Delaware Inland Bays
in Delaware

Every newspaper has headlines that scream warnings to Delaware. 'Crab Populations Down,' 'Poor Trout Season,' 'Fish Stocks Endangered,' 'Clam Harvest Down 90 percent since 1990,' 'Black Ducks Scarce,' and so on.... Yet, Delaware's Inland Bays' nursery and larval areas continue to be polluted and over-exploited. The contribution these Bays make financially to the State and local area is enormous, both from tourism and fishing supplies; yet the valuable, irreplaceable resource has almost no protection except that provided by the Clean Water Act.

—Til Purnell, Executive Secretary
Save Wetlands and Bays

Portrait of the Bays

The Delaware Inland Bays Estuary Program is examining the water quality and habitat problems of the Delaware Inland Bays and the impact that the greater watershed area has on the estuarine system. The Delaware Inland Bays are actually three bays — Rehoboth, Indian River, and Little Assawoman bays — located along the southern Delaware coast. The surface water of the Bays covers 32 square miles.[1] The average depth of the Delaware Inland Bays is a shallow four feet.[2]

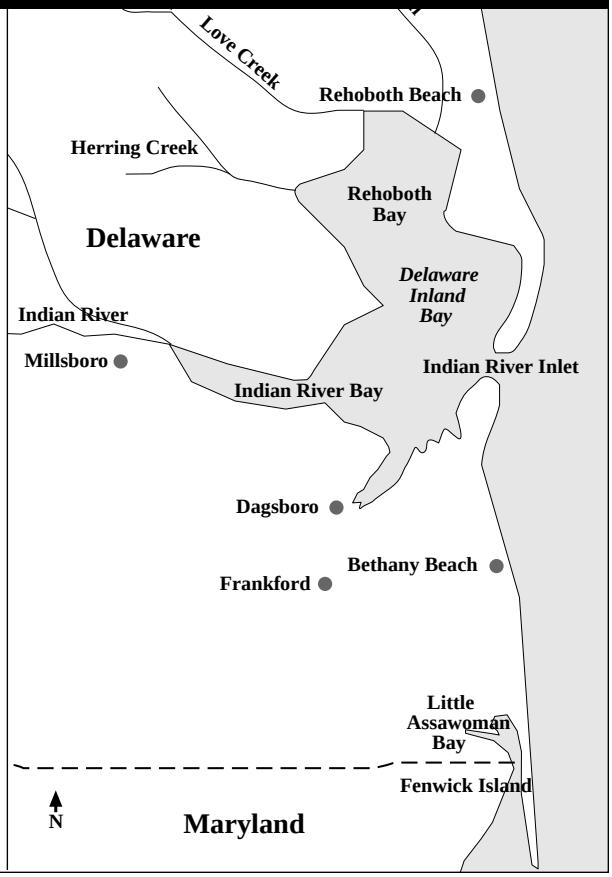
The watershed area of the Bays measures 300 square miles and extends to include portions of

Delaware Inland Bays

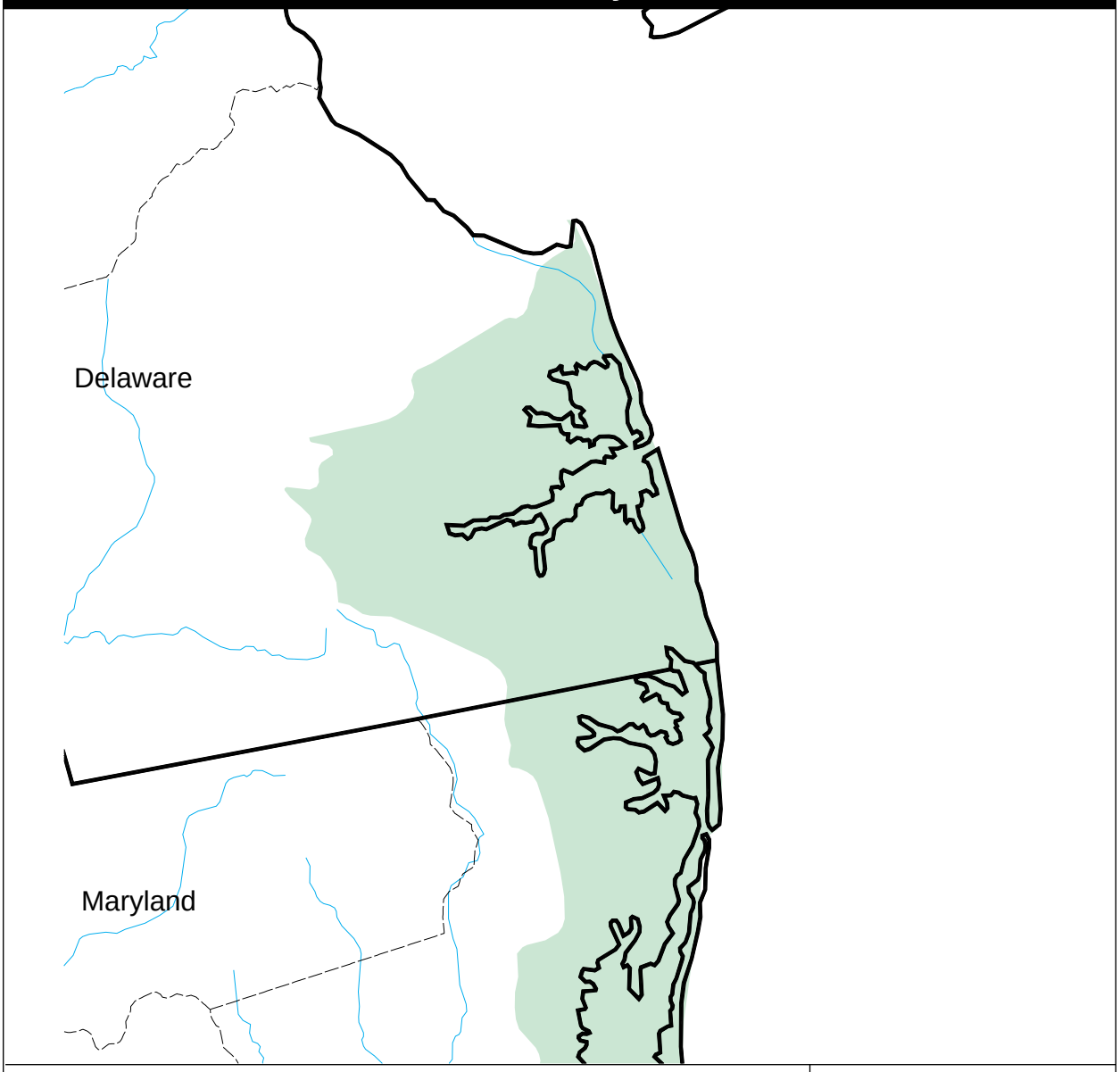
Area of surface water	32 square miles
Area of watershed	300 square miles
Average depth	4 feet
Population	120,000 people
Values	• The hard clam fishery generates $46,000
	• Sport fishing generates $110 million in economic output*
	• Recreational boating generates $14.7 million
Threats	• Nutrient loadings
	• Habitat loss and degradation
CCMP status	Approved in 1995

Designated as a "Nationally Significant" Estuary in 1988.

*State figure



Delaware Inland Bays Watershed

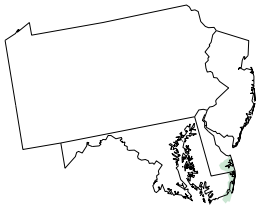


Watershed
Major Rivers
State Boundary
County Boundary

Delaware Inland Bays

Scale: approximately 1:489,800
Sources: NOAA, ARCUSA
October 31, 1995
Map MR00037-9

EPA
Office of Wetlands, Oceans & Watersheds



Mid Atlantic

northern Maryland. Approximately 120,000 persons live within the watershed.[3] Portions of Sussex County, including the communities of Millsboro, Rehoboth Beach, and Bethany Beach, are situated within the watershed. The area is experiencing sizable population increases. The population of Sussex County grew from 80,356 in 1970 to 113,225 in 1990 and is expected to increase to approximately 150,000 by 2011.[4] During the summer months, the resort communities along bay and ocean shores in the region host hundreds of thousands of visitors.

The Bays have a number of features which distinguish them from other estuaries in the United States. First, physical connections with the Atlantic Ocean are limited. Saltwater reaches the Bays via the Indian River Inlet, Lewes and Rehoboth Canal, Roosevelt Inlet, and the Assawoman Canal.[5] Projects to deepen the Indian River Inlet have significantly altered the Inland Bays. During the past 60 years, the Bays have changed from a predominantly fresh water estuary to a marine-dominated one.[6] Barrier islands separate each of the Bays from the Atlantic Ocean. Second, unlike most estuaries which receive the bulk of their freshwater inflow from rivers, the Delaware Inland Bays receive as much as 80 percent of their freshwater, six to nine million gallons a day,[7] from groundwater sources.[8] The main tributaries that carry freshwater to the Bays are Indian River, Love Creek, and Herring Creek. Overall, the freshwater inflow, calculated to be 300 cubic feet per second,[9] is relatively low compared to other estuaries in the nation.[10] Finally, the shallowness of the Bays, coupled with limited freshwater inflow and flushing capacity make them particularly vulnerable to harmful contaminants.

Various types of habitat can be found within the watershed. These habitats include approximately nine square miles of salt marshes and wetlands, which provide critically productive buffer zones between the Bays and uplands.[11] Forested wetlands and sand dunes are other habitat types which support wildlife in the Bays.[12] The Inland Bays are stressed by 495 acres of "dead-end," unflushable lagoons in developments.[13] Many of these are anoxic and thus devoid of life.

Agriculture is the primary industry and the predominant land use in the watershed. Forty-seven percent of the land surrounding the Bays is used for agriculture.[14] Within the entire watershed, urbanized and publicly-owned lands comprise less than 25 percent of the land.[15]

Values of the Bays

The values of the Delaware Inland Bays system are inestimable. Numerous beaches, commercial and recreational fishing grounds, and abundant natural resources are found within this estuary system. Approximately 5,000 acres of public lands exist within the watershed area,[16] including Fenwick Island, Cape Henlopen, Holts Landing, and Delaware Seashore State Parks. These areas provide outdoor enthusiasts with a variety of recreational opportunities. According to a 1995 study, more than five million people visit Delaware every year.[17] Not surprisingly, 78 percent of those surveyed said visiting the beach and partaking in outdoor recreation activities were the primary purposes of their visit.[18] In 1992, domestic travellers spent $813.3 million and international visitors spent an additional $62 million in the State.[19]

Fisheries/Seafood

The Delaware Inland Bays provide important spawning and nursery grounds for commercially valuable fish and shellfish caught in the mid-Atlantic region of the United States. Of the approximately 30 square miles of classified shellfish harvesting areas within the Delaware Inland Bays, nineteen square miles are approved for harvesting.[20] Blue crab and hard clam form the basis of the Inland Bays' commercial and recreational fishing industries.[21] In 1990, the commercial landings for hard clam in the Delaware Inland Bays totaled 45,700 pounds, valued at $46,000.[22] Weakfish, spot, bluefish, and Atlantic menhaden represent the majority of the commercial finfish catch in the Delaware Inland Bays.[23] In 1994, commercial finfish landings for these four fish species in the Delaware Inland Bays totaled 23,166 pounds, valued at $10,900.[24]

In the past, the Bays supported bay scallop, oyster, and other shellfish fisheries as well as runs of anadromous fish such as alewife, herring, shad, and striped bass.[25] However, pollution, habitat alterations, channeling projects, and overfishing have resulted in declining populations of these fish and shellfish. The

clam population has been depleted to less than 10 percent of its former size, and sport fishing stocks are also declining.[26] The loss of these resources has a deleterious effect not only on the livelihoods of local fishermen, but also on the economy of the area.

Recreation/Tourism

The shores of the Inland Bays and the Atlantic Ocean attract millions of tourists and outdoor enthusiasts each year. In 1985, approximately three million persons visited the Delaware Inland Bays.[27] In 1986, over 750,000 people visited the state parks near the Bays.[28] In 1987, Rehoboth beach was designated one of the top ten beaches in the U.S. The present-day number of visitors to the Bays and parks has grown exponentially since the late 1980s. Rehoboth Beach, although on the ocean and not the Bays, is a very popular vacation area in the Inland Bays region. The Bays provide an ideal spot for residents of Washington, D.C. and other major cities to spend a relaxing weekend. Sailing, swimming, sport fishing, water skiing, and hiking are a few of the popular activities which can be pursued in and near the Bays.

Economies of the local communities benefit from the recreational activities which lure visitors to the area. A 1984 study estimated that the recreation industry was responsible for 12.3 percent of the employment in Sussex County. In the same year, tourism and recreation generated visitor expenditures of $140 million and provided $4 million in taxes to state and local governments.[29]

Recreational fishing and boating help to support the coastal communities of Delaware. In the Delaware Inland Bays, recreational boating expenses alone account for an estimated $14.7 million per year.[30] Bluefish is the most commonly-caught recreational fish in the Bays. In 1991, recreational fishing in Delaware generated $110 million in economic output and employed nearly 2,000 people.[31] In that year, 45,000 freshwater and 130,000 saltwater anglers spent a total of 1.2 million days fishing in the waters of Delaware.[32] Two-thirds of the saltwater anglers were nonresidents of the State.[33]

Wildlife

The Delaware Inland Bays support and maintain a plentitude of plant and animal life. Migratory birds use the Delaware Inland Bays and its wetlands as wintering habitat and resting areas along the Atlantic Flyway. These migratory birds supplement the year-round waterbird populations which inhabit the Bays. A few of the many bird species which rely on the Bays include hooded mergansers, canvasback ducks, eagles, cormorants, ospreys, Arctic brant, snow geese, blue herons, glossy ibises, and oyster catchers.[34]

Delaware has 17 animal species on the federal threatened and endangered species list.[35] The endangered bald eagle and the threatened piping plover are protected species which rely on estuarine wetlands and beach habitats.[36]

Threats to the Bays

A full range of environmental stresses threaten the natural environment of the Delaware Inland Bays. Agricultural runoff, urban stormwater, wastewater outfalls, septic system discharges, recreational activities, dredging and coastal development all burden the estuary by destroying pristine habitat and degrading water quality.[37]

The Comprehensive Conservation and Management Plan of the Delaware Inland Bays Estuary Program has highlighted nutrient over-enrichment and habitat degradation as the primary threats to the system's water quality and natural resources. Other areas of concern are circulation patterns, pathogen contamination, and sea level rise.[38]

Nutrient Loadings

Sussex County's landscape and economy is dominated by agricultural production. Throughout the Bays, agricultural operations are the leading source of nitrogen and phosphorus inputs to the Bays.[39] Other nutrient sources include septic systems, sewage treatment plants, urban stormwater, atmospheric deposition, and forested areas.

Excessive levels of these nutrients stimulate the growth of algae in the Bays. As the algae grow and thicken, they not only block essential sunlight from bottom-dwelling plant communities, but also deplete aquatic systems of dissolved oxygen. The process of algal decomposition requires a large amount of oxygen and thereby, levels of oxygen for other aquatic life are reduced. Low oxygen conditions

(called hypoxia) can result in large fish kills. Compared to other middle-Atlantic estuaries, the Delaware Inland Bays, are highly eutrophic.[40] Massive fish kills plagued the Indian River in the late spring of 1987 and 1988.[41]

The application of fertilizer on agricultural lands and residential lawns is a significant source of the nitrogen and phosphorus loadings which enter the Indian River and Little Assawoman Bays. In these areas, the nutrients leach through the sandy, porous soil and eventually permeate the groundwater aquifers in the watershed. The quality of groundwater aquifers is of grave concern, not only from an ecological perspective but also because the population of Sussex County depends on groundwater as the source of its drinking water supply.[42] Groundwater flow within the watershed is extremely slow. It is reported that nitrogen currently being discharged to the Bays was initially applied to lands 20 to 40 years ago.[43] Therefore, fertilizers being used today are likely to be a persistent problem for the Bays for the next several decades. As a result, the problems associated with nitrogen loadings will continue to reappear and present ongoing challenges to efforts to restore the Bays.

Poultry production is a growing industry in Sussex County and Delaware. It is estimated that Delaware produces 18 percent of the nation's broilers.[44] In Sussex County, 83 million chickens, creating over 95,000 tons of manure, are produced each year.[45] Chicken manure and by-products derived from chicken production are spread on agricultural lands in the watershed as fertilizer and are major sources of nutrients which enter the Bays.

Habitat Loss and Degradation

The wetlands and submerged aquatic vegetation that are part of the Delaware Inland Bays ecosystem are threatened and destroyed by eutrophication, high turbidity, sedimentation, natural events, and human activities. Examples of human activities which have modified and destroyed habitat in the estuary include dredging, filling, channelization, inlet stabilization, and construction.[46] Developing lands close to the Bays and its wetlands typically results in increased sedimentation due to land erosion; toxic and organic pollution due to more impervious surface areas — such as pavement and roofs; increased sewage discharges; and changes in water flow patterns and volume.

Eelgrass and widgeongrass are believed to be the only species of submerged aquatic vegetation that were historically found in the Bays.[47] During the past few decades, these grasses have disappeared as a result of the over-enrichment of nutrients and the resulting high turbidity.[48] In 1990, an unsuccessful attempt was made at re-planting eelgrass in the Bays; these beds later died.[49] Since seagrasses provide rich habitat for fish and shellfish, their loss has had an adverse affect on the populations of desirable estuarine resources.

Not only are the Bays losing seagrass habitat, but important wetlands acreage is also disappearing. Between 1938 and 1973, 24 percent of the area's tidal wetland acreage was destroyed,[50] primarily as a result of dredging and filling of the habitat.[51] Tidal wetlands provide important habitat for spawning, nursing, migration, and feeding for a variety of fish, shellfish, insects, birds, amphibians, and mammals. It is estimated that more than 60 percent of the area's freshwater wetlands have been destroyed since 1950 because of channelization and ditching.[52] The freshwater wetlands of the Bays provide critical habitat for anadromous fish, waterfowl, and mammals and filter nutrients, pollutants and sediments. Loss of habitat within the Inland Bays, increased human disturbance, and poor water quality have devastated many plant and animal populations. In addition, economic benefits of wetlands, such as flood control and water quality enhancement, are jeopardized by losses of wetlands in the Delaware Inland Bays area.

Projects to stabilize the Indian River Inlet, conducted in the late nineteenth and early twentieth centuries, have seriously altered the estuarine habitat. The Inlet provided the historical connection between the Atlantic Ocean and the Bays. Originally a freshwater, landlocked system, the Bays have been converted to a marine-dominated estuary. The almost total loss of the tidal freshwater portion of the Inland Bays has virtually eliminated nursery habitat for once-common fish such as striped bass, shad, and herring.[53] The objectives of these stabilization projects were to provide a commercial navigational route; to increase salinity and to decrease stagnation

of the Bays; and to allow more tidal activities in order to control mosquitos.[54] However, the effects on the Bays have been widespread and far worse than anticipated. Shoreline accretion and beach erosion have occurred on nearby coasts. Erosion of the channel banks and channel bottom have widened and deepened the Inlet.[55] These changes have seriously altered the habitats and living resources of the Bays.

Additional Concerns

Pathogen contamination poses another threat to the health of Delaware Inland Bays. Pathogens are disease-causing microorganisms found in human and animal wastes which enter estuaries through sewage treatment plant discharges, combined sewer overflows (CSOs), polluted urban stormwater, agricultural runoff, boating waste, and septic systems. Pathogens in coastal waters pose risks to humans who eat contaminated shellfish or who recreate in beach waters. Gastroenteritis, hepatitis, and other diseases can result from the ingestion of pathogen-contaminated waters. For this reason, beaches and shellfish beds are closed or restricted when water monitoring indicates high levels of enterococcus or fecal coliform bacteria (indicators of pathogen contamination) are present in coastal waters. In the Delaware Inland Bays, the number of closed shellfish beds increased by 75 percent over the past two decades.[56]

The trash accumulated on estuarine beaches threatens the ecosystem and its wildlife inhabitants. The amount found in just one day can be staggering — on September 17, 1994 volunteers cleared 46,000 pounds of marine debris from 115 miles of Delaware's beaches. Of the total amount of marine debris collected, 60.4 percent was plastic, 10.7 percent was metal, 14.2 percent was paper, and 14.7 percent was from other materials.[57]

The Delaware Inland Bays Estuary Program

In June, 1987 Delaware Inland Bays was nominated for inclusion in the National Estuary Program. It was accepted and officially designated an estuary of "national significance" in 1988. The Delaware Department of Natural Resources and Environmental Control, the Department of Health and Social Services, Sussex County and the EPA are coordinating the administration of the Delaware Inland Bays Estuary Program (DIBEP). The DIBEP was created to assess water quality in the Inland Bays; to make recommendations to address problems; and to bring together federal, state and local initiatives to ensure coordination of efforts to solve problems.

After significant public comment, much negotiating, and revisions to four different drafts, the plan to restore the Bays was finally approved. The EPA and the Governor of Delaware approved the final Comprehensive Conservation and Management Plan (CCMP) for Delaware Inland Bays in June, 1995. The Center for the Inland Bays (Center), a nonprofit organization, was established at the recommendation of the DIBEP's Citizens Advisory Committee to oversee and facilitate the implementation of the CCMP. Other post-CCMP activities of the Center include developing a strategic implementation plan, revising the monitoring plan and conducting public education and outreach projects. The Center has stated that it is a neutral arbiter. Unfortunately, the center has decided not to take any action on activities such as protecting eelgrass replanting areas.

From April 1991 through June 1993 the DIBEP convened a series of five "vision" workshops which were used to develop a framework for the CCMP. These workshops proved to be quite instrumental in jump-starting the process to move the CCMP development forward. Throughout the process the DIBEP has emphasized the use of regulatory and non-regulatory tools, ranging from erosion control requirements to landowner stewardship, as mechanisms to encourage wise management of the Bays system. Although the Center does not plan to use regulatory measures in its efforts to facilitate the implementation of the CCMP, some believe that this entity needs to consider both regulatory and non-regulatory mechanisms in order to achieve the community's goals most effectively.

The DIBEP has already made some progress in restoring the Bay. Stormwater management and sediment controls have been implemented for new development projects with the assistance of the DIBEP funding. Conservation plans, which outline ways to

prevent soil erosion and agricultural runoff, have also been developed through the DIBEP for 49,274 out of 60,000 acres of cropland. In addition, the DIBEP is implementing two monitoring programs, one involving grassroots citizen participation as well as a more comprehensive scientific program. Additional educational efforts have focused on proper maintenance of septic tanks by homeowners in the watershed, including the replacement of 4,600 septic systems.

There have, however, been some weaknesses in the program that need to be addressed. Five Action Plans are outlined in the CCMP including an Education and Outreach Plan; Agricultural Source Action Plan; Industrial, Municipal, and Septic System Action Plan; Land-Use Action Plan; and Habitat Protection Action Plan. However, there is no water use plan included in the CCMP. This is particularly troubling since the Inland Bays are already enormously overburdened with boats and the recreational use of the estuary is only expected to increase. The CCMP references "A Water-Use Activity Impacts Report" that was prepared in 1989 which is supposed to serve as a basis for developing a Water-Use Plan for managing use of the Bays' waters. Yet no indication of movement in this direction has been seen.

In addition, although a Land-Use Action Plan exists in the CCMP, there is little mention made in the Plan for ways to control poor development, which is the primary cause of habitat destruction. Many believe that this issue should have been addressed more thoroughly by the DIBEP rather than relying on the Coastal Sussex Land-Use Plan. Although Sussex County is currently reviewing its land-use goals, the State is also developing a new transportation plan which is expected to cause further delays for the Land-Use Plan.

National Coastal Caucus

Save Wetlands and Bays (SWAB) is a nonprofit organization founded in 1980, with its established headquarters in Millsboro, Delaware. Devoted to protecting and restoring the Delaware Inland Bays, SWAB involves itself in issues that threaten the vitality of the water quality and living resources of the Bays.

SWAB has been involved in the NEP since its earliest days. Members, Board of Directors, and volunteers of SWAB have served in numerous capacities in the development of the CCMP and in monitoring of the interim actions and other steps taken to implement the plan. SWAB has played a key role in raising the voice of the citizens and ensuring that public participation remain an important part of the process. Specifically, SWAB has served on the Citizens Advisory Committee, the Scientific and Technical Advisory Committee as the Citizens Advisory Committee liaison, and the Monitoring Committee.

SWAB is an activist organization and its philosophy is one of cooperation and inclusion. Therefore, it works in coalition with a full range of local, state and national organizations, including such groups as the Conservation Network of Delaware, the Audubon Society, The Groundwater Foundation, League of Women Voters, Common Cause, Sierra Club, The Nature Conservancy, and the Chesapeake Bay Foundation. SWAB coordinates and submits public comments on regulatory and legislative proposals affecting the Bays. SWAB works to ensure citizens concerns are raised during public hearings and supports efforts by other local organizations to implement actions identified in the CCMP guidelines.

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End Notes

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