Chapter 1

The Science

I. Wetland Values and Functions

This is a book about wetlands, and the laws that protect wetlands. It seems only natural, therefore, to begin the book by looking at the reasons that there are laws to protect wetlands. This first chapter begins with a focus on the values and functions of wetlands.

In the 19th century, wetlands were considered "a menace, the cause of malaria, and a hindrance to land development." *See* U.S. Congress, Office of Technology Assessment, OTA-O-206, *Wetlands: Their Use and Regulation* 37 (Mar. 1984). Attitudes towards wetlands have changed greatly since then as scientists and the public have discovered the societal benefits and important ecological functions of wetlands. The United Nations Millennium Ecosystem Assessment determined that the ecosystem services provided globally by wetlands in 1997 were worth 15 trillion dollars. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, Wetland Ecosystem Services - An Introduction. Consequently, wetlands frequently provide far greater economic benefits as part of healthy functioning ecosystems than they would provide after being converted to other uses. *Id.* The "ecosystem services" and other values and functions provided by wetlands include:

- ***Provision of Habitat / Protection of Species and Biodiversity***
- ***Flood Control***
- ***Erosion Prevention and Shoreline Stabilization / Protection***
- ***Water Quality Protection*** (removal of sediments, nutrients and toxics)
- ***Groundwater Replenishment***
- ***Climate Regulation***
- ***Wetland Products*** (timber, food products, etc.)
- ***Recreation, Aesthetics, and Education***
- ***Protection of Cultural Values***

Not every wetland provides all of the functions outlined above. The services that each wetland provides will vary based on the type of wetland, its size and location. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - An Introduction*. However, the services that each wetland provides generally benefit much broader segments of the public than would be benefitted by the conversion of the wetlands to unsustainable uses. *Id.* It is not always easy to get that message across, though, as, in the past, there has frequently been a lack of concrete economic data available to demonstrate the monetary value of preserving wetlands in their natural state. *Id.* In addition, some of the values provided by wetlands, such as recreation, aesthetics, education, research and protection of cultural values, are difficult to quantify in dollar figures. Nevertheless, methods for assessing the value of ecosystem services are maturing and a recent study demonstrated that coastal wetlands in the United States provide storm protection worth over 23 billion dollars per year, so that the conversion of one hectare (about 2 ½ acres) of coastal wetlands would eliminate about 33,000 dollars worth of storm protection per year. *Id; see also* Institute for European Environmental Policy, *The Economics of Ecosystems and Biodiversity for Water and Wetlands* 19-33 (2013).

Many of the values and functions provided by wetlands, such as water quality protection, flood control, shoreline stabilization, atmospheric maintenance, and groundwater replenishment, are tied to the integral role of wetlands within the hydrologic cycle. Wetlands receive, store and release water physically through ground water and surface water, and biologically through transpiration by vegetation. *See* U.S. Environmental Protection Agency, Watershed Academy Web, *Distance Learning Modules on Watershed Management, Wetland Functions and Values* 5 [hereinafter "Watershed Academy Web"]*; see also* Institute for European Environmental Policy, *The Economics of Ecosystems and Biodiversity for Water and Wetlands* 5-6 (2013). Wetlands are frequently referred to as "nature's kidneys". *See* Association of State Wetlands Managers, *The Compleat Wetlander: Wetlands - Nature's Kidneys and Other Specialized Services* (Feb. 23, 2010). The United States Supreme Court recognized the central role that wetlands play in the hydrologic cycle and discussed the importance of protecting wetlands in order to protect ecosystems in *United States v. Riverside Bayview Homes*, 474 U.S. 121, 132-133 (1985). The diverse values and functions that wetlands provide are discussed in more detail in the following sections.

A. Provision of Habitat / Protection of Species and Biodiversity

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Wetlands are sometimes referred to as "nurseries of life" because they provide the essential elements of habitat - food, water, and shelter - for thousands of species of aquatic and terrestrial plants and animals. *See* U.S. Environmental Protection Agency, *Wetlands Overview*. Almost 50% of endangered animal species in the United States depend on wetlands for survival and viability, even though wetlands only occupy about 3.5% of the land area in the U.S. *See* William J. Mitsch, James G. Gosselink, *Wetlands* 344 (4th ed. John Wiley & Sons, 2007). More generally, according to Fish and Wildlife Service estimates, 43% of all of the federally listed endangered or threatened species rely on wetlands either directly or indirectly. *See* *Watershed Academy Web,* at 7. Not surprisingly, therefore, the Secretariat for the Ramsar Convention on Wetlands has referred to wetlands as "reservoirs of biodiversity." *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - An Introduction* Globally, coastal wetlands "contain some of the most biologically diverse and productive communities in the world." *Id.*

Wetlands are not just habitat for *endangered or threatened species*, though. About 80% of the breeding bird population in the United States rely on wetlands for their primary habitat. *See* Mitsch & Gosselink, *supra* at 336. Between 1950 and 1994, for instance, the coastal wetlands in the Chesapeake Bay Region supported an annual average of 79,000 black ducks and 14,000 pintails on their southernly migration. *See* *Watershed Academy Web*, at 7. Two thirds of the 10-12 million migratory waterfowl in the continental United States reproduce in the prairie pothole wetlands of the Midwest. *See* U.S. Environmental Protection Agency, *Wetlands Overview*. Many animals, including beavers and wood ducks, and plants, including wild rice and cattails, rely almost exclusively on wetlands. *Id.* at 6.


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Wetlands provide rich habitats for several reasons. In many wetlands, the shallow water, high levels of inorganic nutrients, and high rates of productivity of new plant biomass combine to provide ideal conditions for the development of organisms at the bottom of the food chain. *See* U.S. Environmental Protection Agency, *America's Wetlands: Our Vital Link Between Land and Water* 6-7 (2003) [hereinafter "*America's Wetlands*"]. In addition, the plant biomass in the wetlands is increasingly enriched as it breaks down due to bacterial, fungal and protozoan activity. *Id.* at 6. The biomass provides food for small invertebrates and fish, which, in turn, provide food for larger amphibians, reptiles, fish, birds and mammals. *Id.* The high levels of biomass and invertebrate life make wetlands an important nursery area for many fish and shellfish. *See* *Watershed Academy Web*, at 7. Further, many species of fish rely on wetlands because they require areas of shallow water for breeding and feeding, or for some other portion of their life cycle. *Id.* at 4; *see also* William A. Niering, *Wetlands* 32 (Chanticleer Press, 1985).

B. Flood Control

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Wetlands help prevent or minimize flooding and flood damage by storing and slowing water. *See* *America's Wetlands*, at 8. Like sponges, wetlands absorb and slowly release rain, snow melt, groundwater and surface water, including flood waters. *Id.* By doing so, they reduce the speed and volume of runoff entering streams and rivers. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - Flood Control [hereinafter "Ramsar - Flood Control"]* The trees and vegetation in wetlands can also slow the speed of flood waters and distribute them over the floodplain. *See* *America's Wetlands*, at 8. By storing and slowing water, wetlands can reduce flood heights and reduce erosion downstream. *See* *Watershed Academy Web*, at 9. The flood control benefits provided by wetlands can be particularly important near urban areas where there are significant volumes of runoff from pavement and buildings. *Id.* Regardless of where the wetlands are located, though, by reducing flooding and flood damages, wetlands provide economic benefits, by reducing property damages, and protect health, safety and welfare. *Id.* at 10.

When wetlands within a floodplain are converted to other uses, peak river discharges following snowmelt or heavy rains that used to dissipate broadly across the floodplain are concentrated in a smaller area, leading to deeper and more damaging floods. *See* *Ramsar - Flood Control*. Prior to significant filling and draining, the bottomland hardwood riparian wetlands of the Mississippi River used to store almost 60 days of floodwater. *See* *America's Wetlands*, at 8-9. Now, they only store about 12 days of floodwater. *Id.* Engineered flood control measures, such as dredging or the construction of levees, are significantly more expensive than preserving or restoring wetlands. *Id.* A study in Minnesota determined that it would cost 1.5 million dollars per year to replace the flood control provided by 5000 acres of drained wetlands. *See* *Watershed Academy Web*, at 10.

Coastal wetlands can play a significant role in protecting communities from storm surges and conversion of those wetlands reduces those natural defenses. *See* *Ramsar - Flood Control*. When Hurricane Katrina inundated 80% of the City of New Orleans in 2005, many experts suggested that the destruction of significant amounts of coastal wetlands in the decades prior to the storm, and the artificial constriction of the Mississippi River's floodplains contributed to the magnitude of the flooding. *Id.* Protection of coastal wetlands is particularly important in light of the fact that 39% of the U.S. population lived in coastal shoreline counties in 2010, even though those counties represented less than 10% of the land area of the United States (excluding Alaska). *See* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA's State of the Coast*. In addition, the population in those counties increased 39% between 1970 and 2010. *Id.*

C. Erosion Prevention and Shoreline Protection/Stabilization

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Just as wetlands prevent or reduce flooding by storing and slowing water flows, they also protect shorelines and stream banks from erosion**.** *See* *America's Wetlands*, at 9. The roots of wetland plants stabilize the soil and the plants absorb wave energy and break up currents. *Id.* Erosion prevention can provide significant benefits, as coastal erosion causes 500 million dollars in coastal property loss each year, including damage to structures and conversion of land to aquatic areas. *See* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, *Coastal Hazards*. A study by the Heinz Center in 2000 estimated that erosion may destroy one quarter of the houses located within 500 feet of the shoreline by the middle of this century. *Id.* The federal government spends about 150 million dollars each year on erosion control measures. *Id.* In recognition of the erosion prevention benefits of wetlands**,** some states are restoring coastal wetlands to provide buffers from storm surges. *See* *America's Wetlands*, at 9.

D. Water Quality Protection

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Wetlands play a vital role in protecting and improving water quality by removing sediments, organic and sometimes toxic pollutants, and excess nutrients from water and storing and/or processing those materials. *See* *America's Wetlands*, at 8. Wetland soils and vegetation capture and retain nutrients in water that might otherwise cause dangerous levels of nutrients in groundwater that serves as a drinking water source or cause eutrophication of downstream water bodies. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - Water Purification [hereinafter "Ramsar - Water Purification"]*. Eutrophication of water bodies causes massive growth in algae, which depletes oxygen in the water and blocks sunlight which is essential for many of the plants and animals in the water. *Id.*

Just as wetlands remove and store nutrients, wetland plants trap suspended sediments that could otherwise smother downstream spawning areas, insects and plants. *See* *America's Wetlands*, at 8. In addition, increased turbidity in streams caused by excess sediments can lead to increased water temperatures, reduced light penetration and plant growth, and reduced visibility in the stream, making it more difficult for fish to find prey. *See* North Carolina State University, Department of Biological and Agricultural Engineering, *Soil in Our Streams*, Stream Notes, Vol. 1, No. 1 Some wetland animals, such as oysters in the Chesapeake Bay, can even help to filter out nutrients and sediments from water tha flows through wetlands. *See* *Ramsar - Water Purification*.

Wetland plants also protect water quality by removing and storing organic wastes. *See* *America's Wetlands*, at 8. There are clear economic benefits associated with this filtering function, as a 1990 study determined that the Congaree Swamp in South Carolina removes as much pollution from the water as would be removed by a 5 million dollar wastewater treatment plant. *Id.* Similarly, in 1997, the city of New York determined that it could spend less than half as much to protect the city's water quality by purchasing and protecting wetlands than it would spend if it constructed new wastewater treatment plants. *See* *Ramsar - Water Purification*. Governments and developers are even constructing wetlands to remove nutrients or waste from contaminated water. *Id.*

Some wetland plants can even remove heavy metals and other toxic substances from the water that flows through wetlands. *Id.* As a result, wetlands are being constructed to treat wastewater from mining and other activities, as well as to treat sewage effluent. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - Sediment and Nutrient Retention and Export*.

Although wetlands can provide these water quality protection features, excessive levels of nutrients, sediments, or pollutants in wetlands can degrade the wetlands and reduce or eliminate many of the values that they would otherwise provide. *See* *Watershed Academy Web*, at 9.

E. Groundwater Replenishment

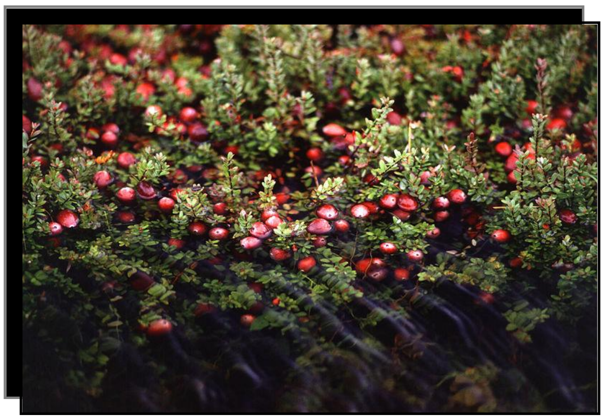
Depending on their location and type, wetlands may maintain stream flow during dry periods and may replenish groundwater. *See* *America's Wetlands*, at 8. Although some wetlands have no connection to groundwater, others are located on permeable soils overlaying aquifers. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - Groundwater Replenishment.* In those wetlands, water can percolate through the soil into the aquifer to recharge the aquifer when the water table is low. *Id.* Conversely, when the water table is high, the wetland can serve as a groundwater discharge zone. *Id.* Globally, almost 95% of available fresh water is contained in groundwater aquifers, and one third of the world's population relies on groundwater for drinking water. *Id.* One of the most productive groundwater sources in the United States is the Floridan aquifer system, which stretches throughout Florida, souther Georgia, and portions of South Carolina and Alabama. *See* *Watershed Academy Web*, at 9. Wetlands in Florida play an important role in recharging that aquifer, as a study found that goundwater in a particular area of the aquifer would be reduced by 45% if 80% of a 5 acre Florida cypress swamp in the area was drained. *Id.*

F. Climate Regulation

While many of the values and functions of wetlands are tied to water and water quality, wetlands can also provide climatic benefits. Some wetlands, especially peat bogs, store large amounts of carbon, functioning as "carbon sinks". *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - Climate Change Mitigation & Adaptation*. By doing so, they help slow the rate of greenhouse gas emissions that contribute to global climate change. *Id.* However, when wetlands are converted for development, trees and vegetation are removed and sometimes burned, releasing the carbon that *was* stored in the wetlands into the atmosphere. *Id.* Those releases may be significant. A recent study indicated that damage to peatlands caused greenhouse gas emissions equal to 1/10 of the emissions from the worldwide use of fossil fuels. *Id.*

Wetlands will be impacted by, and impact society's response to climate change in several ways. First, to the extent that climate change results in the predicted sea level rise and extreme weather events, wetlands will play an important role in adaptation due to the flood control, erosion prevention, groundwater replenishment, habitat protection, and water quality protection functions that they can serve. *Id.* They can only provide those benefits, though, if they survive. Unfortunately, the United Nations Intergovernmental Panel on Climate Change (IPCC) cautions that wetlands are among the ecosystems "most vulnerable to climate change." *Id.*

G. Wetland Products



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Wetlands may also provide more tangible economic benefits in the form of products that can be harvested from them. Cranberries, blueberries, rice and many other plants are produced in wetlands. *See America's Wetlands*, at 10. Various medicines can also be extracted from wetland plants and soils. *Id.*

Timber is frequently harvested from wetlands, and there are 55 million acres of wetlands supporting timber harvesting in the United States. *See* U.S. Environmental Protection Agency, EPA-841-R-02-001, *National Water Quality Inventory, 2000 Report* 45 (2002) *[hereinafter "2000 National Water Quality Inventory"]*. Fish and shellfish are another wetland "product." In the southeastern United States, about 96% of the fish and shellfish that are harvested commercially, and 50% of the fish that are caught by recreational fishers, rely on estuarine or coastal wetlands. *See Watershed Academy Web*, at 11. Nationally, about 75% of the fish and shellfish that are harvested commercially depend on wetlands for food or habitat. *Id.* More than 2 billion dollars worth of fish and shellfish are harvested commercially in the United States every year. *Id.*

Wetlands provide essential habitat for several other animals that are trapped and sold commercially, including muskrat, beaver, otter, mink and alligators. *Id.* at 12. In 2000, EPA estimated that more than 70 million dollars worth of muskrat pelts were harvested every year. *See 2000 National Water Quality Inventory*, at 45.

H. Recreation, Aesthetics, Education and Research

In addition to the values outlined above, wetlands often provide opportunities for recreation, education and research. EPA estimates that more than half of the adult population in the United States hunts, fishes, engages in bird-watching or photographs wildlife, and that they spend about 59.5 billion dollars per year on those activities. *See America's Wetlands*, at 10. A 2011 survey conducted by the Fish and Wildlife Service found that the annual expenditures had increased to 144.5 billion. *See* U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, *2011 National Survey of Fishing, Hunting, and Wildlife Associated Recreation* 4 (2011). A significant amount of that hunting, fishing, or wildlife watching takes place in wetlands, as the natural beauty and diversity of animal and plant life in many wetlands promotes recreational tourism. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services - Recreation & Tourism [hereinafter "Ramsar - Recreation and Tourism"].* In EPA's National Water Quality Inventory report to Congress in 2000, the agency indicated that "[a]t least $18 billion in economic activity is generated annually from recreational fishing in coastal wetlands by 17 million Americans." *See 2000 National Water Quality Inventory,* at 45.

While hunting, fishing and bird-watching attract many people to wetlands, others visit to hike, boat, paint, photograph, record, or otherwise appreciate the beauty and aesthetics of the wetland ecosystems. *See America's Wetlands*, at 10. Many of those wetland values are difficult to capture in purely economic terms.

Wetlands provide rich educational opportunities for students of all ages, ranging from grammar schools through adult continuing education programs and programs at nature centers. *See Watershed Academy Web*, at 13. As EPA notes, wetlands are excellent sites "to learn about vegetative structure ... and ecological functions ..., natural ecological processes ..., biodiversity, and plant-animal interactions." *Id.*

While wetlands can provide significant recreational and educational opportunities, some recreational or tourism uses of wetlands could harm wetlands, so wetland managers frequently must limit recreational and educational uses to specific areas to protect the wetlands. *See Ramsar - Recreation & Tourism*.

I. Protection of Cultural Values

In some cases, wetlands can also be closely tied to the cultural heritage of the surrounding communities. The songs, music, dance, art, literature, stories and rituals of an area may be deeply influenced by the wetland ecosystem in which it is located. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *The Cultural Heritage of Wetlands: Wetlands, An Inspiration in Art, Literature, Music and Folklore*. Like the aesthetics of wetlands, these values are difficult to measure in purely economic terms, but are vital to the communities. *See* Ramsar Convention on Wetlands, Ramsar Convention Secretariat, *Wetland Ecosystem Services: Cultural Values*. As the wetlands disappear, the ties to the land and many of the stories, rituals and traditions of the communities could disappear as well.

Questions and Comments

1. If the services that each wetland provides will vary based on the type of wetland and its size and location, should all wetlands be provided the same level of protection? Are they provided the same level of protection? Think about those questions as you read about the standards that the government uses to determine whether to issue a permit to authorize development in wetlands, the process that the government uses to determine appropriate mitigation for destruction of wetlands, the manner in which the government structures its enforcement programs, the analysis that is used to determine whether government restrictions on wetlands development constitute a taking, and other issues throughout this book.

RESOURCES

EPA Video - Wetlands and Wonders - Reconnecting Children with Nearby Nature
EPA's Watershed Academy - Wetland Values and Functions
EPA - America's Wetlands
Wetlands: Their Use and Regulation (1984 OTA report)
EPA Watershed Academy Webinars (including wetlands)
Videos on wetland values and functions from Conservation Media, GreenTreks Network (Pennsylvania's wetlands), Delaware DNREC, Oklahoma Gardening
Liquidity: The Value of Wetlands - independently produced video
EPA's Connectivity Study - Connectivity of Wetlands and Streams to Downstream Waters

II. Definition and Types of Wetlands

A. Definitions

In general terms, wetlands are "lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface." *See* U.S. Environmental Protection Agency, *Wetland Definitions.* That description, which appears on the web site of the Environmental Protection Agency (EPA), is adapted from a more elaborate definition adopted by the United States Fish and Wildlife Service, which administers a National Wetlands Inventory, as part of its "Cowardin" classification system (named for the scientist who developed it). The Fish and Wildlife Service definition for wetlands is:

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

See L. Cowardin, et al., U.S. Department of the Interior, Fish and Wildlife Service, *Classification of Wetlands and Deep-Water Habitats of the United States* (1979).

EPA and the Army Corps of Engineers have adopted the following conceptually, though not linguistically, similar definition of wetlands for their regulatory programs:

> those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

See 33 C.F.R. § 328.3 (b) (Corps' regulations); 40 C.F.R. § 230.3(t) (EPA's regulations).

Although the Fish and Wildlife Service has developed maps of wetlands as part of its National Wetlands Inventory, the maps are not designed or intended to be used for legal or regulatory purposes to identify the existence of, or boundaries of, wetlands. *See* U.S. Fish and Wildlife Service, *National Wetlands Inventory:*

Frequently Asked Questions. Instead, as outlined in Part IV of this chapter, both the classification of a specific piece of property as a wetland and the boundaries of the wetland are determined through a process known as delineation. The delineation process focuses on whether the property has the ***soils***, ***vegetation***, and ***hydrology*** that are typically found in wetlands.

B. Types of Wetlands

There are many different ways to categorize or classify wetlands. This section begins by examining the Cowardin classification system developed by the Fish and Wildlife Service, takes a closer look at four common types of wetlands, and then focuses on the Hydrogeomorphic (HGM) classification system that categorizes wetlands based on the values and functions that they provide.

1. Cowardin classification

Using the Cowardin classification system mentioned above, the Fish and Wildlife Service identifies the following five types of wetland and deepwater habitat systems:

- **Marine**
- **Estuarine**
- **Lacustrine**
- **Riverine**
- **Palustrine**

Marine systems encompass the open ocean and coastlines, and include coastal lagoons, rocky shores and coral reefs. *See* L. Cowardin, et al., U.S. Department of the Interior, Fish and Wildlife Service, *Classification of Wetlands and Deep-Water Habitats of the United States* 4 (1979).

Estuarine systems encompass deepwater habitats "that are usually semi-enclosed by land but have ... access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land." *Id.* at 4. Estuarine systems include areas such as deltas, tidal marshes, coastal brackish areas, and mangrove swamps. The marine and estuarine systems are generally salt water habitats. The other systems are generally fresh water habitats, although there are some tidal riverine systems.

For wetlands, **lacustrine** systems generally refer to wetlands associated with lakes and reservoirs. *Id.* at 9-10. Similarly, the wetlands included within **riverine** systems are generally wetlands associated with rivers and streams. *Id.* at 7-8. However, whether wetlands in or near rivers, lakes or streams fit within the lacustrine or palustrine categories, or another category, will depend on the amount of "trees, shrubs, persistent emergents, emergent mosses or lichens" in the wetlands. Riverine systems do not include wetlands dominated by those features, and lacustrine systems do not include wetlands where those features cover more than 30% of the wetlands. *Id.* at 7-10. Wetlands associated with rivers and lakes that do not fit within the lacustrine or riverine systems are included with the much broader final category of wetlands, the palustrine system. The **palustrine** system includes "all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens" and similar wetlands in some tidal areas. *Id.* at 10. The system includes marshes, swamps, bogs, fens, and prairies. *Id.* Most of the wetland acreage in the United States is within this category. According to a recent Fish and Wildlife Service report, in 2009, 88% of the wetlands in the conterminous United States were in the palustrine system. *See* Stedman, S. & T.E. Dahl, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Department of the Interior, Fish and Wildlife Service, *Status and Trends of Wetlands in the Coastal Watersheds of the Conterminous United States:2004 to 2009* 38 (2013).

2. Marshes, Swamps, Bogs, and Fens

Within the various wetland and deepwater habitat systems identified above, the most prevalent types of wetlands are marshes, swamps, bogs, and fens. The differences between those types of wetlands are described in the following sections.

Marshes

Marshes are wetlands that are characterized by soft stemmed herbaceous plants, such as cattails and pickerelweed, *see* Niering, *supra*, at 21, and are frequently or continually inundated with water. *See* U.S. Environmental Protection Agency, *Marshes*. While some marshes may be fed by groundwater, marshes usually receive most of their water from surface water. *Id.*

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Tidal marshes are most prevalent on the east coast of the United States and along the Gulf of Mexico . *Id.* **Non-tidal marshes** are "the most prevalent and widely distributed wetlands in North America." *Id.* Non-tidal marshes are often found in poorly drained depressions along streams and in the shallow water along lakes, rivers, and ponds. *Id.*

Included within the category of **non-tidal marshes** are ***freshwater marshes, wet meadows***, ***wet prairies, prairie potholes, vernal pools*** and ***playa lakes***. **Wet meadows** commonly occur in poorly drained areas, resemble grasslands, and are generally drier than other marshes except during seasonal high water periods. *See* U.S. Environmental Protection Agency, *Wet Meadows*. They frequently are found in agricultural areas. *Id.* **Wet prairies** are similar to wet meadows, but are wet for longer periods of time. *See* U.S. Environmental Protection Agency, EPA-843-F-01-002b, *Types of Wetlands* (Sept. 2001). **Prairie potholes** are depressional wetlands that are found most frequently in the upper midwest. *See* U.S. Environmental Protection Agency, *Prairie Potholes*. Many species of migratory waterfowl rely on these wetlands for breeding and feeding. *Id.* **Vernal pools** are seasonal depressional wetlands found primarily on the west coast and in the glaciated areas of the northeast and midwest. *See* U.S. Environmental Protection Agency, *Vernal Pools*. They are covered by shallow water during periods of the winter and spring, but may be dry for the summer and fall. *Id.* They are usually found in gently sloping grassland plains and usually overlay bedrock or a layer of hard clay. *Id.* **Playa lakes** are round hollows usually found in the southern high plains and are only present for short periods during the year. *See* U.S. Environmental Protection Agency, *Playa Lakes*. They are vital because they store water in a region of the country that receives very little rain and has no permanent rivers or streams. *Id.*

Swamps

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Swamps are wetlands dominated by woody plants, such as trees and shrubs. *See* Niering, *supra*, at 22. The soils are saturated during the growing season and standing water is not uncommon during certain times of the year. *See* U.S. Environmental Protection Agency, *Swamps*. Swamps are generally divided into two types, **forested swamps** and **shrub swamps**, depending on the vegetation present. *Id.*

Forested swamps are found throughout the United States and are frequently inundated with surface water from rivers and streams. *Id.* While they vary by geographic region, trees typically found in forested wetlands include red maple, white oak and bald cypress. *See* U.S. Environmental Protection Agency, EPA-843-F-01-002b, *Types of Wetlands* (Sept. 2001). Forested swamps in the south central United States are generally referred to as **bottomland hardwood swamps**.

Shrub swamps are similar to forested swamps and sometime found adjacent to them, but are dominated by shrub vegetation. See U.S. Environmental Protection Agency, *Swamps*. They are often found along streams and in floodplains, although there are also tidal shrub swamps, including **mangrove swamps**. *Id.*

Bogs and Fens

Bogs are acidic peatlands, often covered by a blanket of sphagnum moss. See U.S. Environmental Protection Agency, *Bogs*. They are mostly found in the northeast and the Great Lakes region (**northern bogs**), although they can also be found in the southeast (**pocosins**) and receive most of their water from precipitation, as opposed to runoff, groundwater or streams. *Id.* Large amounts of carbon are stored in the peat deposits in bogs, so these wetlands play an important role in minimizing and adapting to climate change. *Id.*

Fens also are peatlands, but receive water from groundwater as well as precipitation. See U.S. Environmental Protection Agency, *Fens*. Consequently, they are less acidic and have higher nutrient levels than bogs and can support a greater diversity of plants and animals. *Id.*

3. Hydrogeomorphic (HGM) Classification

The hydrogeomorphic (HGM) classification system is a system developed by the U.S. Army Corps of Engineers to classify wetlands and other aquatic systems based on their ability to perform various functions. The HGM system was originally developed in 1993 as a tool to classify wetlands based on their **location within a landscape** ("geomorphic setting" - i.e., location on a hillside, in a valley, adjacent to rivers) and their **hydrology** (based on the source of the water in the wetland, such as runoff, groundwater or precipitation; the flow rate of water; and the duration of water in the wetland). *See* Mark M. Brinson, U.S. Army Corps of Engineers, *Technical Report WRP-DE-4, A Hydrogeomorphic*

Classification for Wetlands (Aug. 1993). It was expanded a few years later to focus on assessing the **functions** of wetlands, based on the original HGM classifications. *See* R. Daniel Smith, U.S. Army Corps of Engineers, *Technical Report WRP-DE-9, An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices* (Oct. 1995). The HGM system was originally designed for use in the Clean Water Act section 404 permit program that the Corps administers, *see* Chapter 2 of this book, but, in 1997, most federal agencies that had jurisdiction over wetlands under various laws agreed to use the HGM system to assess wetland functions. *See* U.S. Army Corps of Engineers, *The National Action Plan to Implement the Hydrogeomorphic Approach to Assessing Wetland Functions*, 62 Fed. Reg. 33607 (June 20, 1997). Pursuant to that 1997 "National Action Plan", the Corps of Engineers has developed a series of regional guidebooks to explain the process for applying the system to various HGM classes across the United States. *See* U.S. Army Corps of Engineers, *Guidebooks*.

The HGM classification system divides wetlands into the following seven classes:

- Depressional
- Riverine
- Mineral Flats (Flats)
- Organic Flats (Extensive peatlands)
- Tidal Fringe
- Lacustrine Fringe
- Slopes

See U.S. Army Corps of Engineers, *Hydrogeomorphic Approach for Assessing Wetlands Functions, Wetland Classifications*.

Some of the characteristics of the various types of systems and some of the types of wetlands included in each system, are identified in the chart on the following page:

HGM Type	**Characteristics**	**Typical Wetlands**
Depressional	Located in topographic depressions; Fed by precipitation, surface water, groundwater; Water flows toward the center of the depression; Duration of wetness varies from ephemeral to perennial.	Prairie potholes, playa lakes, and vernal pools
Riverine	Located in floodplains and riparian corridors associated with stream channels; Water source is primarily overbank flow, with some groundwater and other connections; Water flows out to the channels during rainfall events and after flooding.	Bottomland hardwoods
Mineral Flats	Located on slight slopes; Water source is primarily precipitation; Water moves slowly out of these wetlands.	Pine flatwoods
Extensive peatlands	Located on flat interfluves or in locations where depressions have filled with peat; water source is primarily precipitation; Water flows out through overland flow and seepage to groundwater.	Northern peatlands
Tidal Fringe	Located along the coast and in estuaries; Tidal currents are the predominant water source, although groundwater and precipitation may be additional sources; Bi-directional flow of water between the wetlands and tides; These wetlands are seldom dry.	Salt marsh
Lacustrine Fringe	Usually located adjacent to lakes where the water table of the lake maintains the wetland's water table; Water sources include the lake, precipitation and groundwater discharge; Surface water flow is bi-directional.	Un-impounded marshes bordering the Great Lakes

Slopes	Usually located on slight to steep sloping land; Predominant water source is groundwater and some precipitation; Surface water generally flows quickly downgradient and out of the wetland.	Fens

See U.S. Army Corps of Engineers, *Hydrogeomorphic Approach for Assessing Wetlands Functions, Wetland Classifications*.

Since wetlands in the same HGM category have similar geomorphology (location within a landscape) and similar hydrology, they will generally perform similar functions. *See* Dennis W. Magee, *A Primer on Wetland Ecology, Wetlands Law and Policy: Understanding Section 404* 43-49 (Section of Environment, Energy and Resources, American Bar Association, 2005). For instance, because depressional wetlands trap more water than some other categories of wetlands, they may provide groundwater recharge functions that wetlands in other HGM categories, like slope wetlands, may not. *Id.* at 43-44. Similarly, because of their hydrology and geomorphology, lacustrine fringe wetlands serve a very important floodwater storage function, among other functions. *Id.* at 45-46. Tidal fringe wetlands can perform significant water quality functions, among other functions. *Id.* at 48-49. Since the wetlands within similar categories perform similar functions, the HGM classification system tailors assessment tools within each category to determine how well a specific wetland can perform the functions assessed for that category. *Id.* at 52-53.

RESOURCES

Cowardin Classification
FWS Fact Sheets on Wetland and Deepwater Habitat Systems - Marine, Estuarine, Riverine, Lacustrine, Palustrine
Corps of Engineers HGM web page
EPA Wetland Types web page

III. Status and Trends

At the end of the eighteenth century, it is estimated that there were approximately 392 million acres of wetlands in the United States, with 221 million acres in the lower 48 states. *See* Dahl, T.E., U.S. Department of Interior, U.S. Fish and

Wildlife Service, *Wetlands Losses in the United States: 1780s to 1980s* 1 (1990). By 1980, the Fish and Wildlife Service concluded that, after a "200 year history of wetland conversion", wetland acreage in the lower 48 states had declined by 53% to about 104 million acres. *Id.* Over that time period, therefore, about 585,000 acres of wetlands were lost every year. During that time period, California lost 90% of its wetlands, 10 states (Arkansas, California, Connecticut, Illinois, Indiana, Iowa. Kentucky. Maryland, Missouri, and Ohio) lost 70% or more of their wetlands, and 22 states lost at least 50% of their wetlands. *Id.* at 3-5. Except for Alaska, Hawaii, and New Hampshire, every other state lost at least 20% of their wetlands during that time period. *Id.* An overwhelming percentage of those losses occurred before the 1950s, as a 1983 Fish And Wildlife Service report found that there were 108.1 million acres of wetlands in the lower 48 states in the 1950s. *See* U.S. Department of Interior, U.S. Fish and Wildlife Service, *Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States: 1950s to 1970s* 3 (Apr. 1983). That report also determined that the rate of wetland losses between the 1950s and 1970s was 458,000 acres per year. *Id.* In a follow-up survey, the Fish and Wildlife Service determined that the rate of wetland loss has decreased, between the mid-1980s through mid-1990s, to 290,000 acres per year. *See* Dahl, T.E. & C.E. Johnson, U.S. Department of the Interior, U.S. Fish and Wildlife Service, *Status and Trends of Wetlands in the Conterminous United States: Mid·1970s to Mid·l980s* 3 (1991).

The Fish and Wildlife Service has continued to conduct periodic surveys of the status of wetland acreage in the United States and, in a report issued in 2000, concluded that the rate of wetland loss declined, during the period from 1986-1997, to 58,500 acres per year, and that 105.5 million acres of wetlands remained in the conterminous United States in 1997. *See* Dahl, T.E., U.S. Department of the Interior, U.S. Fish and Wildlife Service, *Status and Trends of Wetlands in the Conterminous United States:1986 to 1997* 9 (2000). Ninety-five percent of the remaining wetlands, at that time, were inland freshwater wetlands, while five percent were estuarine and saltwater wetlands. *Id.* at 10. Ninety-eight percent of the wetland losses during the study period were losses to freshwater wetlands. *Id.* The study suggested that the overall decline in the rate of wetland losses was due to "implementation and enforcement of wetland protection measures and elimination of some incentives for wetland drainage", among other factors. *Id.* For the first time, that study also attempted to identify the types of activities that contributed to the wetland losses. Thirty percent of the wetland losses during the study period were attributed to urban development, twenty-six percent were attributed to agriculture, twenty three percent to silviculture, and 21 percent to rural development. *Id.* at 11. Road construction is a major factor in wetland conversion, as it often entails the placement of fill material in wetlands ***and*** it opens up previously inaccessible areas, wetland and otherwise, to development. *See* Royal C. Gardner, *Lawyers, Swamps, and Money* 95 (Island Press 2009). To serve a growing population, energy exploration, including offshore exploration and mountaintop removal mining, has also grown as a source of wetland destruction. *Id.* at 96.

In 2005, the Fish and Wildlife Service released a report that found, for the first time, that wetland acreage in the conterminous United States was increasing. *See* Dahl, T.E., U.S. Department of the Interior, U.S. Fish and Wildlife Service, *Status and Trends of Wetlands in the Conterminous United States:1998 to 2004* (2005). The study found that there were 107.7 million acres of wetlands in the conterminous United States in 2004, and that wetland acreage increased by 32,000 acres per year between 1998 and 2004. *Id.* at 16. The report suggested that the net gains in wetland acreage were due to "wetlands created, enhanced or restored through regulatory and nonregulatory restoration programs." *Id.* at 16. More specifically, though, the report indicated that most of the gains during the study period were due to the restoration and creation of freshwater ponds through agricultural conservation programs, and that the ponds "would not be expected to provide the same range of wetland values and functions as a vegetated freshwater wetland. *Id.* The authors of the study indicated, at the outset of the report, that "[o]n Earth Day 2004, President Bush announced a wetlands initiative that established a federal policy beyond "no net loss" of wetlands, [which] ... seeks to attain an overall increase in the quality and quantity of wetlands [and that] ... [t]he President set a goal of restoring, improving and protecting more than 3 million acres ... in five years." *Id.* at 15. The authors indicated that the report provided some data regarding the progress being made to meet the goals regarding the increase in quantity of wetlands, but that the report did "not assess the quality or condition of the nation's wetlands." *Id.* Indeed, none of the previous reports assessed the quality or condition of the wetlands either. All of the reports focused simply on the quantity of wetland acreage lost.

In the most recent study of wetland status and trends, the Fish and Wildlife Service found that there was a small, but statistically insignificant, difference between wetland acreage in the conterminous United States between 2004 and 2009, with overall acreage declining by 62,300 acres (or 13,800 acres per year over the 4.5 year study period). " *See* Dahl, T.E., U.S. Department of the Interior, U.S. Fish and Wildlife Service, *Status and Trends of Wetlands in the Conterminous United States:2004 to 2009* 15-16 (2011). As in several previous studies, ninety-five percent of the wetlands identified were freshwater wetlands and five percent were marine or estuarine wetlands. *Id.* at 16. Freshwater pond acreage continued to grow, although more slowly than in the prior report, and forested wetlands "sustained their largest losses since the 1974 to 1985 time period." *Id.* at 16. While the authors indicated that the report did not draw conclusions regarding trends in the quality or condition of wetlands, they wrote, "The cumulative effects of losses in the freshwater system have had consequences for hydrologic and ecosystem connectivity. In certain regions, profound reductions in wetland extent have resulted in habitat loss, fragmentation, and limited opportunities for reestablishment and watershed rehabilitation." *Id.*

Although the rate of wetland loss in the conterminous United States may have leveled off, in some regions, the rate of wetland loss continues to increase. In addition to the reports that focus on wetland acreage in the conterminous United States, the Fish and Wildlife Service has partnered with the National Oceanic and Atmospheric Administration to examine wetland trends in coastal watersheds. Significantly, the agencies found that, during the 1998-2004 time period, the coastal watersheds of the eastern United States lost about 59,000 acres of wetlands each year, at a time when the Fish and Wildlife Service study above was indicating that there was an overall net increase of 32,000 acres of wetlands per year. *See* Stedman, S. & T.E. Dahl, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Department of the Interior, Fish and Wildlife Service, *Status and Trends of Wetlands in the Coastal Watersheds of the Eastern United States:1998 to 2004* 5 (2008). In a more recent report, the agencies concluded that wetland acreage in the coastal watersheds of the United States declined by 360,720 acres between 2004 and 2009, for an average loss of 80,160 acres per year. *See* Stedman, S. & T.E. Dahl, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Department of the Interior, Fish and Wildlife Service, *Status and Trends of Wetlands in the Coastal Watersheds of the Conterminous United States:2004 to 2009* 2 (2013). That represented a 25% increase in the rate of wetland loss when compared to data for the region between 1998 and 2004. *Id.* The greatest losses in acreage are occurring in the Gulf of Mexico and Atlantic regions, with smaller losses along the Pacific coast and net gains in the Great Lakes region. *Id.* at 20. The authors of the report noted that "wetland reestablishment in coastal watersheds has lagged behind reestablishment rates observed nationally [and that] ... [a] strategy of achieving "no net loss" by offsetting wetland acreage losses with wetland creation or reestablishment does not appear to be effective in the coastal watersheds as wetland losses have increased in some coastal regions." *Id.* at 3.

Questions and Comments

1. ***No net loss ...***: In 1987, the Conservation Foundation convened a National Wetlands Policy Forum, which developed a set of consensus recommendations on protecting and managing wetlands. One of the recommendations was that the national policy be guided by a goal of "no overall net loss" of the nation's wetlands and a long term goal to increase the quantity and quality of the nation's wetlands. *See* Julie M. Sibbing, National Wildlife Federation, *Nowhere Near No Net Loss*. President George H.W. Bush endorsed the policy of "no net loss" of wetlands in 1989 and Presidents Clinton and George W. Bush endorsed the policy and expanded it in their administrations to achieve increases in wetland acreage. Note, though, that "no net loss" focuses not just on loss of acreage of wetlands, but on loss of the quality of wetlands - the values and functions. Why have most of the federal government studies focused solely on wetland acreage? EPA and the Fish and Wildlife Service recently completed a National Wetland Condition Assessment to determine the quality of our nation's wetlands. *See* U.S. Environmental Protection Agency, National Wetland Condition Assessment. Will this tool help the agencies determine whether the quality of the nation's wetlands has degraded in the last 50-100 years? The next 50-100 years?

2. The 2005 Fish and Wildlife report indicated that net wetland acreage in the United States had increased between 1998 and 2004. Much of the net growth was attributable to projects to create or restore ponds and other wetlands on agricultural lands. Should the increase in acreage be viewed as a success? When compared to the values and functions provided by the wetlands lost? When compared to the losses of other types of wetlands, such as coastal wetlands, where restoration projects did not outpace conversion projects?

3. ***Mission Accomplished?:*** In 2008, President George W. Bush released a report indicating that more than 3.6 million acres of wetlands had been restored, protected or preserved as part of an initiative that he announced in 2004 to create, improve or protect at least 3 million acres of wetlands by 2009. *See* Office of the President, Council on environmental Quality, *Conserving America's Wetlands 2008: Four Years of Progress Implementing the President's Goal* (April 2008). Environmental groups criticized the report because it did not quantify wetland losses during the corresponding period, or indicate whether the actions resulted in any net gain of acreage, let alone values or functions.

4. The Natural Resources Conservation Service (NRCS), within the U.S. Department of Agriculture, also collects and analyzes data relating to wetland acreage as part of its National Resources Inventory. *See* U.S. Department of Agriculture, Natural Resources Conservation Service, *National Resources Inventory*. It relies on the same classification system for wetlands as the Fish and Wildlife Service, but the study only examines resources on non-federal land in the conterminous United States. *See* U.S. Department of Agriculture, Natural Resources Conservation Service, 2007 *Natural Resources Inventory: Wetlands* 1 (2013). In addition, the study periods are different from the study periods used by the Fish and Wildlife Service. *Id.* Consequently, it is difficult to compare the data from the NRCS and FWS studies. NRCS did, however, find net increases in wetland acreage between 1997 and 2002, and between 2002 and 2007. *Id.* at 5.

5. It is estimated that 75% of the remaining wetlands in the lower 48 states are on private lands. *See* U.S. Environmental Protection Agency, Wetlands Protection: Partnering with Land Trusts. What impacts might that have for regulatory and legislative policy-making?

IV. Wetland Delineation

While Part II of this chapter focused on the classification systems that are used to categorize wetlands, this part examines the "delineation" process that is used to determine whether property is a wetland and to determine the physical boundaries of wetlands. With the exception of the Natural Resources Conservation Service, the federal agencies that regulate wetlands follow procedures in a 1987 technical manual developed by the Army Corps of Engineers to delineate wetlands. *See* U.S. Army Corps of Engineers, Wetlands Research Technical Report Y-87-1, Corps of Engineers Wetlands Delineation Manual (1987) [hereinafter "1987 Corps Delineation Manual"].

The agencies focus on three characteristics of wetlands to determine whether property is a wetland - **vegetation**, **soils** and **hydrology**. *Id.* ¶ 26(b). Except when an area has been altered or in a few other unusual circumstances, positive indicators of all three characteristics must be present for an area to be delineated as a wetland. *Id.* ¶ 26(c). Thus, an area that has wetland vegetation and wetland hydrology, but not wetland soils, will normally not be a wetland. Since vegetation, soils and hydrology differ throughout the country, the Corps has also developed supplements to the 1987 delineation manual that provide guidance on delineating wetlands in 10 different geographic regions. *See* U.S. Army Corps of Engineers, *Regional Supplements to the Corps Delineation Manual*.

Vegetation

Wetlands are areas where the prevalent vegetation is hydrophytic vegetation (species that have the ability to grow, effectively compete, reproduce and/or persist in anaerobic soil conditions). *See* *1987 Corps Delineation Manual* ¶¶ 26(b)(1). The Fish and Wildlife Service publishes a list of hydrophytic vegetation that is used in making this determination. *See* U.S. Department of the Interior, U.S. Fish and Wildlife Service, 2014 National Wetland Plant List. Generally, this criterion is met if more than 50% of the dominant plant species in the area are hydrophytic (categorized as obligate wetland plants, facultative wetland plants or facultative plants on the National Wetland Plant list). *See* *1987 Corps Delineation Manual* ¶¶ 35(a). In addition, identification of trees with shallow root systems, swollen trunks or roots growing from the plant stem or trunk above the soil surface may sometimes indicate that the vegetation criterion is satisfied. *See* U.S. Army Corps of Engineers, *Recognizing Wetlands*.

Soils

Areas meet the criterion for wetland soils if the soils in the area are hydric soils (i.e. "have characteristics that indicate that they were developed in conditions where soil oxygen is limited by the presence of saturated soil for long periods during the growing season.") *See* U.S. Army Corps of Engineers, *Recognizing Wetlands*. The Natural Resources Conservation Service maintains a list of hydric soils, *see* U.S. Department of Agriculture, Natural Resources Conservation Service, Soil Taxonomy (2d ed. 1999), and soil types can usually be identified by comparing soil colors at various depths to soil charts. *See* Munsell Color, *Munsell Soil Color Charts.* Since hydric soils can remain in an area even after the area no longer exhibits wetland hydrology or vegetation, though, soils are considered less reliable indicators than the other two criterion. *See* Mark A. Chertok & Kate Sinding, *Federal Jurisdiction over Wetlands: "Waters of the United States"*, in Wetlands Law and Policy 87 (Section of Environment, Energy and Resources, American Bar Association, 2005).

NRCS Photo By Bob Nichols – Wikimedia

Hydrology

Areas meet the criterion for hydrology if they "are periodically inundated or have soils saturated to the surface at some time during the growing season." *See* *1987 Corps Delineation Manual* ¶¶ 46. The Corps provides the following helpful definition in an information pamphlet on recognizing wetlands, "wetland hydrology refers to the presence of water at or above the soil surface for a sufficient period of the year to significantly influence the plant types and soils that occur in the area." *See* U.S. Army Corps of Engineers, *Recognizing Wetlands*. Normally, areas must be inundated for at least a week during the growing season to meet the hydrology criterion. *See* Chertok & Sinding, *supra, at 87.* Inundation or saturation can be demonstrated by visual observation or recorded data, such as stream gage data, lake gage data, flood predictions and historical data. *See* *1987 Corps Delineation Manual ¶¶ 49*. In addition to those methods, the hydrology criterion may be satisfied through observation of drift lines, sediment deposits, drainage patterns, or watermarks on vegetation. *Id.* Many of those indicators, though, do not reveal the frequency, timing or duration of flooding or the soil saturation. *See* U.S. Army Corps of Engineers, *Recognizing Wetlands*. While hydrology "is often the least exact" of the criterion, "it is essential to establish that a wetland area is periodically inundated or has saturated soils during the growing season." *See* *1987 Corps Delineation Manual ¶¶ 46*.

Interviews

Jan Goldman Carter, Senior Manager and Counsel for the National Wildlife Federation's Wetlands and Water Resources Program, discusses:

1. The value of a scientific background for a career in environmental law. (You Tube)

2. The judicial and legislative understanding of, and receptivity to, scientific issues involving wetlands. (YouTube)

Stephen Samuels, an Assistant Section Chief in the Environmental Defense Section of the Environment and Natural Resources Division of the U.S. Department of Justice, discusses the challenge of influencing courts and legislatures with scientific information on the values and functions of wetlands. (YouTube)

RESOURCES

Corps of Engineers Video on Delineating Wetlands
DNREC (Delaware) Video on Wetlands and Identifying Wetlands
1987 Corps Delineation Manual & Regional Supplements (Map of regions for suppl.)
Field Evaluation Questionnaire used by Corps in delineating wetlands
National Food Security Act Manual (includes NRCS delineation procedures)
National Wetlands Inventory by Fish and Wildlife Service
National Wetlands Inventory - Mapping Utility (Search for Wetlands)
Loria A. Sutter, Royal C. Gardner, James E. Perry, Science and Policy of U.S. Wetlands, 29 Tul. Envt'l L. J. 31 (2015)

Research Problems

1. **Agency Reports:** While federal law requires agencies to publish rules and various adjudicative decisions and guidance documents in the Federal Register, *see* Chapter 3, *infra*, agencies are generally not required to publish reports that they produce in any specific format. However, most agencies make significant reports that they produce available on the agency's website. See if you can locate a report issued by the United States Fish and Wildlife Service entitled "Status and Trends of Wetlands in the Coastal Watersheds of the Conterminous United States 2004 to 2009". According to the report, in 2009, there were an estimated 41.1 million acres of wetlands in the coastal watersheds of the United States.

a. What percentage of those wetlands were freshwater wetlands?
b. What percentage of those wetlands were saltwater wetlands?
c. Which coastal region experienced a new gain in wetland acreage between 2004 and 2009?

2. **Guidance documents:** Although a few agency guidance documents are published in the Federal Register, most are not. However, agencies publish frequently requested guidance documents on their websites. If guidance documents are not available on the agency's website, interested persons normally have to contact the agency to request a copy of the guidance document (if they know that the guidance document exists). See if you can locate the Regional Supplement to the Corps of Engineers Wetland Delineation Manual that would apply to property located in New York State. Which section of the Corps' 1987 Delineation Manual is replaced, for that Region, by Chapter 2 of the Regional Supplement?

Chapter Quiz

Now that you've finished Chapter 1, why not try a CALI lesson on the material at http://www.cali.org/node/10715. It should only take about fifteen minutes.