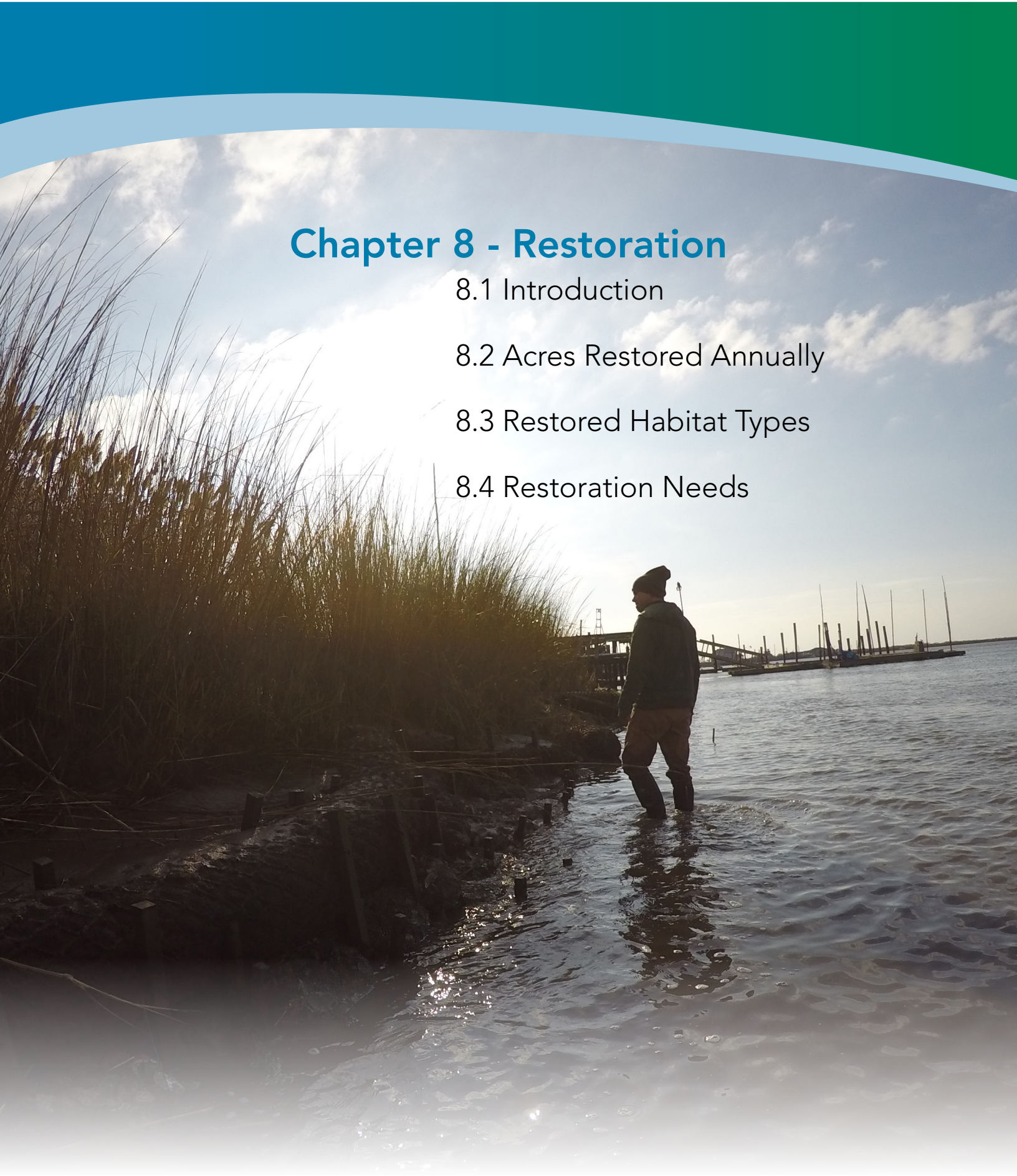

Chapter 8 - Restoration

8.1 Introduction

8.2 Acres Restored Annually

8.3 Restored Habitat Types

8.4 Restoration Needs

Partnership for the DELAWARE ESTUARY

December, 2017 | Report No.17-07

A publication of the Partnership for the Delaware Estuary—A National Estuary Program

8. Restoration

Danielle Kreeger and Sarah Bouboulis
Partnership for the Delaware Estuary

8.1 Introduction

The objective of this section is to provide information on restoration efforts and progress in the Delaware Estuary. Whereas Chapters 1 to 7 review the status and trends of environmental indicators as a way to assess the current health of the Delaware Estuary River and Basin, this chapter reports on the success of collective efforts to improve environmental conditions via management actions that protect, enhance, and restore the system. Although, no entity has quantified the cumulative management and restoration progress across the entire Basin, an initial summary of management and restoration progress was provided for the lower basin in our 2012 Technical Report for the Delaware Estuary and River Basin. The indicators presented in this chapter similarly summarize progress achieved in the lower Basin by the Partnership for the Delaware Estuary and collaborators in the Delaware Estuary Program. These should therefore be regarded as baseline measures to be expanded in future assessments of management progress.

Restoration data from multiple states and programs are challenging to collect and analyze. This report uses the most recent restoration project tracking data routinely collected for the National Estuary Program. Future efforts to assess management and restoration progress can be strengthened with further development and implementation of new project tracking tools which have been piloted by the Partnership for the Delaware Estuary, some of which are discussed in this chapter.

In common usage, the term "restoration" implies some form of remediation or improvement that returns a resource to some former condition or location. In some cases, however, targeting historic conditions is inappropriate because the viable location for a resource or habitat may have shifted in response to changing environmental conditions (e.g., salinity, tidal inundation, temperature). In other cases, the structure and function of restored systems may never match that of undisturbed systems, and various tools are used to set appropriate criteria that defines a project's success. In acknowledging our inability to fully repair disturbed systems, restoration practitioners have adopted various definitions of restoration and restoration-type activities. For example, in its 1992 report, Restoration of Aquatic Ecosystems, the National Research Council defined restoration as the "return of an ecosystem to a close approximation of its condition prior to disturbance." The Society for Ecological Restoration defines ecological restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."

The concept of restoration is further clarified by defining many types of restoration-related activities. There are many management actions that can be considered as restoration activities, such as land and habitat protection, flow management and pollutant regulation. However, for the purposes here, "restoration" refers to on-the-ground actions that either create, enhance, or restore natural resources. With more precise and expansive data provided in the future, management progress could be broadened to include any actions or decisions that lead to improvements in environmental conditions as assessed by the indicators in Chapters 1-7. This includes the elimination or reduction of stressors that degrade natural conditions. In addition to traditional restoration of past natural conditions, the following terms describe activities that are considered as part of restoration for the purposes of this chapter.

Establishment (also referred to as "creation") is the manipulation of physical, chemical, or biological conditions to facilitate development of a target habitat that is representative of natural conditions but that did not previously exist at the project location. Establishment results in acres gained for the target habitat. For example, establishment occurs when a wetland is placed on the landscape by some human activity on a

non-wetland site (Lewis, 1989). Typically, established wetlands are created by the excavation (or addition) of upland soils to achieve elevations that will support the growth of wetland species through the establishment of appropriate hydrology.

Figure 8.1.1 Example of reestablishing a riparian buffer along a tributary in the Delaware Estuary. Photo Credit: USDA-NRCS-New Jersey.

Reestablishment is the manipulation of physical, chemical, or biological characteristics of a site with the goal of returning natural/historic habitat types and functions to the site (Fig 8.1.1). Reestablishment results in the rebuilding of a former habitat and a gain in acres for that target habitat.

Enhancement is the manipulation of physical, chemical or biological characteristics of a site to strengthen ecological conditions and functions, such as for the purpose of improving water quality, flood water retention, or wildlife habitat. Enhancement typically results in improvement of structure and/or function without an increase in acreage (Fig 8.1.2).

Rehabilitation is similar to enhancement and is defined by the USEPA as the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of a degraded habitat. Rehabilitation results in a gain of habitat function but does not result in a gain of acres for that habitat.

In all types of restoration, changes in ecosystem conditions should result in a net gain or improvement in those ecosystem functions that are deemed of highest value by managers. Since the environmental conditions at any location never have zero value, scientists and managers must recognize that any manipulation results in tradeoffs with respect to living resources, and functions. Efforts to control mosquito populations and improve fish habitat by digging ditches in wetlands could result in decreased vegetation cover and carbon sequestration services. Efforts to eradicate invasive forms of the common reed, *Phragmites australis,* to improve fish and wildlife habitat could result in decreased flood protection and carbon sequestration. Restoration activities therefore ultimately reflect value judgments that can differ among

Figure 8.1.2 Example of stream bank stabilization, showing how extreme measures (e.g. use of rock) is sometimes needed to stem erosion and loss of sediment in cases where upstream sources of stormwater runoff are not also curtailed. Photo credit: USDA-NRCS-New Jersey.

different sectors of the science and management community. Our goal is to quantify restoration progress that reflects the current consensus view on ecological priorities, focusing on key natural resources that typify the Delaware Estuary and River Basin.

Activities that might be considered restoration progress but which do not necessarily fit the definition of restoration given above include the following:

Protection is defined as the removal of a threat to, or preventing the decline of, natural healthy environmental conditions. This includes management actions such as land acquisition for public parks, conservation easements, deed restrictions, etc. or other designations to prevent alteration of natural site conditions. This term also includes activities commonly associated with the term "preservation." Although protection efforts are critically important for sustaining ecological function, they do not result in a net habitat gains.

Mitigation refers to the "restoration, creation, or enhancement of wetlands to compensate for permitted wetland losses" (Lewis, 1989). Here, we also extend that definition to include other natural habitats. For example, under Section 404 of the Clean Water Act, wetlands may be legally destroyed, but their loss must be compensated by the restoration, creation, or enhancement of other wetlands. In theory, this strategy should result in "no net loss" of wetlands. Other programs that are similar include the Natural Resource Damage Assessment (NRDA) Process and Supplemental Environmental Projects (SEPs). Whether mitigation is successful or not, the goal is to simply replace or repair injured natural resources, meaning that these activities do not (and in some cases legally cannot) result in net gain of habitat acreage or functions relative to pre-injury conditions.

Nature-Based Infrastructure is a relatively new term used to describe engineered projects that intend to build resilience or promote other ecosystem services by taking advantage of physical, chemical, and biological properties of natural systems and assemblages of organisms. Nature-based infrastructure projects differ from ecological restoration in that they are designed and constructed to achieve specific societal or management goals, such as erosion control. In the wake of Superstorm Sandy, nature-based infrastructure has increasingly been promoted for its ability to increase coastal resilience to storms (Cunniff and Schwartz 2015, Weinstein and Saleh 2016). The US Army Corps of Engineers has also acknowledged the value of nature-based infrastructure, differentiating it from natural restoration (USACE 2015). Nature-based infrastructure projects include a broad spectrum of tactics and range from green (biology-based) to gray (hybrids that include a mix of biology and traditional "hard" structures). When successful and maintained, nature-based infrastructure projects can help avert the loss of habitat acres and result in a gain of habitat function, but they typically do not result in a gain of acres for that habitat.

The approach taken in this chapter was to report available indicators that reflect restoration activities across the Delaware Estuary and Basin, focusing on metrics that can be quantified such as acres, locations, and types of habitats restored and available data. It's important to note that in contrast to these restoration activities, many important habitats are continuing to be lost or degraded (see Chapters 1 and Chapter 5). Therefore, on balance, the net loss of key natural habitats (e.g. forests, wetlands) continues to be substantial, despite these restoration successes.

8.2 Acres Restored Annually

8.2.1 Description of Indicator

Many important resources are found in the Delaware River Basin. For example, the Estuary contains more than 150,971 acres of wetlands, more than 51,252 of which are recognized as internationally important (Tiner et al., 2011). The tidal portion of the system is also one of the largest freshwater tidal estuaries in the world, and despite losing >95% of rare freshwater tidal wetlands, the system still has more acres of this habitat type than anywhere else in the United States. The Delaware Estuary also has 185 natural vegetation community types encompassing 35 broader-scale ecological systems. Delaware Bay contains the largest breeding population of horseshoe crabs (*Limulus polyphemus*) in the world. The watershed also contains critical habitat for endangered populations of dwarf wedgemussels (*Alasmidonta heterodon*), two species of sturgeon (*Acipenser oxyrinchus* and *A. brevirostrum*), and bog turtles (*Glyptemys muhlenbergii*).

Considering the tremendous habitat diversity, numerous geopolitical boundaries, and large size of the watershed, efforts to track restoration progress are hampered by limited data availability among the many different agencies and programs that are responsible for restoration across this large watershed. One of the most straightforward ways to track habitat restoration is to determine acres restored annually, focusing on voluntary actions (and not reparative, regulatory based actions such as mitigation projects). Ideally, restoration activities should also be assessed for specific habitat types. In the future, it would be beneficial to also assess the functionality to restored habitats, since a particular site could be "restored" significantly without any net increase in acreage. Since no database exists to track watershed-wide restoration, as a starting point for this effort, we discuss acreage data that have been reported as restored (and/or protected) by each state (New Jersey, Pennsylvania, and Delaware) annually using the USEPA's National Estuary Online Reporting Tool (NEPORT).

NEPORT is a web-based database that USEPA developed for National Estuary Programs (NEPs) to track the acreage of habitat improvement efforts. The Partnership for the Delaware Estuary has been collecting data on completed restoration projects from partners (mainly state agencies and PDE initiated projects) since 2000 to report to the USEPA annually. The USEPA then provides the project information for every National Estuary Program on this website: http://www.epa.gov/owow_keep/estuaries/pivot/mapping/sat.html and the NEP map website: https://gispub2.epa.gov/NEPmap/.

Core Partners of the Delaware Estuary Program that provide data for NEPORT
Pennsylvania Department of Environmental Protection
Philadelphia Water Department
New Jersey Department of Environmental Protection
Delaware Department of Natural Resources and Environmental Control

Unfortunately, NEPORT is not comprehensive as it only shows project data that have been voluntarily provided by core partners of the Partnership for the Delaware Estuary. Since there are many other restoration activities and organizations and NEPORT data focus only on the lower half of the Delaware River Basin, data for this indicator therefore represents only a fraction of restoration progress at the watershed scale. However, since this approach has been followed for more than ten years, it is possible to examine trends in restoration progress using NEPORT-tracked restoration as an indicator. However, it should be noted that USEPA does occasionally make changes to the NEPORT data collection and reporting process, and this can impact the data. Another advantage of NEPORT data is that the tracking program excludes actions associated with mitigation (e.g. Natural Resource Damage Assessment, Supplemental Environmental Project), which are designed simply

to correct for discrete injuries. Although protection efforts are not the focus of this chapter (see above), NEPORT data for protected acreage are also shown here for comparison purposes.

8.2.2 Present Status

Recent restoration progress was examined qualitatively by contrasting the types of efforts made in the Delaware Estuary from 2006-2016, as reported in NEPORT. NEPORT tracks restoration as either protection, rehabilitation, enhancement, reestablishment, or establishment. The relative balance of these activities (Fig 8.2.1) indicates that considerably more land area has been protected than restored. Among the five types of restoration tracked in NEPORT, more area was enhanced than rehabilitated or reestablished, and newly created acres (establishment) represented a very small portion of overall efforts.

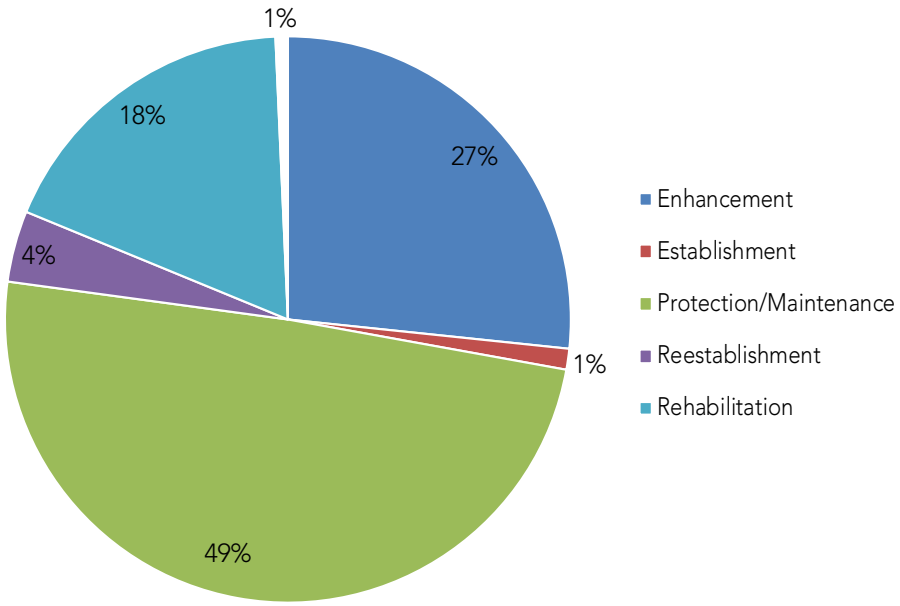

Figure 8.2.1 Comparison of the land area protected versus restored between 2006 and 2016, as reported in NEPORT percent of acres.

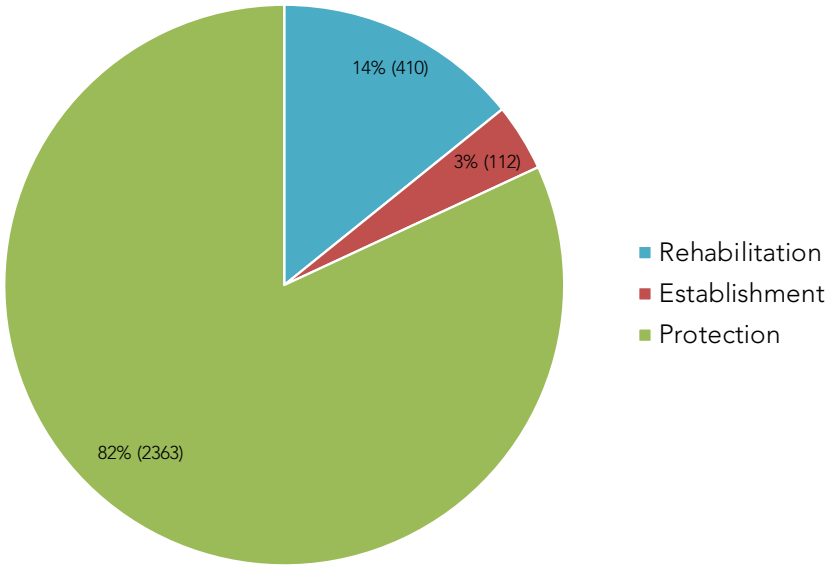

Figure 8.2.2 Comparison of the percent of total acreage that was protected versus restored in 2016, as reported in NEPORT.

As noted above, protection does not necessarily improve ecological conditions. Therefore, summing acreage data from NEPORT does not give a clear representation of actual net ecological improvement since so much of what is reported took the form of protection (Fig 8.2.1). This finding is even more important for the most recent NEPORT data from 2016 (Fig 8.2.2), which shows that protection accounted for more than three-quarters of the total activity. Since yearly acreage data can be skewed by 1 or 2 large projects, a fuller understanding of status and trends should examine the nature of specific projects reported via NEPORT.

8.2.3 Past Trends

As a National Estuary Program, the Partnership for the Delaware Estuary (PDE) is responsible for setting restoration goals every year. Since the advent of NEPORT tracking in 2000, the total number of acres reported to NEPORT each year represent a modest 0.017% of the total area of the Delaware River Basin. As noted above, tracking restoration is challenging because PDE must rely on voluntary reporting by partners. Annual variation in restoration investment also takes place since projects are typically grant-funded and are subject to funding fluctuations. Despite these caveats, restoration progress since 2006 has been considerable (Fig 8.2.3), typically exceeding the annual goal set by PDE and USEPA for the combination of protected and restored acres. Prior to 2011, this annual goal was 2,250 acres. Due to declining acreage that was protected or restored between 2007 and 2010, this annual goal was changed in 2011 to be 1,500 acres. In most years since 2006, protection efforts surpassed restoration efforts, largely due to data reporting from programs such as New Jersey Green Acres that provides funding for land acquisition projects. The 1,500-acre goal is set annually by NEPs to capture projects conducted by partners in the region (Fig 8.2.3). This value can be adjusted by the NEPs reporting out to USEPA based on their understanding of current restoration projects taking place during the reporting year, and is set at a different value for all of the NEPs.

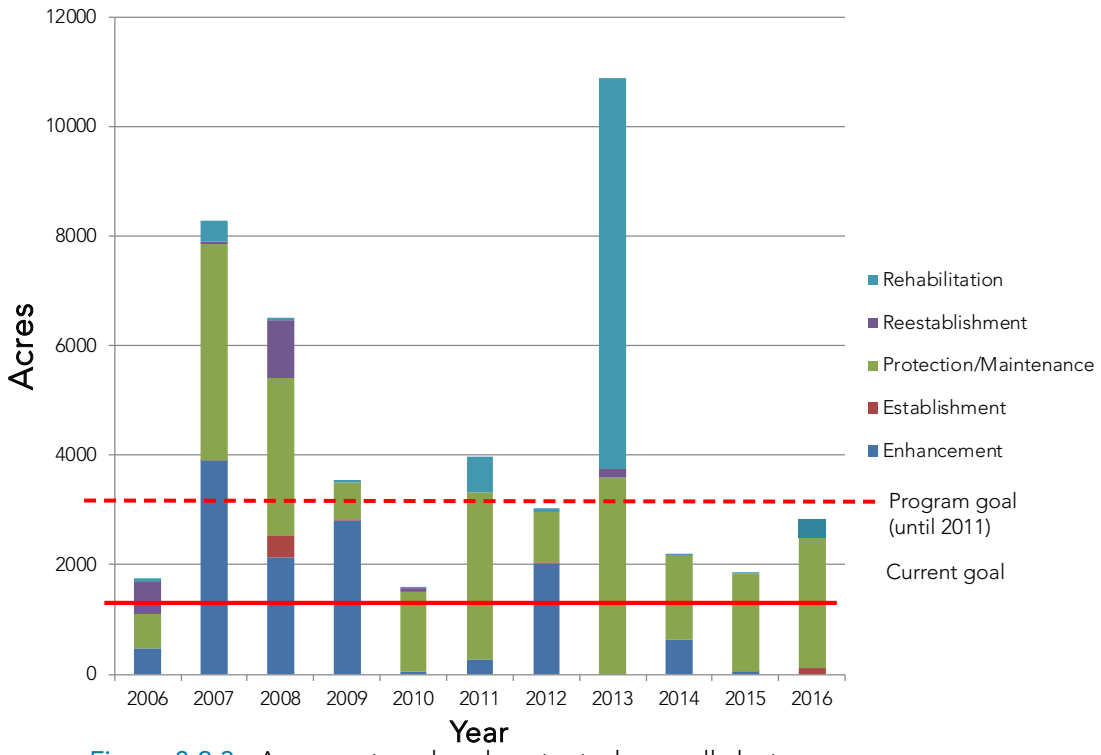

Figure 8.2.3 Acres restored and protected annually between 2006 and 2016, with five types of restoration reported separately. For comparison, the annual NEPORT goals are shown for the 2006-2010 (dashed red line) and 2011-2016 periods (red line).

8.2.4 Future Predictions

The amount of area restored per year in the Delaware Estuary (per NEPORT) through non-mitigation, voluntary actions is dependent on funding, especially from state and federal agencies. The restoration need is high, as judged by the continuing losses of critical habitats. However, we are optimistic that in the long term, the pace of restoration will hasten as our understanding of the ecological and economic consequences of inaction increases. For example, water resources in the Delaware Estuary sustain a $10 billion per year economy, and the loss and degradation of natural systems is certain to have serious economic consequences (Kauffman 2011). In the short-term, we anticipate that restoration progress could be undermined if federal investment in environmental programs is reduced, as has been proposed. Fortunately, non-profit organizations such as the William Penn Foundation have recognized the importance and scale of the restoration need, contributing substantial resources to create a new Delaware River Watershed Initiative that is supporting habitat restoration in many areas (WPF 2014). With sustained or increased investment by other state and local entities, and potentially new public-private partnerships, we anticipate that the Delaware Estuary Program will continue to meet the annual 1500-acre goal.

8.2.5 Actions and Needs

Unfortunately, hundreds of thousands of acres of natural habitats have been destroyed or significantly altered in the Delaware River Basin during the past 15 years despite many governmental protections. Losses of forest area due to development (Chapter 1) and erosion of coastal wetlands (Chapter 5) appear to far exceed gains from restoration. Since these natural habitats purify our water, provide clean air to breathe and furnish other critical goods and services enabling the survival of both humans and natural communities, this trend in net loss of natural habitats is unsustainable, especially considering projections for human population growth (Chapter 1.1).

One of the top goals in the Comprehensive Conservation Management Plan for the Delaware Estuary (CCMP) is the restoration, protection and enhancement of natural habitats. Therefore, it is vital that funding and commitments be sustained and increased for implementation of the CCMP by the various partners of the Delaware Estuary Program. Over the past few decades, federal investment in environmental programs and restoration in the Delaware River Basin has vastly lagged behind other large watersheds in the United States, estimated to be between 1-2% per capita or per basin area. To stem current rates of loss of key natural habitats, this investment needs to be increased or offset by non-federal efforts. Considering the limited restoration funding and high need, careful prioritization is essential so implemented projects target the most critical needs for maintaining core ecosystem functions (PDE 2005, 2009, Kreeger et al. 2006). All citizens in the Delaware River Basin can also play a part in promoting voluntary restoration and protection of our remaining natural habitats. Some ways in which citizens can get involved includes volunteering at cleanups, invasive species removal projects and participating in community restoration projects.

8.2.6 Summary

Quantitative measures of land area restored annually in the Delaware Estuary can be an effective way to track management progress, and analysis of limited data suggests that some progress has been made since 2006. However, the current tracking system used by the Partnership for the Delaware Estuary (NEPORT) is not designed to be comprehensive for the watershed, and it gives a biased estimate of the amount and type of restoration in the Estuary. It is useful as a progress indicator because annual data collection has been consistent for a sufficient period to examine trends, showing that generic restoration targets set by the National Estuary Program have been met. Improvements in such reporting would be to strengthen future status and trends reporting on management progress. Although NEPORT data significantly underestimates actual restoration investment across the entire Delaware Estuary and Basin, the amount of land area restored between 2006-2016 is likely dwarfed by mounting losses of natural lands due to development and other factors. For example, the land use land cover changes described in Chapter 1 clearly suggest that management progress via restoration is not keeping pace with overall needs to sustain core habitats.

8.3 Restored Habitat Types

8.3.1 Introduction

In addition to assessing the amount of area restored, it is helpful to track the types of habitat that are being restored to ensure that restoration progress reflects the balance of habitats that have suffered the most degradation. For example, coastal wetlands are a hallmark feature of the Delaware Estuary, and are critical for supplying diverse benefits to people and the environment, and we have lost more than half of our coastal wetlands mainly due to direct filling and development (Chapter 5.2). Forests are similarly vital for sustaining source water quality and other services, and forest losses continue to be swift due to development (Chapter 1.3). Similar to Section 8.2, data from the National Estuary Program Online Reporting Tool (NEPORT) was examined to discern the types of habitats that have generated the greatest restoration attention since 2006.

8.3.2 Description of Indicator

Healthy estuaries depend on a complex mix of habitats, with each estuary possessing unique character and habitat assemblage. Although the Delaware Estuary and Basin is home to dozens of different habitats and ecological communities, it is most distinct because of its abundant, protective forests in the headwaters, broad freshwater tidal area that supports rare biotic assemblages, and a wealth of coastal wetlands that fringe the tidal estuary. These systems purify our water, provide clean air to breathe, and furnish other critical goods and services enabling the survival of both people and natural communities. To get the greatest benefits, voluntary (non-mitigation) attempts to rebuild these habitats should reflect the natural balance of types that characterizes the watershed.

8.3.3 Present Status

Figure 8.3.1 shows a comparison of all the acres restored between 2006 and 2016 by habitat type. Tidal wetlands and forests have been the focus of management attention since 2006, judging from the combined data for restored habitat types (Fig 8.3.1). Most of the data was collected via efforts to protect and restore tidal wetlands represented the greatest progress (see Section 8.2).

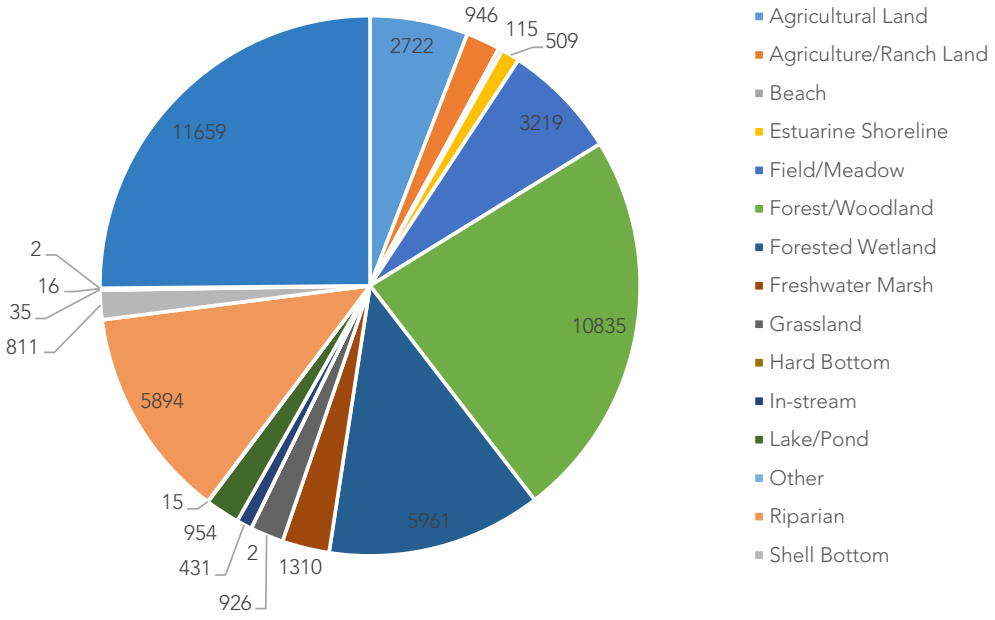

Figure 8.3.1 Comparison of acres restored and protected by habitat type between 2006 and 2016 as reported in NEPORT, numbers are in acres.

As noted in Chapter 5.2, more than half of tidal wetlands have been lost in the Delaware Estuary compared to pre-settlement condition. Between 1996 and 2010, nearly 2% of tidal wetland acreage was lost (Chapter 5.2). Future projections suggest that 119,000 acres (48,000 hectares) will be lost by 2100, assuming that sea level rises by one meter (Kassakian et al. 2017; Kreeger et al 2010). Forests continue to be lost at an even faster rate (Chapter 1.3), and the cumulative impacts from the development of numerous small parcels and pipelines (Fig 8.3.2), and other contemporary challenges threaten to hasten loss rates in the future. Continued focus on tidal wetlands and forests is therefore warranted. Other habitats that have been prioritized such as shellfish beds are arguably even more vital, but they are also smaller in size and harder to capture in terms of acres.

Figure 8.3.2 Example of forest cutting to make wat for a new pipeline near Aston, PA, during October 2017. Photo credit: Danielle Kreeger, Partnership for tthe Delaware Estuary.

8.3.4 Past Trends

The amount of area protected and restored varies widely among years and among habitat types (Fig 8.3.3). This variability is due mainly to fluctuations in funding from year to year, as well as shifts in reporting from various state and local partners who report data to NEPORT. Although it is difficult to draw any conclusions from these limited data, there is an apparent downward trend in the total acreage restored and protected. It is possible that this trend might simply reflect reporting variability or effectiveness rather than real patterns. Nevertheless, the trend is concerning as natural habitat losses have not similarly declined (Chapter 1.3) and the apparent decline in restoration and protection progress is therefore not due to reduced opportunities.

8.3.5 Future Predictions

In the short-term, we anticipate that overall restoration progress could continue to be hampered by a declining level of federal investment in environmental programs, as noted in Section 8.2.4. Conversely, damages from Hurricane Sandy and new threats from development and climate change have energized local and regional efforts to sustain and restore natural habitats, such as coastal wetlands that help buffer coastal flooding. The new Delaware River Watershed Initiative (WPF 2014) and Delaware River and Bay Conservation Act (passed in 2016 and pending funding) are examples of other recent support for watershed restoration. As the various benefits of natural habitats to health and prosperity become clearer, the long term prognosis for protection and restoration of natural areas is good. Habitats that yield the greatest ecosystem services (e.g., clean air and water, flood protection) are likely to be prioritized.

8.3.6 Actions and Needs

Given limited funding for natural area restoration in the Delaware River Basin, it is vital that limited investments be spent wisely by prioritizing areas and habitat types that are deemed most critical for preserving the character and functionality of the unique Delaware Estuary watershed and using scientific information to promote the greatest possible success. Several strategic planning initiatives have been

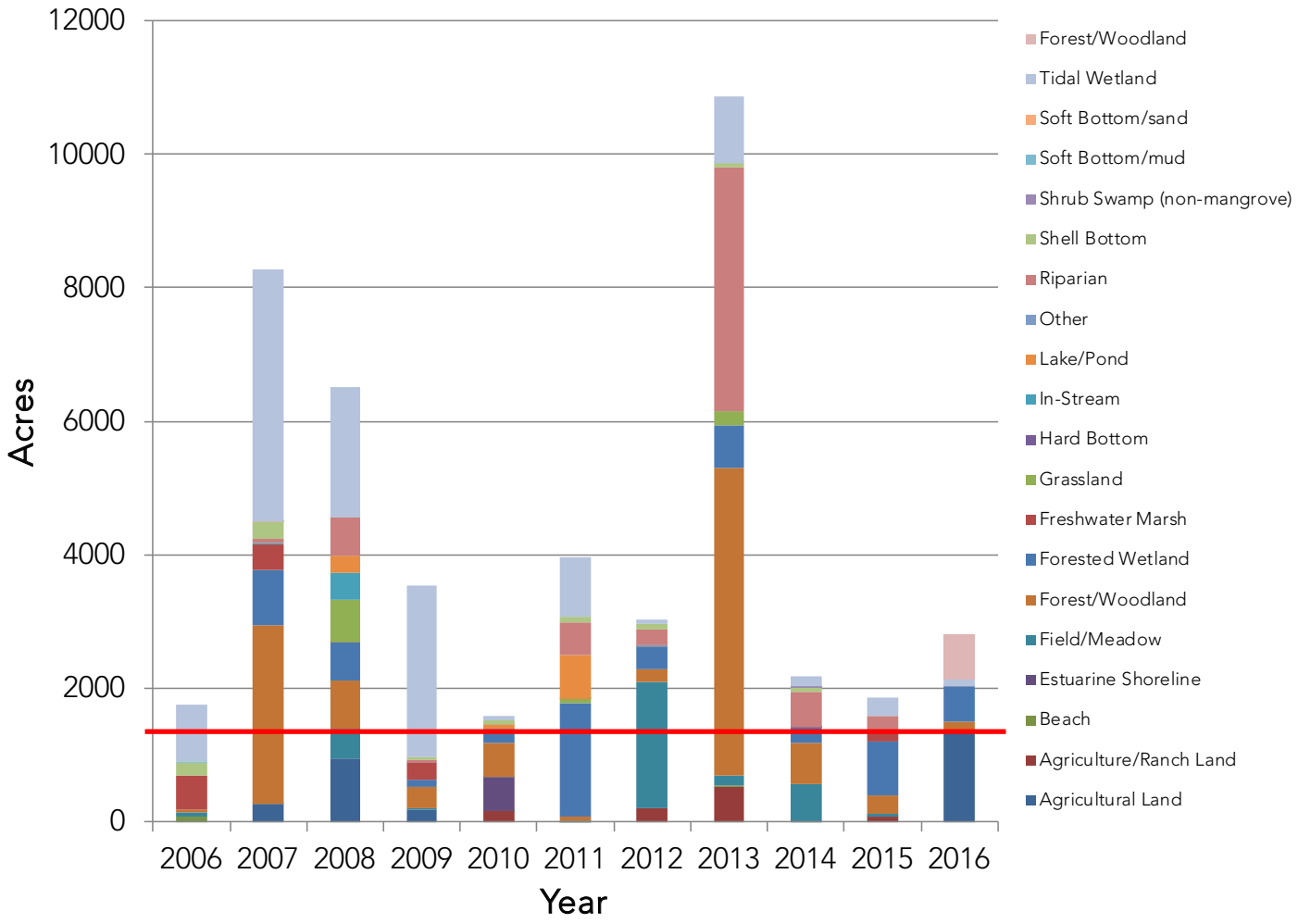

Figure 8.3.3 Total Acres restored annually by habitat type, 2006-2016, in relation to the annual NEPORT goal set by the Partnership for the Delaware Estuary of 1500 acres (red line).

completed in the past 10 years to guide investments in natural habitats at the watershed scale. Some have targeted key species and places with an emphasis on protecting what's left. For example, in November 2011, The Nature Conservancy and partners completed a set of protection and restoration strategies to conserve the Delaware River Basin from the headwaters to the Bay. Their prioritization report (TNC 2011) included various strategies to target high value places in the landscape for protection and restoration. Floodplains, shellfish beds, and habitat preferences of migratory fish were some of their focal resources.

A complementary approach to watershed restoration prioritization has focused on promoting the greatest overall health and functionality of the Estuary's key ecosystems. This ecosystem service approach was articulated in the Regional Restoration Initiative (PDE 2009), which guides future decisions on restoration, protection and enhancement by focusing on habitat types and living resources that furnish core ecosystem goods and services. In addition to habitat type, this approach prioritizes places in the landscape where restoration action can yield the greatest return on investment in the form of natural capital. Urban waterfronts, tidal wetlands, headwater streams, and bivalve shellfish are examples of activities recommended for prioritization.

Another important restoration effort that is underway is being funded by the William Penn Foundation. The partner organizations involved in the Delaware River Watershed Initiative recently completed planning for Phase II (2018-2021), which is expected to lead to diverse new agricultural and stormwater restoration projects within targeted areas referred to as clusters.

These new conservation and restoration prioritization tools that specify habitat types and places to be targeted should be used to guide strategic investments. Continued refinement of these priorities would also benefit from additional research to assess and contrast outcomes from various restoration tactics. For example, living shorelines and thin-layer use of dredge material represent new approaches for stemming losses of tidal wetlands, but project designs and long-term benefits should be scientifically vetted. Similarly, innovative strategies are being tested for managing stormwater and pollutant runoff, such as Philadelphia's Green City, Clean Waters programs. Outcomes from these initiatives will help guide strategic investments in the future.

To facilitate progress implementation and progress tracking, a centralized database for prospective and completed restoration projects would be invaluable. The Regional Restoration Blueprint (PDE 2009) called for the development of this "Project Registry." The registry was created in 2010 and populated with numerous viable pending restoration and protection projects. A workgroup referred to as the Alliance for Comprehensive Ecosystem Solutions was also formed to prioritize projects in the registry for funding. Decisions were based on the estimated natural capital improvement from each project, as determined by a regional restoration subcommittee of the Partnership for the Delaware Estuary's Science and Technical Advisory Committee. This regional restoration effort, including maintenance of the Project Registry, was discontinued in 2013 due to lack of funding. Science-based, regional prioritization and tracking of prospective and completed restoration and protection projects remains a critical need for the Delaware Estuary and River Basin.

8.3.7 Summary

The balance of habitat types restored and protected in the past 11 years can be analyzed with data from the National Estuary Program Reporting Tool. Although results from this analysis should be interpreted with caution because the dataset is limited, restoration progress in the Delaware Estuary appears to be targeting the appropriate habitat types that are considered most vital and which are experiencing greatest losses. Since those losses far exceed the gains from restoration and protection, increased investment and strategic prioritization are warranted.

8.4 Restoration Need

8.4.1 Introduction

The need for more restoration in the Delaware River Basin is sizable based on the disparity between the historic and recent losses in acreage of natural lands (see other chapters) and the relatively small gains in acreage from restoration efforts over the past decade (see Section 8.1). Although science-based planning tools have been recently developed to guide strategic restoration and protection investment at the watershed scale (Section 8.3.5), these tools will be useless without funding to implement new projects to offset losses that go well beyond site-specific, regulatory-based mitigation. This section clarifies restoration need and investment level, and results are contrasted with some other large American "Great Waters."

8.4.2 Description of Indicator

To gauge the current restoration need for the entire Delaware River Basin is a daunting task. One approach is to simply examine the loss rates of key habitats (e.g. wetlands, forests) in other chapters of this report, and infer that those losses should be offset by restoration. However, it is difficult to assign a restoration cost to such large changes and the result would be tremendous (estimated at hundreds of millions of dollars per year) because every year we are losing several square miles of important natural habitats. Natural habitat loss data are more useful for information purposes, providing the impetus for managers to set ambitious restoration targets because they are grounded in tangible data on ecological trajectories of change.

At the other end of the scale, a second approach to gauging restoration is to simply tally the total dollars that would be required to fund all pending protection and restoration projects. As part of the Regional Restoration Initiative (PDE 2009), as Project Registry was created that attempted to capture data on all pending and funded restoration projects in the Delaware Estuary, especially those that focused on high priority habitats and areas. After a successful 3 year pilot, sustained funding for the Initiative and associated registry have not been found and the pending project data are no longer current. When it was last operational in 2013, the registry contained 90 unfunded "shovel-ready" projects totaling over 60,000 acres of possible restoration and budgeted to cost more than 10.5 million dollars, and this was considered to represent only a small fraction of the restoration landscape. Although the project registry data are out of date, they are the most recent example of restoration need for the Delaware Estuary. In addition to the project registry, other organizations have identified restoration project needs, such as witin clusters of the Delaware River Watershed Initiative.

8.4.3 Present and Past Status

The projects listed in the most recent update of the PDE Project Registry (2013) represent only a fraction of total watershed needs to reverse net losses and achieve no net loss of natural lands. Although the projects listed in the 2013 registry aimed to restore or protect 60,000 acres, only about 2.5% (1,500 acres) would have likely been classified as "reestablishment" judging from the array of types of recently completed projects (Fig 8.2.1). Assuming that the 90 projects costing $10.5 million in the 2013 registry would contribute 1,500 acres, then the cost per acre would be $7,000, which is very low relative to typical restoration costs per acre. More than 70,000 acres of forests and wetlands were lost between 1996 and 2010 (Chapter 1), which translates to 4,667 acres per year. Hence, a conservative estimate of the restoration costs just to offset the ongoing forest and wetland losses would be $32,666,667 per year ($7,000 per acre times 4,667 acres per year).

This estimate of $32.7 million per year is simply the cost to sustain the forests and wetlands that we currently have. It does not actually restore historic losses, nor does it account for ongoing losses of other valuable natural habitats to development, such as shellfish beds and agricultural lands. Even if completely funded and

implemented, costs will undoubtedly increase because of inflation and mounting development pressures from human population growth and changing climate conditions (e.g. sea level rise, increased intensity of storms). Although this estimate of restoration need is substantial, it represents only 0.3% of the annual worth of the natural resources within the Delaware Estuary (lower half of the Basin), which have been valued as contributing over $10 billion in annual economic activity associated with water quality and supply, hunting and fishing, forestry, agriculture and commercial and recreational fishing, hunting, and other types of recreational activities (Kauffman 2011).

Although the Delaware Estuary and Basin is similar to other large American "Great Watersheds" in supporting a vibrant economy that is linked to natural resources, it is dissimilar in terms of restoration investment. For example, the Northeast-Midwest Institute reported that the level of investment from one example federal agency, the USEPA, was considerably lower in the Delaware Estuary and Basin than eight of the other most significant aquatic systems that are managed discretely (Strackbein and Dawson 2011). This analysis suggests that federal environmental investment in the Delaware system is far less than 10%, perhaps even 1%, of that invested in the Chesapeake system (Fig 8.4.1), despite supporting a similar human population.

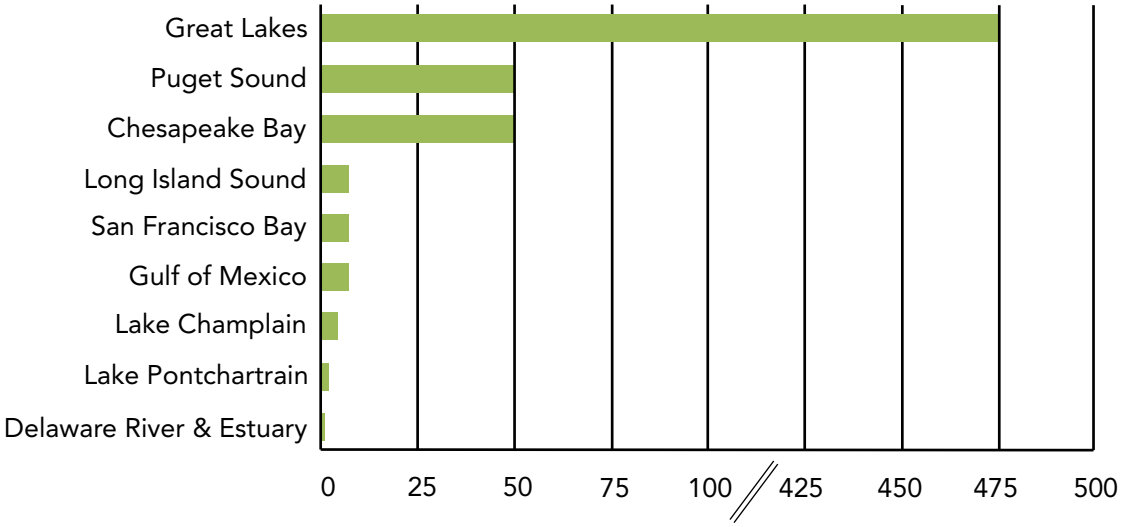

Figure 8.4.1 Comparison of US EPA federal spending in millions ($) for FY2010 on environmental management and restoration in nine major water bodies in the United States (from Strackbein and Dawson 2011).

Restoration investment can also be examined on a geospatial basin, using data from NEPORT (see Chapters 8.1 and 8.2), and this can then be compared with human population in those areas (Fig 8.4.2).

Typically, restoration needs are higher in areas where human population is higher due to habitat degradation associated with pollution, development and other anthropogenic disturbances. Although most people live in the urban portion of the Estuary (Fig 8.4.2), most protection and restoration progress between 2006 and 2016 has been made in less populated areas of the watershed. For example, areas along the Delaware Bay and upper Basin had more investment likely because larger tracts of land can be acquired and protected in these watersheds, and protected acres outnumber restored acres in most years (Fig 8.4.3). This information can be useful for directing the funding for future priority projects, such as by focusing on identifying new opportunities to restore areas in urban landscapes. Further analysis of NEPORT and other data is needed to discern the locations of actual restoration projects. In general, protection is prioritized in less developed areas whereas restoration is prioritized in more developed areas.

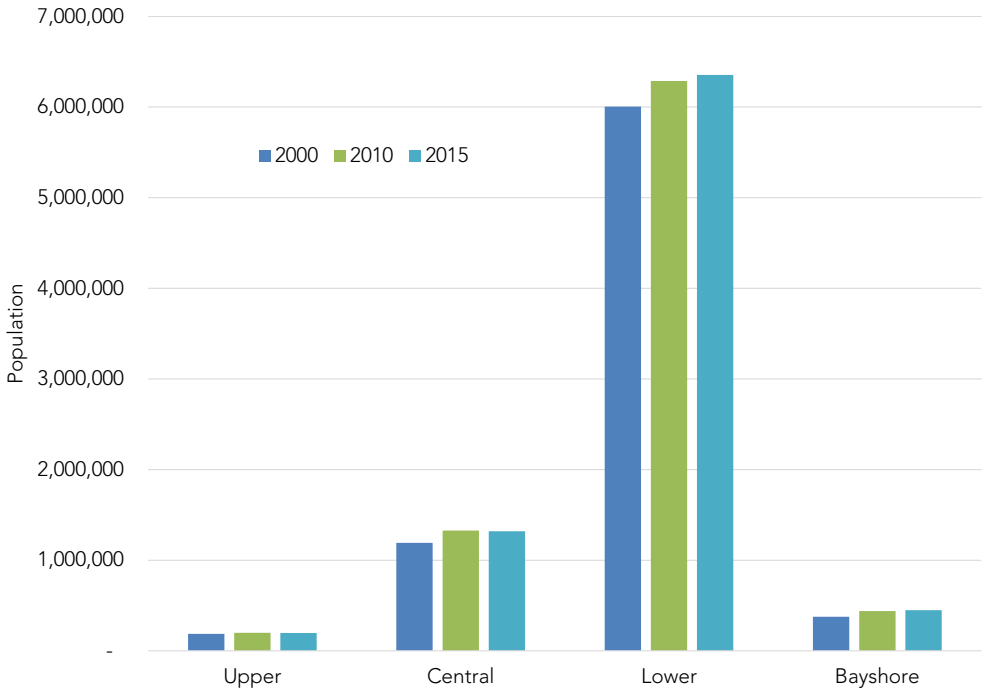

Figure 8.4.2 Comparison of human population in the four watersheds of the Delaware Estuary and Basin (see Fig 0.4).

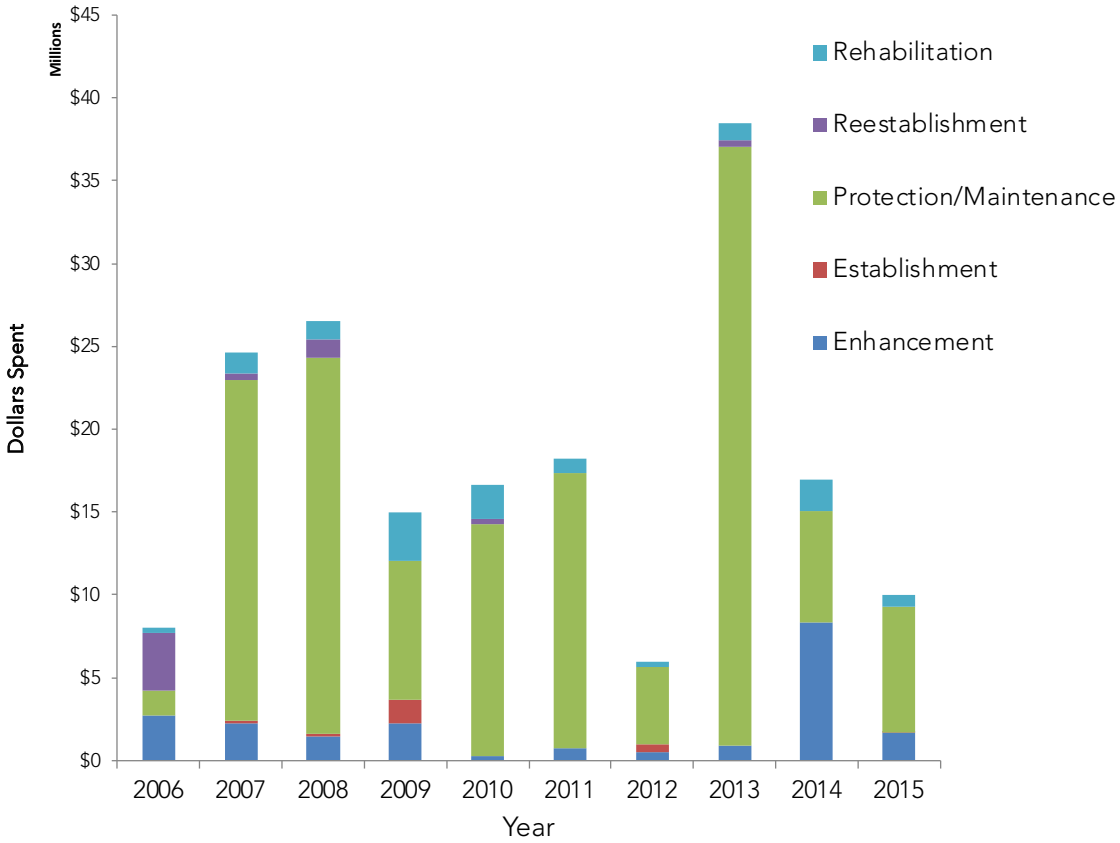

Figure 8.4.3 Comparison of dollars spent from 2006 to 2015 among the different protection and restoration methods.

8.4.4 Actions and Needs

Until sufficient funding can be generated to stem losses of natural lands and restore critical habitats in the Delaware Estuary and Basin, management targets will need to be tempered and continued net losses of vital habitats will unfortunately still occur. As noted above, there are current efforts (PDE and others) to increase efficiency, implement strategic science-based priorities, and coordinate restoration activities. However, these efforts will have limited benefits if restoration needs continue to be largely unmet because of insufficient restoration investment across the Delaware Estuary and Basin.

Thankfully, a substantial amount of new funding for restoration and protection that will benefit many areas is now being contributed by the William Penn Foundation through the Delaware River Watershed Initiative (WPF 2014), showing that non-federal investments are possible and on the upswing since our 2012 Technical Report for the Delaware Estuary and River Basin. But even if that effort can be sustained and the Delaware River and Bay Conservation Act is fully funded, the two new resources will meet less than half of the restoration need estimated here, including some high priority estuary resources (tidal wetlands, shellfish) that are not prioritized in those efforts.

The top restoration need continues to be funding, which can be justified by the economic value of the resources that are being lost every day. Beginning in 2006, the Partnership for the Delaware Estuary proposed the concept of a Delaware Estuary Basin Science & Restoration Trust (Kreeger et al. 2006, PDE 2009), that with sustainable and significant funding, would be capable of addressing diverse restoration needs associated with key living resources, habitats and water resources. Like the Delaware River Watershed Initiative, the Trust is envisioned to be science-based and guided by strategic monitoring and assessment data. The Trust would be maintained and operated by trustees representing federal and state agencies and other groups that have worked together to develop shared, consensus-driven regional restoration priorities. To avoid redundancy with the Delaware River Watershed Initiative and the pending Delaware River and Bay Conservation Act of 2015, priorities addressed by the Trust could fill vital gaps that are not yet being addressed.

In brief, the Trust would provide a new vehicle for accepting and pooling funding from a variety of sources to meet diverse needs, including funding priority restoration and protection projects elevated through the Regional Restoration Initiative. It could include numerous operating centers where contributions could be earmarked for specific protection, restoration, monitoring or scientific activities. The vision is for the Trust to direct and fund wise investments in the future of the Estuary that are not being otherwise supported. Sources of financing for a Trust were explored by PDE with help from the Delaware Community Foundation, the Environmental Finance Center (EFC 2007), the Global Environmental Technologies Foundation, and the Keystone Conservation Trust. The Trust was also identified as a potential means to coordinate watershed-wide restoration funding in the 2013 Regional Sediment Management Plan and the 2010 report by the Delaware River and Bay Oil Spill Advisory Committee. Currently, the Trust is still in the concept stage, and it needs to be further developed and marketed.

8.4.5 Summary

The Delaware Estuary has significant restoration needs, which are conservatively estimated to be greater than $33 million per year. To augment existing investments and fill vital gaps that promote core ecosystem services and the health of local and regional communities, a regional restoration approach is warranted that can prioritize restoration needs, track restoration projects, identify and fill project gaps, and supply funding for high value projects. This will require coordination and sharing among various sectors and development of additional sustainable sources of funding for restoration and protection. A broad-based Science and Restoration Trust would address key gaps in restoration and protection while also providing support for the science and monitoring that is needed to strengthen the scientific basis for restoration decision-making and outcome tracking.

References

Cunniff, S. and A. Schwartz. 2015. Performance of Natural Infrastructure and Nature-based Measures as Coastal Risk Reduction Features. Environmental Defense Fund report, September 2015. 35 p. http://www.edf.org/sites/default/files/summary_ni_literature_compilation_0.pdf (accessed 6/5/17)

DELEP. 1996. The Delaware Estuary, Discover its Secrets: A Management Plan for the Delaware Estuary. The Delaware Estuary Program (now Partnership for the Delaware estuary). http://www.delawareestuary.org/who_we_are_the_ccmp.asp

Guide to the Natural Communities of the Delaware Estuary: Version 1. 2006. Westervelt, K., E. Largay, R. Coxe, W. McAvoy, S. Perles, G. Podniesinski, L. Sneddon, and K. Strakosch Walz. Copyright © 2006 NatureServe, Arlington, Virginia. Partnership for the Delaware Estuary, Report #06-02. 338 pp. https://s3.amazonaws.com/delawareestuary/pdf/ScienceReportsbyPDEandDELEP/GuideNaturalComm_v1.pdf (accessed 6/5/17)

Kauffman, G. 2011. Economic Value of the Delaware Estuary Watershed. Institute for Public Administration, University of Delaware. 78 p. http://www.ipa.udel.edu/publications/DelEstuaryValueReport.pdf

Kreeger, D., J. Adkins, P. Cole, R. Najjar, D. Velinsky, P. Conolly, and J. Kraeuter. June 2010. Climate Change and the Delaware Estuary: Three Case Studies in Vulnerability Assessment and Adaptation Planning. Partnership for the Delaware Estuary, PDE Report No. 10-01. 117 p. https://s3.amazonaws.com/delawareestuary/pdf/Climate/Climate%20Change%20and%20the%20Delaware%20Estuary%20&%20Appendicies_PDE-10-01.pdf (accessed 6/5/17)

Partnership for the Delaware Estuary. 2009. Regional Restoration Initiative: A Blueprint for the Delaware Estuary. PDE Report No. 09-02. 30 p. http://delawareestuary.s3.amazonaws.com/pdf/ScienceReportsbyPDEandDELEP/PDE-Report-09-02-RRI%20Blueprint%20Report.pdf (accessed 6/5/17)

"Ramsar Sites Information Service." Delaware Bay Estuary, https://rsis.ramsar.org/. (accessed 8/29/2017)

Saleh, F. and M. Weinstein. 2016. The Role of Nature-Based Infrastructure (NBI) in Coastal Resiliency Planning: a Literature Review. Journal of Environmental Management 183: 1088-1098.

Strackbein, A. and R. Dawson. 2011. Opportunities to maximize watershed conservation: Delaware River Basin Task Force and Delaware River Basin Conservation Act. Abstract, In: Proceedings of the Fourth Delaware Estuary Science & Environmental Summit. P. Cole and D. Kreeger (eds.) PDE Report #11-01. 154 pp. http://www.delawareestuary.org/news_pde_science_conference.asp

Tiner, R. W., Biddle, M. A., Jacobs, A. D., Rogerson, A. B., & K. G. McGuckin. 2011. Delaware Wetlands: Status and Changes from 1992-2007. United States Fish and Wildlife Service, Hadley, MA and Delaware Department of Natural Resources and Environmental Control, Dover, DE.

The Nature Conservancy. 2011. The Delaware River Basin Conservation Initiative. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newjersey/placesweprotect/delaware-river-initiative.xml.

USACOE (US Army Corps of Engineers). 2015. North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk. Final Report, New York District.

William Penn Foundation. 2014. Delaware River Watershed Initiative: accelerating conservation, assessing impact. 70 p. http://www.williampennfoundation.org/Doc/Complete%20DRWI%20Folio.pdf (accessed 6/5/17)

Suggested Citation for this Chapter

Kreeger, D., S. Bouboulis. 2017. "Chapter 8 - Restoration" in the Technical Report for the Delaware Estuary and Basin. Partnership for the Delaware Estuary. PDE Report No. 17-07, pp. 336-351.

Back to Table of Contents