6-91

Rev. 6-7-94

X-21

- a. Any activity, structure, or use lawfully existing prior to September 2, 1991, but not in conformity with the provisions of this Chapter, may be continued, maintained and operated.
- b. Any structure lawfully existing prior to September 2, 1991, damaged by fire, explosion, act of God, or other causes beyond the control of the owner, may be restored, rebuilt, or repaired without obtaining a wetland use permit, provided construction on the

structure commences within two years from the date the structure was damaged.

Section 105-10 Application Requirements for Wetland Use Permits

Application for approval, appeal, and issuance of wetland use permits shall be concurrent with the application for approval, appeal, and issuance of other necessary Township approvals. The applicant for a wetland use permit shall submit the following to the Director of Planning and Development Control:

- a. An application completed in full, on a form provided by the Township, and including such other information as required by the Director of Planning and Development Control.
- b. A wetland delineation prepared by the applicant's wetland consultant including, but not necessarily limited to the following information: dominant vegetation in the tree, sapling, shrub, and herb layers; presence or lack of accepted wetland hydrology indicators; analysis of soil including a description of the soil profile to at least 20 inches and comparison to Ingham County Soil Survey and maps of the wetland(s) mapped. Mapped data shall be represented in a manner that allows comparison to the Meridian Township Wetland Inventory Map.
- c. Soil drainage and stormwater management plans.
- d. A mitigation plan, if the proposed activity will result in the loss of wetland resources.
- e. The applicant may elect to have the application processed under one of the following procedures:
 1. The wetland application shall be reviewed immediately, either prior to or concurrent with the review of the proposed land use review with the understanding that the land use review may not be completed at the time a decision is rendered on the wetland application. Election of this alternative may require a reopening of the wetland application if the land use approval is inconsistent with the wetland approval.
 2. The wetland application shall be reviewed and acted upon concurrent with the review of the land use proposal submitted by the applicant and the 90 day review period limitation specified in Section 105-11 is hereby extended accordingly.

Adopted 8-6-91

Rev. 6-7-94

X-22

f. Copies of wetland permit applications filed with the MDNR and forwarded to the Township in accordance with Section 6 (3) of the Goemaere-Anderson Wetland Protection Act shall become part of the application for a Meridian Township wetland use permit.

Section 105-11 Method of Review of Wetland Use Permit Application

- a. The Director of Planning and Development Control shall insure that all required information including a wetland delineation and payment of a fee has been submitted. If an application is not complete, the applicant may be granted additional time to complete the application provided that the applicant agrees that the additional time shall not be charged against the Township's 90-day time limit for making a decision. The receipt of the application shall constitute permission from the owner to conduct an on-site investigation.
- b. Upon receipt of an application, the Director of Planning and Development Control shall:
 1. Transmit one copy of the application to the Department of Natural Resources.
 2. Cause to be published a notice of the application and the date and time for submission of written public comments in a newspaper of general circulation in the Township.
 3. Post the subject property with a sign that shall be no less than ten (10) square feet in size.
 4. Transmit one copy of the application and supporting materials to the Township Wetland Consultant to confirm the boundaries of the wetland and to review the proposal in light of the purpose and review standards of Section 105-13 of this Chapter and other applicable sections of this Chapter.
- c. The Township Wetland Consultant shall prepare and transmit a report and recommendation to the Director of Planning and Development Control documenting the review required by Section 105-11(b)(4).
- d. The following process shall apply to wetland use permit decisions by the Director of Planning and Development Control:
 1. For wetland use permit applications submitted in conjunction with activities that do not require approval by the Planning Commission and/or Township Board, the Director of Planning and

Development Control shall approve, approve with conditions or deny the application within 90 days after receipt of an application.

Adopted 8-6-91

Rev. 6-7-94

X-23

2. The Director of Planning and Development Control shall transmit application materials and the report and recommendation prepared by the Township Wetland Consultant to the Wetland Board. The Wetland Board may review the materials and transmit comments for consideration to the Director of Planning and Development Control.

3. Persons wishing to comment on the application must submit their comments in writing to the Director of Planning and Development Control prior to the date and time set in the notice. Persons wishing to receive notice of the Director of Planning and Development Control's decision must submit a written request to the Director of Planning and Development Control.

4. The Director of Planning and Development Control's decision shall be made only after reviewing the report and recommendation from the Township Wetland Consultant, written public comments, and any comments submitted by the Planning Commission or Wetland Board.

5. When a wetland use permit is approved, approved with conditions, or denied by the Director of Planning and Development Control, written notice shall be sent to the applicant, and to all persons who have requested notice of the Director of Planning and Development Control's decision. The denial of a permit shall be accompanied by a written reason of denial.

6. A permit approved by the Director of Planning and Development Control shall not be issued or effective until ten (10) calendar days following the date of the approval and compliance with Section 105-15(c).

e. The following process shall apply to appeals of decisions made by the Director of Planning and Development Control or Planning Commission:

1. Any person who is aggrieved by the approval, approval with conditions, or denial of a wetland use permit by the Director of Planning and Development Control or Planning Commission, as

applicable, may appeal the decision to the Township Board by filing a written statement containing the specific reasons for the appeal with the Township Clerk within ten (10) calendar days following the date of the decision. The timely filing of an appeal shall have the effect of staying the permit pending the outcome of the appeal.

2. In the event that the person(s) filing the appeal is not an owner of property within 500 feet of the property affected, the Township Board shall determine whether the person(s) is an aggrieved person.

3. The Township Board shall hold a hearing on the appeal which shall be open to public comment and shall include opportunity for the appealing party to present their appeal.

Adopted 8-6-91

Rev. 6-7-94

X-24

4. Notice of the time and place for consideration of an appeal shall be placed in a newspaper of general circulation in the Township not less than five (5) days prior to the date of the hearing. A notice shall also be sent by mail or personal delivery to the owners of the property considered in the appeal, and to all owners listed on the most recent tax roll of real property within 500 feet of the boundary of the property in question. Said notice to be sent not less than five (5) days prior to the hearing.

5. The Township Board shall affirm, affirm with conditions, or reverse, the decision of the Planning Commission or Director of Planning and Development Control. The Board's decision shall be based on written findings.

g. The following process shall apply to wetland use permit decisions by the Township Board and Planning Commission:

1. Wetland use permit applications submitted in conjunction with a related land development activity shall be decided by the same entity that decides the related land development activity consistent with the Goemaere-Anderson Wetland Protection Act. The Planning Commission shall decide any wetland use permits in conjunction with special use permit applications and shall require that the delineation and wetland use permit application requests be submitted prior to the special use permit hearing. The Director of

Planning and Development Control shall transmit application materials and the report and recommendation prepared by the Township Wetland Consultant to the Township Board, Planning Commission, and Wetland Board. The Wetland Board may review the materials and provide comments for consideration by the Township Board or Planning Commission, as applicable.

2. After review and study of the application materials, the Township Wetland Consultant's report and recommendation, and optional comments from the Wetland Board, the Township Board or Planning Commission, as applicable, may hold one public hearing after publication in a newspaper of general circulation in the Township not less than five (5) days nor more than fifteen (15) days prior to the date of the hearing. Such notice shall indicate the place, time and subject of the hearing and the place and time the proposed wetland use permit may be examined. The wetland use permit hearing may be held in conjunction with a review of the related land use request.

3. In the event of a public hearing, notice shall be sent by mail or personal delivery to the owners of property for which approval is being considered, and to all owners of property, as listed on the most recent tax roll, within 500 feet of the boundary of the property in question. Notification need not be given to more than one (1) occupant of a structure, except that if a structure contains more than one (1) dwelling unit or spatial area owned or leased by different persons, one (1) occupant of each unit shall receive notice. In the case of a single structure containing more than four (4)

Adopted 8-6-91

Rev. 6-7-94

X-25

dwelling units, notice may be given to the manager or owner of the structure who shall be requested to post the notice at the primary entrance to the structure. A notice containing the time, date, place and purpose of the hearing shall be posted on the subject property at least eight (8) days prior to the hearing. The posting sign shall be no less than ten (10) square feet in size.

4. After completing the review and holding one public hearing, if so required, the Township Board or Planning Commission shall approve, approve

with conditions or deny the application within 90 days after receipt of an application, in accordance with this Chapter.

5. Written notice shall be sent to the applicant upon approval, approval with conditions or denial of a wetland use permit by the Township Board. The denial of a permit shall be accompanied by a written reason for denial.

6. A permit approved by the Township Board or Planning Commission shall not be issued or effective until ten (10) calendar days following the date of the approval and compliance with Section 105-15(c) of this Chapter.

Section 105-12 Criteria for Wetlands Under Two (2) Acres in Size

a. Where an applicant proposes to perform a regulated activity in a wetland less than two (2) acres in size, the Director of Planning and Development Control shall be so advised in writing. The Director of Planning and Development Control shall forward the location and other information concerning the wetland to the Township Wetland Consultant, who shall issue a preliminary finding as to whether one or more of the following criteria are likely to apply to the wetland:

1. The site supports state or federal endangered or threatened plants, fish, or wildlife appearing on a list specified in section 6 of the Endangered Species Act of 1974, Act No. 203 of Public Acts of 1974, being Section 299.226 of the Michigan Compiled Laws and/or subsequent amendments.

2. The site represents what is identified as a locally rare or unique ecosystem.

3. The site supports plants or animals of an identified local importance.

4. The site provides groundwater recharge documented by a public agency.

5. The site provides flood and storm control by the hydrologic absorption and storage capacity of the wetland.

6. The site provides wildlife habitat by providing breeding, nesting, or feeding grounds or cover for forms of wildlife, waterfowl, including migratory waterfowl and rare, threatened, or endangered wildlife species.

Adopted 8-6-91

Rev. 6-7-94

X-26

7. The site provides protection of subsurface water resources and provision of valuable watersheds and recharging groundwater supplies.
8. The site provides pollution treatment by serving as a biological and chemical oxidation basin.
9. The site provides erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
10. The site provides sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

b. The Township Wetland Consultant's report shall be forwarded to the Township Board, which shall determine whether a wetland use permit application meeting the requirements of Section 105-10 of this Chapter shall be required, based on a finding that the wetland is essential to the preservation of the natural resources of the Township. Said determination shall be based on a finding that one or more of the criteria set forth in (a) above are met.

c. If the Township Board determines that the wetland is not essential to the preservation of the natural resources of the Township, the Township Board's decision shall be so noted on the Township Wetland Inventory Map, at the time it is amended. The requested activity shall be approved subject to all other applicable laws and regulations.

d. When a wetland under two (2) acres in size has been determined to be essential to the natural resources of the Township and the Township has found that one or more of the criteria set forth in 105-12(a) exist at the site, the Township shall notify the applicant in writing stating the reasons for determining the wetland to be essential to the preservation of the natural resources.

e. After determining that a wetland less than two (2) acres in size is essential to the preservation of the natural resources of the Township, the wetland use permit application shall be reviewed according to the standards in Section 105-13.

Section 105-13 Review Standards for Wetland Use Permits

The criteria to evaluate wetland use permits under this Chapter and to determine whether a permit is granted

are as follows:

- a. A permit for any activity listed in Section 105-8 shall not be approved unless the proposed activity is in the public interest and is otherwise lawful in all respects. Public input shall be evaluated in approving, approving with conditions, or denying the application. The reasonable use of the property involved in accordance with applicable local ordinances and State law shall also be considered.

Adopted 8-6-91

Rev. 6-7-94

X-27

- b. In determining whether the activity is in the public interest, the benefit which reasonably may be expected to accrue from the proposal shall be balanced against the reasonably foreseeable detriments of the activity. The decision shall reflect the national, state, and local concern for the protection of natural resources from pollution, impairment, and destruction. The following general criteria shall be considered:

1. The relative extent of the public and private need for the proposed activity.
2. The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits from the activity.
3. The extent and permanence of the beneficial or detrimental effects which the proposed activity may have on the public and private uses to which the area is suited, including the benefits the wetlands provide.
4. The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.
5. The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or safety, or fish or wildlife.
6. Economic value, both public and private, of the proposed land change to the general Township area.
7. The findings of necessity for the proposed activity which have been made by other agencies.
8. Amount of wetland remaining in general area and proximity to a waterway.

c. A wetland use permit shall not be issued unless it is shown that an unacceptable disruption will not result to the aquatic resources. In determining whether a disruption to the aquatic resources is unacceptable, the benefits outlined in Section 105-1 and the criteria set forth in Section 105-13 b shall be considered. A permit shall not be issued unless the applicant also shows either of the following:

1. The proposed activity is primarily dependent upon being located in the wetland, or
2. A feasible and prudent alternative does not exist.

d. Failure to submit a complete application may be reason for denial of a wetland use permit.

Adopted 8-6-91

Rev. 6-7-94

X-28

Section 105-14 Consideration of Wetland Mitigation Proposals

To ensure no net loss of wetlands in the Township, mitigation shall be required in instances where there are losses of wetland resources. The Township Wetland Consultant shall review an applicant's mitigation plan and transmit a recommendation to the Director of Planning and Development Control. The Director of Planning and Development Control, Planning Commission, or Township Board, as applicable, shall review the applicant's mitigation plan and consider the Township Wetland Consultant's recommendation as part of the wetland use permit review process. A mitigation plan, if required, shall be approved as part of the wetland use permit decision by either the Director of Planning and Development Control or the Township Board, as applicable. Mitigation shall not be considered a substitute for making all prudent attempts to avoid wetland impacts.

a. Prior to considering a proposal for wetland mitigation it must be shown that it is practical to replace the wetland resource values which will be unavoidably impacted including: flood prevention; wildlife habitat; groundwater resource protection and recharge; pollution treatment; erosion control; nutrient sources; aesthetics; recreation; open space and any other values identified.

b. If determined by the Township Wetland Consultant that the above is met, the following criteria shall be considered when reviewing an applicant's mitigation proposal:

1. Mitigation shall be provided on-site where practical and beneficial to the wetland resources. If mitigation on-site is not practical and beneficial, then mitigation in the immediate vicinity, within the same watershed, of the permitted activity may be considered. Only if all of these options are impractical shall mitigation be considered elsewhere.

2. Any proposal shall assure that there will be no net loss to the wetland resource values.

3. The mitigation plan must comply will all applicable federal, state, and local laws.

4. A plan to monitor preserved and replacement wetlands over a minimum of five years has been specified.

c. Wetland mitigation and monitoring plans shall become conditions to the wetland use permit and shall be the responsibility of the applicant.

d. Financial assurances that mitigation is accomplished as specified by the permit condition may be required by the Director of Planning and Development Control, Planning Commission, or Township Board, as applicable.

Adopted 8-6-91

Rev. 6-7-94

X-29

e. Any mitigation activity shall be completed before initiation of other permitted activities, unless a phased concurrent schedule can be agreed upon between the Director of Planning and Development Control, Planning Commission, or Township Board, as applicable, and the applicant.

f. Wetland mitigation plans that create less than two (2) acre wetlands shall meet one of the conditions listed in Section 105-12(a).

Section 105-15 Wetland Use Permit Conditions of Issuance

a. The Director of Planning and Development Control, Planning Commission, or Township Board, as applicable, shall attach any reasonable conditions considered necessary to insure that the intent of this Chapter will be fulfilled, to minimize or mitigate damage or impairment to, encroachment in, or interference with natural resources and processes within the protected wetland or to otherwise improve or maintain the water quality.

b. The Director of Planning and Development Control, Planning Commission, or Township Board shall fix a reasonable time for the undertaking and completion of all activities and structures, as applicable.

c. Following the approval of the wetland use permit application, a permit shall be issued upon determination that all other requirements of the ordinance and law have been met, including site plan, plat or land use approvals, as applicable, and including issuance of required permits by Ingham County or the Michigan Department of Natural Resources under Act 203 of the Public Acts of 1979, as amended.

d. The Director of Planning and Development Control, Planning Commission, or Township Board, as applicable, upon issuance of a wetland use permit, may require the applicant to file with the Township Treasurer cash, certified check, or an irrevocable bank letter of credit in an amount the Director of Planning and Development Control, Planning Commission or Township Board, as applicable, determines is necessary to insure compliance with the wetland use permit approval conditions and this Chapter.

e. At no time shall the Director of Planning and Development Control, Planning Commission, or Township Board, as applicable, issue a wetland use permit that allows a more extensive alteration of the wetland than permitted by state or federal law.

f. Wetland use permits for seasonal operations need not be renewed annually unless otherwise stated in the permit.

g. Any change that increases the size or scope of the operation and that affects the criteria considered in approving the permit as determined by the Director of Planning and Development Control, Planning Commission, or Township Board, as applicable, shall require the filing of a new wetland use permit application.

Adopted 8-6-91

Rev. 6-7-94

X-30

h. Any temporary, seasonal, or permanent operation that is discontinued for two (2) years or two (2) seasons shall be presumed to have been abandoned and the wetland use permit automatically voided.

i. Any permit granted under this Chapter may be revoked or suspended by the Township Board, after

notice and an opportunity for a hearing, for any of the following causes:

1. A violation of a condition of the permit.

2. Misrepresentation or failure to fully disclose relevant facts in the application.

3. A change in a condition that requires a temporary or permanent change in the activity.

j. An applicant who has received a wetland use permit under this Chapter shall comply with the following in connection with any construction or other activity on the property for which the wetland use permit has been issued:

1. Maintain soil erosion control structures and measures, including but not limited to, silt fences, straw bale berms, and sediment traps. The permittee shall provide for periodic inspections throughout the duration of the project.

2. Maintain clear delineation of the protected wetlands (so marked by the Township Wetland Consultant during the on-site inspection) so that such locations are visible to all construction workers.

3. Post on the site, prior to commencement of work on the site and continuing throughout the duration of the project, a copy of the approved wetland use permit containing the conditions of issuance, in a conspicuous manner such that the wording of said permit is available for public inspection.

k. The wetland use permit shall remain effective for a time period coincidental with any other land use permit reviewed and approved concurrent with the wetland use permit. If applied for prior to the expiration date and concurrent with the expiring land use permit, the applicant may be granted an extension that corresponds to additional time granted for the underlying land use permit. Extensions shall be approved by the same person or body that made the original decision. The maximum number of extensions shall coincide with the maximum number allowed for the underlying land use permit.

l. Where there is no other activity or permit involved, the wetland use permit shall remain effective for one (1) year. A maximum of a one (1) year extension may be approved.

Adopted 8-6-91

Rev. 6-7-94

X-31

Section 105-16 Wetland Board

The Township Board hereby creates a Wetland Board whose membership, appointment and duties shall be as follows:

- a. The Wetland Board shall consist of five (5) residents of the Township appointed by the Township Board; four of whom shall have knowledge and experience in the areas of botany, soils, geology, hydrology, or natural resources. The initial terms of appointment shall be as follows: 2 individuals for 3 years, 2 individuals for 2 years, and 1 individual for 1 year. Thereafter, appointments shall be for a term of three years.
- b. The Wetland Board shall establish rules of procedure.
- c. The duties of the Wetland Board shall include the following:
 1. May advise the Township Board, Planning Commission, and Director of Planning and Development Control, on wetland use permits, appeals of wetland use permits, and mitigation plans.
 2. Serve in an advisory role in setting policy guidelines on wetland issues in the Township.
 3. Identify conflicts with wetland protection by present Township ordinances, Township operating procedures, and Township activities.
 4. Identify and propose solutions to problems associated with wetland management.
 5. Provide recommendations to the Director of Planning and Development Control on map administration.
 6. Coordinate with the Michigan Department of Natural Resources in keeping up-to-date on issues affecting wetland protection.
 7. Recommend a program to protect and acquire important wetlands through tax incentives, donation, development rights, easements, land exchange, purchase, and other means. Assist landowners who are interested in the voluntary protection of wetlands through one of these methods.
 8. Promote wetland education at all levels. Develop education programs for the public and for Township schools. The program should promote the values of wetlands and awareness of the hazards and threats to wetlands. The program

should be particularly targeted to landowners with wetlands and emphasize how best to protect wetland values on their property.

Adopted 8-6-91

Rev. 6-7-94

X-32

9. Coordinate a voluntary wetland stewardship program. Develop an adopt-a-wetland program for interested citizens to participate more directly in preservation of specific wetlands.

10. Review degraded or destroyed wetlands in the Township for possible rehabilitation or restoration.

Section 105-17 Request for Revaluation of Affected Property

The owner of any property for which a wetland use permit was applied for under this Chapter and was denied, upon appeal, by the Township Board may request a revaluation of the affected property by the Township Board of Review for assessment purposes to determine its fair market value under the use restriction. A landowner who is aggrieved by a determination, action, or inaction under this chapter may protest and appeal that determination, action or inaction pursuant to the General Property Tax Act, Act No. 206 of the Public Acts of 1893, being Section 211.1 to 211.157 of the Michigan Compiled Laws.

Section 105-18 Fees

Applications for wetland use permits, wetland verifications and delineations under this Chapter shall be accompanied by an application fee in an amount specified by resolution of the Township Board.

Section 105-19 Penalties and Enforcement

- a. Penalties. In addition to the rights and remedies herein provided to the Township, any person violating any of the provisions of this Chapter shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in an amount not exceeding Five Hundred Dollars (\$500.00), or be imprisoned in the county jail for a period not exceeding ninety (90) days, or both fined and imprisoned. Each violation of this act shall be a separate offense and in the event of a continuing violation, each day during which the violation exists

shall be deemed to be separate and distinct offense. Each day such violation is continued or permitted to continue shall constitute a separate offense and shall be punishable as such hereunder.

b. Stop Work Orders. Whenever any work is performed contrary to the provisions of this Chapter, the Township Superintendent or his agent shall order the work to cease by notice in writing served on any persons engaged in the doing or causing such work to be performed, and any such persons shall, upon receipt of the order, forthwith stop such work until authorized by the Township Superintendent or his agent to proceed.

c. Civil Remedies. Any use of land or premises in violation of any provision of this Chapter is declared to be a nuisance per se. Whenever any work is being done contrary to the provisions of this Chapter, the Township may commence judicial proceedings for injunction, mandamus, or other appropriate relief to prevent, enjoin, abate, correct, restore, or remove

Adopted 8-6-91

Rev. 6-7-94

X-33

any violation of this Chapter. The rights and remedies herein provided are civil in nature and in addition to any criminal remedies under this Chapter or provided by state law.

d. Appearance Tickets. In all arrests and prosecutions for violation of this Chapter, appearance tickets and the appropriate procedures set for in Act 147, Michigan Public Acts of 1968, as amended, may be used.

e. The Director of Planning and Development Control or his agent, officer or employee shall have authority under this Ordinance to enter upon privately owned land for the purpose of performing the Township's duties under this ordinance and may take or cause to be made such examinations, surveys or samplings as are deemed necessary.

f. Law enforcement officials or other officials having the police power shall have authority to assist the office of Planning and Development Control in the enforcement of this ordinance.

g. In the event of a violation of this ordinance, the Township Board shall have the power to order

wetland restoration for the damaged or destroyed wetland area by the owner of the property affected or the person or agent responsible for the violation. If the owner or person responsible does not complete the restoration measures within an ordered period of time, the Township Board may order the affected wetland restored to its prior condition and/or create or restore other wetlands for the purpose of offsetting losses sustained as a result of the violation. The owner or person responsible for the original violation shall be responsible to the Township for the full cost of all such remedial activity.

Section 105-20 Notice to the Michigan Department of Natural Resources

1. The Township shall notify the Michigan Department of Natural Resources of the adoption of this Chapter. The Township shall cooperate with the Department of Natural Resources in the enforcement of Act 203 as to wetlands under the Department of Natural Resources' jurisdiction as defined under this Chapter.

2. The Township shall notify the Department of Natural Resources of its decisions on all applications processed by the Township.

Section 105-21 Abrogation and Conflict of Authority

Nothing in this Chapter shall be interpreted to conflict with present or future state statutes in the same subject matter; conflicting provisions of this Chapter shall be abrogated to, but only to, the extent of the conflict. Moreover, the provisions of this Chapter shall be construed, if possible, to be consistent with and in addition to relevant state regulations and statutes. If any part of this Chapter is found to be invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct and independent provision. Such holding shall not affect the validity of the remaining portions thereof, and the remainder of the Chapter shall remain in force.

Adopted 8-6-91

Rev. 6-7-94

X-34

Appendix III

City of Montezuma, Georgia: Wetland Protection Ordinance

City of Montezuma Wetland Protection Ordinance

Ordinance #313

An Ordinance of the Mayor and Council of the City of Montezuma to Adopt Rules and Regulations to Protect Wetland Areas, as Shown on Attached Maps, Within Montezuma:

Table of Contents

1. Findings and Purpose 1	3.7 Subdivision Design Options 5
1.1 Findings of Fact 1	3.7.1 Lot Size Averaging 5
1.2 Title and Purpose 1	3.7.2 Cluster Development 5
2. Wetland Protection District 1	3.8 Filing Fee 5
2.1 Wetland Protection District 1	3.9 Enforcement Authority 6
2.2 Wetland Protection District Boundaries 2	3.10 Review Procedures 6
2.3 [Optional] Relationship to Zoning 2	3.11 Appeals 6
3. Local Development Permits 2	3.12 Duration of Permit Validity 6
3.1 Local Development Permit Requirements 2	3.12.1 Commencement of Construction 6
3.2 Permissible Uses (Uses as of Right) 2	3.12.2 Suspension or Abandonment of Construction 6
3.2.1 Conservation 3	3.12.3 Written Notice of Pending Expiration 6
3.2.2 Passive Recreational Activities 3	4. Monitoring and Enforcement 6
3.2.3 Forestry 3	4.1 Entrance on Private Property 6
3.2.4 Agriculture 3	4.1.1 Entrance on Private Property to Monitor 6
3.2.5 Pasturing 3	4.1.2 Assistance of Law Enforcement Officials 7
3.2.6 Education, Scientific Research 3	4.1.3 Cease and Desist Order 7
3.3 Temporary Emergency Permit 3	4.2 Compliance Bond 7
3.3.1 Maintenance of Infrastructure 3	4.3 Construction in Violation 7
3.3.2 Stabilization 3	4.4 Removal of Cover - Excavation or Fill 7
3.3.3 Ditching 3	4.5 Violation of Clean Water Act 7
3.3.4 Excavation/Fill 4	4.6 Suspension/Revocation of Permit 7
3.4 Site Plans 4	5. Penalties 8
3.4.1 Cut and Fill Calculations 4	5.1 Fine 8
3.4.2 Wetland Boundaries 4	6. Appeal 8
3.4.3 Impervious Surfaces Shown 4	6.1 Jurisdiction 8
3.4.4 Perennial Streams 4	6.2 Alternative Actions 8
3.4.5 Elevations 4	6.2.1 Negotiated Purchases or Condemnation
3.4.6 Spill and Leak Collection Systems 4	6.2.2 Approve Permit with Lesser Restrictions
3.4.7 Temporary Disruption of Local Hydrology 4	6.2.3 Other Appropriate Actions
3.5 Conformance with Site Plan 4	7. Amendments 8
3.6 Subdivision Approval 5	8. Assessment Relief 8
	9. Separability and Abrogation 9
	10. Definitions 9
	11. Effective Date 10

1. Findings and Purpose

1.1 Findings of Fact. Wetlands are indispensable and fragile natural resources with significant development constraints due to flooding, erosion and soils limitations. In their natural state, wetlands serve man and nature.

They provide habitat areas for fish, wildlife and vegetation; water quality maintenance and pollution control; flood control; erosion control; natural resource education; scientific study; and open space and recreational opportunities. In addition, the wise management of forested wetlands is essential to the economic well-being of many communities within the State of Georgia.

Nationally, a considerable number of wetland resources have been lost or impaired by draining, dredging, filling, excavating, building, pollution and other acts. Piecemeal or cumulative losses will, over time, destroy additional wetlands. Damaging or destroying wetlands threatens public safety and the general welfare.

It is, therefore, necessary for the City of Montezuma, Georgia, to ensure maximum protection for wetlands located in the corporate limits of the City by discouraging development activities that may adversely affect wetlands.

1.2 Title and Purpose. This Ordinance shall be known as the Wetland Protection Ordinance of the City of Montezuma, Georgia. The purpose of this Ordinance is to promote wetland protection, while taking into account varying ecological, economic development, recreational and aesthetic values. Activities that may damage wetlands should be located on upland sites to the greatest degree practicable as determined through a permitting process. The objective of this Ordinance is to protect wetlands from alterations that will significantly affect or reduce their primary functions for water quality, floodplain and erosion control, groundwater recharge, and aesthetic nature and wildlife habitat.

2. Wetland Protection District

2.1 Wetland Protection District. This Ordinance shall apply to all lands within wetlands located in the corporate limits of the City of Montezuma, Georgia. The Generalized Wetland Map, adopted as part of this Ordinance, shows the general location of wetlands and should be consulted by persons contemplating activities in or near wetlands. The Generalized Wetland Map, together with all explanatory matter thereon and attached thereto, is

hereby adopted by reference and declared to be part of this Ordinance. The Generalized Wetland Map shall be on file in the office of the Montezuma city clerk.

2.2 Wetland Protection District Boundaries. The Generalized Wetland Map is a general reference document, and wetland boundaries indicated on the map are approximations. The purpose of the Generalized Wetland Map is to alert developers/landowners that a subject site may be in a jurisdictional wetland or in proximity to a jurisdictional wetland, requiring the Developer/landowner to seek U.S. Army Corps of Engineers guidance as to whether a Section 404 permit will be required prior to initiation of any development activity on the subject site. The Generalized Wetland Map does not represent precise boundaries of jurisdictional wetlands within Macon County and Montezuma, and cannot serve as a substitute for a delineation of wetland boundaries by the U.S. Army Corps of Engineers, as required by Section 404 of the Clean Water Act, as amended. Any local government action under this Ordinance does not relieve the landowner from federal or state permitting requirements.

3. Local Development Permits

3.1 Local Development Permit Requirements. No regulated activity will be allowed within the Wetland Protection District without written permission from the Permitting Officer in the form of a local development permit. Issuance of a local development permit is contingent on full compliance with the terms of this Ordinance and other applicable regulations.

All activities that are not identified in Subsection 3.2 below or by other local development ordinances, shall be prohibited without prior issuance of a local development permit. If the area proposed for development appears to be located within fifty (50) feet of the Wetland Protection District boundary, as determined by the Permitting Officer from review of the Generalized Wetland Map, a U.S. Army Corps of Engineers determination shall be required. If the Corps determines that wetlands are present on the proposed development site and that a Section 404 Permit or Letter of Permission is required, a local development permit will be issued only following receipt by the local Permitting Officer of a copy of the Section 404 Permit or Letter of Permission issued by the U.S. Army Corps of Engineers.

3.2 Permissible Uses (Uses as of Right). The following uses shall be allowed as of right within a wetland to the extent they are not prohibited by any other ordinance or law, including laws of trespass, and provided they do not require structures, grading, fill, draining or dredging except as provided herein.

3.2.1 Conservation or preservation of soil, water, vegetation, fish and other wildlife, provided they do not affect waters of Georgia or of the United States in such a way that would require an individual 404 Permit.

3.2.2 Outdoor passive recreational activities, including fishing, bird watching, hiking, boating, horseback riding and canoeing.

3.2.3 Forestry practices applied in accordance with best management practices approved by the Georgia Forestry Commission and as specified in Section 404 of the Clean Water Act.

3.2.4 The continued cultivation of agricultural crops. Agricultural activities shall; however, be subject to best management practices approved by the Georgia Department of Agriculture.

3.2.5 The pasturing of livestock, provided that riparian wetlands are protected, that soil profiles are not disturbed and that approved agricultural best management practices are followed.

3.2.6 Education, scientific research and nature trails.

3.3 Temporary Emergency Permit. A temporary, emergency permit can be issued by the Permitting Officer for the following reasons:

3.3.1 Maintenance or repair of lawfully located roads or structures and of facilities used in the service of the public to provide transportation, electric, gas, water, telephone, telegraph, telecommunication or other services, provided that such roads, structures or facilities are not materially changed or enlarged, and written notice prior to the commencement of work has been given to the Permitting Officer, and provided that the work is conducted using best management practices to ensure that flow and circulation patterns and chemical and biological characteristics of the wetland are not impaired, and that any adverse effect on the aquatic environment will be minimized.

3.3.2 Temporary water-level stabilization measures associated with ongoing silvicultural operations.

3.3.3 Limited ditching, tilling, dredging, excavating or filling done solely for the purpose of maintaining or repairing existing drainage systems necessary for the cultivation of agricultural crops, provided the maintenance or repair activity does not result in the impairment, alteration or loss of wetlands not previously subject to agricultural and silvicultural use under the terms and provisions of subsection 3.2.4.

3.3.4 Limited excavating and filling necessary for the repair and maintenance of piers, walkways, nature trails, observation decks, wildlife management shelters, boathouses or other similar water-related structures, provided such facilities and structures are built on pilings to allow unobstructed flow of water and preserve the natural contour of the wetland.

3.4 Site Plans. Applications for a local development permit within the Generalized Wetland Protection District shall include a site plan, drawn to a scale of one inch equals fifty feet (1" = 50'), unless a different scale is approved, in advance, by the Permitting Officer, with the following information:

3.4.1 A map of all planned excavation and fill, including calculations of the volume of cut and fill involved with cross-sectional drawings showing existing and proposed grades. Elevations, horizontal scale and vertical scale must be shown on the cross-sectional drawings.

3.4.2 A map of any wetland boundaries occurring within the site must be provided. This boundary may be included on other maps provided by the applicant.

3.4.3 Location, dimensions and area of all impervious surfaces, both existing and proposed, on the site and adjacent to the site for a distance of two hundred (200) feet.

3.4.4 The orientation and distance from the boundaries of the subject site to the nearest bank of an affected perennial stream or water body.

3.4.5 Elevation of the site and adjacent lands within two hundred (200) feet of the site at contour intervals of no greater than two feet; and no greater than one foot for slopes less than or equal to two percent.

3.4.6 Location and detailed design of any spill and leak collection systems designed for the purpose of containing hazardous or toxic materials released accidentally.

3.4.7 All proposed temporary disruptions or diversions of local hydrology.

3.5 Activities to comply with site plan. All development activities or site work conducted after approval of the site plan shall conform with the specifications of said site plan. The site plan may be amended only with approval of the Permitting Officer. The Permitting Officer may require additional information deemed necessary to verify compliance with the provisions of this Ordinance or to evaluate the proposed use in terms of the purposes of this Ordinance.

3.6 Subdivision Approval in the Wetland Protection District. Any application for subdivision approval shall include a Jurisdictional Determination approved by the U.S. Army Corps of Engineers. If the Corps determines that wetlands are present and that a Section 404 Permit or Letter of Permission is required, subdivision approval will be issued only following issuance of the Section 404 Permit or Letter of Permission.

3.7 Subdivision Design Options in the Wetland Protection District. Any subdivision that includes Jurisdictional Wetlands shall be allowed and encouraged to use the following options:

3.7.1 Lot Size Averaging. Lot size averaging is encouraged in single-family detached subdivisions as a means to work around wetland areas. The Permitting Officer may allow a reduction in lot size provided the same number of lots in the same subdivision are oversized by an equal or greater area. The maximum permissible reduction shall not exceed 25 percent of the minimum required lot area. The number of lots with areas reduced shall not exceed 25 percent of the total number of lots in the subdivision. The Permitting Officer shall allow no more than a 25 percent adjustment of rear, side and front setbacks for each affected lot.

3.7.2 Cluster Development. Clustering of residential development is encouraged. When considering subdivision approval, the Permitting Officer will allow incorporation of wetland or other significant natural areas as open space in the subdivision plan. Such plans should designate at least 25 percent of the gross land area as open space. Density shall be calculated by subtracting from the total acreage of a parcel, all land dedicated or in use for private or public roads, including all vehicular rights-of-way. The resultant acreage will then be divided by the minimum

allowed lot size of the district to derive the number of lots permissible.

3.8 Filing Fee. At the time of the application, the applicant shall pay a filing fee specified by the Permitting Officer. Filing fees up to the larger of \$60 or \$100 per acre may be required to evaluate the application.

This fee may be used to retain expert consultants who will provide services pertaining to functional assessment, mitigation and wetland boundary determinations as deemed necessary by the Permitting Officer.

3.9 Enforcement Authority. The Permitting Officer is the department, office or individual assigned the responsibility of administering this Ordinance. At the time this Ordinance is adopted, the administrative authority is vested in the office of the City Manager at City Hall.

3.10 Review Procedures. The application shall be made to the Permitting Officer and will be reviewed within 30 days. The review period shall begin upon determination by the Permitting Officer that the application submitted is complete. The review period shall include the preparation of findings (approval, conditional approval or disapproval) by the Permitting Officer. The applicant will receive written notification of the findings of the Permitting Officer. If the review process is not completed within 30 days, the application is considered to be approved.

3.11 Appeals. Any aggrieved party may appeal a decision under this Ordinance according to Appendix C, Article XIII of the City of Montezuma Code of Ordinances.

3.12 Duration of Permit Validity.

3.12.1 If construction described in the development permit has not commenced within six (6) months from the date of issuance, the permit shall expire.

3.12.2 If construction described in the development permit is suspended or abandoned after work has commenced, the permit shall expire six (6) months after the date that work ceased.

3.12.3 Written notice of the pending expiration of the development permit may be issued by the Permitting Officer, but no such notification is required.

4. Monitoring and Enforcement

4.1 The Permitting Officer shall have authority to enter upon privately owned land for the purpose of

performing duties required under this Ordinance, and may take or cause to be made such examinations, surveys or sampling as the Permitting Officer deems necessary.

4.1.1 The Permitting Officer shall have authority to enter the subject site to monitor development and to enforce this Ordinance; issue permits hereunder; and address violations or threatened violations hereof by issuance of violation notices, administrative orders and civil and criminal actions. All costs, fees and expenses in connection with such actions may be recovered as damages against the violator.

4.1.2 Law enforcement officials or other officials having police powers in the jurisdiction shall have authority to assist the Permitting Officer with enforcement.

4.1.3 The Permitting Officer shall have authority to issue cease and desist orders in the event of any violation of this Ordinance. Cease and desist orders may be appealed to a court of competent jurisdiction, as identified herein.

4.2 The Permitting Officer may require a bond and with surety and conditions sufficient to secure compliance with the conditions set forth in the permit. The particular amount and the conditions of the bond shall be consistent with the purposes of this Ordinance. In the event of a breach of any condition of any such bond, the Permitting Officer may institute an action in a court of competent jurisdiction upon such bond and prosecute the same to judgment and execution.

4.3 When the Permitting Officer determines a building or other structure has been constructed in violation of this Ordinance, the violator may be required to remove the structure at the discretion of the Permitting Officer.

4.4 When removal of vegetative cover, excavation or fill has taken place in violation of this Ordinance, the violator may be required to restore the affected land to its original contours and to restore vegetation, as far as practicable, at the discretion of the Permitting Officer.

4.5 If the Permitting Officer discovers a violation of this Ordinance that also constitutes a violation of any provision of the Clean Water Act as amended, the Permitting Officer shall issue written notification of the violation of the U.S. Environmental Protection

Agency, the U.S. Army Corps of Engineers and the landowner.

4.6 Suspension, Revocation. The Permitting Officer may suspend or revoke a permit if he finds the applicant has not complied with the conditions or limitations set forth in the permit or has exceeded the scope of the work set forth in the permit. The Permitting Officer shall cause notice of denial, issuance, conditional issuance, revocation or suspension of a permit to be published in a daily newspaper having a broad circulation in the areas where the wetland is located.

5. Penalties

5.1 Any person who commits, takes part in or assists in any violation of any provision of this Ordinance shall be punished as set forth in Montezuma Code of Ordinances Sec. 1.6 (a) through (e).

6. Appeals

6.1 Jurisdiction. All final decisions of the Montezuma Board of Appeals concerning denial, approval or conditional approval of a permit issued pursuant to the provisions of this Ordinance may be appealed to the Macon County Superior Court.

6.2 Alternative Actions. Based on the proceedings of the Macon County Superior Court and the decision of said court, the Montezuma City Council may, within the time specified by the court, elect to:

6.2.1. Institute negotiated purchase or condemnation proceedings to acquire an easement or fee interest in the applicant's land;

6.2.2. Approve the permit application with lesser restrictions or conditions (i.e., grant a variance); or

6.2.3. Institute other appropriate actions ordered by the court that fall within the jurisdiction of the Montezuma City Council.

7. Amendments

These regulations and the Generalized Wetland Map may from time to time be amended in accordance with procedures and requirements in the general statutes and as new information concerning wetland locations, soils, hydrology, flooding or plant species peculiar to wetlands becomes available.

8. Assessment Relief

Macon County Tax Assessors and the Macon County Boards of Assessors shall consider wetland regulations in determining the fair market value of land. Any owner of an undeveloped wetland who has dedicated an easement or entered into a conservation program with

the government or a nonprofit organization restricting activities in a wetland shall have that portion of land assessed consistent with those restrictions. Such landowner shall also be exempted from special assessment on the wetland to defray the cost of municipal improvements such as sanitary sewers, storm sewers and water mains.

9. Separability and Abrogation

All sections and subsections of this Ordinance are considered separate and distinct. Should any section, subsection, paragraph or part of this Ordinance be declared by a court of competent jurisdiction to be invalid for any reason, it shall not invalidate any other section, subsection, paragraph or part of this Ordinance. All ordinances and regulations in conflict with this Ordinance are hereby repealed.

10. Definitions

10.1 Generalized Wetland Map - A map showing the general locations of wetlands within Macon County and the City of Montezuma. The Generalized wetland map used at the time this Ordinance is adopted is the National Wetlands Inventory as published by the United States Department of Interior.

10.2 Hydric Soils - Soils that form as a result of saturated soils conditions. A list of these soils is maintained by the Soil Conservation Service.

10.3 Hydrophytic Vegetation - Macrophytic plants tolerant of or dependent on saturated soil conditions.

10.4 Jurisdictional Determination - An official, written statement or map signed by the U.S. Army Corps of Engineers, stating whether a certain specified site is a wetland or is in a wetland.

10.5 Jurisdictional Wetland - A wetland area that meets the definitional requirements for wetlands as determined by the U.S. Army Corps of Engineers.

10.6 Temporary Emergency Permit - A temporary permit that may be issued in certain circumstances specified in Subsection 3.3.

10.7 Wetland - An area that is inundated or saturated by surface water or groundwater at a frequency and distribution sufficient to support, and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation. Wetlands generally include swamps, marshes, bogs and similarly areas.

10.8 Wetland Delineation - The establishment of wetland boundaries by a representative of the U.S. Army Corps of Engineers or an authority designated by the Corps.

10.9 Wetland Protection District - All wetlands within the City of Montezuma and shown on the Generalized Wetland Map.

11. Effective Date. Enacted in regular session this 9th day of February, 1999, this Ordinance shall take effect and be enforceable throughout the corporate limits of the City of Montezuma, Georgia, on and after July 1, 1999.

Appendix

Source Material for the Preparation of Generalized Wetland Maps

A. Available Map Resources

1. **National Wetlands Inventory Maps (NWI).** NWI maps are the most commonly used maps. Most of these maps are at scales of 1:24,000 correspond to United States Geologic Survey (USGS) topographic maps. The minimum area mapped is usually one to three acres. Small wetlands and very narrow wetlands in river corridors may be missed.

These maps were developed from interpretations of available aerial photographs, therefore, mapped boundaries of wetlands do not reflect jurisdictional boundaries [as would be determined if the federal delineation manual were used on the ground].

Only a small portion of the maps has been "ground-truthed," but nationwide efforts to assess the accuracy of the maps have been extensive. Accuracy varies upward from the 60 percent, with most maps being at least 90 percent accurate.

The strength of these maps is the spatial resolution (often to within one acre, which is relatively good). NWI maps identify the location of wetlands and indicate wetland type using the Cowardin classification scheme.

The limitations of these maps are that wetlands that were cultivated at the time of mapping are generally not depicted and forested wetlands are poorly discriminated. In some areas, these two wetland types are a major portion of the wetlands resource. Particularly in areas of rapid growth and accelerated wetlands loss, many maps have become quickly outdated.

Maps are available through:

- a. Department of Community Affairs, 60 Executive Park South, N.E., Atlanta, Georgia 303029-2231. Telephone: 1-404-656-5527.
- b. National Wetlands Inventory, U.S. Fish and Wildlife Service Regional Office, 1875 Century Boulevard, Atlanta, Georgia 30345. Telephone: 1-404-266-8500.
- c. Earth Science Information Center, U.S. Geological Survey, Reston, Virginia. Telephone: 1-800-USA-MAPS.

Other information, including information about wetland functions and values and options for their protection, can be obtained from the EPA Wetland Protection Hotline, LABAT-ANDERSON, Inc., 2200 Clarendon Boulevard, Suite 900, Arlington, Virginia 22201. Telephone: 1-800-832-7828.

2. County Soil Survey Maps. These maps range in scale from 1:15,840 to 1:31,680. Soil maps do not delineate wetlands, but rather their presence may be inferred from the occurrence of soils classified as "hydric" by the Soil Conservation Service. From accompanying soil interpretation record data, wetlands might cautiously be classified by type. These maps were developed by trained soil scientists who examined vertical soil profiles at regular intervals along ground transects and generalized subjectively from them to the surrounding landscape on the basis of landform, vegetation and other factors.

These maps do not specify wetland type as do the NWI maps. Most published soil surveys report the acreage of each soil series in the survey area. Soil survey maps are extensively used as secondary data source for wetlands mapping. However, hydric soil inclusions (patches of hydric soil too small to map) are probably common in many soils mapped as non-hydric, but the extent to which this occurs is unknown. It should also be noted that some soils classified as hydric are not hydric everywhere they are mapped; marginally hydric soils indicate wetlands only in certain landscape positions. Caution should therefore be used when inferring the presence of wetlands from soils classified and mapped as hydric.

The advantage of using these maps is that they are sometimes available in areas where NWI maps are not yet available. Soil surveys might be used, with caution, to infer locations of cropped wetlands not included in NWI maps; to differentiate among some wetland functional types (alluvial seasonally flooded vs. isolated seasonally flooded) when linked with the SCS SOIL5

database which describes the physical properties of each soil series; and to categorize hydrologic and water purification function of specific wetlands.

Limitations of these maps are numerous. Many small but cumulatively significant areas that often are wetlands (with hydric soil inclusions) are not mapped because the soil classification systems used in soil survey maps classify soils in landscape groupings. Aquatic bed and many tidal or permanently flooded wetlands are typically mapped as open water, not wetlands, on SCS maps. Areas classified as having hydric soils are not always wetlands, in part because they may have been drained (either prior to or after the survey was conducted). This can lead to overestimation of current wetlands acreage. Many drained hydric soils can retain sufficient "hydric" features to result in their being classified by soil mappers as hydric even after decades of continuous drainage. Conversely, not all wetlands contain soils that are classified as hydric, and this can lead to underestimation of wetlands acreage. Wetlands may be the result of recent impoundment; in such areas, it typically takes at least a decade for hydric soil features to appear. Moreover, even the soils of some wetlands with hydric characteristics that have existed for decades do not appear on the SCS hydric soils list.

Maps are available through: U.S. Department of Agriculture Soil Conservation Service field offices (generally located in the county seat of each county).

3. State Soil Geographic Data Base (STATSGO) and National Soil Geographic Data Base (NATSGO) maps.

STATSGO maps are available at 1:25,000 scale with about 100 acres resolution. Digital coverage maps will be available by late 1993. These maps include soils on federal land.

NATSGO maps are available at 1:3,000,000 and are currently available showing the entire United States. They do not include federal land.

STATSGO maps are generally based on soil surveys completed since 1960. SCS has determined the map unit composition (the groupings of soil types mapped as a single polygon or unit) by transecting or sampling areas on the more detailed SCS County Soil Survey maps and expanding the data statistically to characterize each whole map unit.

Wetlands themselves are not delineated; rather their presence may be inferred from the presence of soils officially considered "hydric". From accompanying SOIL5 data, which describe the physical properties of each soil series, these wetlands landscapes might cautiously be classified by function.

NATSGO maps are also generally based on soil surveys completed since 1960. Map units are the polygons of SCS's Major Land Resource Area (MLRA) map. The sample points of the National Resources Inventory (NRI) are statistically aggregated within each MLRA unit. Each NRI record keyed to the soil interpretation record (SOIL5) data base so that soil attributes relevant to wetlands function are available for each of the 300,000 NRI sample points.

These maps are relatively new and have not been tested extensively against wetlands field data.

Both map types are the only currently available maps from which the landscape-level water purification and flood control functions of wetlands might be inferred for all areas of the United States.

The scale/resolution of the maps is inappropriate for most planning purposes at the local level. Also, these maps cannot be used to infer the functions of an individual wetland. Inferences of wetlands functions at the landscape level would be based on hydric soils, but not all hydric soils are wetlands. In the case of the STATSGO data, the soil-mapping units do not necessarily coincide with physical boundaries that are relevant to defining landscape functional units (watersheds). This could lead to some imprecision in estimates compiled on that basis. The generation and compilation of thematic maps from STATSGO and NATSGO maps requires a mainframe computer with adequate storage, advanced data base management and GIS software and a skilled computer technician.

Maps are available from:

National Cartographic Center, USDA Soil Conservation Service, Fort Worth, Texas.

4. Soil Conservation Service (SCS) Swampbuster Maps. These maps are mostly at a scale of 1:12,000 or 1:20,000 and primarily cover cropland and areas closely associated with cropland.

Most maps were completed since 1987 and largely represent a one-time assessment; about five percent may be reassessed annually.

Wetland boundaries were hand drawn on recent aerial photographs. The delineations were based on an overlay of hydric soils maps; hydrophytic vegetation and presence of surface water (as visible from aerial photographs from multiple years); and, in some cases, field checking to confirm wetlands status.

These maps probably represent the most extensive, detailed and up-to-date map source for wetlands in certain areas. However, because these maps are relatively new, they are not widely used because of limited distribution.

These maps are not for sale but can be viewed at state SCS offices.

The strength of these maps is that they are a useful complement to NWI maps because they include many of the wetlands that NWI misses, specifically, cropped and very small wetlands.

The strength of these maps is that because wetland boundaries were drawn on aerial photographs not printed for mass distribution, the maps are difficult to access and compile and they often do not include prior converted wetlands.

References

- Adamus, P.R., E.J. Clairain, Jr., R.D. Smith and R.E. Young. 1987. Wetland evaluation technique (WET): Volume II: Methodology. Operational Draft Technical Report. Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station.
- Adamus, P.R., L.T. Stockwell, E.J. Clairain, Jr., M.E. Morrow, L.P. Rozas and R.D. Smith. 1991. Wetland evaluation technique (WET): Volume I: Literature review and evaluation rationale. Technical Report WRP-DE-2. Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station.
- Ammann, A.P., and A.L. Stone. 1991. Method for the comparative evaluation of nontidal wetlands in New Hampshire. NHDES-WRD-1991-3. Concord, N.H.: New Hampshire Department of Environmental Services.
- Arendt, Randall. 1996. Conservation Design for Subdivisions. Island Press.
- Arthur, Francis Oliver. 1981. An Analysis of Private Land Fragmentation by Land Holdings of Less Than 11 Acres in Michigan. Ph.D. dissertation, Department of Resource Development, Michigan State University.
- Benhart, John E., and Alex Margin. 1994. Wetlands: Science, Politics, and Geographical Relationships. National Council for Geographic Education. Indiana University.
- Bennett, Steven Carl. 1986. The Conversion of Prime and Good Farmland to Developed Uses in Southern Michigan. Master's thesis, Michigan State University.
- Brinson, M.M., A.E. Lugo and S. Brown. 1981. Primary productivity, decomposition, and consumer activity in freshwater wetlands. *Annu. Rev. Ecol. Syst.* 12:123-161.
- Buisson, R.S.K. 1994. Human Pressures on Natural Wetlands: Sustainable Use or Sustained Abuse? In: Wetland management. Falconer, R.A. and P. Goodwin (eds.), London, U.K.: Institution of Civil Engineers, Thomas Telford.
- Charter Township of Meridian. 1994. Chapter 105. Wetland Protection Ordinance.
- Clos, Carla. 1995. In Wilfred Cwikel (ed.), *Citizen Wetland Initiatives: Stories from the Great Lakes*. Conway, Mich.: Tip of the Mitt Watershed Council.
- Conservation Foundation. 1990. *Issues in Wetland Protection: Background Papers Prepared for the National Wetlands Policy Forum*. Washington, D.C.: Conservation Foundation.
- Copeland, C., and J. Zinn. 1986. *Agricultural Non-Point Pollution Policy: A Federal Perspective*. Congressional Research Service. Washington, D.C.: Library of Congress.
- Copeland, B.R., and T.M. Scott. 1997. A simple model of trade, capital mobility and the environment. National Bureau of Economics Research.
- Cowardin, L.M., V. Carter, F.C. Golet and E.T. Laroe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. GWS/OBS-79/31. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.
- Cowardin, L.M., and F.C. Golet. 1995. *Classification of Wetlands and Deepwater Habitats of the United States*. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.
- Cwikel, W. 1992. *Michigan Wetlands: Yours to Protect*. Conway, Mich.: Tip of the Mitt Watershed Council.
- Cwikel, W. 1992. *Living with Michigan Wetlands: A Landowner's Guide*. Conway, Mich.: Tip of the Mitt Watershed Council.
- Cwikel, W. 1995. *Citizen Wetland Initiatives: Stories from the Great Lakes*. Conway, Mich.: Tip of the Mitt Watershed Council.
- 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., C.E. Johnson. 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.
- Darnay, A.J. 1994. *Statistical Record of the Environment* (second edition). Detroit: Gale Research, Inc.
- Davis, P.A. 1991. Bills would ease regulation of America's wetlands. *Congressional Quarterly Weekly Report*, Vol. 49, No. 11 (March 1991), p. 672.
- Dean, Lillian. 1991. *Protecting Wetlands at the Local Level: Options for Southeast Michigan Communities*. Detroit: Rouge River Watershed Council.
- DeLaney, Taylor A. 1995. Benefits to Downstream Flood Attenuation and Water Quality as a Result of Constructed Wetlands in Agricultural Landscapes. *Journal of Soil and Water Conservation*, November 1995, pp. 620-26.
-

- Department of the Army. 1984. Memorandum of Agreement between the State of Michigan and the Department of the Army.
- Food Security Act of 1985. U.S. Congress 99, Statute 1354.
- Gadbois, L.E. 1989. Environmental Feasibility of Using Wetlands to Treat Runoff Pollution. Technical Report 1321. Naval Ocean Systems Center.
- Gosselink, J.G., and E. Malthby. 1990. Wetland Losses and Gains. In: *Wetlands: A Threatened Landscape*, Oxford, U.K.: The Institute of British Geographers.
- Gregory, R., J. Flynn, S.M. Johnson, T.A. Satterfield, P. Slovic and R. Wagner. Decision Pathway Surveys. *Land Economics*, vol. 73(2) (May 1997), pp. 240-254.
- Hay, J., and P. Farb. 1966. *The Atlantic Shore: Human and Natural History from Long Island to Labrador*. Harper & Row.
- Held, R., et al. 1984. Rural land uses and planning: a comparative study of the Netherlands and the United States. Amsterdam: Elsevier.
- Houck, O.A., and M. Rolland. 1995. Federalism in wetlands regulation: a consideration of delegation of Clean Water Act section 404 and related programs to the states. *Maryland Law Review*, University of Maryland School of Law.
- Institute for European Environmental Policy. 1991. *Towards an European Ecological Network*. Arnhem, the Netherlands.
- Jaworski, E., and C.N. Rafael. 1978. Fish, wildlife, and recreational values of Michigan's coastal wetlands. Rockville, Md.: Department of the Interior, National Oceans and Atmospheric Administration, Office of Coastal Zone Management.
- Kent, Donald M. (ed). 1994. *Applied Wetlands Science and Technology*. Lewis Publishers.
- Kentula, Mary E., et al. 1992. Trends and Patterns in Section 404 Permitting Requiring Compensatory Mitigation in Oregon and Washington. *Environmental Management* 16:109-119.
- Kusler, Jon A. 1980. *Regulating sensitive lands*. Washington, D.C.: Environmental Law Institute.
- Kusler, Jon A. 1983. *Our national wetland heritage: a protection guidebook*. Washington, D.C.: Environmental Law Institute.
- Michigan Natural Features Inventory. 1995. Lansing: Michigan Department of Natural Resources.
- Michigan Natural Features Inventory. 1996. Lansing: Michigan Department of Natural Resources.
- Michigan's Natural Resources and Environmental Protection Act, 1994.
- Michigan Society of Planning Officials. 1995. *Trend Future Project-Final Report. Patterns on the land: Our Choices-Our Future*. Lansing: Planning & Zoning Center, Inc.
- Michigan Society of Planning Officials. 1995. *Natural Resources and the Environment Trends*. Lansing: Planning & Zoning Center, Inc.
- Michigan Statutes Annotated (1997) - Drain Code.
- Michigan Statutes Annotated (1997) - Part 303 - P.A. 451.
- Michigan Statutes Annotated (1997) - Zoning/planning enabling acts.
- Ministry of Landbouw, Natuurbeheer and Visserij. 1990. *Nature Policy Plan of the Netherlands*. The Hague.
- Mitsch, W.J., and J.G. Gosselink. 1986. *Wetlands*. New York: Van Nostrand Reinhold Co.
- Mitsch, W.J., and J. G. Gosselink. 1993. *Wetlands*. New York: Van Nostrand Reinhold Co.
- Mitsch, W.J. 1994. *Global Wetlands: Old World and New*. Amsterdam: Elsevier.
- Montague, C.L., et al. 1981. Aquatic Macroconsumers. In: *The Ecology of a Salt Marsh*, L.R. Pomeroy and R.G. Weigert (eds.), New York: Springer-Verlag.
- MUCC. 1993. *Saginaw Bay Land use and Zoning Study*. Lansing, Mich.: Michigan United Conservation Clubs.
- MUCC. 1997. *A Review of Michigan's Performance in Wetlands Regulation*. Lansing, Mich.: Michigan United Conservation Clubs.
- National Academy of Sciences, National Research Council. 1995. *Wetlands: Characteristics and Boundaries*. Washington, D.C.: National Academy Press.
- Norgaard, Kurt Jay. 1994. *Impacts of the Subdivision Control Act of 1967 on Land Fragmentation in Michigan's Townships*. Dissertation, Department of Agricultural Economics, Michigan State University.
- Olsen, Jody J. 1994. *Regulatory Takings: Applied to the Endangered Species Act and Section 404 of the Clean Water Act as Parallel Land Use Regulations*. Master's thesis, Department of Resource Development, Michigan State University.

- Rossoll, Martin. 1983. Urbanization and its Relationship to Prime Farmland in Two Michigan Counties. Master's thesis, Michigan State University.
- Roth, E.M., R.D. Olsen, P.L. Snow and R.R. Sumner. 1993. Oregon freshwater wetland assessment methodology. S.G. McCannell (ed.) Salem, Ore.: Oregon Division of State Lands.
- Ruby, Shannon. 1997. Public Attitudes and Preferences Regarding Wetland Preservation in Meridian and Williamstown Townships, Michigan. Master's thesis, Department of Resource Development, Michigan State University.
- Rusk, David. 1996. Acting as One: A Presentation to the Michigan Legislature. Notes, Legislative Workshop on Land use Issues.
- Sadewasser, S. 1996. Land and water management specialist of the MDNR, Land and Water Management Division. Personal communication.
- Salvesen, David. 1990. Wetlands: Mitigating and Regulating Development Impacts. Washington, D.C.: The Urban Land Institute.
- Schultink, Gerhardus, and Richard van Vliet. 1997. Wetland Identification and Protection: North American and European Policy Perspectives. Research Report 554. East Lansing, Mich.: Agricultural Experiment Station, Michigan State University.
- Scott, D.A., and T.A. Jones. 1995. Classification and inventory of wetlands: a global overview. In: C.M. Finlayson and A.G. van der Balk (eds.), Classification and Inventory of the World's Wetlands, Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Shabman, L.A., P. Scodari and D. King. 1994. National Wetland Mitigation Banking Study. Expanding Opportunities for Successful Mitigation. The Private Credit Market Alternative. Alexandria, Va.: U.S. Army Corps of Engineers, Water Resource Support Center, Institute for Water Resources.
- Shaw, S.P., and C.G. Fredine. 1956. Wetlands of the United States, their extent and their value to waterfowl and other wildlife. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.
- Silverberg, S.M., and M.S. Dennison. 1993. Wetlands and coastal zone regulation and compliance. New York: Wiley Law Publications.
- Smith, R.D., A. Ammann, C. Bartoldus and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP-DE-9. Vicksburg, Miss.: U.S. Army Engineer Waterways Experiment Station.
- Thibodeau, F.R., and B.D. Ostro. 1981. An economic analysis of wetland protection legal aspects, Massachusetts. Journal of Environmental Management. Vol.12 (1) (Jan.). pp. 19-30.
- Tiner, R.W., Jr. 1984. Wetlands of the United States: Current Status and Recent Trends. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.
- USACE. 1977. Memorandum of Understanding: Between the State of Michigan, Department of Natural Resources and the United States Army Corps of Engineers, Detroit District.
- USACE. 1987. U.S. Army Corps of Engineers Wetlands Delineation Manual: Final Report. Washington, D.C.
- USACE, St. Paul District, and Minnesota Environmental Quality Board Wetland Evaluation Methodology Task Force. 1988. The Minnesota wetland evaluation methodology for the north central United States. St. Paul, Minn.: Environmental Quality Board.
- Vesterby, Marlow, et al. 1994. Urbanization of Rural Land in the United States. Agricultural Economic Report 673. Washington, D.C.: USDA Economic Research Service.
- VerBurg, K. 1990. Managing the Modern Michigan Township (2nd edition). East Lansing, Mich.: Department of Resource Development, Michigan State University.
- Williams, M. 1990. Wetlands: A Threatened Landscape. Oxford, U.K.: The Institute of British Geographers.
- Wolfson, L.G., Y.T. Kang, T.E. Zahniser and J.F. Bartholic. 1995. A Wetlands Information Management System (WIMS) for Facilitating Wetlands Evaluations. East Lansing, Mich.: Institute of Water Research, Michigan State University.
- Wyckoff, Mark A. 1988. Site Plan Review: A Guidebook for Planning and Zoning Commissions. Lansing, Mich.: Planning and Zoning Center.
- Zahniser, Todd E., and Michael D. Kaplowitz, 1994. An Approach for Valuing Wetlands Using a Wetlands Information Management System (WIMS). East Lansing, Mich.: Michigan State University.





The Michigan State University Agricultural Experiment Station is an equal opportunity employer and complies with Title VI of the Civil Rights Act of 1964 and Title IX of the Education Amendments of 1972.