2.6 WETLANDS

2.6.1 INTRODUCTION

Wetlands represent areas where water is the dominant factor that structures the environment and associated plant and animal communities. These communities are transitional habitats that occur between upland and deep-water habitats, and are considered to be among the most productive ecosystems on Earth. They are characterized by fluctuating water tables, wet soils, and plants adapted to living in wet conditions.

In recent years, Delaware's portion of the Chesapeake Basin has lost significant wetland acreage due to development and/or agricultural land conversion. Although the rate of wetland destruction has slowed in recent years, 54 percent of the wetlands in Delaware, of which the Basin is part, have nonetheless been lost since 1780 (Dahl, 1990). Population increase is expected to contribute to further wetland degradation in the foreseeable future. Therefore, implementation of timely preservation efforts is crucial to stem further losses of these ecologically important wetlands.

The ability of wetlands to retain harmful nutrients or to transform them to environmentally harmless forms is well known. In fact, this knowledge has spurred efforts in the scientific and regulatory community to preserve wetlands for the purpose of controlling nonpoint source pollution. Ignoring or trivializing wetland preservation efforts risks the peril of reducing drinking-water quality, fisheries habitat, and various recreational opportunities.

2.6.1.1 Definition

As defined under Section 404 of the Clean Water Act, *wetlands* are:

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

2.6.1.2 Wetland Attributes

The development of attributes unique to wetlands occurs through the interrelationship of hydrology, soils, and vegetation. Specific diagnostic characteristics for these three parameters must be exhibited in order to designate an area as a wetland.

Wetland Hydrology

The presence of water is the most important determinant in the structure and function of a wetland. Water related mechanisms such as ground-water discharge,

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surface-water runoff, flooding, and tides provide the driving force for creating and maintaining wetlands. These mechanisms affect the nature of soils, which, in combination with water, determine the types of plants and animals that live in a wetlands environment.

Hydric Soils

Hydric soils are a key attribute for identifying wetlands. Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper soil zone (National Technical Committee for Hydric Soils, 1991). Under these saturated, anaerobic conditions, leaching of common soil constituents (such as iron and manganese) occurs. Visual observation of these depletions (i.e., grey or yellow stains to soil matrix by reducing conditions) and concentrations (i.e., red or black colors imparted to soil matrix by oxidative conditions), is made possible by water-table fluctuations.

A significant portion of the soils that are found in the Basin are poorly to very poorly drained. Many of these soils are associated with the floodplains of creeks and rivers. Based on recent efforts by GIS experts in the Department, hydric soils were estimated to comprise at least 48 percent of the Basin's historical land base. It is not certain what percent of the land base is currently occupied by hydric soils. However, it is suspected that the percent would closely mirror the wetland acreage estimates derived from the completed Statewide Wetland Mapping Project (SWMP; see Section 2.6.6.4).

Wetland Vegetation

Hydrophytic or wetland vegetation is characterized by dense growths of vegetation adapted to existing hydrologic and soil conditions typical of wetland environments. Wetland plants are adapted to growing under the anaerobic or low-oxygen conditions that exist when soils are seasonally or continuously flooded. Wetland plants have adapted to such conditions by developing a variety of structural or physiological adaptations (e.g., stomata size; greater pore space in cortical tissues) that essentially mitigate the normally detrimental effects of reduced oxygen conditions.

2.6.2 NATIONAL WETLANDS INVENTORY AND THE STATEWIDE WETLAND MAPPING PROJECT

2.6.2.1 Introduction

In response to the need to inventory and classify wetlands, the U.S. Fish and Wildlife Service, under the supervision of Cowardin and others (1979), developed a method to consistently classify various wetland types throughout the United States. The resultant "Classification of Wetlands and Deepwater Habitats of the United States" was a comprehensive classification of all aquatic and semi-aquatic ecosystems. The "Cowardin Classification System," as it is commonly called, was first employed in the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) maps.

2.6.2.2 Statewide Wetlands Mapping Project

The Cowardin classification scheme has subsequently been adapted for use in the Statewide Wetland Mapping Project. The SWMP is a collaborative project between DelDOT and the Department, and involves an interdisciplinary group of wetland scientists, mapping experts, and engineers. The goal of the SWMP is to improve and update existing wetland inventories and transportation resources. Hard copy and digital SWMP maps *(see Map 2.6-1 Wetland Locations)* are generated from this project. These maps or orthophotographs exhibit various wetland signatures in the form of hues, or darkness/lightness variations, characteristic of specific vegetative types or hydrologic regimes. These photointerpreted signatures, in conjunction with existing wetland inventories, soil survey information, QA/QC field verification data, and other ancillary data, are used to delineate wetland boundaries or polygons on the SWMP orthophotos (Pomato, 1994). The photointerpreted maps, like the NWI maps, utilize alphanumeric codes to convey information about specific wetlands.

The use of aerial color infrared digital orthophotography by the SWMP is a significant improvement over the less distinctive monochromatic NWI maps. The fact that a skilled photointerpreter can delineate and identify mapping units such as vegetative types (e.g., broad-leaved deciduous, broad-leaved evergreen, etc.) or hydrologic regimes (e.g., A, B, C, etc.) with greater precision and accuracy is one of the chief advantages of aerial color photography.

2.6.2.3 Cowardin Classification Scheme applied to NWI or SWMP

This classification scheme is based on a hierarchical approach to classifying wetland types that is analogous to classification of animal or plant species. In this scheme, wetlands are broadly classified into five systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Marine and Estuarine systems are found along coastal environments

Figure 2.6-1

MODIFIED COWARDIN CLASSIFICATION SYSTEM FOR DELAWARE WETLANDS

SYSTEM: PALUSTRINE

CLASS / **Subclass**

- RB-Rock: 1. Bedrock; 2. Rubble
- UB-Unconsolidated Bottom: 1. Cobble-Gravel; 2. Sand; 3. Mud; 4. Organic
- AB-Aquatic Bed: 1. Algal; 2. Aquatic Moss; 3. Rooted Vascular; 4. Floating Vascular; 5. Unknown Submergent; 6. Unknown Surface
- US-Unconsolidated Shore: 1. Cobble-Gravel; 2. Sand; 3. Mud; 4. Organic; 5. Vegetated
- EM-Emergent: 1. Persistent; 2. Nonpersistent
- SS-Scrub-Shrub / FO-Forested: 1. Broad-Leaved Deciduous; 2. Needle-Leaved Deciduous; 3. Broad-Leaved Evergreen; 4. Needle-Leaved Evergreen
- OW-Open Water

SYSTEM: RIVERINE

SUBSYSTEM: 1-Tidal; 2-Lower Perennial; 3. Upper Perennial; 4-Intermittent; 5-Unknown Perennial

CLASS / **Subclass**

- RB-Rock: 1. Bedrock; 2. Rubble
- UB-Unconsolidated Bottom: 1. Cobble-Gravel; 2. Sand; 3. Mud; 4. Organic
- SB-Streambed: 1. Bedrock; 2. Rubble; 3. Cobble-Gravel; 4. Sand; 5. Mud; 6. Organic; 7. Vegetated
- AB-Aquatic Bed: 1. Algal; 2. Aquatic Moss; 3. Rooted Vascular; 4. Floating Vascular; 5. Unknown Submergent; 6. Unknown Surface
- RS-Rocky Shore: 1. Bedrock; 2. Rubble
- US-Unconsolidated Shore: 1. Cobble-Gravel; 2. Sand; 3. Mud; 4. Organic; 5. Vegetated
- EM-Emergent: 1. Persistent; 2. Nonpersistent
- OW-Open Water

SYSTEM: ESTUARINE

SUBSYSTEM: SUBTIDAL

CLASS / **Subclass**

- RB-Rock Bottom: 1. Bedrock; 2. Rubble; 3. Mud; 4. Organic
- UB-Unconsolidated Bottom: 1. Cobble-Gravel; 2. Sand; 3. Rooted Vascular; 4. Floating Vascular; 5. Unknown Submergent; 6. Unknown Surface
- AB-Aquatic Bed: 1. Algal; 2. Aquatic Moss
- RF-Reef: 1. Coral; 2. Mollusc; 3. Worm
- OW-Open Water Unknown Bottom

SUBSYSTEM: INTERTIDAL

- AB-Aquatic Bed: 1. Algal; 2. Aquatic Moss; 3. Rooted Vascular; 4. Floating Vascular; 5. Unknown Submergent; 6. Unknown Surface
- RF-Reef: 1. Coral; 2. Molluse; 3. Worm
- SB-Streambed: 1. Cobble-Gravel; 2. Sand; 3. Mud; 4. Organic
- RS-Rocky Shore: 1. Bedrock; 2. Rubble
- US-Unconsolidated Shore: 1. Cobble-Gravel; 2. Sand; 3. Organic
- EM-Emergent: 1.Persistent; 2. Nonpersistent
- SS-Scrub-Shrub / FO-Forested: 1. Broad-Leaved Deciduous; 2. Needle-Leaved Deciduous; 3. Broad-Leaved Evergreen; 4. Needle-Leaved Evergreen

Table 2.6-1

ADAPTED AND REVISED NWI MODIFIERS FOR DELAWARE'S SWMP

WATER REGIME				**WATER CHEMISTRY**						**SOIL**		**SPECIAL**		**DELAWARE**	
Non-Tidal		**Tidal**		**Coastal Halinity**		**Inland Salinity**		**pH Modifiers for Fresh Water**							
A	Temporarily Flooded	K	Artificially Flooded	1	Hyperhaline	7	Hypersaline	a	Acid	g	Organic	b	Beaver	1	Endangered Species/ Community
B	Saturated	L	Subtidal	2	Euhaline	8	Euhaline	t	Circumneutral	n	Mineral	d	Partially Drained/ Ditched	2	Coastal Plain Pond
C	Seasonally Flooded	M	Irregularly Exposed	3	Mixohaline	9	Mixohaline	l	Alkaline			f	Farmed	3	Atlantic White Cedar Community
D	Seasonally Flooded/Well Drained	N	Regularly Flooded	4	Polyhaline	0	Fresh					h	Diked/ Impounded	4	Bald Cypress Community
E	Seasonally Flooded/ Saturated	P	Irregularly Flooded	5	Mesohaline							r	Artificial Substrate	5	Interdunal
F	Semipermanently Flooded	S	Temporary-Tidal	6	Oligohaline							s	Spoiled	6	Acidic Sea-Level Fen
G	Intermittently Exposed	R	Seasonal-Tidal	7	Fresh							x	Excavated	7	Riparian
H	Permanently Flooded	T	Semipermanent-Tidal											8	Category 1 Buffer Wetland
J	Intermittently Flooded	V	Permanent-Tidal											9	Seasonally Flooded or Wetter Pf
K	Artificially Flooded	U	Unknown											10	Pf Drier than Pf 9
	Intermittently Flooded/ Temporary													11	State-Regulated Wetlands
Y	Saturated/ Semipermanent/ Seasonal														
Z	Intermittently Exposed/ Permanent														
U	Unknown														

and are not typically found in Delaware's portion of the Chesapeake Basin. The other three categories are freshwater wetland systems. Riverine systems are associated with rivers and streams, and are restricted to aquatic beds within channels and to fringes of nonpersistent emergent plants growing on riverbanks or in shallow water. Lacustrine systems are associated with freshwater lakes or deepwater habitats greater than 2 meters deep at low water and greater than 20 acres in size. Palustrine systems areas are also freshwater systems, but are differentiated from lacustrine systems on the basis of water depth and size. Wetland systems such as Palustrine, which means marshy, are wetland systems that describe specific wetland categories such as marshes, swamps, and bogs. Palustrine wetlands and water bodies are wetlands and water bodies that are less than 2 meters deep at low water, and smaller than 20 acres in size. They may be either non-tidal or tidal wetland systems.

As mentioned previously, the Cowardin Classification System uses a hierarchical approach to classifying and delineating wetland types. This system consists of an ordered series of numbers and letters (alphanumeric coding) that reflect specific characteristics of wetlands and deepwater habitats. This classification system begins with the most broadly defined concepts (e.g., Systems), and ends with very specific descriptive modifiers *(see Figure 2.6-1 and Table 2.6-1).*

The *system* is represented by the first letter in the alphanumeric code, and this letter is capitalized. Each system (except the Palustrine System) is divided into *subsystems* based on major hydrologic, geomorphologic, chemical, and biological characteristics. Sub-systems are denoted as numeric characters following the system symbol. Sub-systems are divided into *classes*, which describe the general vegetative appearance in terms of vegetative life form, or the composition of the substrate (e.g., Forested, Scrub-shrub, etc.). Classes are denoted by upper-case letters (e.g., "Scrub-shrub" is "SS"). Classes are subdivided into *subclasses,* which describe specific vegetative or substrate types (e.g., Broad-Leaved Deciduous, Needle-Leaved Deciduous, or Bedrock, Rubble, etc.), and are designated by numeric modifiers specifically keyed to the vegetative or substrate type. Following the subclass is an upper-case letter denoting the *hydrologic regime.* Hydrologic regimes (e.g., temporarily flooded, seasonally saturated, etc.) are coded to specific hydrologic types on the basis of frequency and duration of flooding. Additional refinement of the classification scheme is provided by *modifiers,* which describe specific hydrologic, chemical, soil, human impact and/or other characteristic of a particular wetland *(see Figure 2.6-1 and Table 2.6-1)*

2.6.3 WETLAND VEGETATION AND PLANT COMMUNITIES

2.6.3.1 Introduction

Wetland plant community structure and composition are influenced by many factors, including climate, hydrology, water chemistry and human activities. Important physical factors include (1) location of the water table; (2) fluctuation of the water table; (3) soil type; (4) soil acidity; and (5) salinity. Biotic factors (i.e., plant competition, animal actions, and human activities) also play a role in structuring a community. Plant composition is often altered by channelization and drainage of wetlands. Generation of surface spoil piles and altered surface-water drainage patterns often gives some undesirable plant species (e.g., *Phragmites)* a competitive advantage.

2.6.3.2 Definition of a Hydrophyte

Hydrophyte is the technical term applied to plants adapted to wetland environments. The U.S. Fish and Wildlife Service defines a hydrophyte as "any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content" (Cowardin et al., 1979).

2.6.3.3 Plant Indicator Status Categories

The U.S. Fish and Wildlife Service recognizes four types of hydrophytes:

1. Obligate — Obligate hydrophytes are plants that almost always (estimated probability >99 percent) occur in wetlands, but may occur (estimated probability <1 percent) in non-wetlands.
2. Facultative wet — Facultative wet plants (estimated probability >67 percent to 99 percent) in wetlands, but also occur (estimated probability of 1 percent to 33 percent) in non-wetlands.
3. Facultative — Facultative plants (estimated probability 33 percent to 66 percent) are as likely to grow in both wetlands or in non-wetlands.
4. Facultative upland — Facultative upland plants are sometimes (estimated probability of 1 percent to 33 percent) found in wetlands, but occur (estimated probability (>67 percent to 99 percent) in non-wetlands.

Vegetation is considered hydrophytic when 50 percent of all vegetative strata (e.g., tree, shrub, vine, and herb), have an indicator status of facultative or wetter (Tiner, 1985).

2.6.4 UNIQUE OR THREATENED WETLANDS

Delaware's portion of the Chesapeake Basin contains a number of unique and threatened wetland types. These unique or threatened wetland types in the Basin include bald cypress *(Taxodium distichum),* Atlantic white cedar *(Chamaecyparis thyoides),* and coastal plain ponds (i.e., Carolina bays/Delmarva bays). These communities are considered priorities for protection due to rare species that they often contain, their growth form, and/or their unusual geomorphic setting or geologic origin (McAvoy and Clancy, 1993). In recognition of this fact, the Department and the Delaware Natural Heritage Program identified, inventoried, and mapped these unique wetlands for purposes of regulatory protection and resource management. Those wetlands deemed most threatened or unique were classified as Category I wetlands, while wetlands considered less threatened or unique were assigned higher category numeric designations (i.e., Category II and III). For semantic reasons, the term "categories" has subsequently been changed to "types." However, the numeric designations representing specific wetland types remain the same. Additional information on unique or threatened wetlands can be found in the living resources section of this document.

2.6.5 DISTRIBUTION OF WETLAND TYPES

2.6.5.1 Introduction

The presence of dense growths of plants adapted to the existing hydrologic, chemical, and soil conditions is the most conspicuous characteristic of wetlands in the Chesapeake Basin. As mentioned previously, five major wetland systems are recognized: Marine, Estuarine, Riverine, Palustrine, and Lacustrine. All but the Marine system exist in Delaware's portion of the Chesapeake Basin, and they comprise 100 percent of the total wetland acreage and approximately 25 percent of the Basin's total land area.

2.6.5.2 Palustrine Wetlands

Palustrine wetlands (i.e., bottomland forests, swamps, and marshes) comprise the vast majority (>99 percent) of the freshwater wetlands found within Delaware's portion of the Basin. These wetlands have the greatest floral diversity of any wetland system due to their exposure to the greatest range of moisture regimes (Tiner, 1985). Palustrine wetlands may be tidally influenced and may include riparian and headwater riparian areas.

Riparian Wetlands

Riparian wetland is a sub-category of Palustrine wetlands. These wetlands are immediately adjacent to streams, rivers, or other water bodies, but are most often associated with low-order streams. Riparian wetlands comprise approximately 5 percent of the total wetland base in the Basin. These wetlands are very important for enhancing both ecological and water-quality values because they maintain unbroken wildlife corridors to the floodplain area, and reduce sediment and nutrient loading downstream. Brinson (1993) recognized ecological and water-quality values provided by low-order streams. He found that riparian transport (non-channelized overland flow, or ground-water quick-flow following storms from upland to downstream) is more effective for nutrient and sediment removal than overbank flow from high-order floodplain systems. He also noted that, as floodplain width narrows as one moves upstream (i.e., decreasing stream order), there is an exponential increase in the length of floodplain affected. In other words, low-order riparian wetlands are affected proportionally more per unit length area by anthropogenic impacts than wetlands associated with higher-order streams. Most of the coastal plain streams in the Basin are dominated by riparian flow.

Headwater Riparian Wetlands and Marginally Wet Riparian Wetlands

Because of their initial connection to the floodplain system (1st order streams), headwater riparian wetlands are considered extremely important. According to the *Conservation Design for Stormwater Management* manual (1997), Delaware (including the Basin) has predominately 1st through 3rd order streams. The smallest first-order riparian areas, only 3 meters wide, make up roughly one-third of the total floodplain area for most of the watersheds in the state.

Brinson (1993) found that low-order streams, because of their large surface area, are more susceptible to adverse environmental impacts than higher-ordered floodplain environments. Therefore, protecting these smaller headwater riparian areas can aid in safeguarding the ecological integrity of the larger downstream floodplain systems.

The environmental integrity of headwater riparian wetlands is also often dependent on the surrounding upland environment. Upland forests provide additional water-quality benefits by trapping sediments and converting nutrients to biomass prior to discharge into riparian wetlands (i.e., reducing sediment and nutrient load into the adjacent riparian wetlands).

Protection of headwater riparian wetlands is of critical importance for maintaining the ecological integrity of the entire floodplain system. A lack of regulatory protection and recognition of their ecological importance has often allowed marginally wet headwater wetlands to be filled and/or developed. It is imperative to enact regulations/ and or conservation practices to protect these lands. Conservation practices (e.g., riparian buffers, conservation easements both for farmlands and upland forests, etc.), either through regulatory or economic incentives, would significantly help to maintain a high-quality environment.

2.6.5.3 Estuarine Wetlands

Estuarine wetlands are systems associated with coastal salt or brackish waters. These areas extend upstream into coastal rivers to the point where salinity levels decline to negligible measurable levels [less than 0.5 parts per thousand (ppt)]. These wetland systems comprise less than 1 percent of the wetland base within the Basin.

2.6.5.4 Lacustrine Wetlands

Lacustrine wetlands are systems such as deepwater habitats associated with lakes, reservoirs, and deep ponds. These wetland systems comprise less than 1 percent of the wetland base within the Basin.

2.6.5.5 Riverine Wetlands

Riverine wetlands are systems that encompass freshwater rivers and their tributaries, including the freshwater tidal reaches of coastal rivers where salinity is less than 0.5 ppt. These wetland systems comprise less than 1 percent of the wetland base within the Basin.

2.6.6 WETLAND LOSSES AND TRENDS

2.6.6.1 Introduction

Delaware's portion of the Chesapeake Basin is over 700 square miles and represents approximately 1 percent of the entire Chesapeake watershed. The Basin has lost a significant amount of wetlands acreage although the rate of loss has slowed with increased introduction of wetland regulations. The following trend studies outline wetland losses and trends since the 1950's.

2.6.6.2 Wetlands Trend Study by Tiner (1982 – 1989)

According to Tiner and others (1994), wetlands occupied approximately 105,000 acres in Delaware's portion of the Chesapeake Basin in 1989. This study also showed that, during the same time period, palustrine vegetated wetlands decreased by a net total of 2,921 acres (or by 3 percent between 1982 and 1989) *(see Table 2.6-2)*

Of the three most common wetland types found within the Basin (Palustrine Forested (PFO); Palustrine Scrub-Shrub; and Palustrine Emergent (PEM)), PEM wetlands suffered the greatest losses *(see Table 2.6-2)*. No wetland loss figures were given for Estuarine, Lacustrine, or Riverine wetland systems in this report, presumably because these systems comprise an insignificant portion of the wetlands in the Basin (each less than 1 percent).

Delaware's portion of the Chesapeake Basin also contains about 46 percent of all ditched wetlands in the entire Chesapeake watershed (Tiner et al., 1994). This figure is disproportional to the total area of the state, given that Delaware has only one percent of the entire Basin's area. According to Tiner et al. (1994), this extensive network of ditches impairs, to some extent, the natural functions of wetlands. As a result, large acreages of wetlands have been lost or irrevocably impacted by channelization activities.

2.6.6.3 Wetland Trend Study by Dahl and Others (1997)

Wetland loss concerns prompted an additional study by the United States Fish and Wildlife Service (USFWS). The study entitled *Status and Trend of Wetlands in the Conterminous United States* by Dahl and others (1997), for the USFWS, is the most recent attempt by this agency to determine wetlands losses and trends. The study projected wetland losses by using a statistical sampling design, random sample plots combined with special mathematical techniques, and updated photointerpretation.

Although this technique projected wetland losses over wide geographic regions beyond the Chesapeake Basin, it provided a reasonable estimate of the wetlands losses in our region. The projected wetland loss for the northeastern physiographic stratum, which encompasses the Chesapeake Basin, was estimated to be 20 percent between 1985 and 1995 (Dahl et al., 1997). Most of the loss of wetlands estimated during this time period was due to conversion of wetlands for agricultural land use.

Wetland losses between the mid-1950s and the late 1970s were considerably greater than wetland losses that occurred between 1985 and 1995. According to Tiner (1987), approximately 21 percent of Delaware's inland vegetated wetlands and 6 percent of its coastal wetlands disappeared during the earlier time period. However, like the wetland loss figures presented from Dahl's report, these wetland loss figures are for a somewhat larger geographic area (in this case, the entire State of Delaware). Nevertheless, these figures provide a reasonable estimation of wetland losses experienced in Delaware's portion of the Chesapeake Basin.

2.6.6.4 Trend Study Utilizing Statewide Wetland Mapping Project Data

In an attempt to improve existing wetland inventories, the Statewide Wetland Mapping Project (SWMP) was initiated. Previously, the most comprehensive mapping effort undertaken in Delaware's portion of the Chesapeake Basin had been the United States Department of the

Table 2.6-2

CHANGES IN SPECIFIC TYPES OF VEGETATED WETLANDS IN THE DELAWARE PORTION OF THE CHESAPEAKE WATERSHED (1982-1989)

VEGETATED WETLAND TYPE	1982 ACRES	1989 ACRES	ACRES CHANGED TO OTHER VEG WETLANDS	ACRES GAINED FROM VEG WETLANDS	ACRES DESTROYED	ACRES GAINED FROM OTHER AREAS	NET CHANGE	% PALUSTRINE WETLAND LOSS 1982 – 1989
PFO	92,205**	91,407**	2,268*	579*	1,109*	0	(-)2,798**	~3%
PSS	3,395*	5,580*	767*	2,452*	151*	111	(+)1,645*	
PEM	3,963*	2,189*	624	627	1,947*	170*	(-)1,774*	

Adapted from Tiner (1994)

* Standard error is less than 50 percent of the estimate, but greater than 20 percent of the estimate.

** Standard error is 20 percent of less than the estimate.

Note: Estimates without an asterisk have higher standard errors.

Interior, Fish and Wildlife Service, National Wetland Inventory (NWI) Project. This nationwide project was conceived in 1974 to provide information on the location, characteristics, and extent of wetlands.

With the advent and availability of higher resolution aerial color infrared photography in 1992, the SWMP was able to more accurately distinguish and identify wetland areas previously missed during the earlier NWI Project. The recently completed report by Tiner and others (1999) utilized this improved aerial photography in conjunction with Departmental "groundtruthing," to generate the data necessary to assess wetland losses between the 1981/2 – 1992 time period.

From this data, a loss of 722 acres of palustrine vegetated wetland was projected. Of this total, 608.7 acres (84 percent) of these losses were due to agriculture. Wetland destruction from pond construction, industrial development, residential development, commercial development and highway and road construction was 45.7 acres (6.3 percent). The remaining vegetated palustrine wetlands: herbaceous rangeland, transitional land, and riverine deepwater habitats had projected losses of 67.9 acres (9.4 percent).

During this same period, only 10 acres of new palustrine vegetated wetlands were reestablished. Therefore, a net loss of 712 acres of palustrine vegetated wetlands were assessed for the Basin.

In the Chesapeake Basin, both the lacustrine and riverine systems had minor wetland increases. These increases are not noteworthy since the palustrine wetland system occupies over 99% of the Basin's acreage.

2.6.7 WETLANDS MITIGATION AND COMPENSATION

2.6.7.1 Introduction

Any significant construction project may negatively impact tidal and/or non-tidal wetlands. Today, such projects (and their impacts) usually require some level of permit approval that ensures compensation for wetland impacts. Generally, wetlands in non-tidal areas are regulated by the federal government (U.S. Army Corps of Engineers), while tidal areas are regulated by the Department. In some instances, wetlands compensation is required by one or both of these agencies as any project may impact jurisdictional wetlands in both tidal and non-tidal areas. Depending on the quality of the negatively impacted wetland, the requirements for replacement/compensation vary in both size and quality. Where compensation requirements overlap, the federal agency requirements usually take precedent.

Among wetlands resource managers, scientists, and the general public, wetlands "compensation" and wetlands "mitigation" are used synonymously to describe wetlands *compensation*. To clarify, wetland *mitigation* is the actual process which a person conducting a project must complete to reach the stage of *compensation*. The mitigation process involves investigating project alternatives for avoiding impacts, rectifying actual impact by repairing, reducing/minimizing impact, and compensating for unavoidable impacts. Traditionally, compensation has taken place at or near the site of impact (i.e., on-site) and involves replacement of the impacted wetlands with wetlands of similar type (i.e., in-kind). In some unavoidable circumstances, compensation must take place away from the site of impact.

2.6.7.2 Wetlands Compensation Goals

The original intent of wetlands compensation was to attempt to replace the impacted wetlands with one adjacent to it so that species of plants and animals would not be displaced, and wetland functions would not be completely lost. While in many cases this intent remains a viable option, wetlands scientists and resource managers have acknowledged that the on-site and in-kind type of replacement compensation is often not practical. Impracticalities of this option are often shown to outweigh the benefits of doing such. In most cases, the replacement wetland has to be a created wetland, and created wetlands generally have a lower success rate compared to restoring a previously converted wetland, or enhancing a wetland in need of improvement. It is much more difficult to create a wetland where one has not previously existed. The inability to maintain appropriate hydrologic regimes can be a problem, and replacing wetlands occupying specific niches is another. Developers are also wary of the cost of creating versus restoring a wetland. Consequently, "off-site" and even "out-of-kind" compensation projects are now an alternative that have become part of the *mitigation* decision-making process.

Increased flexibility in the wetland's mitigation process has improved the success rate of compensation projects. In the past, the creation, restoration, and even the enhancement of wetlands had been a very inexact science. Through the evaluation of data derived from increased research and completed compensation projects, it has become apparent that the use of replacement wetlands to offset impacts is both viable and more stable. Continually evolving wetlands assessment methodologies, coupled with the identification of planning issues associated with wetlands compensation projects, have contributed to this realization. These planning issues include type of hydrologic source desired (i.e., ground water, surface water run-off, and/or overbank flow); presence/absence of an open water component; type of vegetation needed to develop the desired community type; and geology/soils investigation to determine whether existing substrates are conducive to wetland development.

In addition, the establishment of a more flexible mitigation and compensation process is what State of Delaware resource managers need to properly plan for to ensure conservation of water and wetlands resources. Certain watersheds need improvements whether they are for water quality, habitat, nutrient removal, or any other of the functions that wetlands can provide. Depending on the size of the compensation project, wetlands can be strategically placed to make improvements on either a sub-watershed or watershed level. A very large compensation project, or a wetland's compensation bank, could provide an even greater mechanism to achieve these same goals.

2.6.7.3 Wetlands Compensation Banks

The purpose of wetlands compensation banks is to establish compensation "credits" for wetlands that have been negatively impacted. For example, wetlands in one area or region can be replaced by a created, restored, or enhanced wetland in another. The permit requirements and mitigation sequencing of the federal agencies would be best served by wetlands banks, and the reduction of wetlands impacts as part of the mitigation process results in a need for banks. Through the sequencing process, the result is usually lower amounts of required compensation. Instead of doing a multitude of small compensation projects, a bank can offer more value when the bank is strategically located in a watershed of need. Although there are projects with large impacts, the majority of projects impacting wetlands only require minor compensation.

The siting of wetlands banks can offer a wide range of wetland benefits (e.g., water purification and filtration, flood attenuation, ground-water recharge) and values (e.g., recreation, fish and wildlife habitat, education, aesthetics, uniqueness, and heritage) in comparison to smaller piece-meal wetlands compensation sites. Another advantage of wetlands banks is they can be constructed and functioning (both administratively and ecologically) in advance of project impacts, thereby reducing temporal losses, as well as reducing the risk of failure associated with individual wetlands compensation projects. With individual wetlands compensation sites, the created or restored wetlands are not fully functioning until well after the impact has occurred. In pre-planning these wetland banks, resource management and regulatory agencies can coordinate more effectively, and, through improved planning, provide more attention to meeting multiple ecological objectives. Permit timing is also reduced if compensation wetlands are available at a bank for a developer to use. In summary, establishment of wetland banks can more efficiently combine financial resources, planning expertise, and scientific expertise.

Monitoring of wetland banks may provide information to improve the probability of success for subsequent mitigation efforts. The required monitoring of banks is usually for a five-year period, with a maintenance requirement of much longer duration. This level of monitoring will ensure that the integrity of a wetland bank is maintained.

Wetlands banks have already become a landscape feature in some areas of Delaware. For the most part, the Delaware Department of Transportation has created banks to address impacts associated with roadwork. These banks have occurred mostly near the Route 1 corridor. There are many developers and consultants that have an interest in banking and have expressed their desire to develop banks. These "private sector" banks are in the planning stages and will probably be constructed within the next few years.

At this time, there are no wetlands banks in the Chesapeake Basin, nor are there any planned in the near future. The increase in development within the Basin will ultimately require a wetlands bank to compensate for wetlands impacts within the Basin. There have been small compensation projects within the Basin. These smaller wetlands compensation projects are almost exclusively associated with drainage/tax ditch projects.

2.6.8 CHANNELIZATION

2.6.8.1 Historical Perspective and Need

Many areas of the nation have historically based land uses on an infrastructure of man-made drainage systems. Delaware is no exception, and it has community and private drainage systems that date back to the 1700s. In the 1700s, drainage of wetlands was considered necessary for several reasons (e.g., food was desperately needed for armies and war-ravaged countries, so farming of every available acre was necessary; wetland-related diseases seriously affected populations; timber harvests were essential, etc.). The extensive drainage patterns constructed in early times were extensions of natural drainage patterns into poorly drained upland flats. These channels were constructed to better manage soil and water resources, and for flood protection.

The average annual rainfall in Delaware usually exceeds plant needs and evaporation rates, creating excess water for extended periods. The result is drainage and flooding problems for agricultural areas, as well as towns, rural communities, forests, and transportation facilities.

Without proper drainage systems, soils become oversaturated, or have standing water on them. This situation precludes efficient farming operations, as farmers cannot get into their fields for timely agricultural operations. Adverse effects on crop production include (1) inability to prepare soils for planting; (2) delays beyond optimum planting dates; (3) inhibited plant growth due to excess water in the soil profile; and (4) restricted harvests and/or the inability to harvest. In addition, crops impacted by flooding or poor drainage often under-utilize nutrients, thereby creating potential excess nutrient contamination problems in downstream areas. Approximately 48 percent of the soils in the Chesapeake Basin are poorly drained due to low permeable clay type subsoil.

Today, proper water management for optimizing farming operations has become even more vital due to increasingly complex and expensive equipment and inputs (such as fertilizers and chemicals). The existence of stable drainage systems plays a large role in determining the economic success of most farming operations within the Basin. In addition to farming concerns, many rural roads depend on proper drainage outlets to control flooding and to minimize upkeep and maximize longevity.

For urban communities, controlling surface water runoff is critical. Proper drainage in areas with residential and industrial development is essential for maximum utilization of related facilities. Basements, septic systems, streets, recreational areas, storm-water facilities, parking lots, schools, and businesses all depend on an effective drainage system for proper utilization. Numerous programs, some dating back to the 1700s, have been implemented to address drainage and flooding issues.

The development of a drainage infrastructure in Sussex County received a large boost in 1935 when the Levy Court was authorized to sell bonds for drainage improvements. Ditch company operations for care and maintenance were also turned over to the Levy Court. Additionally, significant assistance came in the 1930s and 1940s with the formation of the Works Progress Administration (WPA) and the Civilian Conservation Corps (CCC). A primary function of these two groups was to construct drainage channels. In 1944, the formation of Conservation Districts further addressed statewide drainage problems. These Districts, with help from the Soil Conservation Service, provided construction equipment, cost-sharing benefits, and technical assistance for survey and design. A significant effort in the reconstruction of drainage channels took place after Public Law 566, known as "The Watershed Protection and Flood Protection Act" was passed in 1954. Most of the tax ditches in the Nanticoke, Marshyhope, and Choptank watersheds were reconstructed as a result of this law and related funding.

Over 200 years of channel work has established a basic drainage system throughout the state. However, maintenance of these systems for most of this time was not formally addressed, and, at best, took place voluntarily. As a result, the condition of the channels has slowly deteriorated due to sediment accumulation and vegetation overgrowth in the channels, and obstruction caused by fallen trees.

2.6.8.2 Tax Ditch Organizations

The Delaware General Assembly enacted the 1951 Delaware Drainage Law to establish ditch companies and to resolve related financial and maintenance issues. As an outgrowth of this law, the Division of Soil and Water Conservation (the Division) is mandated to carry out a comprehensive drainage program through Title 7, Chapter 41 of the *Delaware Code* — Drainage of Lands: Tax Ditches.

A tax ditch is a governmental subdivision of the state. It is a watershed-based organization formed by a prescribed legal process in Superior Court. The organization is comprised of all landowners (also referred to as taxables) of a particular watershed or sub-watershed.

Formation of a tax ditch can only be initiated by landowners who petition Superior Court to resolve drainage or flood protection concerns. Governmental agencies do not initiate the formation process. This petition action results in the Conservation District requesting an investigation by the Division to "determine whether the formation of the tax ditch is practicable and feasible, and is in the interest of the public health, safety and welfare." If so determined, the Conservation District files the petition in Superior Court, and a Board of Ditch Commissioners (as directed by the resident judge) prepares a report on the proposed tax ditch. This report contains all required information per Title 7, Chapter 41, and is the basis for a hearing held for the affected landowners. At the conclusion of the hearing, a referendum is held for the landowners to approve or disprove formation of the tax ditch. The Board of Ditch Commissioners files the results of the hearing and referendum in Superior Court, and the Court holds a final hearing for any person to object to the formation of the tax ditch. Following the outcome of the final hearing, and if deemed appropriate, the Superior Court judge issues a Court Order establishing the tax ditch organization. The Court Order grants permanent rights-of-way to the tax ditch organization for construction and maintenance operations. It also empowers the organization with taxation authority to collect, from all affected landowners, funds to perform this construction and maintenance. Taxation amounts (ditch assessment base) for individual properties are also established through the Court Order.

Ditch managers and a secretary/treasurer oversee the operations of a tax ditch. These officers are landowners within the watershed and are elected at an annual meeting by the taxables.

To date, 228 individual tax ditch organizations have been formed throughout the state. These organizations range in size from the 56,000 acre Marshyhope Creek Tax Ditch to a 2-acre system in suburban Wilmington. These organizations manage over 2,000 miles of channels and provide direct or indirect benefits to approximately 100,000 people and almost one-half of the state-maintained roads. *Map 2.6-2 Drainage Ditch Areas* shows the extent of these organizations in the Chesapeake Basin.

Tax ditch channels range in size from approximately 6 to 80 feet wide, and 2 to 14 feet deep. Size variation is due to the number of acres that drain to a particular site, and the topography of the area. For example, channels constructed through higher areas will be deeper than those going through lower areas. Generally, the more acres served by a channel, the wider it will be. In addition, the bottom "grade" of a channel and the degree of drainage required in an area will necessitate fluctuations in size.

Although tax ditches directly resolve many drainage and flooding problems, their primary purpose is to establish channel outlets for drainage and flood protection. From these channel outlets, individual landowners can construct private channels for use in management of their lands and for implementing various Best Management Practices for conservation.

Dependable drainage and flood protection in the Chesapeake Basin is essential for the management of many resources. Approximately 65 percent of the tax ditch organizations within the state are located in the Basin. Within the Basin, there are currently 148 tax ditch organizations containing approximately 1,528 miles of rights-of-way established for tax ditch management. These channels provide drainage and flood protection for approximately 298,650 acres, or 66 percent of the Basin area. It is estimated that an additional 1,200 miles of private channels exist throughout the Basin.

Tax ditches within the Chesapeake Basin have been organized and constructed utilizing the 1951 Delaware Drainage Law. These organizations are locally managed, with most following federally mandated operations and maintenance plans. The age of these organizations varies from 47 years old to the most recent, which is 3 years old. The older organizations have undergone routine vegetative maintenance and sediment dip-outs. The newer ones are now entering this phase. The condition of most of these channels is very good, although a few isolated organizations have not received adequate maintenance. In most of these isolated cases, negligence was/is mainly due to original landowners dying, and the influx of new landowners to the area. In most cases, these new landowners are simply unaware of the negative impact of a failing drainage system.

Currently, there are only a few areas within the Basin where landowners have petitioned for the formation of a new tax ditch organization. Many (approximately 20 – 30) areas have been investigated to solve small individual drainage problems. These smaller problems will probably be resolved through the public ditch program.

The breakdown of tax ditch data within the Chesapeake Basin on a county level is indicated in the chart above. In addition to tax ditch requests, the Division's Drainage Section also responds to requests (mostly from legislators) for public ditches. Public ditches are generally smaller drainage systems that involve only a few mutually cooperative landowners. In the case of public ditches, landowners voluntarily grant temporary construction easements, usually to a Conservation District or a town/city. There are no provisions for perpetual maintenance by an organized group. The public ditches are planned utilizing the same BMPs used for tax ditches, constructed, and then left to the individual landowner's responsibility for future maintenance. Many isolated drainage problems have been resolved in the Chesapeake Basin utilizing this one-shot approach.

COUNTY	NO. OF TAX DITCH ORGANIZATIONS	% OF BASIN UNDER TAX DITCH MANAGEMENT
New Castle	5	19
Kent	62	95
Sussex	81	59

2.6.8.3 Environmental Concerns and Mitigation

The Division's Drainage Section is responsible for the formation, construction, and maintenance of Group Drainage Associations' tax ditches and public ditches. Historically, the planning and construction of water management systems has been accomplished with only administrative considerations from governmental agencies. The traditional program was a single-purpose program (namely, drainage). Little consideration was given to environmental issues such as habitat or wetlands. As Delaware addressed clearly evident environmental concerns related to industrial and municipal discharge, development, and other areas, the environmental focus eventually progressed beyond these areas to other activities now recognized as also having potentially "significant environmental impacts." Drainage of lands through tax ditches is one such activity.

Various environmental groups and regulatory agencies began to question the potential impacts these projects were having on natural resources. For example, interpretation of the Army Corps of Engineers and state wetland regulations became a frequent, ongoing process used by groups in an attempt to halt or minimize projects. Regulatory exemption requirements for channel construction were tightened, and wetland/habitat mitigation was more frequently required.

Changes in the water management program were initiated in response to these environmental concerns and issues. Additionally, Governor Castle's Executive Order No. 56 mandated state agencies to achieve projects with a no net loss of wetlands. It is now recognized that natural resource impacts resulting from the reconstruction of drainage systems can and should be minimized. Weighing wetland concerns against drainage benefits prior to reconstruction of deteriorated channels has resulted in changes in procedures for selecting which channels to work on and what methods to use. For the past 10 years, numerous governmental agencies have performed a rigorous review process out of which comments are incorporated into related project plans. Ideally, these extensive reviews ensure that environmental impacts are minimized, or at least compensated for when deemed unavoidable. Implementation of this process over the last 10 years has resulted in development of a detailed list of proven environmental practices that minimize impacts. This list has evolved into the Delaware Tax Ditch Best Management Practices (BMPs). Resource managers and planners on all water management projects routinely employ the BMPs. Some of the more significant practices include the following:

1. Minimize clearing widths;
2. Relocate channels around sensitive areas;
3. Perform only one-sided construction;
4. Save trees within construction zone;
5. Minimize construction of downstream outlets;
6. Install berm along wetlands with side inlet pipes at or above biological benchmarks; and
7. Block off old channels that drain only wetland areas.

To complement this effort, the Drainage Section has held wetland/environmental training sessions for both technical and administrative staff members.

The most significant environmental impact from channel construction is the fill and drainage of forested wetlands. Fill results from clearing operations and disposal of excavated materials. Drainage occurs when wetland areas are not protected from surface flow into the channel. Loss or alteration of these wetlands is compensated through the creation or restoration of freshwater wetlands, usually in marginal agricultural fields. During the past 10 years, adherence to planning principles, policies, and conservation management practices has minimized environmental impacts and provided long-term economic and environmental stability.

The Drainage Section has also carried out several projects to test new construction techniques and established demonstration/education sites. Most of the channel construction techniques emphasize minimal clearing and spoil disposal. The demonstration/education sites incorporate these new construction techniques with wetland restoration in adjacent agricultural fields. Three such project demonstrations have been performed in the Chesapeake Basin and have effectively shown that drainage and environmental quality do not have to be mutually exclusive. In addition, drainage channels essentially link upland farms, cities, industrial sites, etc., to receiving bodies of water. Although channels themselves produce very little nutrients or sediment, they *do* represent the primary transport mechanism for these parameters.

Sediment load in drainage channels usually represents a short-term problem that occurs during reconstruction or maintenance events. Once stabilized, within six months to one year after such an event, channels discharge minimal amounts of sediment and actually act as sediment traps as vegetative growth eventually covers the channel bottoms and side slopes. These short-term sediment load problems can be lessened if sediment traps and water-control structures are added. Such practices slow water flow and provide areas for sedimentation and nutrient uptake by plants.

However, when water-control structures are used, a concern exists that phosphorus tied to the sediment trapped upstream of these structures may be re-suspended through saturation. Current studies by Delaware State University on this potential problem are nearing conclusion.

Resolution of nutrient problems within the Basin will hinge on controlling and managing the source of these nutrients through effective use of BMPs for land management in cities, agricultural fields, rural areas, and industrial sites. For drainage channels themselves, increased usage of current and new BMPs for tax ditch construction and maintenance will assist in reducing sediments delivered by drainage channels.

Once tax ditch channels are constructed, maintenance is the primary function of each individual tax ditch organization. Maintenance consists of the routine control of vegetation within the rights-of-way and the periodic removal of accumulated sediment in the channel bottom. Control of woody vegetation adjacent to and within the channel is needed to retain access to the channel for future dip-outs of sediment. Rotary mowers and boom arm mowers have replaced traditional hand labor, utilizing tools such as bush axes. Unfortunately, mowing machines are not selective, and cut all vegetation, including shrubs and grasses that are desirable for wildlife habitat. Mowing is generally performed every other year on established channels.

The Drainage Section and Conservation Districts continually search for viable alternative methods for maintenance. Several attempts have been made to establish vegetative maintenance programs utilizing herbicide application. This method, which decreases maintenance frequency and promotes growth of desirable species, has had varying degrees of success and acceptance by the tax ditch community. Recent experimental attempts include the use of a “weed wiper bar.” This machine applies herbicides to targeted species by a wiping bar and leaves most desirable species untouched.

An alternative to controlling vegetation along rights-of-way for dip-out purposes is to allow trees to fully grow in the channel and along the accessway. This alternative presents a serious access problem every 15 – 20 years, when sediment needs to be removed. The channel and accessway would have to be stripped of this large vegetation, with resultant significant soil disturbance and erosion. By contrast, maintaining vegetation at desired levels (i.e., at heights/densities where dip-outs can readily be performed) is a more preferred method, as minimal channel-bank disturbance occurs during dip-out. As practicable alternative techniques for maintenance are developed, they are slowly incorporated into tax ditch maintenance plans through educational and promotional efforts.

In pursuing further innovations, the Drainage Section has become increasingly involved in David Rosgen's "Geomorphic" approach to streambank restoration and channelization. Geomorphic design concepts are based on the evaluation of local/regional streams to measure natural characteristics that promote channel stabilization. Where applicable, these natural characteristics are integrated into tax ditch channel designs. A demonstration project utilizing these concepts has been implemented as part of the Pratt Farm Water Management project. In this project, a floodplain and sinuous low-flow channel were constructed in a marginal agricultural field to replace the historic straight channel. This Geomorphic approach will require special conditions and very receptive landowners to be successful. The Drainage Section will continue to develop data for use in this initiative as opportunities arise.

2.6.9 REGULATORY PROGRAMS FOR PROTECTION OF AQUATIC AND WETLAND RESOURCES

There are several federal and state level laws designed to protect the water resources and wetlands of Delaware. The most significant statutes at the federal level include the Rivers and Harbors Act of 1899 and the Clean Water Act of 1972. The most significant state laws are the Wetlands Act of 1973 and the Subaqueous Lands Act of 1969. The United States Army Corps of Engineers administers the federal laws. The Wetlands and Subaqueous Lands Section of the Department's Division of Water Resources administers the state laws. Although there are some jurisdictional differences between the federal and state programs, the Corps of Engineers and the Wetlands and Subaqueous Lands Section coordinate their programs to minimize overlapping authority. Additionally, the Wetlands and Subaqueous Lands Section has assumed authority for certain jurisdictional functions formally handled by the Corps of Engineers. Both agencies have developed expedited procedures for reviewing projects under their jurisdiction.

2.6.9.1 Rivers and Harbors Act of 1899

The Rivers and Harbors Act of 1899 regulates activities in navigable waters of the United States. Navigable waters are defined in Delaware as all tidal waters and their tributaries to the head of the tide. In tidal waters, the shore boundary extends to the mean high-water line. In non-tidal waters, the shore boundary extends to the ordinary high-water line.

The law applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or other modifications of a navigable water. The law also applies to construction of structures, including but not limited to, docks, piers, jetties, groins, weirs, breakwaters, shoreline protection (e.g., rip-rap revetments or bulkheads), pilings, aerial or subaqueous utility crossings, intake or outfall pipes, boat ramps, or navigational aids.

2.6.9.2 The Clean Water Act

Section 404 of the Clean Water Act requires authorization from the Army Corps of Engineers for the discharge of dredged or fill material to go into waters of the United States, including wetlands. This Act applies to navigable waters, their tributaries, intermittent streams, lakes, ponds and wetlands. The criteria for determining whether an area is a wetland subject to Corps jurisdiction is contained in the *Corps of Engineers Wetlands Delineation Manual*. The criteria are based on specific vegetation, soil and hydrology characteristics (Environmental Laboratory, 1987).

Permits also are required for temporary fill projects such as temporary fills for access roads, cofferdams, storage and work areas, or dewatering of dredged material prior to final disposal.

2.6.9.3 Federal Permitting Requirements

Permits issued by the Corps of Engineers pursuant to the requirements of the Rivers and Harbors Act and the Clean Water Act are designed to ensure that this nation's water resources are safeguarded and used in the best interest of the people. Environmental, social, and economic concerns are weighed as part of the permit application process. The Corps makes their decision about whether to issue a permit after a thorough analysis of a proposed activity's probable impacts, including its cumulative impact on the public. Numerous factors, including general environmental concerns and existence of wetlands, are taken into consideration. Permits are generally issued unless the Corps of Engineers determines the proposed activity is not in the public interest.

To expedite the permitting process, the Corps of Engineers developed a system of nationwide and general permits designed to reduce the paperwork and time necessary to obtain an individual permit. Nationwide permits allow numerous pre-authorized activities. Activities include bank stabilization, road and utility crossings in wetlands, minor filling of wetlands, filling of headwaters, construction of boat ramps, and placement of mooring buoys. All such activities are conducted under certain pre-authorized conditions mandated by the Corps of Engineers.

General permits are designed to expedite the permitting process for certain structures in navigable waters.

These permits are also designed to meet criteria specific to the state in which they are issued. General permits are issued by the Wetlands and Subaqueous Lands Section.

2.6.9.4 The Wetlands Act

Tidal wetlands in Delaware are protected under the Tidal Wetlands Act of 1973 (7 Del. Code, Chapter 66). The act and the regulations written pursuant to the law regulate activities in tidal wetlands. Tidal wetlands are defined as:

> "Those lands above the mean low water elevation including any bank, marsh, swamp, meadow, flat or other low land subject to tidal action in the state along the Delaware Bay and Delaware River, Indian River Bay, Rehoboth Bay, Little and Big Assawoman Bays, the coastal inland waterways, or along any inlet, estuary or tributary waterway or any portion thereof, including those areas which are now or in this century have been connected to tidal waters, whose surface is at or below an elevation of 2 feet above local mean high water, and upon which may grow or is capable of growing any but not necessarily all of the following plants: [list of plants] and those lands not currently used for agricultural purposes containing 400 acres or more of contiguous non-tidal swamp, bog, muck or marsh exclusive of narrow stream valleys where fresh water stands most, if not all, of the time due to high water table, which contribute significantly to ground-water recharge, and which would require intensive artificial drainage using equipment such as pumping stations, drainfields or ditches for the production of agricultural crops."

Tidal wetlands meeting this definition have been delineated on maps available from the Department. These maps are for public use to determine whether an area is a tidal wetland. The law states that a permit is required for any activity conducted in a tidal wetland. Activities include dredging, draining, filling, or bulkheading. They also include construction of any kind, including but not limited to, construction of a pier, jetty, breakwater, boat ramp, or mining, drilling, or excavation. Projects that are exempted from the permit requirement include mosquito control activities authorized by the Department, construction of directional aids to navigation, duck blinds, foot bridges, boundary stakes, wildlife nesting structures, grazing or domestic animals, haying, hunting, fishing, and trapping.

The Department's Wetlands and Subaqueous Lands Section issues permits. Applications for a permit are evaluated for environmental impact, aesthetic effect, the number and type of supporting facilities, including their environmental impact, and their effect on neighboring land uses. State, county and municipal comprehensive plans for the development and/or conservation of their areas of jurisdiction and economic effect also are considered. All applications are put on public-notice and any comments received are resolved prior to issuance of a permit.

Although not explicitly cited in the law or regulations, mitigation, in the form of creating compensatory wetlands, is required to offset the impacts of displacing wetlands for some public works projects, including those conducted by the state Department of Transportation.

The Wetlands Act has proven very effective in controlling destruction of tidal wetlands. During 1995 through 1996, less than one acre of tidal wetlands was permanently displaced under the permitting process.

Currently, the State of Delaware does not have a regulatory mechanism for protecting non-tidal wetlands. Non-tidal wetlands comprise the vast majority of wetlands in the state, including the Chesapeake Basin. There are no efforts at this time to propose a non-tidal wetlands law.

2.6.9.5 The Subaqueous Lands Act

Rivers, streams, and other bodies of open water are protected under the state Subaqueous Lands Act (7 Del. Code, Chapter 72). The stated purpose of the Subaqueous Lands Act and the regulations written pursuant to the law is to protect subaqueous lands against uses or changes which may impair the public interest in the use of tidal or navigable waters. Subaqueous lands are defined as "submerged lands and tidelands."

Subaqueous lands subject to jurisdiction under the law are shown on U.S. Geological Survey 7.5-Minute Series (Topographic) Quadrangle Charts for the State of Delaware. The law states that a permit is required for certain activities conducted in subaqueous lands. Activities include dredging, draining, or filling, and construction of any kind.

Permits are issued by the Wetlands and Subaqueous Lands Section. The Regulations Governing the Use of Subaqueous Lands stipulate that no activity may be undertaken which might contribute to the pollution of public waters, adversely impact or destroy aquatic habitats, or infringe upon the rights of public or private owners. The regulations specify the requirements for constructing boat docking facilities, shoreline erosion control measures, and activities involving dredging, filling, excavating, or extracting materials in public and privately owned subaqueous lands. Applications for permits are put on public notice to solicit public input. The application process is also coordinated with the Army Corps of Engineers.

To expedite the permitting process, a system of statewide activity approvals has been developed by the Wetlands and Subaqueous Lands Section. The statewide activity approvals provide an abbreviated review process and authorization for relatively small projects. Applicable projects range from docks or rip-rap revetments in artificial lagoons to placement of utility lines across streams. Repair and replacement of existing structures is handled by an abbreviated review process and follow-up Letter of Authorization.

2.6.10 WETLAND FUNCTIONS AND VALUES

For many years, wetlands were viewed as disease ridden, worthless wastelands requiring filling, dredging, or channelization. This view has changed significantly in recent years, as the connection between wetlands wildlife, water quality, and other ecological and economic factors has been studied.

Research over the past couple of decades has found that wetlands provide many benefits to society. In fact, some of these values are vital to man's existence. Wetlands intercept pollutants and nutrients from upland runoff and protect organisms dependent on clean water (humans included) from the poisonous effects of both nonpoint and point source pollution.

Ecological processes inherent in wetland ecosystems are usually described by *functions*. An example of a function would be wildlife habitat support. Further classification of a function, on the basis of its value, connotes usefulness to humans. The location of the wetland, human pressures on it, or the extent of the wetland may indicate the value of a functional ecologic process (Mitch and Gosselink, 1986). For example, clean water associated with wetlands provides drinking water to upland species, provides an uncontaminated environment necessary for many fish species, and ultimately, recreational value, in the form of hunting and fishing for humans.

It is important to keep in mind the differences between functions and values. Functions are things that a wetland does and are independent of our attempt to assign an arbitrary monetary value to them. In contrast, values are primarily human constructs, subject to whims of the marketplace. As a result, a wetland with a given function in one locality may be more highly valued than a wetland of similar function in another locality.

Because wetlands are diverse and occupy a variety of habitats, they do not all provide the same functions and values. Therefore, it is generally difficult to determine a wetland's function without a specific site analysis. Variables to consider in assessing a wetlands function include wetland type, soils, hydrology, size, and adjacent land use.

Current development practices ignore the importance of preserving wetlands with specific functions crucial to maintaining the environmental integrity of a region or watershed. In other words, we have been allowing development in areas (i.e., wetlands) normally deemed unsuitable for conventionally designed septic disposal systems simply because recent technology has enabled us to site alternative septic disposal systems that overcome the limitations imposed by site hydrology. Such development has been carried out without any attempt to assign any ecological or monetary value to the lost wetland functions. Conversely, if we should eliminate alternative technologies, are we then "backdooring" a freshwater wetlands program through the septic site evaluation process?

According to Wohlgemuth (1991), wetlands offer three broad categories of values: fish and wildlife habitat values, environmental quality values, and socioeconomic values.

2.6.10.1 Fish and Wildlife Habitat

Wetlands provide food and habitat for a variety of fish, birds, mammals, amphibians, reptiles, and invertebrates. Some of these animals are either fully or partially dependent on wetlands to complete their respective life cycles. Most commercially important fish species, for example, are wholly dependent on wetlands for spawning and nursery areas. Wetlands also provide breeding ground and habitat for a variety of waterfowl species and furbearers. Some species of frogs, toads, and salamanders depend on wet habitat for their survival, and provide food for animals in higher trophic levels. Reptiles, such as turtles and snakes, use these areas for the same reasons as the above. Invertebrates, such as aquatic bugs or insects, are important in the maintenance of the food web.

Additional information on the interdependence of wetlands with fish and wildlife habitat can be found in the Living Resources section (2.7).

2.6.10.2 Environmental Quality Benefits

Wetlands are considered among the most productive ecosystems in the world. Wetland plants produce more plant material than most very productive cultivated farm fields. The major value of wetland plants occurs when the plants die and are broken down into detritus by bacteria and other microorganisms. Detritus forms the base of the food web that supports higher animals such as commercial fish species. Wetlands also help maintain and improve water quality.

The following are specific environmental quality benefits of wetlands:

- Pollutant removal (heavy metals, pathogens)
- Sediment trapping
- Nutrient uptake and recycling
- Oxygen production
- Wastewater treatment
- Storm-water treatment

2.6.10.3 Socioeconomic Values

Some of the benefits that wetlands provide are benefits of more tangible economic value, such as protection from flood and storm damage. Because these benefits provide dollar savings, they tend to be more appreciated.

The following are some socioeconomic wetland values:

- Flood and storm-water damage protection
- Erosion control
- Water supply and ground-water recharge
- Natural products supply (e.g., timber, fish, wildlife, firewood, etc.)
- Recreation (e.g., waterfowl, fishing, boating, nature study, etc.)

2.6.11 DATA GAPS AND RECOMMENDATIONS

1. Need to develop baseline wetland losses in Chesapeake Basin and identify areas that are losing wetlands due to urbanization and/or agriculture.
2. Recommend that the Department develop BMPs for pond maintenance and remediation.
3. Promote the acquisition and protection of wetlands and natural heritage sites.
4. Adopt department-wide comprehensive wetland plan.
5. Examine current pond management approaches and develop a more effective, broad-based management approach. Educate pond managers and concerned public to the problems confronting the eutrophication problem in ponds.
6. Establish a methodology for discouraging development in Sensitive Areas.
7. Adopt statewide wetland mitigation policy. Include the concept of "Land Banking."
8. The Statewide Wetland Mapping Project data should be compared with the Natural Heritage Inventory to identify areas where additional research and/or protection are needed.
9. Develop Best Management Practices and an accompanying manual that promotes riparian buffers to help trap nutrients and improve water quality in both channelized and natural streams.
10. Promote the establishment of forested wetlands and upland forest to supplement and/or restore natural riparian buffers.
11. Implement the channelization BMP manual that promotes riparian buffers to help trap nutrients and excessive overland runoff. Alternative maintenance techniques should be considered, including saving trees, mowing along one side of ditch, use of herbicides for those landowners who refuse to establish woody vegetation, or not mowing at all.
12. Educate the agricultural community and other people affected by ditching that drainage and wetlands habitat can coexist if managed properly.
13. Require the use of existing and new BMPs for channel construction activities.
14. Finalize products of the Department's Comprehensive Tax Ditch Committee.

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