Wetland Protections in Tompkins County: Existing Status, Gaps, and Future Needs

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Wetland Protections in Tompkins County, New York: Existing Status, Gaps and Future Needs

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Executive Summary

Wetlands are widely recognized today as being important components of our landscape. Wetlands can reduce flooding and erosion, improve water quality, and provide wildlife habitat. These are just a few of the services wetlands provide. The loss of wetlands that once acted as both sediment traps and as sites of chemical transformations contributes to local water quality impairments. Increasing rates of land development within rural and semi-rural areas containing Tompkins County's remaining wetlands has the potential to lead to further adverse impacts to water quality. The importance that people in Tompkins County view these services can be seen in various conservation efforts. Over eighty designated Unique Natural Areas in Tompkins County are wetlands or wetland complexes. Three wetland-associated ecotypes are identified as Natural Features Focus Areas: the Fens, the Airport Ponds and Wetlands, and the Wetland/Upland Forest. The Cayuga Lake Watershed Intermunicipal Organization's Cayuga Lake Watershed Restoration and Protection Plan and the Tompkins County Comprehensive Plan also recommend preserving existing wetlands and restoring degraded wetlands.

Prior to 2001, most waters (including wetlands) in the United States were regulated by the U.S. Army Corps of Engineers through provisions in the Clean Water Act. Recent decisions by the U.S. Supreme Court have reduced the reach of the Clean Water Act over certain types of waters. In general, geographically isolated wetlands are no longer regulated by the Corps while low-flow streams, and their associated wetlands, may only be regulated when the Corps determines that they have a significant influence on navigable waterways. Neither New York State law or local regulations cover these types of waters to any appreciable extent. New York State wetland law is generally limited to large wetlands over 12.4 acres in size. Although many local land use regulations address potential wetland impacts, no local municipalities possess wetland-specific regulations. More often, local municipalities rely on federal or New York State agencies to protect wetlands. Changing federal regulations, combined with limitations in State and local law, have created regulatory gaps with classes of wetlands vulnerable to unregulated development.

A survey of wetlands in Tompkins County found that between 8 and 19% of the wetland acreage surveyed may no longer be regulated under the Clean Water Act because they are geographically isolated or lack a significant influence on a navigable water. In general, these wetlands are not listed on New York State wetland maps for regulation under State law. These findings indicate that a significant amount of wetland acreage in Tompkins County currently lack federal or State oversight.

Municipalities face a challenge in adopting consistent, comprehensive, watershed-based wetland policies that provide protections of wetland functions as well as wetland acreage. Tompkins County contains more than 15 separate governmental units responsible for local regulations protecting natural resources. These communities vary dramatically in their level of environmental regulation. Uniformity in wetland management programs is critical for the comprehensive protection of wetlands by providing consistency across municipal boundaries and for ensuring that the complexity of a wetland and watershed management program – or the lack of a program– does not shift economic development disproportionately to or away from a particular municipality. In the short-term, municipalities can adopt site-specific regulations and practices to fill the regulatory gaps and improve the consistency in the application of existing regulations. In the longer-term, developing landscape-based wetland conservation strategies, and incorporation of these strategies into municipal comprehensive plans, is needed.

Section 1: Wetland Overview

What Are Wetlands and Why are They Important?

Wetlands are diverse. They include ponds, bogs, fens, marshes, river and stream edges, wet meadows, forested swamps, and seep areas. Wetlands vary greatly in nature and appearance due to physical features such as geographic location, water source and permanence, and chemical properties. This section contains a brief overview of wetlands. A more extensive review is presented in Appendix D.

Wetlands are complex and they are often defined somewhat differently among ecologists, managers and government regulators. The U.S. Army Corps of Engineers, the agency most responsible for implementing federal wetland regulations, uses the presence of three environmental characteristics to identify wetlands:

1. Vegetation - a prevalence of water-loving plants adapted to growing in inundated or saturated soil.
2. Hydric soils - soils that developed under inundated or saturated conditions that limit oxygen.
3. Hydrology - inundation or saturation by water at some time during the growing season (the time when plants are actively growing).

The combination of water with distinctive soils and plants forms unique communities within the landscape. River channels or flood plains, topographic depressions, seeps (where groundwater flows onto the surface of slopes), and lake fringes are areas in Tompkins County where wetlands are commonly found.

Wetland functions are the things that wetlands do. Specifically, these functions are the physical, biological, chemical, and geologic interactions that occur within a wetland and between the wetland and its surrounding landscape. Wetlands can perform a number

Wetlands are not always wet

Temporary and seasonally flooded wetlands do not contain water year-round. Vernal pools are an example of these types of wetlands in Tompkins County. The productivity of these wetlands is maintained by the wet/dry cycle and many of the plants and animals (such as Spotted Salamanders) found in these wetlands are specifically adapted to the cycle. These wetlands also provide water storage and groundwater recharge.

Wetlands Functions

1. Improve water quality
2. Reduce flooding
3. Reduce soil erosion
4. Supply water
5. Provide habitat for wildlife and plants
6. Provide recreation for people

of critical environmental functions, many of which are defined by their value to people, such as stormwater storage and retention, groundwater discharge/recharge, and maintaining and protecting water quality. Wetlands also provide habitat for a wide diversity of important invertebrates, amphibians, birds, and mammals. More recently, the term "ecosystem services" has been introduced to stress the value of these functions to society.

Wetlands can remove many common water pollutants to improve water quality. They act as filters, slowing water down and allowing many pollutants, like sediments, to settle out. As the water moves slowly through the wetland, chemical transformations take place that alter or trap other pollutants (for example, nitrates in the water are converted into harmless nitrogen gas). As a result of these processes, the water that leaves a wetland is cleaner than the water that entered. Other water quality functions include removing phosphorous, metals, and toxic compounds.

Function versus Values.

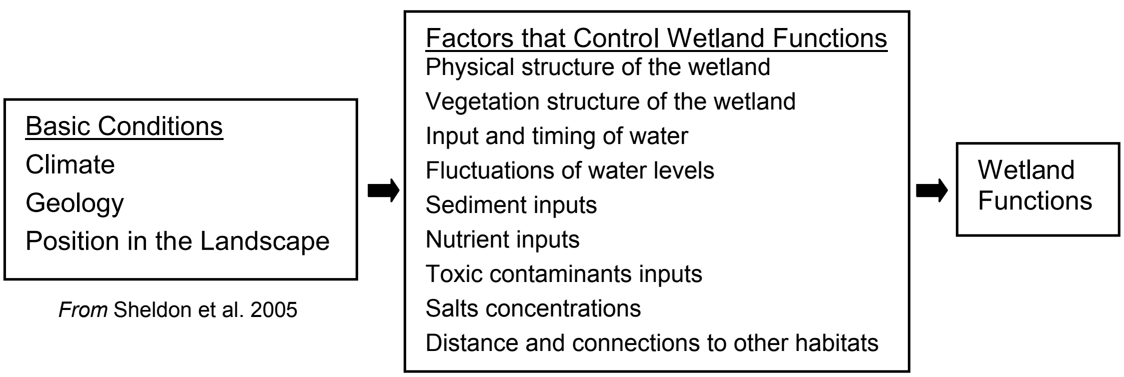
It is important to maintain a distinction between wetland *functions* and *values*. Value is usually associated with goods and services that a community recognizes as beneficial and not all environmental processes are recognized or valued. In addition, since value is a societal perception it can change over time or from person to person even as wetland functions remain constant. For example, a wetland's ability to hold water and reduce downstream flooding may have little value to a person living outside of the watershed but great value to a downstream landowner.

Wetlands help regulate the quantity of water flowing through a watershed. Many wetlands act as a sponge by storing water temporarily and allowing it to percolate into the ground, evaporate, or slowly release back into streams and rivers. This storage and slow release reduces flooding and erosion downstream after a storm. The slow percolation of water from wetlands can help recharge groundwater aquifers and the slow release of water to streams can help maintain stream flows through dry periods, helping to maintain water supplies for municipal and agricultural users as well as fish and wildlife.

Wetlands are very productive habitats. They produce more plant and animal life per acre than cropland, prairies, or forests. This productivity makes wetlands important habitat for many different kinds of wildlife. Wetlands provide migration, breeding, and feeding habitat for waterfowl, songbirds, and other wildlife. Amphibians, reptiles, and invertebrates may depend on wetlands for parts of their lifecycles. Wetlands also provide important winter shelter for deer and other wildlife.

Wetland functions depend on factors that operate across spatial and temporal scales. Climate, geology, and the hydrologic characteristics in a watershed control how water, sediment, and nutrients move through the landscape and these characteristics of the landscape then interact with factors within the wetland itself to control the functions performed. The conditions of functions can directly or indirectly dictate conditions of other functions. Wetlands may perform functions at different levels at different times of the year in response to seasonal variations in factors such as precipitation or plant growth. Finally, wetlands and the functions they perform can naturally change over the

Figure 1. Determinants of wetland functions



From Sheldon et al. 2005

course of years. Because the capacity of a particular wetland for performing specific functions is dependent on multiple interacting factors, not all wetlands provide every possible function or necessarily provide functions at the same level over time.

How People Impact Wetlands

Approximately 110 million acres of wetland have been lost in the contiguous U.S. since European settlement (Mitsch and Gosselink 2000). Most of this loss occurred through the physical removal of wetlands (for agriculture prior to the 1950's and for urban development more recently). In addition to physical removal, activities associated with urbanization, agriculture, and deforestation can cause disturbances that change the environmental factors that control wetland functions. For example, if nutrients from agricultural fields flow into a wetland that naturally would have low nutrients (a bog, for example), the excess nutrients can change the type of plants growing in the bog and result in a change to the bogs' habitat structure. In this example, human-caused excess nutrients would lead to a change in the wetlands' habitat function. Table 1 on page 7 summarizes these impacts.

Urban impacts cause a variety of changes that include filling wetlands, clearing vegetation, soil compaction, alteration of hydrodynamics, and introduction of chemicals and nutrients. The most direct impact to wetlands from urbanization is physical loss of wetland area, with one study finding that urban areas have lost 85% of their wetlands with the remaining 15% having impaired functions (Kusler and Niering 1998). Even if wetlands are not directly filled they can be filled by increased sediment runoff from surrounding development. Urbanization can change the volume and timing of water that reaches wetlands that in turn can lead to changes in wetland vegetation, downcutting of natural channels that may result in the removal of wetlands from floodplains, and changes in seasonal saturation or inundation. Nutrients like phosphorous and nitrogen are introduced into runoff from construction site sediments, lawn fertilizer, and septic systems. Finally, urbanization affects habitat as new developments encroach on natural areas, fragment habitat into patches, and isolate remaining habitat patches from each other.

Farming practices and forestry can impact the physical structure of wetlands through filling, tilling, and removing wetland vegetation. Lower water levels in a wetland result from direct ditching and draining. Tillage and grazing can disrupt soil and create a source of sediment for stormwater or wind transport into wetlands or other receiving waters. Fertilizers, herbicides, pesticides and fungicides applied to fields can enter wetlands and other waters in surface runoff, subsurface infiltration, or through adsorption to sediment particles. Agriculture also results in habitat fragmentation by removing patches of wetland in the landscape. As with agriculture and urbanization, forestry practices cause several types of disturbances that can affect wetland functions . These include increased peak flows, increased water level fluctuations, increased nutrients, increased sedimentation, and introduction of exotic species.

Wetland protection means maintaining the integrity of wetlands, wetland functions, and the landscape over time. This interplay of spatial and temporal scales means that wetlands are subject to degradation from the accumulation of impacts that occur through-

Table 1. Summary of impacts from human-caused disturbances to wetlands

Impacts from Physically Disturbing Wetlands

- Filling or draining a wetland can create an area that can no longer support wetland vegetation or maintain hydric soils, leading to loss of most or all functions.
- Removing vegetation reduces habitat functions for invertebrates, fish, amphibians, birds, and mammals.
- Grazing in wetlands has been documented to reduce habitat functions for invertebrates and birds.
- Both vegetation removal and grazing tend to favor invasive species that can tolerate disturbance.
- Soil compaction from construction activity affects absorption and infiltration of water.

Impacts from Changing Wetland Hydrology

- Lower water levels and decreasing the area of seasonal inundation in wetlands lead to decreased nitrogen removal.
- Both increasing and decreasing water levels impact habitat values for plants and wildlife. Water level increases may be beneficial to some species over the long run but water level decreases are generally detrimental to wetland species richness and abundance.
- Changes in water level fluctuations in wetlands have been associated with reductions in species richness and abundance of invertebrates and amphibians, with reductions in species richness for plants.

Impacts from Increasing Sediment

- Increased sedimentation in wetlands reduce the amount of water they can store, with a resulting decreased ability to reduce flood effects downstream, store water for recharge of downstream waterbodies or groundwater, and perform water quality functions.
- Increased sedimentation decreases plant richness and tends to favor invasive species.
- Invertebrates, amphibians, and fish all generally have reduced species richness and abundance in response to increased sedimentation.

Impacts from Increasing Nutrients

- Increased nutrients lead to changes in plant species composition and abundance both positively through stimulating plant growth and negatively through eutrophication.
- Nutrient-stimulated increases in plant densities may improve flood control functions by providing more resistance to flood flows.
- Excessive nutrients may reduce the ability of wetland microbes to detoxify particular pesticides and remove nitrogen.
- For wildlife, increased nutrients can both improve habitat through the production of plant food and reduce habitat through eutrophication.

Impacts from Habitat Fragmentation

- Increased isolation of wetlands from other wetlands is a major factor in reducing richness and abundance of wetland-associated species.
- Evidence points to the increasing isolation of wetlands due to wetland loss as a significant factor in declining amphibian populations.
- Bird species richness tends to decline with increased fragmentation of wetland complexes.

out the watershed (Council of Environmental Quality 1997, U.S. EPA 1999, Granger et al. 2005). The wide range of spatial and time scales over which wetland functions operate present an obvious challenge for local management. Measures that act at the scale of an individual wetland will be much easier to implement then measures that act across the scale of an entire watershed, and across multiple governmental jurisdictions.

Section Summary

Maintaining good water quality, reducing flooding from storms, recharging groundwater, maintaining stream flows, and providing habitat for plants and animals are but a few of the services that wetlands supply. Wetlands are impacted by land uses, chiefly urban development but also agriculture, forestry, and other activities. Wetland functions are determined in part by processes in the landscape around them and human land use impacts these processes to affect wetland functions. Land disturbances also impact wetlands directly through physical removal, introducing excess sediments, changing hydrology, and adding nutrients.

Section 2: Wetland Regulations

During the latter part of the 20th Century, a growing understanding of the beneficial functions provided by wetlands led the introduction of regulations to reduce the loss of wetlands to human land use (Mitsch and Gosselink 2000). At the federal level, wetlands are regulated primarily under the Clean Water Act. In New York State, the Freshwater Wetlands Act provides the Department of Environmental Conservation with the authority to regulate wetlands.

The nationwide rate of wetland loss has been reduced from 458,000 acres per year between the mid 1950's and mid 1970's to 58,500 acres between 1986 and 1997 (Dahl 2000, Frayer et al. 1983). The most recent report by the U.S. Fish and Wildlife Service documenting the status and trends for wetlands in the lower 48 states estimates an annual net gain of 32,000 acres of wetland between 1998 and 2004 (Dahl 2005). The reduction in the rate of wetland loss is largely credited to wetland regulations (Mitsch and Gosselink 2000, NRC 2001).

Recent rulings by the United States Supreme Court regarding the Clean Water Act have removed federal regulatory authority over some types of wetlands. These changes, along with pressure from increased urbanization, have increased the threat to wetlands from land development and other land disturbances. This section will discuss changes to federal wetland regulations and the regulatory gap created by these changes. The ability of existing New York State law and existing local land use regulations to fill the regulatory gap is also discussed.

Federal Regulation of Wetlands

The primary federal authority used for wetland (and stream) protection is the Clean Water Act. The Department of Agriculture also has wetland regulatory authority through provisions in the Food Security Act enacted in 1985. Provisions in the Food Security Act provides incentives for wetland conservation and restoration on agricultural lands. Recent evidence indicates that these programs are leading to an nationwide increase in wetland area in agricultural lands (Dahl 2005). Since these programs have not been subject to recent court-mandated changes, they will not be discussed in further detail. However, increases in farm commodity prices could lead farmers to optout of conservation programs.

When Congress passed the Clean Water Act (CWA) in 1972, its stated goal was to restore and maintain the chemical, physical, and biological integrity of our nation's waters and eliminate water pollution (33 U.S.C. § 1344). To accomplish these goals, the CWA sought to regulate "navigable waters" and defined navigable waters as "waters of the United States." Unlike the term navigable waters, which had been used to define federal regulation of waterways since the 1800s, the term "waters of the United States" was a new and apparently much broader term (Craig 2004). By the late-1970's the Corps and EPA were regulating virtually all surface waters in the U.S., even small streams and their surrounding wetlands, geographically isolated waters like prairie potholes, and constructed ditches, canals, and similar structures that replaced or acted like natural tributaries (ELI 2007).

The specific authority to regulate wetlands resides in Section 404 of the CWA and this authority is administered by the U.S. Army Corps of Engineers (Corps) and U.S Environmental Protection Agency (EPA). Impacts to wetlands are not banned outright under the Section 404 program. Rather, impacts are regulated under a permit system. Activities that result in discharges into wetlands requires a permit from the Corps (certain activities are exempt from regulation: for example, existing agriculture and some landscaping practices). This permit system does allow wetland impacts to occur but an applicant for a 404 permit must demonstrate that steps have been taken to: (1) avoid impacts to regulated waters, (2) minimize any potential impacts and/or, (3) perform mitigation to compensate for any unavoidable impacts. "Mitigation" in this context is the creation of new wetlands in areas they would not otherwise exist, the restoration of previously filled or drained wetlands, or the enhancement of degraded wetlands (sometimes, the protection of existing wetland is counted as mitigation). Since the early 1990's, the federal government has had a "no net loss" goal for wetlands and wetland functions.

Recent court rulings have changed the definition of the wetlands and streams that are considered jurisdictional under the CWA. In 2001, a U. S. Supreme Court ruling, Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers (531 U.S. 159, 2001), commonly referred to as SWANCC, determined that isolated, non-navigable and intrastate waters were no longer protected under CWA Section 404 based solely on their use by migratory birds. SWANCC involved an appeal of the Corp's denial of a Section 404 permit to fill an abandoned sand and gravel pit in Illinois that had become a wetland used by migratory birds. The U.S. Supreme Court ruled that the Corps could not deny a Section 404 permit to alter isolated wetlands and other waters based on use by migratory waterfowl alone. This ruling potentially reduced the acreage of wetlands subject to Section 404 permits because prior to SWANCC the Corps often justified having jurisdiction over isolated wetlands based largely or solely on migratory bird use (Tiner et al. 2002). The Supreme Court itself did not clearly define "isolated" waters and left open the possibility for the Corps could use other justifications to extend CWA jurisdiction over these wetlands (such as use by irrigation or other uses that influence interstate commerce). However, the Corps published guidance in 2003 that largely excluded from federal jurisdiction geographically isolated wetlands, and defined these wetlands as wetlands that do not have a surface water connection to streams or channels that flowed ultimately to navigable waterways (U.S. EPA and USACE 2003). A study by the U.S. Government Accountability Office (GAO 2005) found that the Corps rarely attempted to extend jurisdiction over isolated wetlands under its remaining authority.

In June 2006, another U.S. Supreme Court ruling resulted in additional confusion and potential vulnerability for wetlands, and streams, nationwide. In the consolidated cases of Rapanos v. United States and Carabell v. United States Army Corps of Engineers (126 S. Ct. 2208, 2006), referred to as Rapanos, the Court vacated judgments against two Michigan property owners who were denied permits to fill (in fact, had already filled without permits) wetlands on their respective properties. The wetlands in question drained to navigable waters or their tributaries through ditches that generally flowed intermittently (i.e. seasonally) or ephemerally (i.e. only after a storm or snow melt). The Justices issued five separate decisions, with a majority agreeing only that the Corps did not perform a rigorous enough test to determine whether the wetlands in question were subject to CWA jurisdiction. Justice Scalia concluded that "the waters of the U.S." included only relatively permanent bodies of water connected to traditional interstate navigable waters, and for wetlands to be jurisdictional they must have a continuously flowing surface connection with these waters. However, Justice Kennedy, in what has been referred to as the controlling opinion, concluded that waters are subject to regulation under the CWA if they have a "significant nexus" to navigable waters. Kennedy further stated that this nexus must be assessed in terms of the goals of the CWA which are "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters".

In June 2007, EPA and the Corps released guidance in identifying waters subject to

CWA jurisdiction based on the issues raised in Rapanos (U.S. EPA and USACE 2007). The guidance states that CWA jurisdiction extends over "relatively permanent" tributaries of navigable waters and wetlands with a continuous surface connection with such tributaries. "Relatively permanent" means the tributary flows continuously at least seasonally (i.e. 90 days). The agencies will generally not assert jurisdiction over ditches in or draining upland areas, and swales or erosional features.

Kennedy's significant nexus test applies for non-navigable tributaries that are not relatively permanent and their adjacent wetlands. Determination of a significant nexus will be based on an evaluation of whether a stream's water flow characteristics and functions, in combination with the functions of associated wetlands, is likely to have an effect that is "more than speculative or insubstantial on the chemical, physical, and biological integrity of a traditional navigable water." Factors to consider when determining the existence of a significant nexus are: volume, frequency, and duration of water flow; proximity to a navigable water; size of the watershed; climate; and the ability of the stream and associated wetlands to impact ecological factors of navigable waters, such as removing pollutants or supporting biota.

Some Important Terminology

Geographically isolated wetland – wetlands that are completely surrounded by upland. While geographically isolated wetlands may have no apparent surface water connection to rivers and streams, lakes, estuaries or the ocean, these wetlands are rarely hydrologically isolated in a scientific sense because most wetlands also have important groundwater connections.

Relatively Permanent Water– Corps term for rivers and streams that have no flow during dry months but flow continuously at least seasonally (i.e. 3 months)

Intermittent stream – streams that flow in response to seasonal rainfall or snow melt patterns. For example, these streams may be wet primarily in the spring when groundwater tables rise in response to snowmelt. Many of these may be identified as Relatively Permanent Waters by the Corps.

Ephemeral stream – streams that only flow periodically, generally in response to storm events. These are sometimes referred to as dry washes or swales in arid regions. Groundwater is generally not a water source for ephemeral streams.

Stream order– A numerical system that classifies stream segments according to size and relative position in a drainage basin network: 1st-order streams are small, unbranched segments; 2nd-order streams are formed by the junction of two 1st-order streams; etc.

The Environmental Law Institute (ELI 2007) recently developed a set of checklists for determining whether a particular stream or wetland is covered under the CWA. These checklists reflect the recent EPA/Corps guidance and an adapted list is presented in Table 2 on page 13. Figures 1 through 3 on pages 14-16 contain examples of wet-

Table 2. Checklist for Clean Water Act coverage (Adapted from ELI 2007)

*A **"yes"** response to any question indicates Clean Water Act coverage.*	
Question	**Legal Rule or Test**
1. Does the wetland or stream cross state lines?	Interstate Waters
2. Is the wetland or stream a navigable water?	Traditional Navigable Waters
3. Is the wetland adjacent to traditional navigable waters ("adjacent" means bordering, contiguous, or neighboring. Wetlands separated from navigable waters by man-made dikes or barriers, or natural features such as river berms and beach dunes are adjacent.) **OR** Is the stream a continuously flowing or a relatively permanent body of water that flows into traditional interstate navigable waters (flow through the tributary is year-round or continuous at least seasonally)?	Adjacency Rule
4. Is the wetland adjacent to, and does it have a continuous surface connection with a relatively permanent, standing or continuously flowing body of water that is connected to traditional interstate navigable waters?	Adjacency + Continuous Surface Connection Test
5. Could the degradation or destruction of the wetland or stream affect interstate or foreign commerce? Includes any wetland or stream: (A) that is or could be used by interstate or foreign travelers for recreational or other purposes; or (B) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (C) that is or could be used for industrial purpose by industries in interstate commerce?	Affecting Interstate or Foreign Commerce Test
6. Does the wetland or stream, either alone or in combination with similarly situated waters in the region, significantly affect the (A) chemical integrity, or (B) physical integrity, or (C) biological integrity, of any traditional navigable waters?	Significant Nexus Test

lands, streams, and other water bodies to demonstrate the existing jurisdiction under the Clean Water Act.

Both the SWANCC and Rapanos rulings left in place federal jurisdiction over navigable waters, their continuously flowing or relatively permanent tributaries, and any wetlands adjacent to them. These types of waters are clearly recognizable in most cases. Unfortunately, there remains a great deal of uncertainty in just how to determine a significant nexus for low-flow streams and their associated wetlands. For example, although volume of water flow must be considered, just how much volume constitutes a nexus is

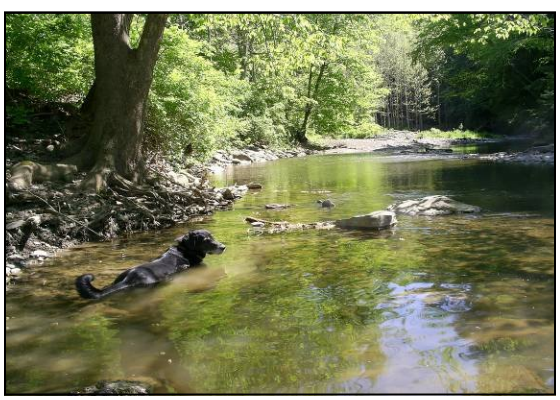
Figure 2. Waters jurisdictional under the CWA

Navigable waterway– Cayuga Lake (*photo courtesy National Scenic Byways Program*)

Navigable waterway, Erie Canal (*photo courtesy of the U.S. Army Corps of Engineers*)

Wetland adjacent to navigable waterway- Kanawha River, WV. (*photo courtesy of the Army Corps of Engineers*)

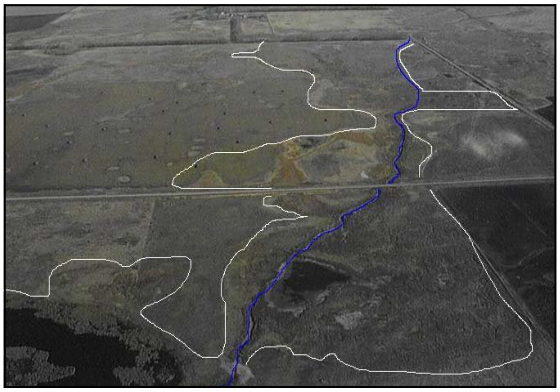
Wetland adjacent to but separated from navigable waterway by man-made berm. (*photo courtesy of the Army Corps of Engineers*)



Permanent flowing tributary to navigable waterway– Sixmile Creek.

Intermittent tributary that leads indirectly, via Sixmile Creek, to a navigable waterway. Tributary has a continuous seasonal flow, defined by the Corps as 90 consecutive days of flow.

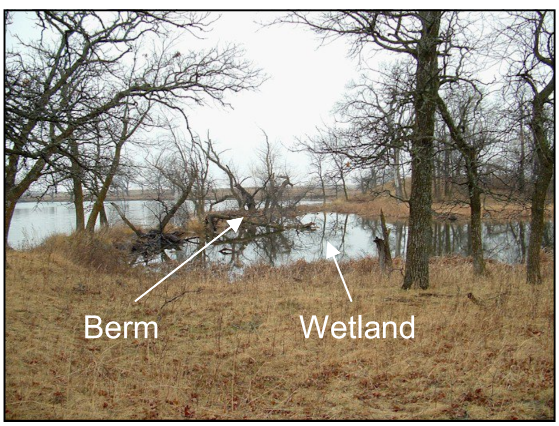
Figure 2 (continued). Waters jurisdictional under the CWA



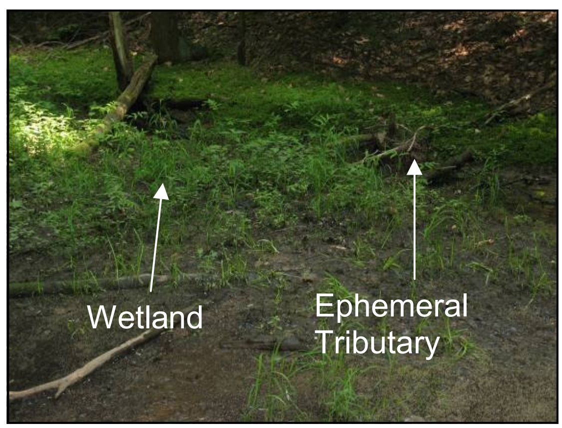
Wetland adjacent to, and has a surface connection with, a permanently flowing tributary to a navigable waterway. Blue line represents the channel; white lines mark approximate location of boundaries between wetlands and uplands (*photo courtesy of the Army Corps of Engineers*).

Wetland is adjacent to, and has a surface connection with, a relatively permanent tributary to a navigable waterway. Tributary has continuous seasonal flow (*photo courtesy of the Army Corps of Engineers*).

Figure 3. Waters requiring a significant nexus determination. Corps staff will need to perform a significant nexus evaluation to determine if the stream or wetland (in combination with similarly situated wetlands) contributes significantly to the physical, biological, or chemical integrity of a navigable water.



Wetland adjacent to, but **without** a surface connection with, a permanently or seasonally flowing tributary to a navigable water (*photo courtesy of the Army Corps of Engineers*).



Wetland adjacent to any tributary to a navigable water, where that tributary does not have permanent flow or flow that continuous at least seasonally. For example, streams that only flow during and shortly after a storm.

Figure 3 (continued). Waters requiring a significant nexus determination.

Ephemeral tributaries. Water typically flows during and after storm events (*photo courtesy of the Army Corps of Engineers*).

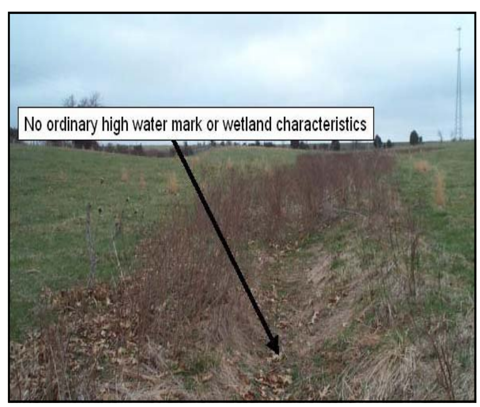
Ephemeral tributary to Sixmile Creek. Water typically flows only during and after storm and snow melt events.

Figure 4. Waters assumed to have no significant nexus to "waters of the U.S." These waters are generally exempt from regulation under the CWA .

Isolated wetland, Town of Lansing. Geographically isolated waters are generally not jurisdictional unless a sufficient link to interstate commerce exists.

Isolated wetland, Hammond Hill State Forest.

Ditches (including roadside ditches) excavated entirely in and draining only uplands and that do not carry at least a seasonally continuous flow of water. Ditches that do carry at least a seasonally continuous flow of water directly or indirectly to a navigable water or between two or more jurisdictional waters, including wetlands, are generally regulated under the CWA.



Swales. These features have no defined channel or wetland characteristics (*photo courtesy of the Army Corps of Engineers*).

not clearly stated in the current guidance. Functions of both streams and wetlands are to be considered, but how to measure those functions or what level of function constitutes a nexus is also not clear. It is uncertain whether the significant nexus test allows for the consideration of impacts to a stream in combination with similarly situated streams in the region- as may be done with wetlands. For ditched waterways, those excavated entirely in and draining only upland will generally not be regulated by the Corps. However, the guidance states that these features may contribute a surface water connection to a water of the U.S. but what this means for Corps regulation (or non-regulation) of these features is not stated. It is currently unknown how Corps staff will apply the Rapanos guidance in regard to these questions. The larger the volumes of water and the higher the level of functions required to establish a significant nexus, the

Summary of Vulnerable Wetlands

1. Geographically isolated wetlands- those wetlands completely surrounded by uplands and without any surface water connection to streams or other water bodies.
2. Ephemeral and intermittent streams and wetlands drained by these streams that the Corps and EPA determine lack a significant nexus to "waters of the U.S."

higher the number of low-flow, 1st-order streams and associated wetlands that will lose federal oversight. In the absence of state or local protections that fill this regulatory gap, these wetlands and streams are vulnerable.

The impact of the Rapanos ruling is not limited to wetlands but extends to first-order streams, ditches and other low-flow watercourses. The determination of exactly what streams and wetlands are considered "waters of the U.S." is critical because it affects many programs that are administered by the Corps and EPA and operate under the same definition of "waters of the U.S." This includes Section 402 National Pollutant Discharge Elimination System permits, Section 401 water quality certification, Section 301 water quality standards, and others (Nadeau and Rains, 2007).

Regulation of Wetlands by New York State

Wetlands in New York State are subject to State regulation but this regulation has significant limitations. The New York State Legislature passed the Freshwater Wetlands Act in 1975 with the intent to "preserve, protect and conserve freshwater wetlands and their benefits” (ECL § 24). However, a wetland must be 12.4 acres or larger to be subject to regulation. Smaller wetlands may be protected if they are considered of unusual local importance. In addition, the DEC is required to map all wetlands protected by the Act, with the intent that affected landowners and other interested parties will know where state-regulated wetlands exist. Although wetlands smaller than 12.4 acres can be regulated, in Tomkins County only seven wetlands smaller than 12.4 acres are mapped (Tompkins County Natural Resource Inventory, January 2008). These wetlands total 71 acres out of over 5000 acres of State-regulated wetlands in the County.

Certain activities, such as normal agriculture and recreation, are exempt from regulation. To conduct any regulated activity in a protected wetland or an adjacent 100 foot buffer, a permit is required. The permit standards require that impacts to wetlands be avoided and minimized. Impacts to wetlands often, but not always, require mitigation such as creating a wetland or restoring a degraded wetland. In addition, the DEC ranks wetlands in one of four classes ranging from Class 1, which represents the greatest wetland benefits, to Class IV. The permit requirements are more stringent for a Class I wetland than for a Class IV wetland.

In New York State, the U.S. Army Corps and the DEC coordinate wetland permitting through a joint permit application process. An applicant submits duplicates of a Joint Application For Permit form to the Corps and to the DEC (in other areas of the state, such as the Adirondacks, the Joint Application must be submitted to additional state agencies with wetland regulatory authority). However, the DEC can only fill the regulatory gap created by the changes in federal rules if those wetlands meet the standards for state jurisdiction set forth in the Freshwater Wetlands Act, i.e over 12.4 acres in size or considered of unusual local importance. Wetlands over 12.4 acres generally have a significant nexus to navigable waters. Wetlands that lack a significant nexus as defined by the Corp tend to be relatively small and, therefore, must individually demonstrate unusual local importance to earn DEC oversight. In practice, this is a time-consuming, wetland-by-wetland process and does not offer an efficient way to fill the regulatory gap. Recent attempts in the Legislature to reduce the acreage threshold of the Freshwater Wetlands Act have been unsuccessful.

Local Wetland Protections and Regulation

A review of wetland regulation in the land use codes of municipalities in Tompkins County is included in Appendix B. There currently exist no specific laws or mechanisms that allow local governments to fill the regulatory gap created by the recent changes in federal regulations, although identification of potential impacts is often required and a few recently enacted stormwater laws provide incentives for wetland protection.

Identification of potential wetland impacts is an important component of the State Environmental Quality Review (SEQR) Act process. The SEQR process itself does not regulate impacts to wetlands but allows for a process whereby municipalities can ensure that agencies with regulatory authority for wetlands are notified of possible impacts. However, the SEQR process does not protect wetlands that are not regulated by existing federal, state, or local law.

Zoning and subdivision regulation of several municipalities contain requirements for identifying wetlands on site plans and subdivision plats. Stormwater Laws in the Towns of Caroline, Dryden and Ithaca and the City of Ithaca contain provisions to reduce wetland and wetland buffer impacts and, in some cases, incentives to promote wetland conservation. For example, the Town of Dryden's Stormwater Law allows developers to choose wetland conservation measures from a menu of actions required to limit the impacts of stormwater runoff from certain development activities. Municipalities also designate some wetlands as Unique Natural Areas (UNA) as a tool to identify important wetland areas for landowners and land managers. Although no municipalities explicitly restrict land use or impose conditions on development in UNA-designated areas, the designation is often considered during the land use review process.

Effectiveness of Wetland Regulation

As noted at the beginning of this section, the rate of wetland loss is dramatically lower today than it was just 30 years ago. However, impacts to wetlands have not been eliminated. Regulatory programs allow wetland impacts but, in theory, require that the wetland area and functions lost must be mitigated either by creating new wetlands or restoring degraded wetlands so that total wetland area either remains the same or even increases. However, mitigation is difficult and often unsuccessful, resulting in an overall loss of both wetland area and wetland function. A National Research Council study in 2001 estimated that 85 percent of wetland creation and restorations nationwide are unsuccessful (NRC 2001) and more recent studies have found that success rates have not improved significantly (Kettlewell et al. 2008, Brody et al. 2008). The NRC determined that the federal goal of “no net loss” of wetlands and functions could not be confirmed. Poor administration or outright failure of mitigation projects was a major problem, but the NRC also found that case-by-case permitting as conducted under the structure of current regulatory programs reduced the opportunity to consider the landscape factors that control wetland functions, or consequences of the cumulative and synergistic impacts of wetland loss across the landscape. Various studies have documented the failure of case-by-case permitting to account for landscape scale processes that create and maintain wetland functions, allowing cumulative impacts due to processes that operate across jurisdictional boundaries and through time (Bedford and Preston 1988, Bedford 1999, Brody et al. 2008, Council of Environmental Quality 1997, Dale et al. 2000, Kettlewell et al. 2008, U.S. EPA 1999, Wissmar and Bechta 1998).

Major findings from “*Compensating for Wetland Losses Under the Clean Water Act*” by the National Research Council (NRC 2001)

- The goal of ‘no net loss’ of wetlands and functions could not be confirmed due to poor data management and inadequate consideration of wetland functions.
- Mitigation projects often out of permit compliance: unclear performance standards, inadequate or failure to perform compensation actions and lack of long-term management were major factors.
- EPA and Corps of Engineers had inadequate staff and support for staff.
- Permit decision-making would be improved by using a watershed approach rather that the existing case-by-case-approach.
- Findings supported in reviews of New York State wetland mitigation projects (Taylor 2004, Chin 2006).

The most recent report by the U.S. Fish and Wildlife Service documenting the status and trends for wetlands in the lower 48 states estimates an annual net gain of 32,000 acres of wetland between 1998 and 2004 (Dahl 2005). Dahl identified a difference in the types of landscapes where wetland gains and losses occurred. In aggregate, wetlands were lost in urbanizing areas while wetland acreage was gained in agricultural lands and non-developed lands (conservation lands and unmanaged forests, prairie, and scrub lands). The impact of this transfer of wetlands and their functions across landscapes is unknown.

Finally, several studies have found that inconsistent regulations, or implementation of regulations, between jurisdictions can lead to the loss of wetlands and their functions (Brown and Veneman 2001, Cole and Shafer 2002, National Research Council 2001, New Jersey Department of Environmental Protection 2002, Sheldon et al. 2005). Inconsistencies across jurisdictions promotes an inability to consider landscape factors and increases the likelihood for cumulative impacts.

Section Summary

Prior to 2001, most waters (including wetlands) in the United States were regulated by the U.S. Army Corps of Engineers through provisions in the Clean Water Act. Federal regulation did not necessarily prohibit impacts to regulated waters, but incentives to avoid and requirements to mitigate impacts have dramatically reduced overall wetland losses in recent years. Recent decisions by the U.S. Supreme Court have reduced the reach of the CWA over certain types of waters. In general, geographically isolated wetlands and some types of ditches are no longer regulated by the Corps. Low-flow streams, and their associated wetlands, may only be regulated by the Corps when a “significant nexus” exists to a navigable water. Neither New York State law or local regulations cover these types of waters to any appreciable extent.

Section 3: Extent of Vulnerable Wetlands in Tompkins County

Geographically isolated wetlands are often small and individual headwater or first-order (low-flow) streams are by definition small. However, studies indicate that these wetlands and streams may be a significant proportion of water resources in many watersheds. Estimates made by EPA, the Natural Resources Defense Council and National Wildlife Federation indicate that approximately 20% to 30% of the wetland acreage in the contiguous U.S., approximately 20 million acres, could be considered geographically isolated (Meyer et al. 2003, Kusler 2004). A study by Comer et al. (2005) estimated that 29% of the wetland and riparian systems described in a national database of natural heritage data met their definition of “isolated”. EPA estimates that the percentage of stream miles in the contiguous U.S that can be considered headwater, intermittent and/or ephemeral ranges from 53% to 59% (Nadeau and Rains 2007). These national estimates may significantly underestimate the extent of these small, headwater streams and wetland systems because they are often are not included in mapping databases due to the limitations of scale (Nadeau and Rains 2007).

It is difficult to determine how many miles of stream and acres of wetlands are at risk nationally because there are currently no formal scientific definitions for terms such as “isolated” and “significant nexus” that can be used to make definitive measurements. Federal guidance exists that attempts to assist regulators in making jurisdictional determinations but in practice these determinations are legal determinations and not strictly based on science.

Vulnerable Wetlands in Tompkins County

The study by Comer et al. (2005) estimated that 44% of the New York State wetland and riparian systems described in a natural heritage database met their definition of isolated. There is little additional data on the prevalence, in either New York State or Tompkins County, of wetlands now vulnerable due to the U.S. Supreme Court’s SWANCC and Rapanos rulings. Local wetland inventories are mostly dependent on the National Wetland Inventory (NWI) and DEC wetland maps. These databases very rarely include adequate information on surface water connectivity to make determinations of a significant nexus or geographic isolation.

In an effort to estimate the extent of vulnerable wetlands in the County, a field survey was conducted during the summer of 2007 (more complete details about the survey are included in Appendix A). During this study, surveyors walked several transects running north to south through the Towns of Lansing and Dryden. As wetlands were encountered along the transect line, the surveyors attempted to answer three main questions:

(1) are the wetlands completely enclosed by uplands and therefore geographically isolated?
(2) does a “significant nexus’ exist to a water of the U.S. as defined by the Army Corps of Engineers?
(3) are the wetlands included in NWI and/or DEC databases?

This last question was important to provide some information about the accuracy and inclusiveness of the existing wetland databases. Results are shown in Table 3.

Table 3. Tompkins County Wetland Survey results			
Total number of wetlands on transects = 42 Total wetland area in transects = 89.6 acres			
	Percent of Individual of Wetlands	Percent of Transect Wetland Area	Average Wetland Size (acres)
Geographically Isolated	39	6	0.4
Fail Significant Nexus Test	19	2	0.3
Significant Nexus Test Indeterminate	15	11	1.9
Not in NWI Database	68	20	0.5
Not in DEC Wetland Database	77	39	0.9

Results of the survey indicate that up to 19% of the wetland acreage included in the survey may fall outside of CWA regulation: 6% were geographically isolated, 2% were judged to definitely fail the significant nexus test, and 11% might or might not fail the significant nexus test (the significant nexus test guidance was released in June 2007 and how to apply this guidance in the field was not entirely clear at the time of the survey). Assuming 20,000 acres of wetlands in the County (as listed in the NWI database) these results, if applicable across the entire County, would translate to approximately 1,600 acres of wetland lacking federal regulation under the Clean Water Act because they are geographically isolated or fail the significant nexus test. An additional 2,200 acres may or may not fail a significant nexus test. With the exception of one 0.5 acre wetland, none of the wetlands that lacked or may lack federal regulation were listed on the New York State wetland maps for coverage under the Freshwater Wetland Act.

The average size of the isolated wetlands and wetlands that failed the significant nexus test was small, averaging less than 0.4 acres in size. These small wetlands, particularly when located within forest canopies, can be difficult to detect with the photo-interpretation techniques used develop the NWI database. In fact, twenty percent of the total wetland area encountered during the survey was not present in the NWI database. Managers should be aware of this underreporting of wetlands when reviewing land use permitting documents that rely solely on the NWI database to demonstrate that wetlands are not present on-site. Additionally, the majority of all individual wetlands encountered during the survey were non-NWI listed wetlands (68% of all individual wetlands). These small wetlands may constitute an important mosaic ecosystem within the landscape that is not currently well documented.

Revisiting Wetland Functions: Why Vulnerable Wetlands and Streams are Important

Section 1 provided an overview of the functions that wetlands provide. Since these vulnerable wetlands, in general, are small and may lack or have an intermittent surface water connection to other water bodies, do they perform similar functions as other wetlands? Although these systems have not been as well-studied as larger systems, a summary of the ecological, hydrologic, water quality and biological benefits of these streams and wetlands is provided below. Many of the studies focused on ephemeral and intermittent streams but these first-order systems are often composed of closely associated wetlands. These studies show that organic matter processing, plant and animal habitat, and maintenance of groundwater through infiltration are just a few of the functions provided by these small, vulnerable systems.

Water Quality Functions

Isolated wetlands can act as nutrient sinks, and several studies have found that wetlands associated with the smallest streams provide the most nutrient removal, possibly due to the high land/water interspersion in these systems that provides a great opportunity for nutrient removal (Meyer et al. 2003). A study by the North Carolina Division of Water Quality (2006) found that wetlands associated with headwater streams significantly reduce the levels of sediment and other pollutants that flow into first-order streams due to topography and natural obstructions, such as rocks and downed logs, retain sediment. Peterson et al. (2001) found that despite their small dimensions, headwater streams play a disproportionately large role in nitrogen transformations on the landscape and typically retain and transform more than 50% of their nitrogen inputs.

Water Quantity Functions

Isolated wetlands do not have an obvious surface water connection but they store and slowly release water into groundwater, aquifers and surface waters. The surface water storage capacity of isolated wetlands can be enormous. For example, South Carolina's geographically isolated wetlands are estimated to store 4.58 billion gallons of water (SELC 2004). Isolated wetlands have a high perimeter to volume ratio, which gives them a large capacity to recharge groundwater, and are important for receiving waters that are connected to the wetlands through groundwater (Weller 1981).

First-order streams play a critical role in the hydrology of downstream receiving waters by moderating downstream flooding during periods of high flow, and by maintaining flow during dry weather. These functions are possibly due to the significant storage and recharge capacity of these systems. Headwater systems recharge groundwater because of the large surface area of the channel bed in contact with available water, allowing infiltration and reducing the volume that travels downstream (Meyer et al. 2003). During dry periods, the opposite occurs, with groundwater replenishing flow in the stream.

Habitat Functions

Isolated wetlands are used by a wide variety of species during different portions of their life cycle, and their unique characteristics make them critical for certain species (NRDC 2002). Many amphibian populations have evolved in areas with abundant small, isolated wetlands that are used as "stepping stones" to aid in dispersal and recolonization of suitable habitats (Tiner et al. 2002). One South Carolina study estimated that 20 species of amphibians would become extinct if all of the state's isolated wetlands were lost (SELC 2004). A single isolated wetland can support more than 100 species of aquatic insects, and species richness in small isolated wetlands has been shown to be comparable or possibly higher than estimates for much larger wetlands (SELC 2004, Semlitsch 2000). Isolated wetlands provide refuge from predators and sources of drinking water (Leibowitz 2003, Moler 2003).

Headwater wetlands and associated streams are unique and diverse habitats that support species abundance and diversity. These areas are important as spawning and nursery habitats, seasonal feeding areas, refuge from predators and competitors, thermal refuge, and travel corridors (Meyer et al. 2007). Other species, such as birds, do not actually live in headwater areas but depend on them for food, water, habitat, or movement corridors. Some of these species are headwater specialists, restricted to headwaters.

Perhaps the most important function of headwater aquatic systems is to process organic matter before it is transported downstream. These systems are largely based on detritus: leaves, woody debris, and detritus enter and microorganisms transform this organic matter into a form other organisms can use for food (Mitch and Gosselink 2000). This process is the basis of the food web in freshwater ecosystems. Headwater systems are significantly more efficient at retaining and transforming organic matter than larger streams because debris dams and lower or infrequent flows prevent the downstream movement of larger materials. The storage and transformation of organic matter in headwaters prevents downstream water quality degradation due to excess organic matter and affects the survival and condition of organisms that depend on this food source.

Section Summary

A limited survey of wetlands conducted within the Towns of Dryden and Lansing found that between 8 and 19% of the wetland acreage surveyed may no longer be regulated under the Clean Water Act because they are geographically isolated or lack a significant nexus to a navigable water. In addition, 16% of the wetland acreage (66% of the individual wetlands) was not listed on the National Wetland Inventory database, a primary tool used to identify the presence of wetlands. Although these wetlands are small, the scientific literature indicates that similar wetlands provide significant wetland function within a landscape.

Section 4: Improving Wetland Protections in Tompkins County

As indicated in the proceeding discussion on wetland regulations, wetlands are subject to various federal, state and local laws. However, statutory language, court rulings, or regulatory program deficiencies have resulted in regulatory gaps through which certain wetlands may fall, with the result that those wetlands and their functions lack protections from land use impacts. These vulnerable wetlands are generally small. However, the scientific literature indicates that these wetlands provide significant water quality, water quantity and habitat functions.

This study of existing wetland regulations identified three major factors that lead to wetland vulnerability and the continued loss of wetlands and their functions identified by the National Research Council and other investigators:

Factor 1: Regulatory Gap. Many wetlands are vulnerable due to regulatory gaps that exist in current federal and state regulations. New York State laws generally excludes regulation of wetlands smaller than 12.4 acres in size. Recent U.S. Supreme Court cases have removed from federal jurisdiction geographically isolated wetlands and other wetlands deemed not to have a "significant nexus" to navigable waterways. Local governments do not have their own wetland regulations to any significant extent, resulting in many wetlands that are vulnerable to loss to development due to these regulatory "gaps". Local governments can reduce these regulatory gaps by implementing local wetland regulatory programs.

Factor 2: Inconsistent Implementation of Wetland Regulations. Existing wetland laws are often unevenly implemented. Most municipalities, and this includes all municipalities in Tompkins County, rely heavily on federal and New York State wetland programs to protect wetlands or to mitigate for wetland losses that result from land development. Studies have found that a significant amount of development of wetlands under federal jurisdiction has occurred without the necessary permits (NRC 2001, Sheldon et al 2005). Most failures of federal program implementation are beyond the scope of local governments. However, as managers with primary responsibility for local land use decisions, local officials can assist in the implementation of federal and state programs through improved education about wetland regulations and requirements and improved communication between local officials and regulatory staff, especially with regards to monitoring permit compliance.

Factor 3: Need for Landscape-scale Management. Site-specific, case-by-case permitting as conducted under current regulatory programs reduce the opportunity to consider the broader landscape, the environmental factors that control wetland functions, or consequences of the cumulative impacts of wetland loss across the landscape. Wetland policy should be based not solely on the wetland and its immediate buffer but additionally on landscape-scale management linked to specific ecosystem functions. Protection and management at a larger geographic scale would improve permit decision-making.

Factor 1 and Factor 2 are perhaps the easiest issues to deal with at the local level. Most local governments that choose to regulate wetlands usually do so through local land use laws, the arena where they have the greatest control and flexibility. Municipalities in Tompkins County vary in size, technical and financial resources, and planning and land use review processes. A variety of wetland protection options designed to meet issues identified in Factors 1 and 2 are provided below. Managers can then determine the most appropriate strategies for their community, depending on the wetland protection needs and the capacity to implement the options.

Local municipalities face obvious challenges to developing and implementing landscape- and watershed-based approaches to wetland management. Foremost of these challenges is inconsistent priorities among multiple municipalities and agencies within a single watershed. Large costs are associated with implementing a landscape-scale program (costs of landscape analysis, wetland inventories, and assessments). Officials and the public may lack awareness of the ecological consequences of existing regulatory programs. Finally, there are few examples of successful intermunicipal collaboration to emulate. Although implementing a landscape-based framework in Tompkins County may be difficult, the existence of comprehensive plans and watershed strategies at the County level as well as on the part of several individual municipalities provide a base for the development of landscape-scale wetland conservation.

Many frameworks for landscape-based wetland management have been developed (Kusler 2004b, Cappiella et al. 2005, Cappiella et al. 2006, Granger et al. 2005).

Landscape approaches are a strategy that will require patience and commitment on the part of the various municipalities in the County to develop. Municipalities should adopt both site-specific tools to address the federal and state regulatory gaps and shortcomings in the near-term while working to develop a landscape approach for long-term wetland protection.

Options for Factor 1: Regulatory Gap

These options focus on protecting wetlands made vulnerable by the regulatory gaps in federal and state programs.

Option: Wetland Protection Ordinance
In New York State, local governments have the primary responsibility in making land use decisions. Special protection ordinances provide a local government with the authority to directly regulate activities in and around wetlands. To protect all vulnerable wetlands, the definition of wetland in the ordinance should include all wetland types regardless of size or isolation. An alternative is to only regulate at the local level those wetlands that are outside of federal or state jurisdiction. Wetland ordinances require significant administration on the part of the local government and it is important that the municipality have the necessary enforcement authority, resources, and training to ensure effective implementation of the regulation.

Many municipalities in New York State have adopted wetlands protection laws. Some examples are: Town of Wappinger (viewed online at http://www.e-codes.generalcode.com/codebook_frameset.asp?t=tc&p=0691%2D137%2Ehtm&cn=338&n=[1][115]), Town of Langrange (viewed online at http://www.e-codes.generalcode.com/codebook_frameset.asp?t=tcfull), Town of Brookhaven (viewed online at http://www.e-codes.generalcode.com/codebook_frameset.asp?t=ws&cb=0012_A), and Town of Clifton Park (viewed online at http://www.e-codes.generalcode.com/codebook_frameset.asp?t=ws&cb=1051_A). The wetland committee of the Tompkins County Water Resources County is currently developing a Model Wetland Ordinance based on wetland laws from New York State municipalities and other guidance.

Option: Encourage Better Site Design in Existing Zoning and Site Plan Regulations

One way to mitigate the impacts of storm water runoff on downstream waters and wetlands is to control the way that development sites are designed. Better Site Design refers to a collection of site design techniques that reduce storm water runoff by minimizing impervious cover, conserving wetlands and other natural areas, and providing more distributed storm water management. Better Site Design has also been promoted as being economically advantageous because these developments can be cheaper to build, bring higher premiums, and sell faster than conventional developments, depending on the site design and local costs and market conditions (CWP 1998). Three Better Site Design strategies that are particularly applicable to wetland protection are designs that (1) minimize the number of wetland crossings, (2) encourage or require the use of open space design to protect wetlands, and (3) encourage designs that utilize the natural drainage system.

Option: Promote Wetland Conservation Practices in Stormwater Laws

Municipal Separate Storm Sewer System (MS4) municipalities in Tompkins County can utilize their stormwater regulations to help protect wetlands. In addition to requirements to identify wetlands and other watercourses, New York State stormwater regulations allow applicants to receive credits for preserving wetlands and wetland buffers located on site through the use of Better Site Design practices. The stormwater laws for the Town of Dryden and the Town of Ithaca specifically promote the use of these wetland conservation practices. Municipalities can modify existing stormwater laws to strengthen wetland conservation incentives.

Option: Include Wetland Protections in Existing Land Use Regulations

Municipalities can choose to include specific wetland protection measures similar to those in stand-alone wetlands ordinances to allow wetland regulation at the local level that fill gaps in federal and state regulations. Elements of Better Site Design can also be promoted through site plan review regulations.

Options for Factor 2: Uneven Implementation of Laws

These options focus on increasing compliance with federal and state regulatory programs.

Option: Require Field Surveys for Wetlands When Land Use Decisions Involve Flood Plains, Stream Corridors, and Hydric Soils

Land use permit applications and SEQRA documentation often relies on NWI wetland maps to determine the absence of wetlands on site. A wetland survey (Appendix A) found that 16% of all wetland area surveyed was not identified in the NWI database. Reference to outdated or inaccurate NWI wetland maps means managers may not realize that wetlands subject to federal, state, or local regulation are present. Wetlands are often associated with other natural features such as floodplains, stream corridors, and hydric soil. Municipalities that require field surveys for wetlands when floodplains, stream corridors, and hydric soils are present can improve the likelihood that wetlands are subjected to federal, state, and local wetland programs

Option: Improve Accuracy of Local Wetland Maps and Databases

In addition to the under-reporting of wetlands in the NWI database detailed above, another inaccuracy is the over-reporting of wetlands through the listing of those wetlands that no longer exist due to land development. The combination of these inaccuracies will impact the efficacy of landscape-scale planning processes. A countywide effort, perhaps coordinated by the Water Resources Council, is needed to improve the accuracy of this database both for its use as tool used by developers and municipal officials for site scale land use decisions and as a tool used in comprehensive planning.

Option: Quantify the Extent and Value of Vulnerable Wetlands

Local governments can quantify the extent and value of wetlands that fall into federal and state regulatory gaps and are therefore vulnerable to development. Quantifying the acres of wetlands that can potentially be lost because of inadequate protection can be a very powerful tool to leverage support for expanded local protection. The wetland field survey detailed in Appendix A was limited in scope but indicated that a significant proportion of wetland area within Tompkins County are vulnerable due to gaps in federal and state wetland regulations. Increasing the extent of the survey across the County will provide a better picture of the extent of these wetlands.

In addition to mapping the extent of vulnerable wetlands, assessments that quantify the functional benefits provided by these wetlands should also be undertaken to give scientific weight for their protection. The development or adoption of a wetland assessment tool for use in consistently measuring functions would assist in this process.

Option: Link Permit Approval to State and Federal Permits

One basic approach to local government wetland protection is to tie local permit approvals for proposed development to the acquisition of the necessary state and federal wetland permits. This regulatory networking approach facilitates communication between local governments and federal and state regulatory agencies and provides wetland-related information to the local government.

Permit applicants should be informed in the early stages of site planning that project approval is conditional on the project receiving the proper federal and state permits. Applicants should be encouraged to conduct wetland delineations as early in the process as possible since avoiding impacts to wetlands and wetland buffers is an important way to avoid the added costs of obtaining and complying with the conditions of federal and state permits.

Option: Develop/Adopt Wetland Functional Assessment Tool and Include Assessments in Existing Land Use Regulations

Studies suggest that the use of wetland functional assessments can enhance planning and the enforcement and monitoring of existing regulations. Wetland assessment tools can be required in existing land use regulations to provide information on wetland type, wetland functions and connections to other water bodies. Functional assessments can also be incorporated into mitigation performance standards to ensure that wetland functions as well as wetland area are replaced or restored. This information can then be used by local land use managers to help ensure that federal, state and any existing local wetland laws are applied consistently.

Option: Monitor Development In and Near Wetlands

Local governments have a vital role in monitoring activities near or in wetlands within their municipal boundaries and should have access to all related project plans and permit requirements to facilitate monitoring. Monitoring project development periodically will increase compliance and provide additional influence over local wetland management.

Option: County-level Wetland Resource

Create a County-level position, paid for and shared by all municipalities, to aid landowners in identifying wetlands on their properties, assist landowners and municipal officials with regulatory questions, monitor mitigation activities in the county, and perform other activities that will ensure an even application of wetland regulation across the

County.

Factor 3: Need for Landscape-scale Management

One way of conceptualizing a landscape approach to wetland management is that wetlands and their respective functions are determined at three landscape scales and protecting ecological integrity of functions must occur at the appropriate scales: (1) the wetland; (2) the adjacent environment; and (3) the greater watershed.

At the site scale, dredging, filling, channelization and other actions directly alter a wetlands morphology, soils, hydrology and vegetation to affect water quality, water quantity, and habitat functions. Wetlands have buffer areas immediately adjacent that protect and add to (or harm if disturbed) wetland functions. Undisturbed, these areas provide pollutant and nutrient removal functions and provide refuge for plant and animal species from natural and human-caused disturbances. Finally, landscape-scale processes control factors that influence wetland functions, such as the movement of water, sediments and nutrients into and out of wetlands.

The challenge is to manage the impact of land use change on relevant scales. For hydrology, the relevant landscape scale may include the basin, sub-basin or larger watershed. For groundwater interactions, the appropriate area of influence may include recharge areas beyond the watershed or other drainage systems. The appropriate management scale for wildlife may encompass the habitat used by a species, together with the other organisms with which it coexists, and the landscape units that affect them.

This challenge of managing water resources at multiple scales has been the focus of many recent publications and a variety of frameworks have been proposed (Cappiella et al. 2005, Cappiella et al. 2006, Granger et al. 2005, Kusler 2004b). A framework that synthesizes the various approaches and provides opportunities for using information from different scales might include five steps:

1. Define goals and objectives of a watershed plan. This includes assessing needs in the watershed, prioritizing functions, and identifying stakeholders.
2. Analyzing the landscape. This includes reviewing existing data, conducting resource inventories, and analyzing functions at multiple scales.
3. Identify solutions. These would include regulatory and non-regulatory mechanisms.

4. Implement solutions.
5. Monitor the results and adaptively manage solutions.

A framework more specific to wetland conservation on the scale of the watershed has been developed by the Center for Watershed Protection (CWP) for the U.S. EPA (Cappiella et al. 2005, Cappiella et al. 2006) and is outlined in Appendix D. Since watersheds are complex, it should not be surprising to find that planning on the scale of a watershed is also complex. In brief, the CWP process involves first developing goals, priorities, planning opportunities, and assessments for the watershed as a whole. Then, specific planning for each component of the watershed would follow; for example wetlands, streams, groundwater would each be a separate component. However, planning for each of the components would help meet the needs and priorities of the entire watershed.

The primary watershed scale planning in Tompkins County is the Cayuga Lake Watershed Intermunicipal Organizations' Cayuga Lake Watershed Restoration and Protection Plan, or RPP (CLWIO 2001). The RPP calls for a watershed-based approach that considers Cayuga Lake and its contributing basins as an interconnected system and to establish watershed priorities. The related Cayuga Lake Watershed Preliminary Watershed Characterization has identified priority areas (CLWIO 1999). Excess sediment and excess nutrients such as phosphorous and nitrogen are identified priority areas where wetland functions are important. The Fall Creek and Gulf Creek watersheds in Tompkins County were specifically identified in the RPP for wetland restoration and protection efforts. Additional wetland conservation strategies identified in the RPP includes: requirements for the review of disturbances within 100 ft of all natural wetlands in municipalities that have land use control ordinances; inventory all wetlands in watershed to establish priorities; restore degraded wetlands; and incorporate wetlands as an important component of regional stormwater management.

Comprehensive planning by governments in Tompkins County will be necessary to implement or improve these recommendations. The Tompkins County Comprehensive Plan (TCPD 2004) recognizes that water resources "...should be considered and managed as a system…" An analysis of the landscape to identify wetland-associated Natural Features Focus Areas is an important step. Specific tools listed in Appendix D such as incorporating wetland management into land use decisions or developing assessment-based performance standards need to be adopted.

Section Summary

Three major factors contribute to the vulnerability of wetlands in Tompkins County to losses due to land disturbance activities: (1) the regulatory gap resulting from changes in federal regulations, (2) inconsistent application of existing regulations, and (3) general absence of management on a landscape-scale. In the short-term, municipalities can adopt regulations and practices fill the regulatory gaps and improve the consistency in the application of existing regulations. In the longer-term, developing wetland specifics for the watershed-based approach envisioned by the RPP, and incorporation of this approach into municipal comprehensive plans, is needed.

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Appendix A: Gap Analysis Field Survey

Recent U.S. Supreme Court cases have removed particular waters and wetlands from jurisdiction under the Clean Water Act, in particular geographically isolated wetlands and ephemeral/intermittent wetlands and streams (ELI 2007). The impact of the loss of federal jurisdiction to the annual losses of wetland acreage and/or wetland functions have not been studied by the U.S. EPA or U.S. Corps of Engineers, and the need for this accounting is critical for an effective management of federal wetland programs (U.S. Government Accountability Office 2005). Estimates from the impacts of these jurisdictional changes to New York State wetlands or Tompkins County wetlands specifically were not found in the literature to date.

Studies have estimated the extent of wetlands and streams potentially at risk. Nationwide, approximately 20% to 30% of the wetland acreage in the contiguous U.S., approximately 20 million acres could be considered geographically isolated (Meyer et al. 2003, Kusler 2004). An estimated 44% of the New York State wetland and riparian systems described in a natural heritage database met a definition of isolated (Comer 2005). Beyond that, there is little data on the prevalence of geographically isolated and other wetlands vulnerable due to the U.S. Supreme Court's SWANCC and Rapanos rulings. Local wetland inventories are mostly dependent on the National Wetland Inventory (NWI) and DEC wetland maps. These databases very rarely include adequate information on surface water connectivity to make a determination of isolation and/or a significant nexus as defined by the Corps and EPA guidance.

In an effort to estimate the extent of vulnerable wetlands in the County, a field survey was conducted between June 6, 2007 and August 27, 2007. During this survey, researchers walked several transects running north to south through the Towns of Lansing and Dryden. The jurisdictional status of wetlands were judged based on geographic isolation and significant nexus to a navigable waterway.

Inaccuracy of the NWI wetland database has long been recognized. For municipalities, this is a particular problem since an initial identification of potential wetlands that may be impacted during land development, as required under SEQRA, often relies on a search of the NWI database. Therefore, the survey also sought to determine the accuracy of the existing NWI database along the transects. The survey did not attempt to determine the accuracy of database information about the wetland boundaries or acreage.

Methods

Transect generation: A 100 meter Universal Transverse Meridian (UTM) grid was generated over 7.5 minute scale USGS quadrangles (TOPO! Software, National Geographic, 2001). For the Town of Lansing, 140 lines running north to south resulted and 150 lines resulted for the Town of Dryden. Two lines for each Town were selected as transects via random number generation (www.randomizer.org).

Land access: Tax parcel numbers were used to identify property owners along the transects. Property owners were notified about the survey by post card and asked to give permission by phone or email for access to their property. For nonrespondents to the post card, telephone contact was attempted up to four times.

Wetland survey and evaluation: Start and endpoints of each transect were located using GPS (Garmin Geko 301). Location of individual wetlands were located using GPS when a signal was available, otherwise wetlands were located by estimations using map and compass. Transect width was 100 feet. Wetland area within the transect and total wetland area were estimated using best judgment. The surveys were conducted by: Nick Schipanski (consultant; M.S. University of Washington, certified Wetland Manager), Darby Kiley (Environmental Planner for the Town of Lansing, M.S. in Natural Resources, Cornell University), Debbie Gross (consultant; M.S. in Natural Resources, Cornell University), and Lynne Vacarro (consultant; M.S. in Natural Resources, Cornell University)

Wetlands were identified using U.S. Army Corps of Engineers delineation criteria (USACE 1987). Clean Water Act jurisdictional status and significant nexus determination was performed using EPA and Corps guidance (U.S. EPA and USACE 2007, U.S. EPA and USACE 2003). The "significant nexus test" guidance was released by the Corps and EPA in June of 2007 and its application in the field was not entirely clear at the time of the survey. As a result, the significant nexus status of some wetlands could not be definitively determined and these were categorized as "indeterminate". A wetlands' presence in the National Wetlands Inventory (NWI) was evaluated using the Fish and Wildlife Services online database (NWI 2007). Determination of a wetlands presence on New York State Department of Environmental Conservation Freshwater

Wetland database was determined using the Tompkins County Natural Resource Inventory (Tompkins County 2007). Microsoft Excel 2003 was used to calculate standard errors across transects (except for “fail significant nexus test” results where n=2).

Results

Of a combined transect length of 33.4 miles, landowner access was granted for 17.4 miles (data not shown). Any bias in landowner approvals due the presence or absence of wetlands was not determined. A total of 42 wetlands were identified and the total acreage under the transects was 89.6 acres (Figures A-1 and A-2; Table A-2). Results are summarized in Table A-1.

Table A-1. Wetland Field Survey Results Summary

Total number of wetlands on transects = 42 Total wetland area in transects = 89.6 acres			
	Percent of Individual of Wetlands	Percent of Transect Wetland Area	Average Wetland Size (acres)
Geographically Isolated	27 ± 9	6 ± 3	0.4
Fail Significant Nexus Test	19	2	0.3
Significant Nexus Test Indeterminate	15 ± 2	11 ± 5	1.9
Not in NWI Database	68 ± 7	21 ± 6	0.5
Not in DEC Wetland Database	77 ± 5	39 ± 13	0.9

Discussion

Results of the survey show that up to 19% of the wetland acreage included in the survey may fall outside of federal wetland regulations (6% were geographically isolated, 2% were judged to definitely fail the significant nexus test, and 11% might or might not fail the significant nexus test). Assuming 20,000 acres of wetlands in the County (as listed in the NWI database) these results, if applicable across the entire County, would translate to approximately 1,600 acres of wetland lacking federal regulation under the Clean Water Act because they are geographically isolated or fail the significant nexus test. An additional 2,200 acres may or may not fail a significant nexus test. With one exception (Wetland L6), none of the wetlands that lacked or may lack federal regulation were listed on the New York State wetland maps for coverage under the Freshwater Wetland Act.

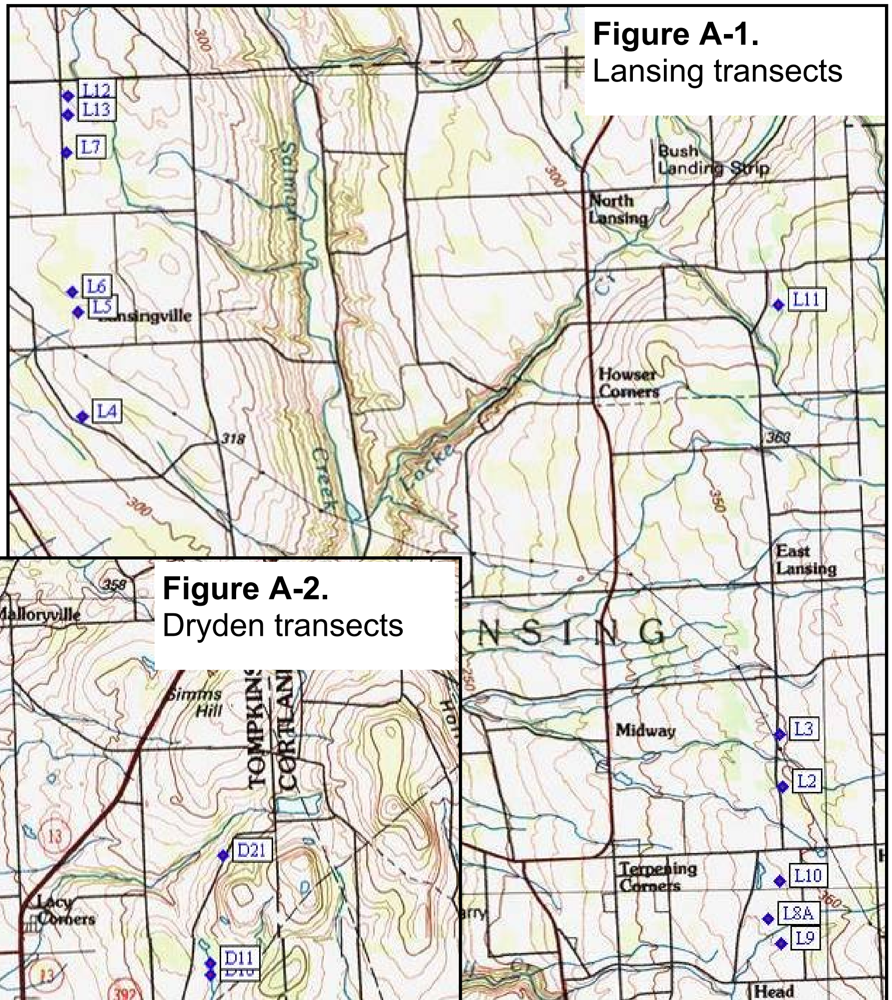

Figure A-1.
Lansing transects

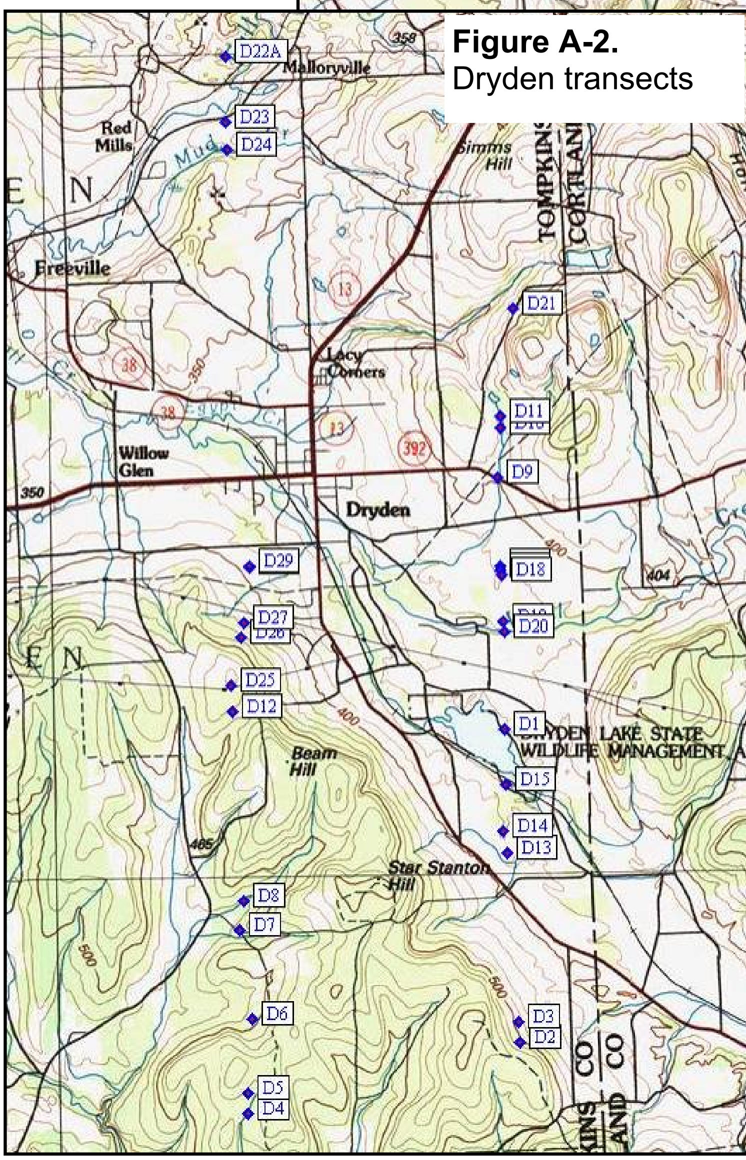

Figure A-2.
Dryden transects

Table A-2. Wetland Survey Results

Wetland I.D.	NWI?	DEC?	DEC I.D.	Observed Cowardin Class	Total Wetland Area (ac)	Transect Area (ac)	Is wetland CWA Jurisdic-tional?	Reason for nonjuris-dictional determina-tion
D 1	no	yes	DR-8	PEM	79.2	0.75	yes	
D 2	no	no		PEM, PSS	3	3	yes	
D 3	no	no		PEM	0.1	0.1	indeterminate	nexus indeterminate
D 4	no	no		PEM	0.2	0.2	yes	
D 5	no	no		PEM	0.4	0.4	no	isolated
D 6	no	no		PFO	0.4	0.4	indeterminate	
D 7	no	no		PFO	0.1	0.1	no	isolated
D 8	no	no		REM	0.5	0.1	yes	
D 9	yes	no		PEM, PSS	0.5	0.5	yes	
D 10	yes	yes		PUB	1.2	1.2	indeterminate	nexus indeterminate
D 11	yes	yes		PUB	0.3	0.3	indeterminate	nexus indeterminate
D 12	no	no		PFO	0.05	0.05	no	isolated
D 13	yes	no		PSS	1	1	yes	
D 14	yes	no		PEM	2	2	no	isolated
D 15	yes	yes	DR-8	PEM, POW		3	yes	
D 16	no	no		PEM	0.25	0.25	no	isolated
D 17	no	no		PEM	0.1	0.1	no	isolated
D 18	no	no		PEM	0.2	0.2	no	no significant nexus
D 19	no	no		PEM, PFO	0.2	0.2	no	no significant nexus
D 20	yes	no		PEM, PFO, PSS	4	4	yes	
D 22	yes	yes	GR-12	PEM, PFO, PSS, POW	23	5	yes	
D 23	no	no		PEM	0.1	0.1	no	isolated
D 24	yes	yes	GR-14	PFO	240	20	yes	
D 25	no	no		PEM	0.1	0.1	no	isolated
D 26	no	no		PEM	0.1	0.1	no	isolated
D 27	no	No		PEM	0.2	0.2	indeterminate	nexus indeterminate
D 28	no	no		PEM	0.05	0.05	no	isolated
D 29	no	no		PEM	0.5	0.5	no	isolated

Table A-2 (continued). Wetland Survey Results

Wetland I.D.		NWI?	DEC?	DEC I.D.	Observed Cowardin Class	Total Wetland Area (ac)	Transect Area (ac)	Is wetland CWA Jurisdic-tional?	Reason for nonjuris-dictional determina-tion
L	1	no	no		PEM, PSS, PFO	3	3	yes	
L	2	no	no		PEM, PFO	3	2	yes	
L	3	yes	no		PEM, PSS	2.4	2.4	yes	
L	4	yes	no		PEM, PFO	5.3	5.3	indeterminate	nexus indeterminate
L	5	yes	yes	LD-2	PFO	185	18	yes	
L	6	no	yes	LD-2	PEM	0.5	0.5	no	isolated
L	7	no	no		PFO	0.5	0.5	no	isolated
L	8	yes	yes	WG-14	PEM,PSS,PFO	44	10	yes	
L	9	no	no		POW, PEM	1	1	no	no significant nexus
L	10	no	no		PEM	0.3	0.3	no	isolated
L	11	no	no		PSS	0.2	0.2	no	no significant nexus
L	12	no	no		RFO/PFO	3	0.5	yes	
L	13	no	no		PFO	3	2	yes	
				Total Area (acres) =		**608.95**	**89.6**		

The average size of the isolated wetlands and wetlands that failed the significant nexus test was small, averaging less than 0.4 acres in size. These small wetlands, particularly when located within forest canopies, can be difficult to detect with the photo-interpretation techniques used develop the NWI database. In fact, twenty-one percent of the total wetland area encountered during the survey was not present in the NWI database. Managers and planners should be aware of this under-reporting of wetlands when reviewing land use permitting documents that rely solely on the NWI database to demonstrate that wetlands are not present on-site. Additionally, the majority of all individual wetlands encountered during the survey were non-NWI listed wetlands (68% of all individual wetlands). These wetlands may constitute an important mosaic ecosystem within the landscape that is not currently well documented.

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Appendix B: Existing Local Wetland Regulations in Tomkins County

The analysis reviewed Zoning and any Site Plan Review laws, Subdivision regulations, and other land use laws and provisions in the code that might affect wetland regulation. The analysis used the Tompkins County Planning Departments' archive of municipal laws for municipality in Tompkins County. In addition, on-line code databases were used to review the codes of the City of Ithaca (PC/CodeBook, updated 11-10-2007) and Town of Ithaca (E-code Library, updated 11-15-2007).

Results of the local regulatory analysis are found in Table B-1. Although there is some effort to identify potential impacts to wetlands and some incentives to reduce wetland impacts, there exist no specific laws or mechanisms to allow local governments to fill the regulatory gap created by the recent changes in federal regulations.

Zoning and subdivision regulation of several municipalities contain requirements for identifying wetlands on site plans and subdivision plats. Draft Stormwater Laws in the Towns of Caroline, Dryden and Ithaca contain non-binding language to reduce wetland and wetland buffer impacts and, in some cases, incentives to promote wetland conservation. Municipalities also designate some wetlands as Unique Natural Areas (UNA), although UNA designation does not explicitly restrict land use.

Table B-1. Municipal Wetland Regulation Analysis Results

Municipality	Local Code Where Provision is Found (with citation)				
	Zoning	**Site Plan Review**	**Subdivision Regulation**	**Stormwater Law**	**Other**
City of Ithaca	§ 325-29.8- Avoid wetlands in siting wireless towers.			§ 282-6.C: Incentives for avoiding wetland impacts include reduced regulatory requirements. § 282-10.B(12): Requires wetland delineations when wetland presence indicated. § 282-10.B(13): Full SWPPPs require use of at least 2 Better Site Design practices if site requires a full SWPPP- these practices do include protecting wetlands § 282-42: Prohibits untreated stormwater discharge to a wetland. § 282-48.A: awards credits for maintenance of wetland buffers.	§ 176-4: Require EIS for unlisted actions occurring within 100' of Freshwater wetlands, as defined in Article 24 of the ECL.
Town of Caroline					
Town of Danby					

Table B-1. Municipal Wetland Regulation Analysis Results

Municipality	Local Code Where Provision is Found (with citation)				
	Zoning	Site Plan Review	Subdivision Regulation	Stormwater Law	Other
Town of Dryden				Schedule C: avoid and minimize disturbance of wetlands to maximum extent practicable. To the extent possible, buffer must be maintained between land development and wetland. Schedule C: Full SWPPPs require use of at least 2 Better Site Design practices if site requires a full SWPPP- these practices do include protecting wetlands Schedule C: awards credits for maintenance of wetland buffers.	Local Law #2-1982: Requires adherence to State Conservation Laws' Article 24.

Table B-1 (continued). Municipal Wetland Regulation Analysis Results

Municipality	Local Code Where Provision is Found (with citation)				
	Zoning	**Site Plan Review**	**Subdivision Regulation**	**Stormwater Law**	**Other**
Town of Enfield					
Town of Groton					
Town of Ithaca	§ 270-22: Within Conservation Zones, no construction shall be located within 100' of wetlands over 1/10 acre unless otherwise authorized by the Planning Board	§ 270-189: No site plan shall be approved for disturbance of land in wetlands, unless the applicant demonstrates activity may occur without adverse impacts. § 270-188: Site Plan review must consider effects on wetlands		§228-9: avoid and minimize disturbance of wetlands to maximum extent practicable. To the extent possible, buffer must be maintained between land development and wetland. § 228-10: Full SWPPPs require use of at least 2 Better Site Design practices if site requires a full SWPPP- these practices do include protecting wetlands	§ 161-1: Under Article 24 of the ECL Town of Ithaca shall fully undertake and exercise its regulatory authority over State-regulated wetlands and areas within 100' of these wetlands.
Town of Lansing					
Town of Newfield					
Town of Ulysses					6.5: in fairgrounds district, buildings or other structures shall not be located within 100' of wetlands

Table B-1 (continued). Municipal Wetland Regulation Analysis Results

Municipality	Local Code Where Provision is Found (with citation)				
	Zoning	Site Plan Review	Subdivision Regulation	Stormwater Law	Other
Village of Cayuga Heights					Local Law #1-1993: Regulations for Planned Unit Development state "Existing features on the site shall be preserved to the maximum extent feasible and incorporated into the site design."
Village of Dryden					
Village of Groton					
Village of Freeville					
Village of Lansing	§ 145-48: All uses in lands designated as Unique Natural Areas a Special Permit and an environmental review. § 145-61: Special permit applications in UNA must include plan to limit impacts to wetlands.		Appendix D.7: Recommends preserving natural watercourses in drainage design		
Village of Trumansburg					

Appendix C: Outline for a Watershed Planning Process

A framework more specific to wetland conservation on the scale of the watershed has been developed by the Center for Watershed Protection for the U.S. EPA (Cappiella et al. 2005, Cappiella et al. 2006). To illustrate the complexity of the process, provided here are several tables that summarize the authors' conceptual framework. The first step involves implementing a Watershed Planning Process:

Table C-1. Watershed Planning Process (from Cappiela et al. 2006)

Watershed Planning Step	Description
Step 1: Develop Watershed Planning Goals	The goals, objectives, and indicators that will guide the watershed plan are developed based on existing watershed data, local capacity to implement the plan, and stakeholder concerns.
Step 2: Classify and Screen Priority Subwatersheds	Communities with limited resources must target a subset of priority subwatersheds--typically those most vulnerable to development or with the greatest restoration potential--on which to focus watershed planning efforts.
Step 3: Identify Watershed Planning Opportunities	Existing programs and regulations are evaluated in the context of watershed planning, and field assessments are conducted to identify potential protection and restoration opportunities.
Step 4: Conduct Detailed Assessments	Detailed field investigations of candidate projects are conducted to acquire more detailed information to develop initial project designs
Step 5: Assemble Recommendations into Plan	Recommended projects and changes to existing local programs and regulations are prioritized and transformed into a draft watershed plan.
Step 6: Determine If Watershed Plan Meets Goals	The proposed combination of watershed plan recommendations is evaluated to determine if they are capable of meeting watershed goals.
Step 7: Implement the Plan	The final plan is implemented, and much of the effort is devoted to the final design, engineering and permitting for individual projects and to programmatic and regulatory changes.
Step 8: Measure Improvements Over Time	Progress of implementation and success of individual projects is measured and tracked over time and results are used to periodically update the plan.

Next, wetland-specific needs must be addressed in the watershed plan:

Table C-2. Principles of Watershed Planning for Wetlands
(from Cappiela et al. 2006)

Watershed Planning Principles to Protect Wetlands	**Specific Methods**
1. Compile Wetland Information on a Watershed Basis	1.1 Review existing plans 1.2 Compile additional data
2. Assess Local Wetland Protection Capacity	2.1 Conduct Needs and Capabilities Assessment 2.2 Conduct 8 Tools Audit
3. Identify Wetland Partners and Roles	3.1 Involve wetland partners in stakeholder process 3.2 Consult with wetland partners for technical support 3.3 Form partnerships for implementation
4. Define Wetland Goals and Objectives for the Watershed	4.1 Define wetland goals 4.2 Define specific wetland objectives
5. Create an Inventory of Wetlands in the Watershed	5.1 Update existing wetland maps 5.2 Estimate historic wetlands coverage 5.3 Delineate wetland contributing drainage areas 5.4 Estimate wetland functions 5.5 Estimate wetland condition 5.6 Estimate effects of future land use changes on wetlands
6. Screen Wetlands for Further Assessment	6.1 Screen for priority subwatersheds using wetland metrics 6.2 Screen wetland inventory for conservation sites 6.3 Screen wetland inventory for sensitive wetlands 6.4 Screen wetland inventory for restoration sites
7. Evaluate Wetlands in the Field	7.1 Conduct rapid assessment of wetland impacts 7.2 Conduct detailed wetland assessments
8. Adapt Watershed Tools to Protect Wetlands	8.1 Review 8 Tools Audit 8.2 Make specific recommendations for each tool

Table C-2 (continued). Principles of Watershed Planning for Wetlands	
Watershed Planning Principles to Protect Wetlands	**Specific Methods**
9. Prioritize Wetland Recommendations	9.1 Compile list of wetland recommendations 9.2 Rank recommendations to identify priorities
10. Coordinate Implementation of Wetland Recommendations	10.1 Implement changes to local programs and regulations 10.2 Coordinate with wetland regulatory agencies 10.3 Implement projects with wetland partners
11. Monitor Progress Toward Wetland Goals	11.1 Update the wetland inventory 11.2 Track implementation of wetland projects 11.3 Conduct wetland monitoring

Finally, an assortment of Watershed Tools is provided, each of which has multiple components for managing impacts in and near wetlands and within the contributing basin of wetlands (CDAs):

Table C-3. Eight Tools of Watershed Protection for Wetlands (from Cappiella et al. 2005)	
Watershed Protection Tool	**How to Apply the Tool to Protect Wetlands and Their CDAs**
1. Land Use Planning	• Incorporate wetland management into local watershed plans • Adopt a local wetland protection ordinance • Adopt floodplain, stream buffer, or hydric soil ordinance to indirectly protect wetlands
2. Land Conservation	• Identify priority wetlands to be conserved • Select techniques for conserving wetlands • Prioritize other conservation areas in wetland CDAs
3. Aquatic Buffers	• Require vegetated buffers around all wetlands • Expand wetland buffers to connect wetlands with critical habitats • Increase stream buffer widths to protect downstream wetlands

Table C-3 (continued) . Eight Tools of Watershed Protection for Wetlands	
Watershed Protection Tool	**How to Apply the Tool to Protect Wetlands and Their CDAs**
4. Better Site Design	• Encourage designs that minimize the number of wetland crossings • Encourage or require the use of open space design to protect wetlands • Encourage designs that utilize the natural drainage system
5. Erosion and Sediment Control	• Require perimeter control practices along wetland buffer boundaries • Encourage more rapid stabilization near wetlands • Reduce disturbance thresholds that trigger ESC plans • Increase ESC requirements during rainy season • Increase frequency of site inspections
6. Storm Water Treatment	• Prohibit use of natural wetlands for storm water treatment • Discourage constrictions at wetland outlets • Restrict discharges of untreated storm water to natural wetlands • Encourage fingerprinting of STPs around natural wetlands • Discourage installation of STPs within wetland buffers • Develop special sizing criteria for STPs • Promote effective STPs to protect downstream wetlands • Encourage the incorporation of wetland features into STPs and landscaping
7. Non-Storm Water Discharges	• Conduct illicit discharge surveys for all outfalls to wetlands • Actively enforce restrictions on dumping in wetlands and their buffers • Require enhanced nutrient removal from on-site waste water treatment systems • Require regular septic system inspections
8. Watershed Stewardship	• Incorporate wetlands into watershed education programs • Post signs to identify wetlands, buffers, and wetland CDA boundaries • Manage invasive wetland plants • Establish volunteer wetland monitoring and adoption programs • Encourage wetland landowner stewardship • Establish partnerships for funding and implementing wetland projects

Appendix D: Review of Wetland Science and Management

What Are Wetlands

Wetlands are diverse and Tompkins County wetlands are no exception. They include ponds, bogs, fens, marshes, river and stream edges, wet meadows, forested swamps, and seep areas. Wetlands vary greatly in nature and appearance due to physical features such as geographic location, water source and permanence, and chemical properties. Some wetlands hold water for only a few weeks or less during the spring while others never go completely dry. The water in wetlands can range from acidic to basic. Many wetlands receive their water from groundwater while others are completely dependent on precipitation and runoff.

Since wetlands are complex, there is no single definition of wetlands shared by all ecologists, managers or government regulators. The National Research Council (1992) has identified wetlands as transitional areas between terrestrial and open water systems. Other wetland scientists define a wetland ecologically as an ecosystem that "arises when inundation by water produces soils dominated by aerobic processes and forces the biota, particularly rooted plants, to exhibit adaptations to tolerate flooding" (Keddy 2000).

Wetlands are regulated by several laws, and wetland definitions are needed to apply these laws. In New York State, freshwater wetlands regulated under the State's Environmental Conservation Law are defined by vegetation type: "…lands and submerged lands commonly called marshes, swamps, sloughs, bogs, and flats supporting aquatic or semi-aquatic vegetation…" or "lands and submerged lands containing remnants of any vegetation that is not aquatic or semi-aquatic that has died because of wet conditions over a sufficiently long period…" (ECL, §24-0107.1). The federal government has developed a definition for use by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency in administrating federal wetland regulations under the Clean Water Act. In this definition, wetlands are "those areas that are inundated by surface or ground water with a frequency and duration sufficient to support, and in normal conditions do support, a prevalence of vegetation adapted to survive in saturated soil conditions" (U.S. ACE 1987). In applying this definition, Federal agencies use three environmental characteristics to identify wetlands (but in atypical and disturbed wetlands less than three characteristics may occur):

- Vegetation - defined by a prevalence of hydric (water-loving) plants adapted to growing in inundated or saturated conditions.

- Hydric soils - the presence of soils that developed under inundated or saturated conditions that limit oxygen (anaerobic conditions).

- Hydrology - defined by inundation or saturation by water at some time during the growing season (the time when plants are actively growing).

Even though regulatory and ecological definitions may vary, a commonality of most definitions is that wetlands occur in the landscape because of a combination of water, soils, and plants that form unique communities.

Governments can, and often do, differentiate between wetlands and regulated wetlands (i.e., wetlands they intend to subject to specific laws and regulations). Sometimes excluded from regulation are specific wetlands types, such as small wetlands or wetland without surface water connection to other water bodies. Although usually excluded to reduce a regulatory burden, the scientific literature shows that these types of wetlands provide important functions.

Wetland Types

Historically, colloquial terms (marsh, swamp, etc.) were used in regulatory and legal language because professionals used these terms to describe wetlands and their functions. Wetlands are also known and classified by specific ecological technical terms. One common ecologically based wetland classification system is the Cowardin Classification (Cowardin et al. 1979), developed by the U.S. Fish and Wildlife Service in 1979 and still widely used by wetland professionals today. The Cowardin system groups wetlands based on dominant vegetation communities, water regime, and soil substrate . The system was developed to aid a national inventory of wetlands, known as the National Wetlands Inventory (NWI), using aerial photographs and was not designed to determine wetland functions (i.e. the wetlands ability to improve water quality or provide wildlife habitat).

More recently, a second ecologically based wetland classification method was developed for the U.S. Army Corps of Engineers (Corps). This system groups wetlands by hydrogeomorphic characteristics; i.e. geomorphic setting (position in the landscape), plus water source and hydrodynamics (flow and fluctuation of water within the wetland). It is named the Hydrogeomorphic Method, or HGM, and it was developed to specifically address differences in how various wetlands function (Brinson 1993). Wetlands formed on a river floodplain with unidirectional downstream flow of water are classified as *riverine* wetlands. Bogs and other wetlands in topographic depressions fed mainly by water from precipitation and runoff from adjacent slopes are classified as *depressional* wetlands.

Table D-1. Representative Tompkins County HGM wetland types

Hydrogeomorphic Class	Dominant Source of Water	Dominant Movement of Water
Riverine	Overbank flow from a channel, or underground flow in a floodplain	One direction, horizontal
Depressional	Surface runoff, or "daylighting" of groundwater	Vertical
Slope	"Daylighting" of groundwater on slopes	One direction, horizontal
Lacustrine (Lake) Fringe	Lake water	Two directions, horizontal

Wetland Functions

Wetland functions are the things that wetlands do. Specifically, these functions are the physical, biological, chemical, and geologic interactions among different components of the environment that occur within a wetland. Wetlands potentially perform a number of critical environmental and ecological functions, many of which are defined by their value to humans (Kusler and Opheim 1996, NRC 1992, NRC 2001). These include flood storage and retention, groundwater discharge/recharge, maintaining and protecting water quality and providing clean potable water. Wetlands can help maintain stream base flow, and may enhance the water quality within streams and lakes with important fish and wildlife species. Wetlands provide habitat for a wide diversity of important invertebrates, amphibians, birds, and mammals. Wetland areas are also used for a broad range of recreational and esthetic activities including hunting, bird watching, and hiking.

Functions are usually grouped into three broad categories: biogeochemical functions, hydrologic functions, and habitat functions (Adamus et al. 1991, Brinson 1993, Mitch and Gosselink 2000, Semlitsch 2000) (Table D-2 on page 61).

> **Biogeochemical Functions.** Wetlands can remove many common water pollutants. Wetlands act as a filter, slowing water down and allowing many pollutants, like sediments, to settle out. As the water moves slowly through the wetland, chemical transformations take place that alter or trap other pollutants (for example, nitrates are converted into harmless nitrogen gas). As a result, the water that leaves a wetland is cleaner than the water that entered. These processes improve the water quality within a watershed.
>
> **Hydrologic Functions**. Many wetlands act as a sponge by storing water temporarily and allowing it to percolate into the ground, evaporate, or slowly release back into streams and rivers. This temporary storage and slow release reduces flooding and erosion downstream after a storm. Wetlands also slow the overland flow of water, further reducing storm-related erosion. The slow percolation of water from wetlands can help recharge groundwater aquifers and the slow release of water to streams can help maintain stream flows through dry periods, helping to maintain water supplies for municipal and agricultural users as well as fish and wildlife. These processes regulate the quantity of water in a watershed.
>
> **Habitat Functions**. Wetlands are very productive biological systems. They produce more plant and animal life per acre than cropland, prairies, or forests. This productivity makes wetlands important habitat for many different kinds of wildlife. Wetlands provide migration, breeding, and feeding habitat for waterfowl, songbirds, and other wildlife. Amphibians, reptiles, and invertebrates may depend on wetlands. Wetlands also provide important winter shelter for deer and other wildlife.

These broad categories of functions can be subdivided into more specific groups by processes or interactions that are related and are on a similar temporal and spatial scale. They are also grouped based on management needs. For example, managers may need to know how well a wetland removes specific pollutants that cause poor water quality (such as sediment or nutrients) rather than having only a general assessment of how well a wetland removes all potential pollutants that may cause poor water

Table D-2. Representative wetland functions (*adapted from Sheldon et al. 2005***)**		
Biogeochemical Functions	Hydrologic Functions	Habitat Functions
• Removing Nutrients • Removing Sediment • Removing Metals and Toxic Compounds	• Reducing Peak Flows • Decreasing Down-stream Erosion • Recharging Ground-water	• Habitat for Inverte-brates • Habitat for Amphibians • Habitat for Fish • Habitat for Wetland-Associated Birds • Habitat for Wetland-Associated Mammals

quality.

Determinants of Wetland Function

Not all wetlands provide every possible function or necessarily provide functions at the same level over the course of the year. The capacity of a particular wetland for performing a specific function is dependent on several factors: (1) wetland characteristics (e.g. size and shape); (2) position of wetland in the watershed; (3) adjoining environment; and (4) watershed characteristics; (Mitsch and Gosselink 2000, Keddy 2000, Fairbairn and Dinsmore 2001, NRC 1995, NRC 2001, NRC 2002).

Geomorphology (e.g. size and shape) and position of the wetland in the landscape have a large impact on biogeochemical and hydrologic functions (Brinson 1993). For example, riverine wetlands do not reduce peak flows to the extent of depressional wetlands of the same size because in depressional wetlands the dominant hydrodynamics include the capture of water. Deep, steep-sided depressional wetlands generally provide maximum flood control while depressional wetlands with gradual slopes and shallow basins exhibit less flood storage capacity (Hruby et al. 1999).

Habitat functions of wetlands are also dependent on wetland geomorphology, but adjoining watershed characteristics may have a larger inpact on these functions (Cronk and Fennessy 2001; Keddy 2000; Richter and Azous 2001a-d). Wetlands adjoining forests and other natural habitats usually exhibit high diversity of plants and wildlife because of their sheltered condition and joint use by aquatic as well as upland species. Wetlands within or adjacent to agricultural and residential developments may be isolated from natural habitats and this usually reduces biodiversity (Liddle and Scorgie 1980; Kulzer et al. 2001, Richter and Azous 2001a-d).

Wetland functions are interdependent and conditions of functions directly or indirectly dictate conditions of other functions (Azous and Cooke 2001; Mitsch and Gosselink 2000; Semlitsch 2000). Hydrology is often the single most important determinant of the establishment and maintenance of wetland type, wetland vegetation and wetland processes that influence function. For example, a change in flow from dredging or the partial filling of a wetland (an impact to a hydrologic function) has a primary effect on flood storage and secondary effects on water quality enhancement. In turn, changes in both flood storage and water quality alter vegetation, potentially changing a wetland's value to wildlife. However, the capacity of a particular wetland for performing a specific function is dependent on other factors beyond the amount and type of hydrology such as the wetlands' size and shape, its position in the watershed, the adjoining environment; and watershed characteristics.

Since the functions that wetlands perform are determined by multiple independent factors, it follows that not all wetlands provide every possible function or necessarily provide functions at the same level over time. It is possible to quantitatively measure, to some extent, the level at which certain functions are performed: for example, experiments can measure the rate at which nitrates are converted to nitrogen gas. However, the time commitment and equipment expense required for these studies generally make them untenable for use by regulators. Several models have been developed that attempt to qualitatively estimate a wetlands' function based on a rapid field survey of its hydrology, soils, and plants (Magee 1998, WaFAM 1999). The accuracy and utility of these models is not accepted by all ecologists. These models are also generally developed for use in specific geographic regions and models specific for regions in New York State are not available as of April 2008.

Spatial and Temporal Scales

The functions that wetlands provide depend on factors that operate on different spatial scales. Climate, geology, and the hydrologic characteristics in a watershed control how water, sediment, and nutrients move through the landscape and these characteristics of the landscape then interact with factors within the wetland itself to control the functions performed (Bedford 1999, Gersib 2001). For example, a wetland may produce large amounts of vegetation to support food webs. To provide this function, the wetland needs to have water rich in nutrients entering it, good exposure to sunlight, and a way for the plant material produced to leave the wetland into downstream aquatic systems. The controls for this food web support function depend on the movement of water to and from the surrounding landscape as well as process that occur within the wetland.

Wetland functions may remain relatively constant over short time frames of five years or so, but wetlands naturally evolve and change so the capacity of wetlands to perform specific functions can vary greatly over ten or more years and may change completely over longer periods (Middleton 1999). Likewise, disturbances are essential for the long-term maintenance of most ecosystems, including wetlands (Averill et al. 2003, NRC 1995, Middleton 1999). Although disturbance can be essential to maintain some functions, processes such as recurrent flooding potentially redirect a wetland's evolution and subsequent functions. Wetland protection means maintaining the ecological integrity of wetlands so their functions remain self-sustaining. Consequently, hydrological processes, groundwater interactions, water quality enhancement, species and habitat support, and other existing functions need to persist in perpetuity, though they may vary somewhat from year to year or decade to decade within a single wetland.

The functional benefits that wetlands provide, if exceeded beyond their natural capacities and thresholds, leads to their deterioration and ultimate losses of their functions (Horner 1995, Horner et al. 2001). For example, hydrological benefits such as flood control are functions of a wetland's live-storage. If flooding occurs at levels beyond those that are within the normal historical range, sediment loading may increase, plant communities may change and live storage may decrease. The impacted wetland may no longer provide the flood control benefits exhibited by the pre-existing wetland. Altered flood regimes may also change water quality enhancement, wildlife benefits, and other functions. Likewise, water quality enhancement can only be maintained as long as wetland vegetation exhibits the density and species to slow current velocity to settle sediments, immobilize pathogens and enable plants to incorporate nutrients and detoxify toxins (Mitsch and Gosselink 2000).

The wide range of time and spatial scales over which wetland functions operate present a great challenge for local governments. Measures that act at the scale of an individual wetland will be much easier to implement then measures that protect functions across the scale of an entire watershed since that would require cooperation among multiple governmental jurisdictions.

Human Impacts on Wetlands

Human activities represent a significant source of change to the environment worldwide and this is certainly true in Tompkins County. For wetlands, alterations in land use and vegetation cover both within wetlands and in the surrounding landscape can change the environmental factors that control wetland functions. Human activities associated with urbanization, agriculture, deforestation, and mining have historically driven the site-specific and landscape scale changes that influence hydrology within both wetlands and watersheds. In Tompkins County, urbanization and agriculture are the major contributors to these changes to natural processes, although forestry also produces impacts.

As discussed above, disturbances to wetlands can actually be an essential ecological process and wetlands have evolved in response to these disturbances. However, disturbances caused by humans often differ from natural ones by occurring at different scales, intensities, and locations (Dale et al. 2000). These differences generally cause ecosystems to respond differently to human-caused disturbances.

Wetland disturbances are changes to those factors that control wetland functions. Wetland functions are determined by the geomorphology, hydrology and habitat at site and landscape scales. If nutrients from agricultural fields flow into a wetland that naturally would have low nutrients (a bog, for example), the excess nutrients can change the type of plants growing in the bog and result in a change to the bogs' habitat structure. In this example, human-caused excess nutrients would lead to a change in the wetlands' habitat function.

Disturbances Caused by Urbanization

Urbanization impacts wetlands at both the site scale and landscape scale. Urban disturbances cause a variety of changes that include filling wetlands, clearing vegetation, soil compaction, alteration of hydrodynamics, and introduction of chemicals and nutrients (U.S. EPA 1993). These changes impact not only wetlands but all areas of an urban watershed.

The most direct impact to wetlands from urbanization is physical loss of wetland area. Approximately 13% of the wetland losses in the U.S. have been attributed to urbanization (Tiner 1984). Other studies have found that urban areas have lost 85% of their wetlands with the remaining 15% having impaired functions (Kusler and Niering 1998).

Wetlands are directly filled because they offer flat, attractive sites for building and road construction. Even if wetlands are not directly disturbed they can be filled by increased sediment runoff from surrounding development since sediments are generally the largest constituent of pollutant loads to waters in urban areas and runoff from construction sites is the largest source of this sediment in urban areas (U.S. EPA 1993, U.S. EPA 2003).

Urbanization can change the volume and timing of water that reaches downgradient wetlands. Collecting stormwater through stormwater drains, culverts, and catchments results in the transport of storm runoff into rivers, lakes and wetlands at faster rates and higher volumes than under natural conditions (Booth and Henshaw 2002, May 2000). Research shows that the amount of impervious surface within a watershed has significant correlation to increases in flows and volumes of water in the system (Azous and Horner 1997). Several studies have shown that urbanization increases the frequency of erosive flows by increasing peak flow rates during storm events (Booth and Henshaw 2002). These changes in flows and volume of water can also lead to changes in wetland vegetation and water level fluctuations, downcutting of natural channels that may result in the removal of wetlands from floodplains, changes in seasonal saturation or inundation, and erosion of wetland substrates (Booth and Henshaw 2002, Reinelt and Taylor 2001, Thom et al. 2001, U.S. EPA 1993).

Nutrients such as phosphorous and nitrogen are introduced into runoff from various urban sources that include nutrients bound to sediments from construction sites, lawn fertilizer, septic systems, and leaves and grass decomposing on impervious surfaces (Johnson and Juengst 1997, Valiela et al 1993). Nitrogen can also enter aquatic systems from the release of nitrogen compounds from vehicle emissions and the burning of wood and coal (Pearl and Whitall 1999). Urban land uses contribute a wide range of other pollutants into runoff (Schueller and Holland 2000, U.S EPA 1993): heavy metals and hydrocarbons (automobiles, industrial sources), organic matter (septic systems, automobile oil and grease) and pesticides (lawns and commercial landscaping).

Urbanization impacts habitat as new developments encroach on natural areas, fragment large habitat patches into smaller patches, and the remaining habitat patches become isolated from each other (Aurambout 2003, Dale et al. 2000). Gibbs (2000) studied the distribution of wetlands along urban to rural gradients in New York State and found correlations between increasing population density and 1) increasing distance between wetlands and 2) decreasing percent of the landscape that was in wetlands.

Increasing urbanization also increases disturbance to wetland habitats from human recreational use, household pets and the introduction of exotic plant species (Sheldon et al. 2005).

Disturbances Caused by Agriculture

Wetlands have historically been some of the first places within a landscape used for agriculture. In the southern part of Tompkins County farms were established within broad valleys that characterize this region, while in the north farms occupied wide areas of the Ontario-Erie Plain and northern plateau. These areas often contained wetlands due to high water tables that persisted late into the growing season. Beaver activity further modified floodplains to create areas where sediments and organic matter accumulated to produce fertile soils. Agriculture is still a dominant land use in many parts of the County and existing agricultural practices play a significant role in the movement of water, sediments, nutrients, and other chemicals through landscapes.

As with urbanization, agriculture can disturb the physical structure of wetlands. Conversion of wetlands for crop agriculture include activities such as filling, tilling, draining through tiles or channels, and removing wetland vegetation (Mitsch and Gosselink 2000). Studies on the effects of grazing on wetlands primarily has focused on riparian wetlands and impacts include loss of vegetation, stream bank erosion, and shallower and wider streams (Armour et al. 1991, Clary 1995, Jansen and Robertson 2001).

Tillage and grazing can disrupt soil and create a source of sediment for stormwater or wind transport into wetlands or other receiving waters (Baker 1992, Mitsch and Gosselink 2000). The export of phosphorous and nitrogen from agricultural land can be 3 times higher for phosphorous and 12 times higher for nitrogen than from forested land and these nutrients can be transported into surface waters and infiltrate groundwater (Omernik 1977, Williamson et al. 1998). Herbicides, pesticides and fungicides applied to fields can enter downgradient wetlands and other aquatic resources via surface runoff, subsurface infiltration, or through adsorption to sediment particles (Neely and Baker 1985, Thurston 1999).

Lower water levels in a wetland result from direct ditching and draining for agricultural purposes. The ditching may be so effective that the area becomes upland or the extent of drainage may allow part of the wetland to remain, but with lower water levels and/or reduced area. In arid parts of the U.S., extensive irrigation has been associated with both reduced inflows into wetlands from diversions and increased inflows to wetlands from excess irrigation water (Adamus 1993, Creighton et al. 1997, Peck and Lovvorn 2001) but no studies of this effect were found for New York State.

Agriculture also results in habitat fragmentation (Dale et al. 2000, Farig 2003). The loss of wetlands to conversion to agriculture increases fragmentation by removing patches of wetland in the landscape.

Disturbances Caused By Forestry

A comparatively small amount of land in Tompkins County is managed for timber in comparison to urbanization and agriculture. Forestry practices cause several types of disturbances that can affect wetland functions as seen with agriculture and urbanization, mainly through hydrology changes due to vegetation removal. These include increased peak flows, increased water level fluctuations, increased nutrients, increased sedimentation, soil compaction and introduction of exotic species.

Regulations Allow for Impacts to Wetlands

One aspect of both federal and New York State wetland regulations is that impacts to wetlands are not eliminated. Regulatory programs do strictly prohibit development in wetlands but follow a specific sequence of actions to reduce the loss of wetlands and their functions. This sequence is (1) avoid impacts, (2) if impacts can not be avoided then minimize impacts, and (3) mitigate impacts that do occur. Wetlands can be destroyed but, in theory, the regulations require that the wetland area and functions lost must be “mitigated” either by creating new wetlands or restoring degraded wetlands (in rare cases, protecting existing wetlands is also considered mitigation) so that total wetland area either remains the same or even increases. However, mitigation is difficult and often unsuccessful and, in practice, this regulatory system may still result in overall loss of both wetland area and wetland function. The National Research Council (2001) has estimated that on a national level 85 percent of wetland creation and restorations are unsuccessful. Their specific findings were that:

1. The performance standards sought in compensatory mitigation have not often been well defined.
2. Wetland restoration and creation trajectories do not suggest equivalency with reference sites within the commonly used 5-year monitoring period.
3. The literature and testimony provided to the committee indicate that the national

goal of “no net loss” for permitted wetland conversions is not being met.

4. The gap between what is required and what is realized not precisely known; however, the evidence strongly suggests that the required compensatory mitigation called for by wetland permits to date will not be realized.
5. Permit follow-up is sparse or too infrequent, and a higher post- monitoring rate will Increase permit compliance rates. Compliance monitoring is commonly known to be nonexistent after 5 years. Better documentation and monitoring will increase compliance rates.
6. The sparse compliance monitoring is a direct consequence of its designation as a “below-the-line” policy standard. Raising compliance monitoring to “above the line” will greatly enhance mitigation success.”

Failure of wetland mitigation generally occurs during both in the creation and restoration of wetland acreage and common factors in failures include lack of suitable water regimes, inadequate soil or plant conditions, poor design and inadequate follow-up by regulatory agencies (NRC 2001, Johnson et al. 2000, Johnson et al. 2002, Mockler et al. 1998). Recognizing the fact that mitigation is not 100 percent reliable in replacing wetland acreage and function, “ mitigation replacement ratios” are commonly used. These ratios are used to address risk of failure, temporal loss (due to the length of time it takes even successful sites to be fully functioning), and the frequent tradeoffs in wetland functions that occurs in mitigation.

These studies suggest that mitigation success can be enhanced through increased enforcement and monitoring of existing regulations, the use of functional assessments to develop better performance standards, larger buffers, more detailed plans, longer-term maintenance, and increased replacement ratios.

Continued and Cumulative Impacts to Wetlands

The current annual net loss of wetlands in the lower-48 United States has been reduced dramatically from rates experienced during the middle part of the 20th century. Frayer (1983) estimated that 458,000 acres of wetland were lost annually between the mid-1950’s and mid-1970’s. Between 1998 and 2004, Dahl (2005) measured a net increase of 32,000 acres of wetland per year. However, this gain was largely due to the inclusion of approximately 700,000 acres of constructed freshwater ponds, largely on agricultural lands. This type of non-vegetated water body is generally not considered a wetland for mitigation purposes by the U.S. Army Corps of Engineers because they perform different types and levels of functions than the wetlands that are usually lost to development. In fact, Dahl found human-caused losses of 495,000 acres of vegetated freshwater wetlands during this time.

It has been repeatedly stressed that wetlands do not function in isolation from the landscape that surrounds them. Their functions are influenced not just by conditions within the wetland itself but also by conditions in the landscape that determine the quantity and timing of water flows, sediments, nutrients and movement of species that use wetlands for habitat. However, existing wetland regulations at the federal, state, and local level (to the extent they exist) are usually applied on a site-specific basis (the literature often refers to site-specific decisions as “case-by-case”). Rarely are the implications to the larger landscape considered during these case-by-case management decisions (Bedford and Preston 1988, Bedford 1998).

From 1986 to 1997, the National Research Council (2001) estimated that annual loss of wetlands nationwide continued to be about 58,500 acres per year and that case-by-case permitting as conducted under the structure of current regulatory programs reduced the opportunity to consider the landscape factors that control wetland functions, or consequences of the cumulative and synergistic impacts of wetland loss across the landscape. The NRC concluded in 2001 that since the existing case-by-case approach had not worked to ensure an existing federal policy of “no net loss” of wetland area and functions, protection and management at a larger geographic scale would improve permit decision-making.

The failure of case-by-case permitting to account for landscape scale processes that create and maintain wetland functions has been reported in numerous studies (Wissmar and Beschta 1998, Council of Environmental Quality 1997, Dale et al. 2000, U.S. EPA 1999). Two primary types of cumulative impacts are cross-boundary impacts (impacts that occur at some distance from the source, such as increased eutrophication in wetlands from additional nutrient discharges that occur up gradient in the watershed) and habitat fragmentation (such as when additional land development increasingly restricts corridors used by animals to move between habitat patches). Other cumulative impacts include thresholds (the accumulation of disturbances that cause fundamental change in ecosystems), compounding effects (impacts arising from multiple sources), space crowding (impacts occurring in physical proximity), and time crowding (disturbances that occur before the ecosystem has recovered from a previous disturbance).

Finally, several studies have found that inconsistent regulations, or implementation of regulations, between jurisdictions can lead to the loss of wetlands and their functions (Brown and Veneman 2001, Cole and Shafer 2002, National Research Council 2001, New Jersey Department of Environmental Protection 2002, Sheldon et al. 2005). Inconsistencies across jurisdictions promotes an inability to consider landscape factors and increases the likelihood for cumulative impacts.

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