Socioeconomic Value of Delaware Wetlands

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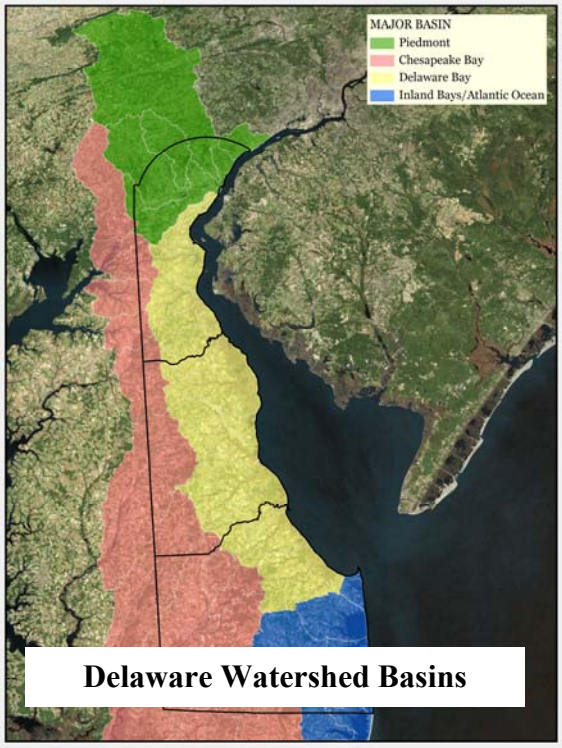

Delaware Watershed Basins

Wetlands, marshes, and bogs in Delaware provide significant economic value ranging from $1 billion to $3 billion annually and support 25,000 jobs with $568 million in wages in the state and surrounding region. This report examines the economic value of wetlands in Delaware in three ways:

- **Economic value directly related to Delaware wetland habitat.** Delaware wetlands contribute over $1 billion in annual economic value from water quality, flood control, parks/open space, fish/wildlife, recreation, forested wetlands/carbon storage, and nonuse value (willingness to pay) functions.

- **Value of goods and services provided by Delaware wetlands**. Wetland ecosystems in Delaware provide a present value (PV) of $3 billion per year in goods and services in 2010 dollars with a net present value (NPV) of $99 billion calculated over a 100-year period.

- **Employment supported by Delaware wetlands.** Delaware wetlands support 25,000 direct and indirect jobs with $568 million in wages from employment in the living marine resources, tourism/recreation, fishing/hunting/birding, national wildlife refuge, outdoor recreation, and wetland organization sectors.

Wetlands that cover about a quarter of the State of Delaware land mass provide significant economic benefits to the First State and are worthy of investment to keep these productive living resources healthy and productive. These estimates were made by utilizing values from the peer reviewed literature and existing studies and applying them to Delaware using ecological economics and benefits-transfer techniques described in this report. All values in are in 2010 dollars except where noted.

It is also important to note that the estimates presented in this report are not all inclusive due to a lack of data for some economic sectors. Some values were not included in these estimates because the data to assess them either are not readily available or do not exist. Regardless of the lack of data in some economic sectors, these estimates clearly indicate that Delaware wetlands contribute between $1 billion and $3 billion annually to the state and regional economy and support at least 25,000 jobs.

Chapter 1 - Introduction

Objectives

This report summarizes the socioeconomic value of natural resources, and ecosystems in Delaware's wetlands. The University of Delaware Water Resources Center worked with the Delaware National Estuarine Research Reserve (DNERR) to quantify the economic value of Delaware wetlands in three ways: (1) annual economic activity (market/non-market) supported by water quality, flood control, parks/open space, fish/wildlife, recreation, forested wetlands/carbon storage, and nonuse value (willingness to pay) functions, (2) ecosystems goods and services value (natural capital) provided by Delaware wetlands/open water habitat measured on an annual basis (present value, PV) and net present value (NPV) measured over a hundred years , and (3) jobs and wages directly and indirectly supported by wetlands. This economic valuation will be used for outreach to officials and the public in support of the mission of the Delaware National Estuarine Research Reserve.

Rationale

As the lowest lying state in the U.S. at a mean elevation of 60 ft. above sea level along a hundred-mile Atlantic coast line, Delaware's wetlands occupy approximately a quarter of the First State's land area and supply important ecosystem services functions in the flood control, water quality, fisheries, and recreation sectors of the economy. Little is known about the socioeconomic value of this important coastal habitat. What is the economic value of wetlands in Delaware? What is the value of these natural resources in terms of ecosystem goods and services? How many jobs are supported by wetlands? The University of Delaware Water Resources Center sought to quantify the economic value of wetlands in Delaware utilizing the principles of ecological economics and willingness to pay models

The Value of Wetlands

The Millennium Ecosystem Assessment (2003) classified the ecosystem services of wetlands into four categories (Marsden Jacob Associates 2012) as:

Provisioning services: Products obtained from wetland ecosystems such as fresh water and fish for human consumption.

Regulating services: Benefits to humans attributable to the regulation of ecosystem processes such as water treatment and local climate regulation.

Supporting services: Production of all other ecosystem services such as nutrient cycling, water cycling, and provisioning of habitat.

Cultural services: Non-material benefits received by people from direct and indirect interactions with wetlands such as recreation, aesthetic values, spiritual benefits (e.g. Indigenous connections with wetlands) and enhancements in knowledge.

The total economic value of wetlands can be derived by tabulation of direct values, indirect values, option values, and existence values as described in Figure 1 (Emerton and Bos 2004).

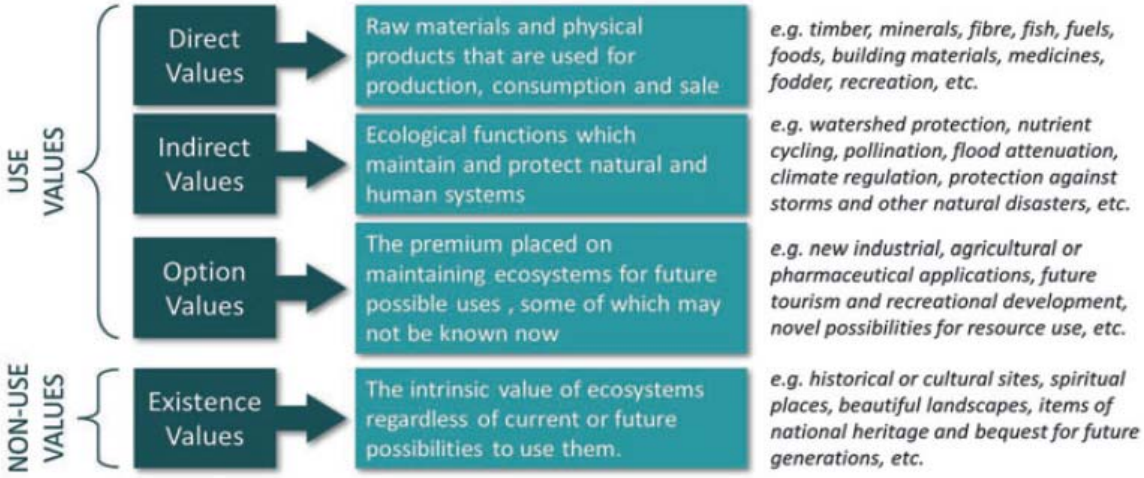

Figure 1. Total economic value of wetland ecosystems (Emerton and Bos 2004)

As some of the most productive ecosystems on Earth, wetlands have been called "the kidneys of the landscape" and "biological supermarkets" due to the water treatment and biodiversity functions they provide (Barbier, Acreman, and Knowler 1997). Wetlands cover about 6% of the Earth and freshwater wetlands are home to 40% of the world's plant species and 12% of all animal species (Brander and Schuyt 2004). The National Wetland Condition Assessment (USEPA 2016) reported that coastal marshes "provide food supply, shelter, and nursery areas for both marine and freshwater species, fueling a commercial and recreational fishery economy worth billions of dollars." Brander and Schuyt (2004) prepared a synthesis of data that indicated the economic value of wetland ecosystem services ranged from $9/ac for fuel wood provision to $293/ac for flood control protection in $2015 (Table 1).

Table 1. Wetland economic values by wetland function

Wetland Function	2000[1] ($/ha)	2000 ($/ac)	2015[2] ($/ac)
Flood Control	464	188	293
Recreational Fishing	374	151	236
Amenity/Recreation	492	199	310
Water Filtering	288	117	182
Biodiversity	214	87	135
Habitat Nursery	201	81	127
Recreational Hunting	123	50	78
Water Supply	45	18	28
Materials	45	18	28
Fuel Wood	14	6	9
Total	**2,260**	**915**	**1,426**

1: Brander and Schuyt 2004. 2: Converted to $2015 based on 3% change in annual Consumer Price Index

Wetlands provide extraordinary habitat functions in the United States (USEPA 2006):

- Wetlands cover about 5% of the contiguous 48 states yet are habitat for 1/3 of all threatened and endangered species and 31% of all plant species.
- Louisiana commercial fish landings that exceeded 1 billion pounds worth $343 million.
- Wetland supported 30% of the total fish catch by weight in the lower 49 states.
- One half of all North American bird species nest or feed in wetlands.

Wetland ecosystems have significant economic value (Table 2). The Millennium Ecosystem Assessment prepared by Costanza et al. (1997) estimated the value of wetlands in the world was $15 trillion. Brander and Schuyt (2010) reported the global economic value of 8.5 million acres of wetlands (13,280 mi^2 or 6 times the size of Delaware) was $3.4 billion/yr. Boutwell and Westra (2015) reported the storm protection value of coastal wetlands in buffering hurricane devastation in the US was $23 billion/yr. Researchers wrote in "Scientific Reports" that coastal marshes and wetlands prevented $625 million in flood damages during Superstorm Sandy in October 2012 in 12 mid-Atlantic states including Delaware (Narayan et al. 2017).

Table 2. Estimates of economic value of wetlands

Source	Wetland Function	Wetland Value ($)
Costanza et al. 1997	Global value of wetlands	$15 trillion
Boutwell and Westra 2015	Hurricane protection in US	$23 billion/yr
Brander and Schuyt 2010	8.5 million acres world-wide	$3.4 billion/yr
Narayan et al. 2017	Superstorm Sandy damage protection	$625 million

Delaware Watersheds

Delaware is drained by four major basins: Piedmont, Delaware Bay and Estuary, Inland Bays, and Chesapeake Bay (Figure 2). Delaware's four major basins include 46 watersheds that flow from Piedmont and Coastal Plain physiographic provinces to the tidal Delaware River/Bay, Chesapeake Bay, or Atlantic Ocean.

Piedmont: The Piedmont Basin, where the upper 80% originates in Pennsylvania, empties into the Delaware River. The Piedmont Basin supplies significant drinking water supplies from surface and groundwater sources. The geologically unique Fall Line in the Piedmont Basin runs from Newark to Wilmington and separates the hilly, rocky, Piedmont to the north from the flat, sandy Coastal Plain to the south. This transition zone supports a wide array of flora and fauna. The Piedmont Basin contains the following watersheds:

Brandywine Creek
Red Clay Creek
White Clay Creek
Christina River
Naamans Creek
Shellpot Creek

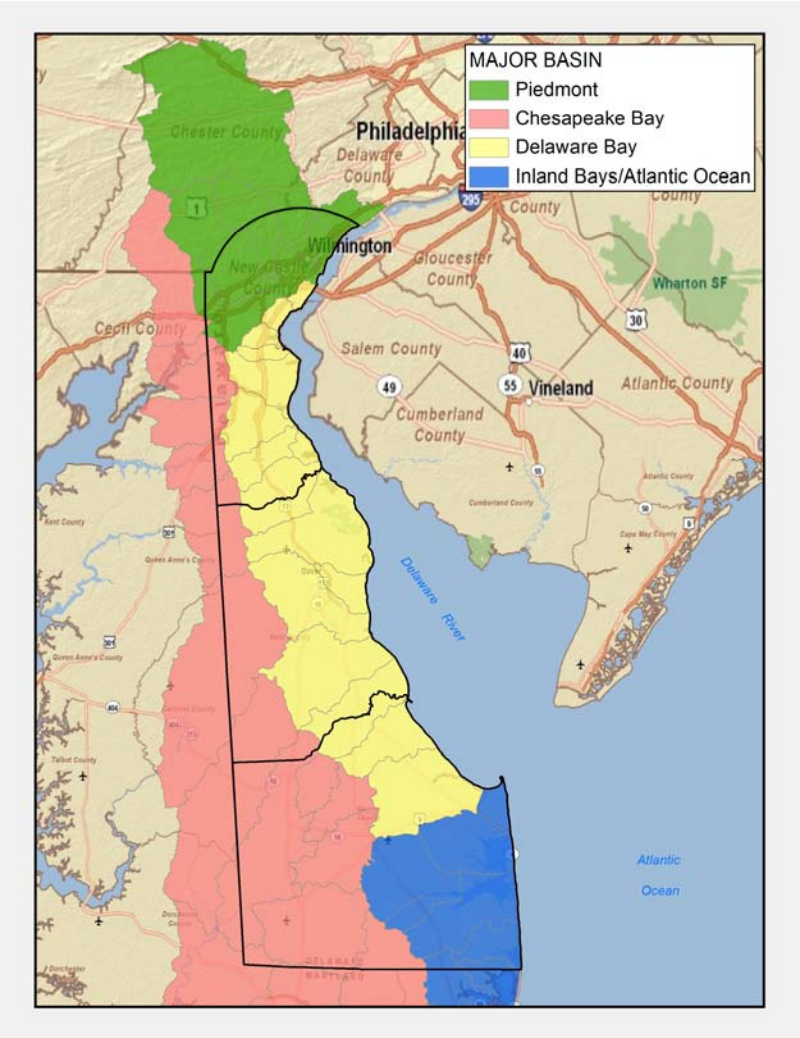

Figure 2. Major basins and watershed boundaries in Delaware

Delaware Bay and Estuary: The Delaware Bay and Estuary Basin lies entirely within the Atlantic Coastal Plain physiographic province in south New Castle County and eastern Kent County and Sussex County. Topography in the northern part of the basin is dominantly undulating and rolling with moderate dissection. In the southern portion of the drainage basin, flatter (slope gradients <1%) landscapes dominate. Some of the most productive farms in Delaware, some of which are still owned by the original families, are located within this basin. The basin drains 520,960 acres, or 814 square miles, and encompasses the following watersheds:

Delaware River
Army Creek
Red Lion Creek
Dragon Run Creek
Chesapeake & Delaware Canal
Appoquinimink River
Blackbird Creek
Delaware Bay
Smyrna River
Cedar Creek
Little Creek
St. Jones River
Murderkill River
Leipsic River
Mispillion River
Broadkill River

Inland Bays/Atlantic Ocean Basin: Comprises 313 square miles of eastern Sussex County, Delaware. The Inland Bays/Atlantic Ocean Basin lies entirely within the Atlantic Coastal Plain physiographic province. The dominant physiographic features of the basin are the three "inland bays" that are located just landward of the Atlantic Ocean. Other distinctive physiographic characteristics include the flat topography and man-made drainage ditches that are used to drain soils with perennially high water tables, which are mostly limited to the area south of Millsboro and Indian River Bay. The Inland Bays Watershed supports Delaware's ocean and coastal tourism economy and contains rapidly growing industries of poultry farming and second-home residential development. From north to south, these watersheds are:

Lewes-Rehoboth Canal	Indian River Bay
Rehoboth Bay	Little Assawoman
Indian River	Assawoman
Iron Branch	Buntings Branch

Chesapeake Bay Basin: Drains to the nation's largest estuary, the Chesapeake Bay. As an estuary, the Chesapeake Bay contains a mixture of fresh and saltwater, creating an ideal habitat for a diverse array of plants and animals. The bay's welfare is heavily reliant on the land use of the basin, since Delaware's portion of the Chesapeake Basin contains headwater areas, the area where a waterway originates. The basin encompasses 769-square miles of land in western New Castle, Kent, and Sussex Counties. More geological formations exist in the Chesapeake Basin than in any of the other three basins. Delaware's Coastal Plain contains very thick sedimentary deposits. These unique deposits formed because of Delaware's position along an extremely active continental plate boundary. The basin encompasses the following 16 watersheds:

Bohemia Creek	Gravelly Branch	Pocomoke River
Broad Creek	Gum Branch	Sassafras River
C&D Canal West	Marshyhope Creek	Wicomico River
Deep Creek	Nanticoke River	
Elk Creek	Perch Creek	

The Delaware DNREC Division of Watershed Stewardship issued wetlands health report cards for Delaware watersheds that range from a "C" for the Mispillion, Broadkill, and Murderkill rivers to F for the Christina River (Table 3).

Table 3. Wetland health in Delaware watersheds

Watershed	Wetland Health
Mispillion River	C
Broadkill River	C
Murderkill River	C
St. Jones River	C
Nanticoke River	C-
Leipsic River	C+
Inland Bays	D+
Christina River	F

Land Use

Wetlands cover 20% of Delaware including 12% as freshwater wetlands, 5% as saltwater wetlands, and 3% as open freshwater (Table 4 and Figure 3).

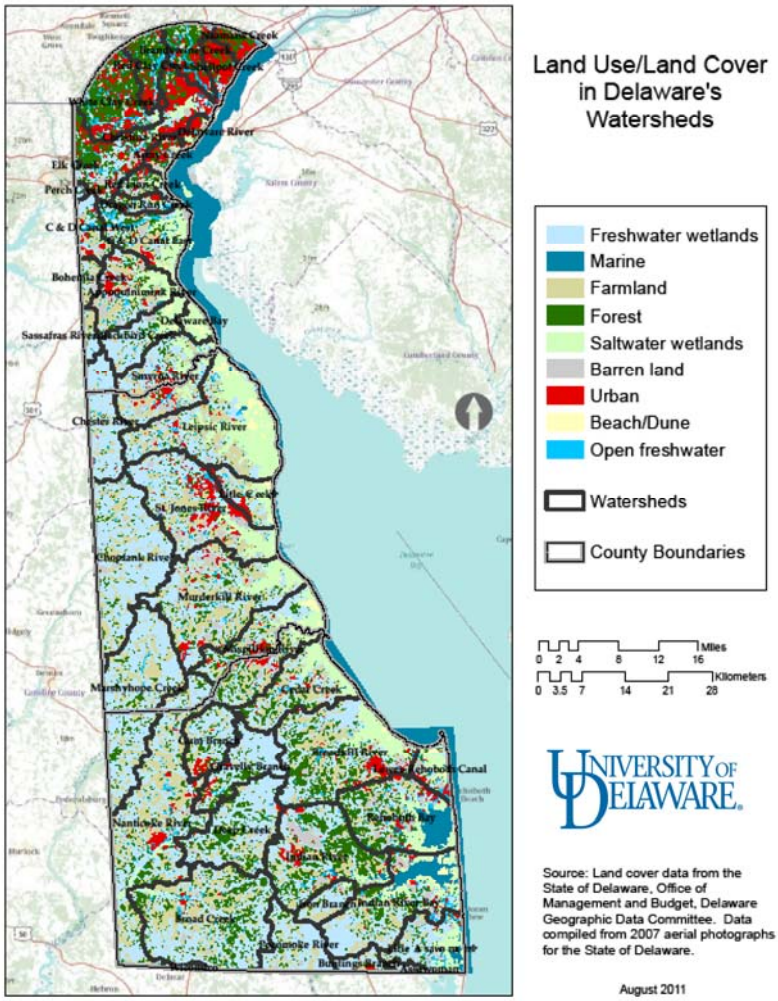

Figure 3. Land cover in Delaware watersheds (NOAA CSC 2007

Table 4. Wetland area in Delaware watersheds (NOAA CSC 2007)

Ecosystem	Piedmont (ac)	Delaware Estuary (ac)	Chesapeake Bay (ac)	Inland Bays/ Atlantic Ocean (ac)	Total (ac)
Freshwater wetlands	4,732	58,390	81,130	34,379	178,632
Saltwater wetlands	919	61,617	353	8,111	71,001
Open freshwater	575	14,056	1,780	31,842	48,253
Total	**116,435**	**625,435**	**449,248**	**324,145**	**1,515,263**
Freshwater wetlands	4.1%	9.3%	18.1%	10. 6%	11.8%
Saltwater wetlands	0.8%	9.9%	0.1%	2.5%	4.7%
Open freshwater	0.5%	2.2%	0.4%	9.8%	3.2%

Population

According to the U.S. Census Bureau (2010), 897,934 people lived in Delaware on 1,956 square miles, a population density of just over 450/sq. mi. (Table 5). New Castle County is the most populous county comprising 60 percent of the population (538,479), 162,310 people reside in Kent County (18%), and 197,145 reside in Sussex County (22%). About 436,574 people were employed in Delaware in 2017, with 286,532 jobs in New Castle County (68%), 65,742 jobs in Kent County (15%), and 84,300 (17%) jobs in Sussex County (Table 5).

Table 5. Land area, population, and employment in Delaware

State/County	Area (sq. mi.)	Population[1] 2010	Employment[2] 2017
New Castle	426	538,479	286,532
Kent	590	162,310	65,742
Sussex	940	197,145	84,300
Delaware	**1,956**	**897,934**	**436,574**

1. U.S. Census Bureau 2010. 2. U.S. Bureau of Labor Statistics 2017

Between 2000 and 2010, Delaware population grew by 14.6 percent or 114,334 people (Table 6 and 5). Over the decade, population increased by over 25 percent in Kent and Sussex counties and by 7.6 percent in New Castle County. By 2030, the population in Delaware is projected to grow by 156,697 (18%) to over a million people.

Table 6. Population change in Delaware by county, 2000-2030

State/county	Pop. 2000	Pop. 2010	Projected Pop. 2030[2]	2000-2010 Change	2000-2010 % Change	2010-2030 Change	2010-2030 % Change
New Castle	500,265	538,479	589,267	38,214	7.6	50,788	9
Kent	126,697	162,310	192,853	35,613	28.1	30,543	19
Sussex	156,638	197,145	272,511	40,507	25.9	75,366	38
Delaware	**783,600**	**897,934**	**1,054,631**	**114,334**	**14.6**	**156,697**	**18**

1. U.S. Census Bureau 2010. 2. Delaware Population Consortium 2010

Chapter 2 - Methods

Valuation Techniques

The University of Delaware derived the economic value of Delaware wetlands from published studies that employed the following valuation techniques:

Avoided Cost: Society sustains costs if certain ecosystems were not present or are lost. For instance, the loss of wetlands may increase economic cost from flood damage.

Replacement Cost: Natural services are lost and replaced by more expensive human systems. For instance, forests provide water-filtration benefits that would be replaced by costly water-filtration plants.

Net Factor Income by Enhancement of Income: Improved water quality is known to enhance fishing productivity and boost fishing jobs/wages.

Travel Cost: Visitors are willing to pay to travel and purchase food and lodging to visit ecosystems and natural resources for tourism, boating, hunting, fishing, and birding.

Hedonic Pricing: Residents may be willing to pay more for higher property values along scenic bay and river coastlines with improved water quality.

Contingent Valuation: Valuation by survey of individual preferences to preserve ecosystems. People may be willing to pay more in fees or water rates to preserve river and bay water quality.

Methods

The University of Delaware derived the economic value of Delaware wetlands according to the following scope of work.

1. Area of Interest: The area of interest is defined as Delaware wetlands in the Delaware River/Bay, Chesapeake Bay, and Atlantic Ocean/Inland Bay basins. The University of Delaware developed ArcGIS map layers of watersheds, population, ecosystems, habitat, and land use/land cover for the study area to perform the analysis.

2. Literature Review: Gather published literature and demographic/socioeconomic data including databases from the U.S. Census Bureau, U.S. Bureau of Labor Statistics, U.S. Department of Agriculture, U.S. Forest Service, U.S. Fish and Wildlife Service, NOAA Coastal Services Center (CSC), and NOAA National Marine Fisheries Service together with material from emerging fields in ecological economics and ecosystem services. Review published studies on the following valuation techniques for value transfer to Delaware wetlands: avoided cost, contingent valuation, hedonic pricing, net factor income by enhancement of income, replacement cost, and travel cost models.

3. Annual Economic Value: Estimate the direct (market) and indirect (non-market) economic value of water quality, flood protection, fish/wildlife, and recreation, by utilizing population, employment, industrial activity, and land-use data (Figure 4). Total economic activity is the sum of use and non-use values (Hodge and Dunn 1992). Use values include direct values, such as market goods from sales of crops, fish, and drinking water and unpriced benefits from recreation and aesthetic view sheds; and ecological-function values (ecosystem services) from water storage, and waste-assimilation services of wetland and forest habitat. Non-use values include future-option values such as future drug discoveries from wetland plants and future recreation, existence values from satisfaction that a water resource exists but may never be visited, and bequest values such as preserving water quality for future generations (Ingraham and Foster 2008). Values are converted to 2010 dollars based on the change in the Consumer Price Index (CPI) in the Northeast Region as reported by the Bureau of Labor Statistics.

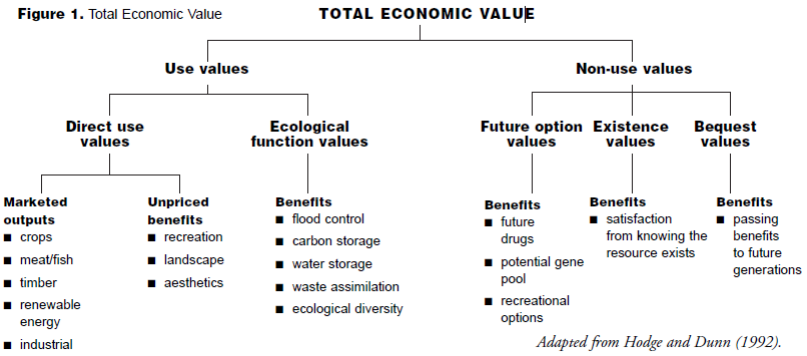

Figure 4. Economic value of water resources (Hodge and Dunn 1992)

4. Ecosystem Services: Tabulate the market value of natural resources (ecosystem services value) of wetlands and open water habitat. Ecosystem services (ecological services) are economic benefits provided to society by nature such as water filtration, flood reduction, and drinking water supply. Using ArcGIS, map and tabulate ecosystem areas (acres) using NOAA Coastal Services Center (CSC) land cover data for freshwater wetlands, saltwater wetlands, and open freshwater. Review published research studies and gather economic value ($/acre) data for wetlands ecosystem goods and services such as: (a) carbon sequestration, (b) flood control, (c) drinking water supply, (d) water-quality filtration, (e) waste treatment and assimilation, (f) nutrient regulation, (g) fish and wildlife habitat, (h) recreation and aesthetics. Compute ecosystem services value by multiplying land-use area (acres) by ecosystem value ($/acre).

Wetland ecosystem services are estimated using value (benefits) transfer where published literature from similar watersheds are reviewed and applied to the resource in question Value-transfer techniques include selecting data from published literature from another watershed or study area and applying the dollars-per-acre values to wetland habitat area. While primary research data from the area in question is preferable and will be used in many cases in this report, value transfer is the next best practical way to value ecosystems, especially when, in the absence of such data, the worth of ecosystems have been deemed zero.

5. Jobs and wages: Estimate wetland-related direct and indirect jobs and wages. Obtain employment and wage data from the U.S. Department of Labor, U.S. Census Bureau, NOAA, National Ocean Economics Program, and others. Estimate direct/indirect jobs by North American Industry Classification System (NAICS) codes such as shipbuilding, marine transportation/ports, fisheries, recreation, minerals, trade, agriculture, and others. NAICS data is supplemented with NOAA wetlands jobs data and U.S. Fish and Wildlife Service tourism jobs data.

6. Report: Prepare a report that summarizes (1) annual economic value of Delaware wetlands, (2) ecosystem goods and services (natural capital), and (3) jobs and wages directly and indirectly supported by wetlands in 2010 dollars.

Chapter 3 - Economic Value

The annual economic value of Delaware wetlands from water quality, flood control, parks/open space, fish/wildlife, recreation, forested wetlands/carbon storage, and nonuse value (willingness to pay) functions exceeds $1 billion (Figure 5 and Table 7).

Water Quality	$474 million
Flood Control	$66 million
Parks/Open Space	$411 million
Fish/Wildlife	$386 million
Recreation	$124 million
Forested Wetlands	$91 million
Nonuse Value	$50 million

Table 7. Annual economic value of Delaware wetlands

Activity	2010 ($ million)	Source
Water Quality		
Water Treatment (1.2% decrease in wetlands)	0.8	Industrial Economics Inc. (2011)
Wastewater Treatment (120,000 wetland acres)	166	Greeley-Polhemus Group (1993)
Wastewater Assimilation ($2.00/lb BOD removal)	307	DeLorme and Wood (1976)
Flood Control		
Stormwater Detention (increase property value by 5%)	42-105	Braden and Johnston (2004)
Flood Protection (marshes reduced Sandy damage 10%)	24	Narayan et al. (2017)
Parks/Open Space		
State Parks (1.6 million annual visitors)	390	Rockport Analytics (2017)
National Wildlife Refuges (390,000 annual visits)	21	Carver and Caudill (2007)
Fish/Wildlife		
Fishing/Viewing (spending in view of tidal wetlands)	62	Santoni, Arvay, and Scarborough (2017)
Fishing (166,000 anglers)	104	U.S. Fish and Wildlife Service (2014)
Hunting (23,000 hunters)	41	U.S. Fish and Wildlife Service (2014)
Wildlife/Bird Watching (243,000 viewers)	170	U.S. Fish and Wildlife Service (2014)
Commercial Fish Landings ($0.60/lb)(	9	NMFS, Nat'l Ocean Econ. Program (2007)
Recreation		
Outdoor Recreation (18,680 paddlers)	124	Outdoor Industry Association (2016)
Forested Wetlands/Carbon		
Carbon Storage ($827/acre)	63	U.S. Forest Service, Del. Ctr. Hort. (2008)
Carbon Sequestration ($29/acre)	2	U.S. Forest Service, Del. Ctr. Hort. (2008)
Air-Pollution Removal ($266/acre)	20	U.S. Forest Service, Del. Ctr. Hort. (2008)
Building Energy Savings ($56/acre)	4	U.S. Forest Service, Del. Ctr. Hort. (2008)
Atmospheric Carbon (1.2% decrease in wetlands)	2	Industrial Economics, Incorporated (2011)
Nonuse Value		
Willingness to Pay for Wetland Protection/Management	16-84	Santoni, Arvay, and Scarborough (2017)
Delaware Wetlands	**>$1 billion**	

Note: Total economic value is rounded down to avoid double-counting.

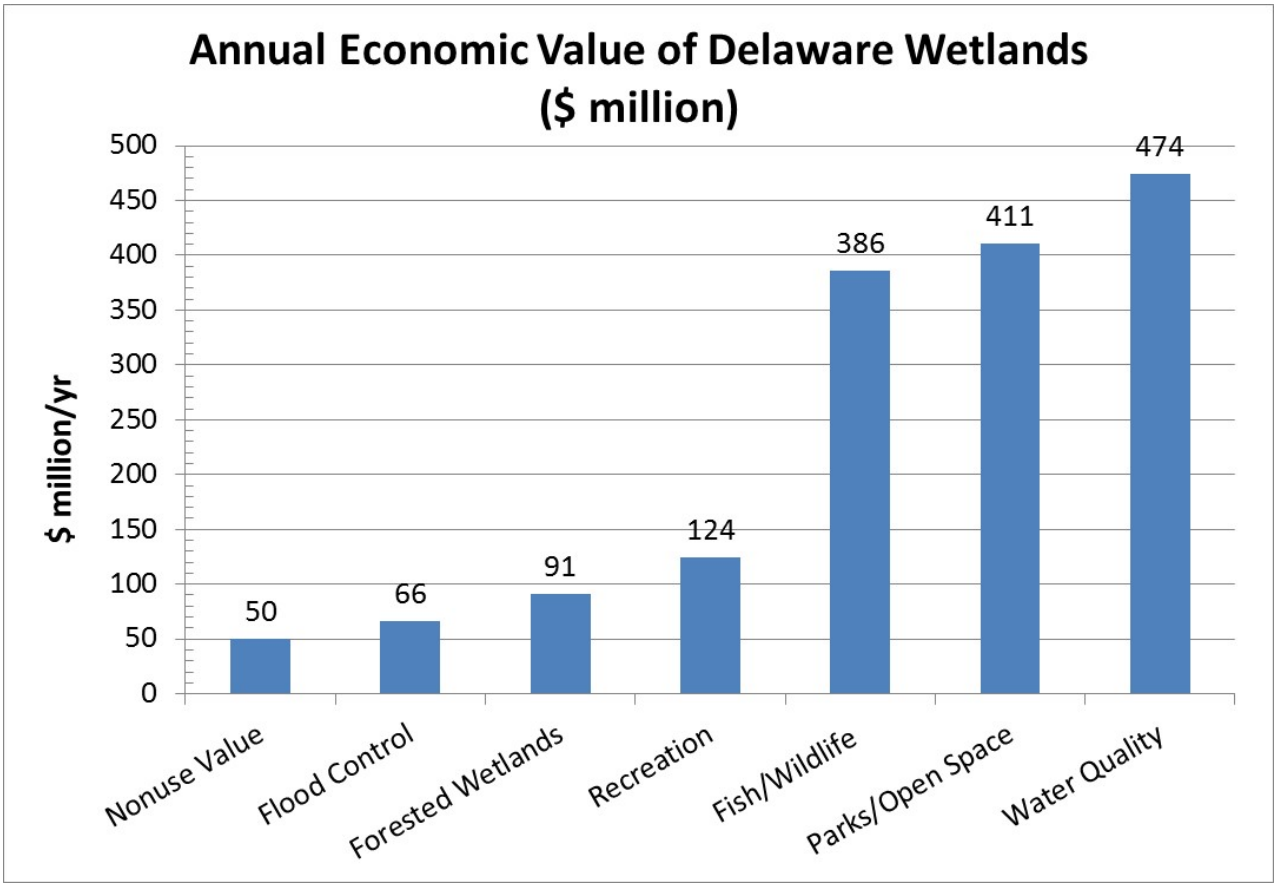

Figure 5. Annual economic value of Delaware wetlands

Water Quality

Water Treatment: Industrial Economics Inc. (2011) reported that a 1.2% decrease (+3,132 ac) in wetlands in Delaware from over 15 years from 2007 to 2022 would result in increased municipal water treatment costs of $9.67 million or an annualized cost of $770,000.

Wastewater Treatment: The Greeley-Polhemus Group (1993) estimated the Delaware Estuary supported 123,000 jobs, $4.3 billion in wages, and annual wetlands replacement values for wastewater treatment of $638 million. If wetlands in Delaware (120,000 ac) cover 26% of the total wetlands in the Delaware Estuary watershed (463,000 ac), then by proportion the wetland replacement value in the Delaware portion of the estuary watershed was$166 million.

Wastewater Assimilation: DeLorme and Wood (1976) reported that 463,000 acres of wetlands in the Delaware Estuary watershed had the capacity to treat 1.6 million pounds of waste per day or 590 million pounds per year. At $2.00/lb BOD removal, Delaware Estuary wetlands had an annual economic replacement value of $1.18 billion or $255 per acre. If wetlands in Delaware (120,000 ac) cover 26% of the total wetlands in the Delaware Estuary watershed (463,000 ac), then by proportion the annual wetland replacement value for wastewater assimilation in Delaware is $307 million.

Flood Control

Stormwater Detention: Braden and Johnston (2004) from the University of Illinois estimated that onsite stormwater detention provides flood mitigation and water quality protection services totaling 2% to 5% of property value for properties in the floodplain. If 211,840 acres (17%) of Delaware's land mass is within the 100-year floodplain covered mostly by wetlands and the average value of floodplain land is $10,000/acre, then the total value of floodplain land in Delaware is $2.1 billion. If onsite stormwater detention increases downstream property values by 2% to 5%, then stormwater detention from floodplains and wetlands provides $42 to $105 million in economic benefits in Delaware.

Flood Protection: Researchers reported in "Scientific Reports" that coastal marshes and wetlands in 12 mid-Atlantic states (including Delaware) prevented $625 million in flood damages during Superstorm Sandy in October 2012 (Narayan et al. 2017). Delaware, where 1/5 of the land is covered by wetlands, coastal marshes reduced flood damages during Superstorm Sandy by 10% or by $24 million (Figure 6 and Table 8)

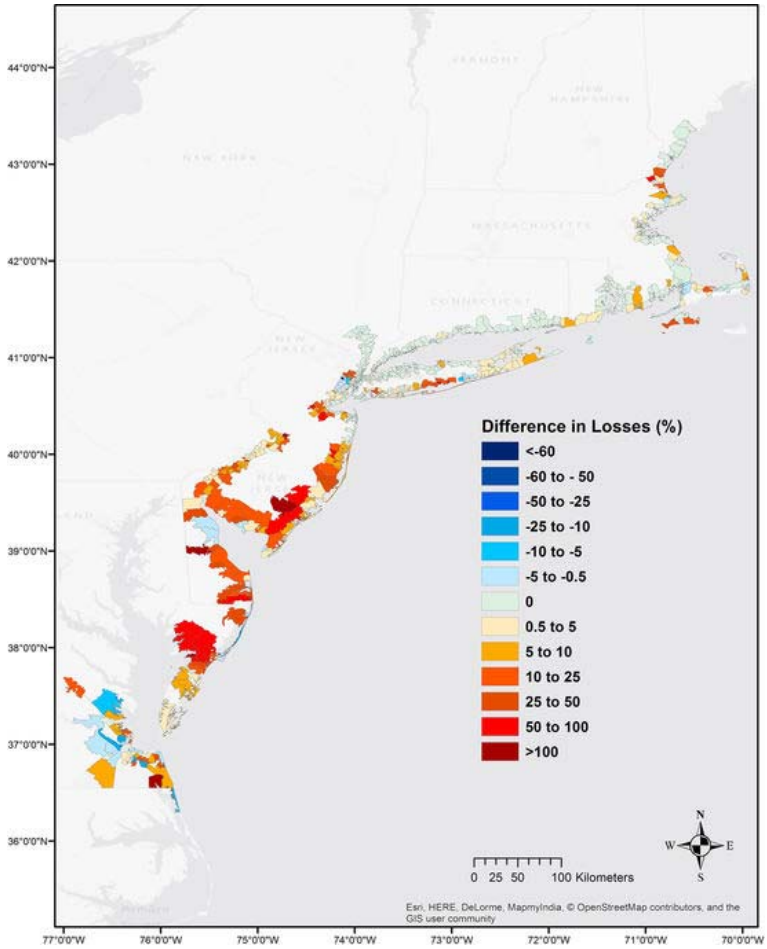

Figure 6. Reduced property loss due to wetlands during Hurricane Sandy in October 2012 (Narayan et al. 2017).

Table 8. Reduced property loss due to wetlands during Hurricane Sandy in October 2012 (Narayan et al. 2017).

State	Damages: Wetlands Present ($)	Damages: Wetlands Lost ($)	Difference ($)	% Difference (total damages)
Connecticut	2,180,600,000	2,181,000,000	400,000	0.02
Delaware	**228,100,000**	**251,900,000**	**23,800,000**	**10.43**
Massachusetts	1,452,300,000	1,458,600,000	6,300,000	0.43
Maryland	15,500,000	20,000,000	4,500,000	29.03
Maine	17,600,000	17,603,000	3,000	0.02
North Carolina	9,400,000	8,800,000	−615,000	−6.47
New Hampshire	29,600,000	30,500,000	900,000	3.04
New Jersey	14,014,600,000	14,443,300,000	428,700,000	3.06
New York	32,314,600,000	32,452,800,000	138,200,000	0.43
Pennsylvania	174,400,000	188,100,000	13,600,000	7.86
Rhode Island	72,100,000	72,400,000	300,000	0.42
Virginia	195,400,000	205,300,000	9,900,000	5.07

Parks/Open Space

State Parks: Delaware state parks such as Delaware Seashore State Park, Cape Henlopen State Park, and Brandywine Creek State Park are covered in large part by tidal and freshwater wetlands that provide recreational and wildlife habitat benefits. Rockport Analytics (2017) reported that the economic impact of the Delaware State Park System was $390 million/yr in 2017-2017 from spending by 1.6 million visitors (Table 9).

Table 9. Delaware state parks visitation & visitor spending FY 2016/2017 (Rockport Analytics 2017)

State Park	Attendance	Visitors	Spending ($)	% Spending	Rank
Delaware Seashore S.P.	1,055,759	588,906	$172,984,023	44.4%	1
Cape Henlopen State Park	1,276,040	591,141	$128,481,875	33.0%	2
Fenwick Island State Park	232,832	115,909	$60,032,326	15.4%	3
Lums Pond State Park	316,253	71,726	$7,323,283	1.9%	4
Killens Pond State Park	260,959	93,698	$6,548,569	1.7%	5
Bellevue State Park	351,235	30,230	$4,236,074	1.1%	6
Trap Pond State Park	116,626	51,050	$3,512,408	0.9%	7
White Clay Creek State Park	175,076	15,068	$2,111,508	0.5%	8
Brandywine Creek State Park	129,006	11,103	$1,555,877	0.4%	9
Alapocas Run State Park	109,229	9,401	$1,317,356	0.3%	10
Brandywine Zoo	97,686	8,408	$1,178,060	0.3%	11
First State Heritage Park, Dover	18,878	1,625	$227,662	0.1%	12
Fort Delaware State Park	14,128	1,216	$170,379	0.0%	13
Holts Landing State Park	8,592	739	$103,621	0.0%	14
Fort DuPont State Park	5,485	472	$66,148	0.0%	15
Auburn Heights Preserve	3,188	274	$38,443	0.0%	16
All State Parks	**4,170,969**	**1,590,967**	**$389,887,614**		

National Wildlife Refuge: The Bombay Hook and Prime Hook National Wildlife Refuges (NWR) on the Delaware Bay marshes contributed over $21 million to the Delaware economy from 390,000 annual visitors and supported over 200 jobs with $6 million in wages. The U.S. Fish and Wildlife Service reported that the 16,000-acre Bombay Hook National Wildlife Refuge in Delaware was the 4th most visited refuge in the nation with nearly 271,000 recreational visits in 2006 (Carver and Caudill 2007). The Bombay Hook NWR is the 6th most valuable refuge in the U.S. as it contributed $20.2 million to the economy from food, lodging, equipment, and transportation expenditures ($13.4 million from bird watching) and supported 198 jobs with $5.5 million in annual income. The 8,900-acre Prime Hook National Wildlife Refuge in Delaware recorded 120,000 visits in 2004 (Carver and Caudill 2007) and contributed over $1 million to the local economy and was responsible for 13 jobs with $419,000 in annual income.

Fish/Wildlife

Fishing/Viewing: In 2015, Delaware residents spent an estimated $62 million on fishing ($38 million), wildlife viewing ($15 million), hunting ($9 million) within view of tidal wetlands (Santoni, Arvay, and Scarborough 2017).

Fishing, Hunting, and Bird/Wildlife Watching: Much of the fishing, hunting, and wildlife/birding recreation in Delaware occurs on wetlands, and freshwater ecosystems such as the Prime Hook and Bombay Hook National Wildlife Refuges, Cape Henlopen State Park, and other state parks and forests in Delaware and along the state's rivers, bays, and ocean. In Delaware, the U.S. Fish and Wildlife Service (2014) estimated the annual economic value of recreational fishing (166,000 anglers), hunting (23,000 hunters), birding/wildlife watching (243,000 viewers) at $315 million in 2011 dollars (Table 10). Trip-related expenditures include the market value of purchases and sales of food and lodging, transportation, and hunting, fishing, and wildlife-watching equipment.

Table 10. Value of fishing, hunting, and wildlife recreation in Delaware (USFWS 2014)

Recreation Activity	Value[1] ($2011 million)	Participants
Fishing	**$104.4**	**166,000 anglers**
Trip-related	$48.7	
Equipment/Other	$55.6	
Hunting	**$40.8**	**23,000 hunters**
Trip-related	$5.4	
Equipment/Other	$35.3	
Wildlife/Birding	**$169.8**	**243,000 viewers**
Trip-related	$36.1	
Equipment/Other	$133.7	
Total	**$315.0**	

Commercial Fishing: Wetlands act as nurseries for most commercial fish species along the Delaware Bay and Atlantic coast. The annual value of commercial fish landings in the waters of Delaware is $7.9 million in 2007 dollars or $8.6 million in 2010 dollars (National Marine

Fisheries Service and National Ocean Economics Program 2007). Table 11 ranks the most lucrative fisheries in 2010 dollars as blue crab ($5.8 million/year), with the eastern oyster, striped bass, and knobbed whelk each at approximately $0.5 million/year. Figure 7 shows fish harvests by weight and revenue for blue crab, striped bass, and eastern oyster harvests at Delaware docks.

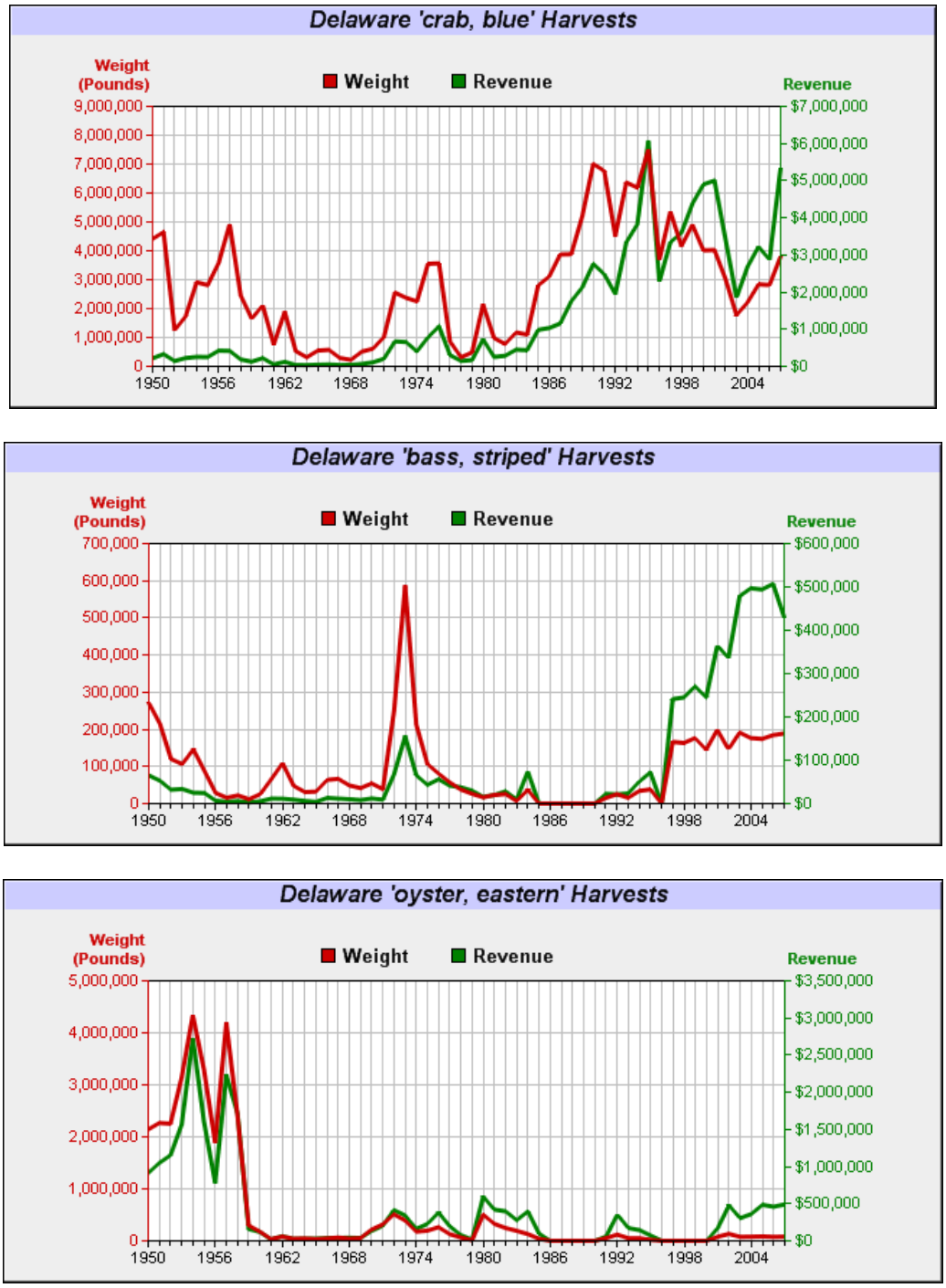

Figure 7. Blue crab, striped bass, and eastern oyster harvests in Delaware (NMFS and NOEP 2007)

Table 11. Value of commercial fish harvests in Delaware

Species	Pounds (2007)	Landed Value (2007 dollars) [2]	Landed Value (2010 dollars) [2]
Blue Crab	3,799,820	$5,329,182	$5,823,341
Eastern Oyster	79,933	$490,465	$535,944
Knobbed Whelk	260,078	$456,368	$498,686
Striped Bass	188,671	$429,994	$469,866
American Eel	139,648	$315,094	$344,312
Black Sea Bass	72,675	$200,902	$219,531
Northern Quahog Clam	44,618	$181,350	$198,166
Spot	128,209	$99,995	$109,267
Shellfish	30,130	$76,119	$83,177
Channeled Whelk	17,139	$54,804	$59,886
Horseshoe Crab	229,602	$48,978	$53,520
White Perch	55,973	$46,865	$51,211
American Shad	71,445	$42,408	$46,340
Weakfish	24,604	$36,177	$39,532
Black Drum	37,712	$21,867	$23,895
Finfishes, UNC General	5,421	$18,018	$19,689
Summer Flounder	5,464	$11,119	$12,150
Atlantic Croaker	13,651	$8,281	$9,049
Bluefish	19,565	$8,075	$8,824
Atlantic Menhaden	85,080	$6,635	$7,250
Channel Catfish	6,922	$3,929	$4,293
Tautog	1,976	$3,723	$4,068
Common Carp	3,764	$865	$945
Butterfish	946	$843	$921
Blueback Herring	1,434	$609	$665
Northern Kingfish	690	$548	$599
Conger Eel	1,241	$517	$565
Flatfish	676	$362	$396
Finfished, UNC Bait and animal food	28	$7	$8
Total	**5,327,115**	**$7,894,099**	**$8,626,096**

1. NMFS and NOEP 2007. 2. Adjusted to 2010 dollars at 3% annual change in CPI.

Recreation

Outdoor Recreation: The Outdoor Industry Association (2016) concluded 467,000 people in Delaware participated in recreation activities such as bicycling, camping, fishing, hunting, paddling, hiking, and wildlife viewing who contributed $3.1 billion and 29,000 jobs with $959 million in wages to the regional economy. If paddling related to wetlands and marshes in Delaware is 4% of the outdoor recreation economy, then 18,680 paddlers contribute $124 million in consumer spending to the economy and 1,160 jobs with $38 million in wages (Table 12).

Table 12. Economic value of outdoor recreation in Delaware

Economic Activity	Outdoor Recreation Delaware[1]	Paddling Delaware[2]
Consumer Spending	$3.1 billion	$124 million
Participants	467,000	18,680
Jobs	29,000	1,160
Wages	$959 million	$38.4 million

1. Outdoor Industry Association 2016. 2. Paddling is 4% of Delaware outdoor recreation economy.

Forested Wetlands/Carbon Storage

Forests: Palustrine forests cover 64% or 76,800 acres of the 120,000 acres of wetlands in Delaware (Tiner et al. 2011). The U.S. Forest Service and Delaware Center for Horticulture (Nowak et al., 2008) estimated that 7,137 acres of forests in New Castle County provide environmental benefits such as carbon storage of $5.9 million ($827/acre) and air-pollution removal of $1.9 million ($266/acre/year). Applying these multipliers, 76,800 acres of forested wetlands in Delaware have benefits of carbon storage ($63.5 million), carbon sequestration ($2.27 million), air-pollution removal ($20.4 million), and building-energy savings ($4.3 million). In addition, forested wetlands in Delaware provide environmental benefits by regulating climate change, cooling, and air-emissions control including 3.1 million tons of carbon-storage capacity, 107,000 tons of carbon sequestration, 3,072 tons of air-pollution removal, 10,752 tons of avoided carbon-emissions capacity (Table 13).

Table 13. Economic and environmental benefits of forested wetlands in Delaware

Benefits	Forests New Castle County[1]		Forested Wetlands In Delaware[2]	
	Environmental (tons/acre)	Economic ($/acre)	Environmental (tons)	Economic ($)
Carbon Storage	40.00	$827	3,072,000	63,513,600
Carbon Sequestration	1.40	$29	107,520	2,227,200
Air Pollution Control	0.04	$266	3,072	20,428,800
Energy Savings		$56	0	4,300,800
Avoided Carbon Emissions	0.14	$3	10,752	230,400

1. Nowak et al. 2008. 2. Computed for 76,800 acres of forested wetlands in Delaware

Atmospheric Carbon: Industrial Economics, Inc. (2011) reported that for a 1.2% decrease (3,132 ac) in wetlands in Delaware from 2007 to 2022, the social cost of additional carbon in the atmosphere (damages from climate change) is $19.9 million (present value over 15 years) with an annualized cost of $1.59 million.

Nonuse Value

Willingness to Pay: Delaware residents are willing to pay between $16 to $84 million per year in increased taxes and fees for wetland protection and management programs on 320,000 wetland acres where 25% are tidal (Santoni, Arvay, and Scarborough 2017).

Chapter 4 - Ecosystem Services

Ecosystem services (natural capital) are the sum of goods (commodities like water and fish that can be sold) and services (functions like flood control, water filtration, and fisheries habitat) provided by wetland habitat. The following studies were examined to estimate ecosystem-services values of wetlands in Delaware:

- Cecil County green infrastructure study by the Conservation Fund, Annapolis, Md. (2007)
- Mates and Reyes with the NJDEP and the University of Vermont (2007)
- Ecosystem services value of Peconic Estuary watershed by University of Rhode Island (2002)
- U.S. National Wildlife Refuges by University of Maryland and Nature Conservancy (2008)
- Economic value of ecosystem services in Massachusetts by the Audubon Society (2003).

Related Research

Ecosystem services include air filtration, water filtration, recycling nutrients, soil conservation, pollinating crops and plants, climate regulation, carbon sequestration, flood/stormwater control, and hydrologic-cycle regulation. Ecological resources provide marketable goods and services such as timber, fish and wildlife recreation, hiking, and boating/kayaking.

Mates and Reyes (2007) partnered with the New Jersey Department of Environmental Protection (NJDEP) and University of Vermont and estimated the value of New Jersey's natural capital at $20 billion/year in 2004 dollars with a net present value (NPV) of $681 billion. NPV takes the value of a dollar today and projects it into the future summed annually over a lifetime (say 100 years) given the annual value is discounted by a rate (3%) due to inflation based on the Consumer Price Index.

Others have calculated the value of natural capital in wetland ecosystems along the Atlantic seaboard and across the United States. Weber (2007) from the Conservation Fund found the largest wetlands ecosystem services values in Cecil County, Maryland are from stormwater/flood control, water supply, and clean water functions (Table 14). A contingent value study by University of Rhode Island economists found that natural resources values in the Peconic Estuary watershed in Suffolk County on Long Island New York was $6,560/ac for saltwater wetlands (Johnston et al. 2002). The University of Maryland studied the U.S. National Wildlife Refuge System and determined that ecosystem values of freshwater wetlands and open water are $6,268/ac and $217/ac, respectively (Ingraham and Foster 2008). The Audubon Society found the economic value of ecosystems in Massachusetts ranged from $12,580/ac for saltwater wetlands to $15,452/ac for freshwater wetlands (Breunig 2003).

Data from the NJDEP study are used for value transfer to the valuation study of Delaware wetlands as the two study areas just across the bay from each other share similar ecosystems (forests/wetlands), climate (humid continental at 40 degrees north in latitude), physiographic provinces (Coastal Plain), aquifers, and soils (Table 15). NJDEP ecosystem-services values are lower than Cecil County's for wetlands and Mass. Audubon's for wetlands. NJDEP estimates are higher than the U.S. Wildlife Refuge for freshwater wetlands. Values are adjusted to 2010

dollars based on 3 percent annually. Net present values are calculated based on an annual discount rate of 3 percent in perpetuity (over 100 years in the future).

Table 14. Ecosystem services values for Cecil County, Maryland (Weber 2007)

Ecosystem Service	Riparian Forest/Wetland ($/ac/yr)	Nonriparian Wetlands ($/ac/yr)	Tidal Marsh ($/ac/yr)
Carbon sequestration	65	65	65
Clean air	191	191	
Soil and peat formation	946	450	1,351
Stormwater/flood control	32,000	32,000	1,430
Water supply	8,630	8,630	
Clean water	1,925	1,100	11,000
Erosion/sediment control	3,418	151	12,700
Water temperature regulation	4,450		
Pest control	50	50	
Pollination	75	75	
Wood products			
Recreation, fish, wildlife habitat	534	534	544
Community services savings	439	439	439
Increase in property values	42		
Total	**52,765**	**43,685**	**27,529**

Table 15. Comparison of ecosystem goods and services values from various studies

Ecosystem	Cecil Co. Md. 2006 ($/ac/yr)	NJDEP 2007 ($/ac/yr)	Peconic Estuary 1995 ($/ac/yr)	USFWS 2008 ($/ac/yr)	Mass. Audubon 2003 ($/ac/yr)
Freshwater wetland	43,685	11,802		6,268	15,452
Saltwater wetland	28,146	6,269	6,560		12,580
Open freshwater		1,686		217	983

Wetland Ecosystem Services

The estimated value of goods and services provided by Delaware wetlands (465 sq. mi. or 297,885 acres) is $3.0 billion (in 2010 dollars) with a net present value (NPV) of $98.8 billion (Table 16). Ecosystem services habitat within Delaware wetlands (Figure 8) are comprised of freshwater wetlands (60%), saltwater wetlands (24%), and open freshwater (16%).

Freshwater wetlands, saltwater wetlands, and open freshwater provide ecosystems goods and services values (Figure 9). The Chesapeake Bay watershed, at $2.0 billion, provides the highest value of annual wetland ecosystem services, followed by the Delaware Estuary ($1.3 billion, Inland Bays ($590 million), and Piedmont ($72 million) watersheds (Figures 10 and 11). Delaware watersheds with the highest value of annual wetland ecosystem services per acre include the Chesapeake Bay ($13,344/acre), Piedmont ($11,600/acre), Delaware Estuary ($9,462/acre), and Inland Bays ($7,923/ac) watersheds as these systems have the highest amounts of freshwater and saltwater wetland habitats (Figure 12).

Table 16. Value of ecosystem goods and services provided by Delaware wetlands

Watershed/ Wetland Type	Area (acres)	$/acre/yr	PV ($/yr)	NPV $
State of Delaware	297,885	10,208	**3,040,663,834**	**98,821,574,614**
Freshwater wetlands	178,632	13,621	2,433,081,000	79,075,132,489
Saltwater wetland	71,001	7,235	513,691,702	16,694,980,313
Open water	48,253	1,946	93,891,133	3,051,461,812
Piedmont	6,226	11,600	**72,220,827**	**2,347,176,886**
Freshwater wetlands	4,732	13,621	64,452,985	2,094,722,008
Saltwater wetland	919	7,235	6,649,002	216,092,568
Open water	575	1,946	1,118,840	36,362,310
Delaware Estuary	**134,064**	9,462	**1,268,470,242**	**41,225,282,856**
Freshwater wetlands	58,390	13,621	795,317,362	25,847,814,257
Saltwater wetland	61,617	7,235	445,802,585	14,488,584,028
Open water	14,056	1,946	27,350,295	888,884,572
Chesapeake Bay	9,462	13,344	**1,111,066,067**	**36,109,647,188**
Freshwater wetlands	81,130	13,621	1,105,045,825	35,913,989,309
Saltwater wetland	353	7,235	2,556,702	83,092,815
Open water	1,780	1,946	3,463,540	112,565,064
Inland Bays	74,332	7,923	**588,906,698**	**19,139,467,684**
Freshwater wetlands	34,379	13,621	468,264,828	15,218,606,915
Saltwater wetland	8,111	7,235	58,683,412	1,907,210,902
Open water	31,842	1,946	61,958,457	2,013,649,867

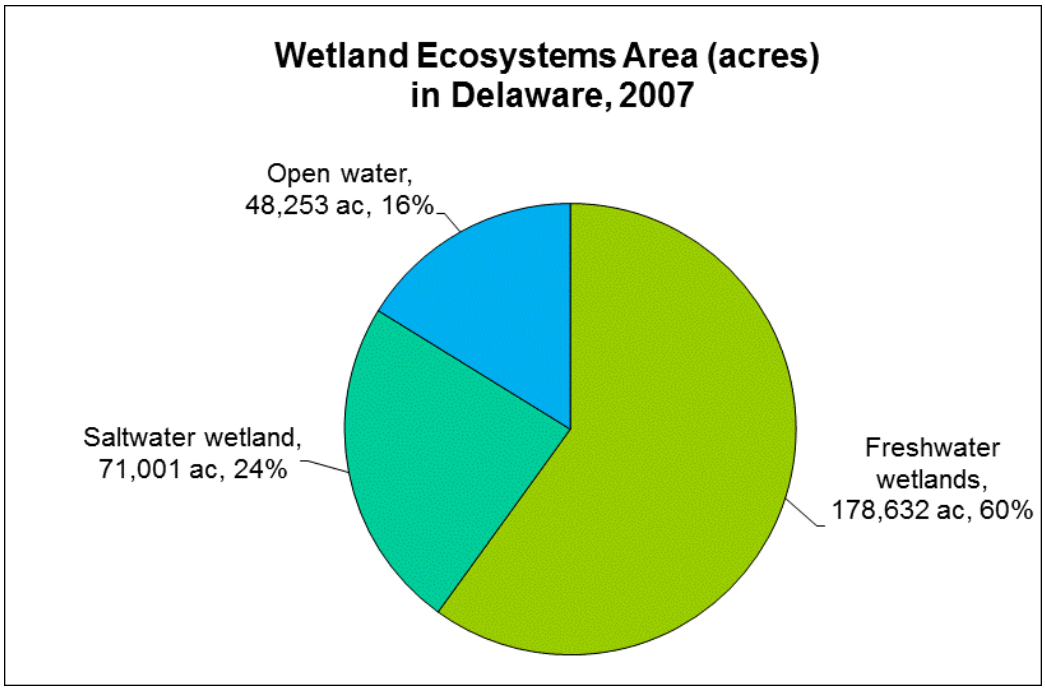

Figure 8. Ecosystem service area of Delaware wetland habitat

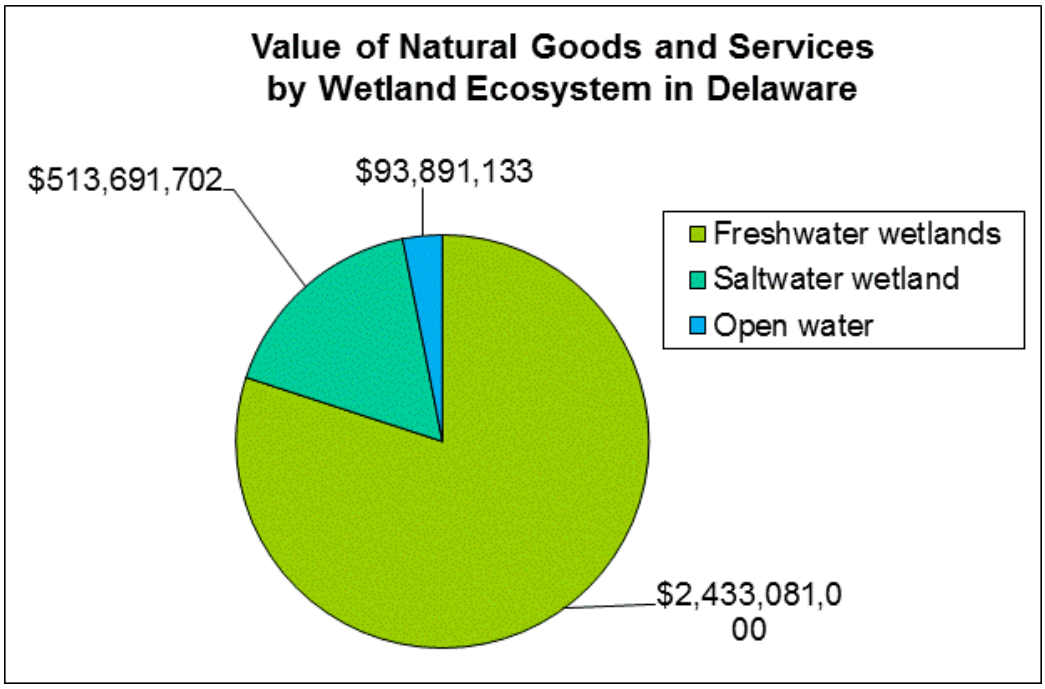

Figure 9. Value of natural goods and services by wetland ecosystem in Delaware

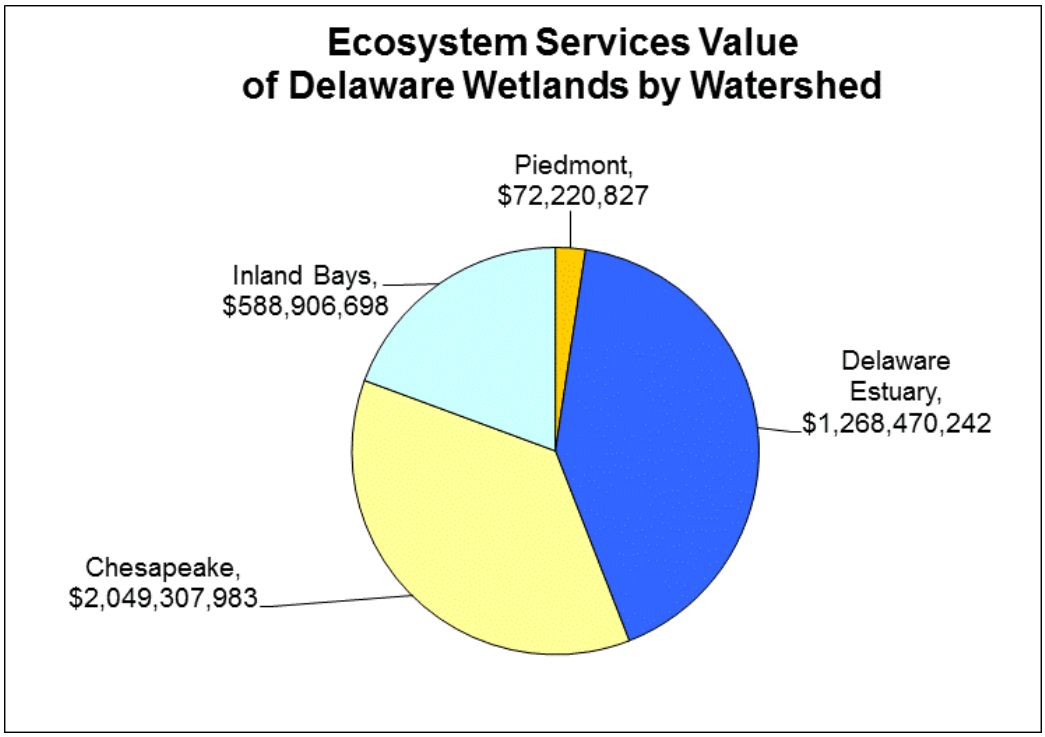

Figure 10. Value of wetlands natural goods and services by watershed in Delaware

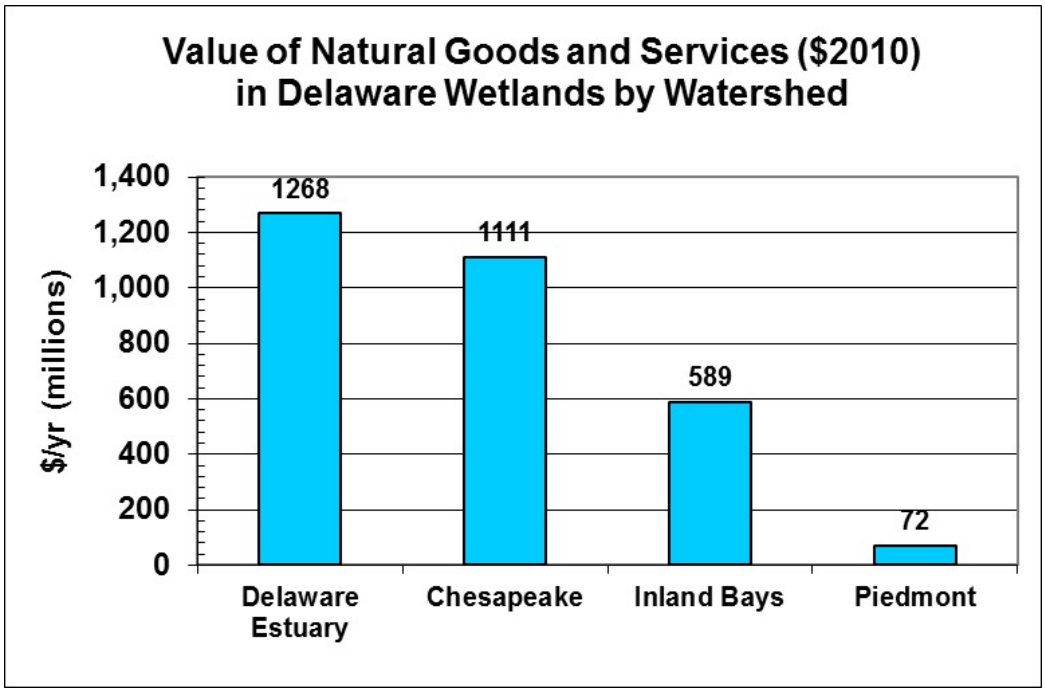

Figure 11. Value of wetlands natural goods and services by watershed in Delaware

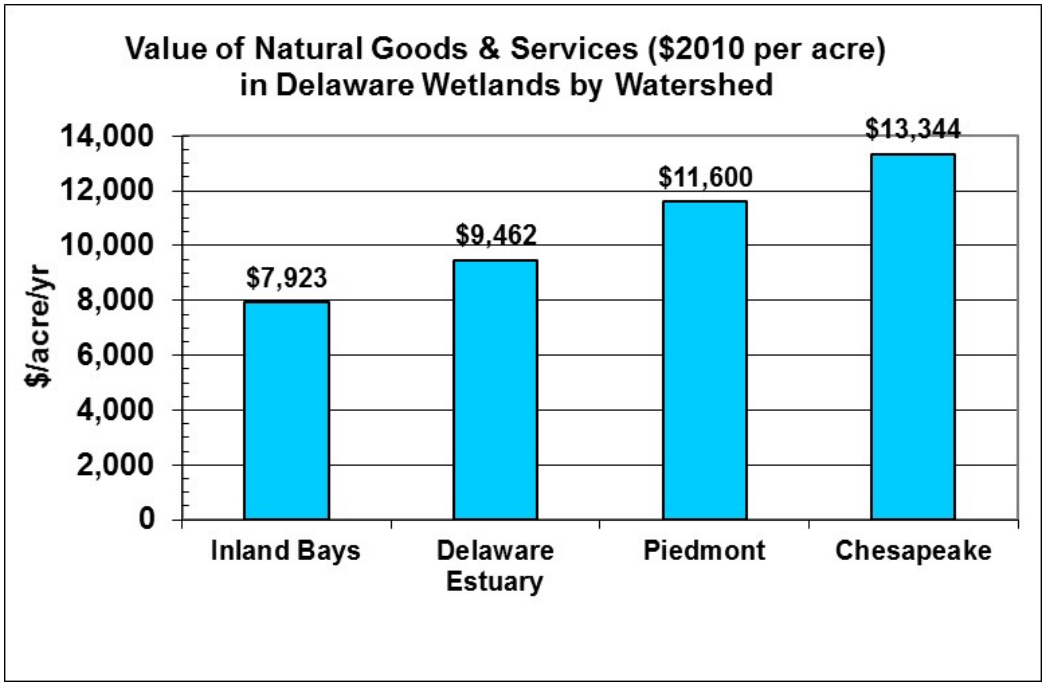

Figure 12. Per acre value of wetland natural goods and services by watershed in Delaware

Ecosystem services in Delaware wetlands transferred from the NJDEP values are worth $3.0 billion (2010 dollars) or $98.8 billion (NPV), conservatively in the lower end of the range (Table 17). If lower per-acre estimates of ecosystem services from other studies are used instead of the

NJDEP values, ecosystem services in Delaware wetlands would be $1.6 billion with NPV of $51.2 billion. If higher per-acre estimates from other studies are used, the ecosystems services value of Delaware wetlands would be $9.9 billion with a NPV of $321.1 billion (Table 18).

Table 17. Present value of wetland ecosystem services in Delaware

Range	PV ($B)	NPV ($B)
Low	1.6	51.2
Mid-range (NJDEP	3.0	98.8
High	9.9	321.2

Table 18. Range of ecosystem services values provided by Delaware wetlands

Ecosystem	Area (acres)	$/acre/year	PV ($/yr)	NPV ($)
Low Range	**297,885**		**1,575,236,043**	**51,195,171,401**
Freshwater wetlands	178,632	6,268	1,119,662,818	36,389,041,588
Saltwater wetland	71,001	6,269	445,102,324	14,465,825,530
Open water	48,253	217	10,470,901	340,304,283
Mid Range (NJDEP)	**297,885**	**10,208**	**3,040,663,834**	**98,821,574,614**
Freshwater wetlands	178,632	13,621	2,433,081,000	79,075,132,489
Saltwater wetland	71,001	7,235	513,691,702	16,694,980,313
Open water	48,253	1,946	93,891,133	3,051,461,812
High Range	**297,885**		**9,883,256,574**	**321,205,838,669**
Freshwater wetlands	178,632	43,685	7,803,521,093	253,614,435,509
Saltwater wetland	71,001	28,146	1,998,380,924	64,947,380,025
Open water	48,253	1,686	81,354,558	2,644,023,135

1. Cecil Co., Md., 2006. 2. NJDEP, 2007. 3. Wilderness Society, 2001. 4. Peconic Estuary, 1995. 5. Ingraham and Foster, 2008. 6. Breunig, 2003.

Chapter 5 - Jobs and Wages

Delaware wetlands support 25,000 direct and indirect jobs with $568 million in annual wages in the living marine resources, tourism and recreation, fishing/hunting/birding, national wildlife refuge, outdoor recreation, and wetland organization employment sectors (Table 19).

Table 19. Jobs and wages directly and indirectly related to Delaware wetlands

Sector	Jobs	Wages ($M)	Data Source
Living Marine Resources	442	10	National Coastal Economics Program (2009)
Tourism & Recreation	12,997	188	National Coastal Economics Program (2009)
Fishing/Hunting/Birding	9,591	315	U.S. Fish and Wildlife Service (2008)
National Wildlife Refuges	200	6	Carver and Caudill (2007)
Outdoor Recreation	1,160	38	Outdoor Industry Association (2016)
Wetland Organizations	115	6	
Wetlands	496	5	NOAA Coastal Services Center (2011)
Delaware Wetlands	**25,000**	**$568 million**	

Delaware Jobs

The U.S. Bureau of Labor Statistics (2017) reported there were 436,574 jobs with wages of $5.8 billion in Delaware in Kent County (65,742 jobs, $708 million in wages), New Castle County (286,532 jobs, $4.3 billion in wages), and Sussex County (84,300 jobs, $808 million in wages)

National Coastal Economy

The National Ocean Economic Program (2009) published a report that summarized the coastal economy in the U.S. for the following industrial sectors: Marine Transportation, Tourism and Recreation, Living Marine Resources, Marine Construction, Ship and Boat Building, Mineral Extraction. For coastal job sectors related to wetland functions such as Living Marine Resources and Tourism and Recreation, coastal counties in Delaware contributed 13,439 coastal jobs, representing $199 million in annual wages and $393 million toward the state GDP (Table 20).

Table 20. Coastal employment, wages, and GDP related to wetlands in Delaware (NOEP 2009)

Sector	Employment	Wages ($ million)	GDP ($ million)
Living Marine Resources	442	10.3	19.2
Tourism & Recreation	12,997	188.5	373.9
Delaware wetlands	13,439	198.8	393.1

Fishing/Hunting/Bird and Wildlife Recreation Jobs

The Mates and Reyes (2007) NJDEP study estimated the average annual salary per ecotourism job is $32,843, using figures from the 2001 U.S. Fish and Wildlife Service report on fishing,

hunting, and wildlife-associated recreation. Fishing, hunting, and bird/wildlife-recreation associated with Delaware wetlands account for $315 million in annual economic activity in 2011 dollars and at the average salary ecotourism accounts for 9,591 jobs (Table 21). While this estimate of ecotourism jobs is not exact, it provides a reasonable estimate of the jobs provided by fishing, hunting, and bird/wildlife recreation associated with Delaware wetlands.

Table 21. Jobs from fishing, hunting, and wildlife recreation in Delaware wetlands

Recreation Activity	Economic Activity[1] ($2011 million)	Delaware Recreation Jobs[2]
Fishing	**$104.4**	**3,179**
Trip-Related	$48.7	
Equipment/other	$55.6	
Hunting	**$40.8**	**1,242**
Trip-Related	$5.4	
Equipment/other	$35.3	
Wildlife/Birding	**$169.8**	**5,170**
Trip-Related	$36.1	
Equipment/other	$133.7	
Total	**$315.0**	**9,591**

1. USFWS 2014. 2. Jobs based on $32,843 average salary.

National Wildlife Refuge

The Bombay Hook and Prime Hook National Wildlife Refuges (NWR) on the Delaware Bay marshes contributed over $21 million to the Delaware economy from 390,000 annual visitors and supported over 200 jobs with $6 million in wages (Carver and Caudill 2007).

Outdoor Recreation

The Outdoor Industry Association (2016) concluded 467,000 people in Delaware participated in recreation activities such as bicycling, camping, fishing, hunting, paddling, hiking, and wildlife viewing that supported 29,000 jobs with $959 million in wages to the regional economy. If paddling related to wetlands and marshes in Delaware is 4% of the outdoor recreation economy, then paddling (by 18,680 paddlers) supported 1,160 jobs with $38 million in wages.

Wetland Organization Jobs

More than 20 nonprofit watershed and environmental organizations employ at least 115 staff to work on programs to protect the land and waters that flow into Delaware wetlands (Table 22). Assuming that the average salary is $48,000/person working in a wetland-organization job in Delaware, these jobs account for $5.5 million in annual wages.

Table 22. Watershed organization jobs related to Delaware wetlands

Watershed Organization	Town	Jobs	Salaries
Appoquinimink River Association	Middletown	1	48,000
Brandywine Valley Association[1]	West Chester (Pa.)	2	96,000
Brandywine Conservancy[1]	Chadds Ford (Pa.)	7	336,000
Christina Conservancy, Inc.	Wilmington	1	48,000
Chesapeake Bay Foundation[2]	Annapolis (Md.)	1	48,000
Coalition for Natural Stream Valleys	Newark	0	0
Delaware Audubon Society	Wilmington	1	48,000
Delaware Center for Horticulture	Wilmington	18	864,000
Delaware Center for the Inland Bays	Rehoboth Beach	6	288,000
Delaware Chapter of the Sierra Club	Wilmington	0	0
Delaware Greenways	Wilmington	6	288,000
Delaware Low-Impact Tourism Experiences (DLITE)	Salisbury (Md.)	1	48,000
Delaware Native Plant Society	Dover	0	0
Delaware Nature Society	Hockessin	20	960,000
Delmarva Ornitholigical Society	-	0	0
Delaware Riverkeeper Network[2]	Bristol (Pa.)	1	48,000
Delaware Rural Water Association	Milford	9	432,000
Delaware Wild Lands	Odessa	5	240,000
Ducks Unlimited	-	-	-
Fairfield Watershed Association	Newark	0	0
Friends of Bombay Hook	Smyrna	1	48,000
Friends of the Delaware Bay	Sussex County	-	-
Friends of Prime Hook National Wildlife Refuge	Milton	0	0
Friends of the Nanticoke River	Nanticoke (Md.)	0	0
Friends of White Clay Creek State Park	Newark	1	48,000
League of Women Voters of Delaware	Wilmington	5	240,000
Naamans Creek Watershed Association	Arden	0	0
Nanticoke Watershed Alliance	Vienna (Md.)	3	144,000
National Wildlife Federation	Annapolis (Md.)	1	48,000
Partnership for the Delaware Estuary	Wilmington	16	768,000
Red Clay Valley Association	West Chester (Pa.)	1	48,000
Save Wetlands and Bays	Millsboro	-	-
Sierra Club	Wilmington	0	0
St. Jones River Greenway Commission	Magnolia	0	0
St. Jones River Watershed Association	Dover	1	48,000
Surfrider Foundation Delaware Chapter	Millsboro	-	-
The Academy of Natural Sciences	Philadelphia (Pa.)	0	0
The Conservation Fund	Centreville	1	48,000
The Nature Conservancy - Delaware Chapter	Wilmington	2	96,000
Urban Environmental Center	Wilmington	1	48,000
Waterfront Watch of Wilmington	Wilmington	1	48,000
White Clay Creek Watershed Association	Newark	0	0
White Clay Creek Watershed Management Committee	Newark	1	48,000
White Clay Flyfishers	Landenburg (Pa.)	-	-
Widener Environmental and Natural Resources Law Clinic[2]	Wilmington	1	48,000
Total		**115**	**5,520,000**

Wetland Jobs

The NOAA Coastal Services Center (2011) estimates wetlands cover 404 mi^2 (21%) of Delaware and support 496 commercial, recreational, and fishing jobs with $5 million in business output and $9.4 million in self-employed revenue (Table 23).

Table 23. Economic output associated with Delaware wetlands (NOAA CSC 2011)

County	Wetland Area (ac)	Wetland Area (%)	Jobs	Business Output ($)	Self Employed Revenue ($)
New Castle	37,568	13%	191	$1,500,000	$4,300,000
Kent	91,974	24%	176	$443,000	$2,000,000
Sussex	128,926	21%	129	$3,100,000	$3,100,000
State	**258,468**	**21%**	**496**	**$5,043,000**	**$9,400,000**

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