

# Final Evaluation Findings

## Delaware National Estuarine Research Reserve

October 2011 to October 2020

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## Summary of Findings

The Coastal Zone Management Act requires the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management to conduct periodic evaluations of the operation and management of each national estuarine research reserve participating in the National Estuarine Research Reserve System. This evaluation examined the operation and management of the Delaware National Estuarine Research Reserve (Delaware Reserve) by the Delaware Department of Natural Resources and Environmental Control, the designated lead agency, for the period from October 2011 to October 2020. The evaluation focused on two target areas: coastal resilience and habitat restoration.

The findings in this evaluation document will be considered by the NOAA Office for Coastal Management in making future financial award decisions concerning the Delaware National Estuarine Research Reserve. The evaluation came to these conclusions:

### Findings for Program Administration

**Accomplishment:** The Delaware Reserve staff excel at providing mentorship to students and building the next generation of coastal managers and scientists, including underserved youth.

**Accomplishment:** The Delaware Reserve's numerous public access improvements, including trails, updates to its facilities and visitor center, and the state's acquisition of over 900 acres facilitating conservation, provide visitors with enhanced educational and recreational opportunities and allow the reserve to better protect, manage, and restore its estuarine ecosystems.

**Accomplishment:** The Delaware Reserve staff members' expertise and dedication has strengthened and informed the National Estuarine Research Reserve System and regional, state, and local efforts to improve coastal management.

**Necessary Action:** The Delaware Reserve (a) must work with the Office for Coastal Management to develop and submit a timeline for the review and approval of its management plan by October 30, 2021 that includes both the reserve and the Office for Coastal Management's tasks and (b) must complete the final management plan by the agreed-upon date in the approved timeline.

**Necessary Action:** The Delaware Reserve must meet its task in its annual federal assistance award, of hosting a Teachers on the Estuary training for Delaware teachers. The reserve must report annually on this necessary action until it meets this requirement for two consecutive years.

**Recommendation:** The NOAA Office for Coastal Management encourages the Delaware Department of Natural Resources and Environmental Control and the Delaware Reserve to pursue the addition of a part- or full-time volunteer coordinator position, which will enable the reserve to further increase its capacity and engagement with the community.

**Recommendation:** The NOAA Office for Coastal Management encourages the Delaware Reserve to use the management plan and other planning processes to further integrate the reserve’s research, stewardship, training, and education capabilities into addressing priority coastal issues and to communicate its success.

### **Findings for Coastal Resilience**

**Accomplishment:** The Delaware Reserve has continued to build on its early groundwork to increase the state’s coastal resilience. The reserve

- brought together state agencies and other partners to collaborate through the Resilient and Sustainable Communities League;
- supported communities’ efforts to build resilience through leadership, coordination, and technical assistance, including identifying resources;
- provided educational and outreach opportunities to build capacity throughout the state; and
- supported research to inform decision-making.

### **Findings for Habitat Restoration**

**Accomplishment:** The Delaware Reserve’s research and monitoring of habitat restoration and recovery from impacts is providing valuable insights that are being used for project design, adaptive management, and informing permitting decisions. Examples include the reserve’s monitoring of the 4,000-acre Prime Hook National Wildlife Refuge restoration project and the St. Jones Reserve power line replacement project.

This evaluation concludes that the Delaware Department of Natural Resources and Environmental Control is adhering to the programmatic requirements of the National Estuarine Research Reserve System in the operation of the Delaware National Estuarine Research Reserve.

## Program Review Procedures

The Coastal Zone Management Act of 1972, as amended,<sup>1</sup> requires that state coastal zone management programs (coastal programs) and national estuarine research reserves (research reserves) that are developed under the act and approved by the secretary of the Department of Commerce be evaluated periodically. Section 315 of the Coastal Zone Management Act and implementing regulations at 15 CFR 921, Subpart E, require that a research reserve be periodically evaluated with regard to 1) their operation and management, including education and interpretive activities; 2) the research being conducted within the research reserve; and 3) adherence to the requirements of section sections 315(b)(2) of the Coastal Zone Management Act.

The National Oceanic and Atmospheric Administration (NOAA) evaluated the Delaware National Estuarine Research Reserve in fiscal year 2020. The evaluation team consisted of Carrie Hall, evaluation team lead; Nina Garfield, stewardship coordinator and program specialist; and Will Underwood, Coastal Sections administrator, Alabama Department of Conservation and Natural Resources. The support of reserve staff members was crucial in conducting the evaluation, and this support is most gratefully acknowledged.

NOAA sent a notification of the scheduled evaluation to the secretary of the Delaware Department of Natural Resources and Environmental Control, published a notice of “Intent to Evaluate” in the *Federal Register* on September 11, 2020, and notified members of Delaware’s congressional delegation. The reserve posted a notice of the public meeting and opportunity to comment in the *Delaware State News* and *The News Journal* on August 30, 2020.

As part of the evaluation process, a review of relevant information was conducted, including annual federal financial assistance award reports, the previous evaluation findings, and information provided by the programs documenting how they are implementing their programs and addressing the programmatic requirements of the Coastal Zone Management Act. A survey of stakeholders was conducted, and research reserve sector leads were interviewed.

The information review and survey results informed the identification of two target areas for the evaluation: coastal resilience and habitat restoration. A virtual site visit was conducted and the evaluation team held meetings with staff members and group discussions with stakeholders and program staff members about the target areas. In addition, a virtual public meeting was offered on Wednesday, October 14, 2020 at 12:00 p.m., to provide an opportunity for members of the public to express their opinions about the implementation of the program. Stakeholders and members of the public were also given the opportunity to provide written comments. No written comments were received. NOAA then developed draft evaluation findings, which were provided to the Delaware Department of Natural Resources and Environmental Control for

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<sup>1</sup> 16 U.S.C. 1451 et. seq.

review, and the department's comments were considered in drafting the final evaluation findings.

Final evaluation findings for a national estuarine research reserve highlight the reserve's accomplishments in the target areas and include recommendations, which are of two types.

**Necessary Actions** address programmatic requirements of implementing regulations of the Coastal Zone Management Act. These must be carried out by the dates specified. Failure to address necessary actions may result in a future finding of non-adherence and the invoking of interim sanctions, as specified in the Coastal Zone Management Act.

**Recommendations** are actions that the office believes would improve the program but which are not mandatory. The state is expected to have considered the recommendations by the time of the next evaluation or dates specified.

## Evaluation Findings

### Program Administration

#### *Reserve and Coastal Program Integration*

The Delaware National Estuarine Research Reserve is administered under the Coastal Programs Section of the Delaware Department of Natural Resources and Environmental Control, along with the state's coastal program. The reserve and coastal program work closely together to address coastal management issues in the state. Several positions are jointly funded including the section administrator; part-time administrative assistant; stewardship coordinator, who is also responsible for federal consistency reviews concerning critical land and habitat impacts; Coastal Training Program coordinator, who supports the coastal program's outreach and community interactions; and research coordinator, who also serves as the senior scientist for the coastal program. The research coordinator reports directly to the Coastal Programs Section Environmental Program administrator, which seems to be working well by helping to avoid the burnout often seen when staff are working for two programs. The coastal program also provides research funding to the reserve to investigate issues that are of concern to the coastal program and networked partners. This close working relationship has amplified the ability of both programs to assist coastal communities and habitat managers in improving resilience.

#### *Staff and Staffing*

Stakeholders and partners describe the reserve staff as knowledgeable, friendly, dedicated, enthusiastic, and collaborative. They commended them for going above and beyond and reaching out to partners. They noted the reserve's trusted reputation and that they enjoyed working with staff. Stakeholders and partners value their relationship with the reserve.

The reserve has been challenged with staff turnover during the evaluation period. There have been three section administrators, three reserve managers, three education coordinators, three research coordinators, five assistant education coordinators, two administrative assistants, six conservation technicians, and seven new staff in the fiscal department that handles the reserves' grants and accounts. These changes have been driven by a number of factors including retirements and staff leaving for better paying jobs. The reserve uses desk manuals to pass on key information to new staff, but turnover is still a challenge and requires rebuilding of relationships with each change.

To help alleviate the constraints of a small staff, the reserve has focused on building a more robust volunteer program. Volunteers now staff activities during research projects and public outreach events. The reserve could build on the success of this effort and hire a part- or full-time volunteer coordinator to grow the volunteer program and further engage community members in the support of the reserve's education, training, stewardship, and research and monitoring activities. A volunteer coordinator could also help further support the reserve's success in building the next generation of scientists and coastal managers. The need for a

volunteer coordinator was identified as one of the reserve's three staffing priorities in the reserve's 2013-2018 management plan and is the only staffing priority that remains unfilled.

**Recommendation:** The NOAA Office for Coastal Management encourages the Delaware Department of Natural Resources and Environmental Control and the Delaware Reserve to pursue the addition of a part- or full-time volunteer coordinator position, which will enable the reserve to further increase its capacity and engagement with the community.

### ***Management Plan***

The previous evaluation findings (2012) had a necessary action to submit a final management plan by December 31, 2012. The reserve addressed this necessary action with the approval of the Delaware National Estuarine Research Reserve Management Plan 2013-2018. The reserve has been successful in implementing its management plan across all sectors and through the improvement of public access and land acquisition. The reserve is currently working on updating its management plan and submitted a draft management plan to NOAA for review on March 24, 2021.

**Necessary Action:** The Delaware Reserve (a) must work with the Office for Coastal Management to develop and submit a timeline for the review and approval of its management plan by October 30, 2021 that includes both the reserve and the Office for Coastal Management's tasks and (b) must complete the final management plan by the agreed-upon date in the approved timeline.

The reserve sectors are all contributing to furthering climate resilience and have made a major impact in the state. Through the development of the management plan and other processes, the reserve has the opportunity to further increase the integration and impact of the reserve's four sectors in areas of regional importance. The coastal program has recently added a new staff member who is working full-time on resilience issues, which provides new opportunities for the reserve. Additional opportunities for integration across sectors and regional priorities include aligning the management plan with Delaware's Climate Action Plan and exploring using structured decision making, an approach that has been successfully used by the Weeks Bay National Estuarine Research Reserve to address coastal issues. The U.S. Fish and Wildlife Services' National Conservation Training Center offers classes in structured decision making. The Office for Coastal Management also encourages the reserve to share its successes with NOAA and through state outlets to ensure that stakeholders, partners, and the public are aware of the reserve's impact.

**Recommendation:** The NOAA Office for Coastal Management encourages the Delaware Reserve to use the management plan and other planning processes to further integrate the reserve's research, stewardship, training, and education capabilities into addressing priority coastal issues and to communicate its success.



### ***Regional and National Leadership***

Reserve staff members' significant leadership and contributions to National Estuarine Research Reserve System workgroups continue to strengthen the national program and benefit the state. For example, the System-Wide Monitoring Program technician assisted in the testing and creation of guidance for the Storm 3 telemetry unit and provided assistance to other reserves as it was fully implemented by the system. Telemetry has allowed reserves to have access to real-time data for use in decision-making, research, and education. The System-Wide Monitoring Program coordinator is a leader in the Data Management Committee and Sentinel Site Application Module (SAM) 1 technical committees.

The education coordinator led a national initiative to develop a market analysis and needs assessment policy for the education sector. The Coastal Training Program coordinator served a term as chair of the program's Oversight Committee and participated in other workgroups, and the stewardship coordinator has served on the national Sentinel Site Stewardship Planning Group. The research coordinator has served on the steering committee for the Mid-Atlantic Coastal Acidification Network and as chair of the National Estuarine Research Reserve System's Ocean Acidification Workgroup. In addition to their national and regional work, staff also serve and contribute their expertise to many state councils, workgroups, and committees, some of which are discussed in the findings.

**Accomplishment:** The Delaware Reserve staff members' expertise and dedication has strengthened and informed the National Estuarine Research Reserve System and regional, state, and local efforts to improve coastal management.

### ***Building the Next Generation***

The reserve invests significant resources in mentoring students and fellows, from high school to graduate students, and building the next generation of coastal managers and scientists. The reserve's support of students and fellows also raises their awareness, and that of their advisors, of opportunities to conduct research and work with the national reserve system.

The reserve hosted and mentored four Graduate Research Fellows during the evaluation period. Two of the fellows remain important partners in the region in their current roles as the restoration programs manager for the Partnership for the Delaware Estuary, working with the reserve on living shorelines, and a Wesley College professor working with the reserve on a research project to better understand how ghost trees are created in the St. Jones River and how living trees may respond to rising seas.

The reserve actively pursues opportunities to work with students in order to provide workforce development opportunities. In the fall of 2015, the reserve partnered with the University of Delaware's Computer Science Program in the College of Engineering. The education coordinator acted as the client for an Introduction to Software Engineering course, providing students with the requirements for their semester-long project. The students were tasked with creating educational computer games about estuary topics. Student interns were hired in the summers

of 2017 and 2018 to refine the games for use. The reserve partnered with the Guana Tolomato Matanzas and Mission Aransas Reserves to secure a Science Transfer Grant from the Science Collaborative to purchase equipment and install the games in the reserves' visitor centers. In addition to coding and programming skills, students gained skills in client relations and public speaking. Other projects include partnering with the Visual Communications Program at Delaware Technical Community College to design communication products related to the Blackbird Creek Fall Festival and National Estuaries Day, and partnering with Wesley College to work with education majors to create a curriculum for use at the reserve.

In an effort to reach at-risk and underserved student populations, the reserve education program began partnerships with Wilmington's Green Jobs Program, Kent County Green Jobs, Delaware Youth Opportunities Initiative, and Junior Achievement of Delaware. All four programs target high school students from less affluent areas to provide them with job shadowing and educational programs. Through work with Junior Achievement of Delaware, the education coordinator has also been able to work with students in juvenile detention centers. The reserve often mentors one to six summer interns, including NOAA Hollings Scholars and National Science Foundation Established Program to Stimulate Competitive Research interns. These interns help expand staff capacity, but also conduct and contribute to novel applied science. For example, the Coastal Training Program coordinator mentored a summer intern who created a resilience StoryMap.

The research coordinator has also worked with Delaware Sea Grant since 2016 to offer competitive mini-fellowships to graduate students. While this effort is funding dependent, it has often allowed graduate students to include the reserve within the scope of their graduate studies. For example, a 2016-2017 project titled "The Effects of Salinity and Vegetation on Blue Carbon Density" allowed a George Washington University master's student to include sediment samples from the St. Jones and Blackbird Creek components in their thesis.

**Accomplishment:** The Delaware Reserve staff excel at providing mentorship to students and building the next generation of coastal managers and scientists, including underserved youth.

### ***Land Acquisition and Public Access***

The reserve invested approximately \$1.7 million in acquiring land, and the state an additional \$3.2 million to acquire land within the St. Jones watershed, enabling the reserve to better protect, manage, and restore the natural functions, diversity, and cultural integrity of the estuarine ecosystems within its boundary. Through NOAA Procurement, Acquisition, and Construction funding, the Delaware Open Space Program, and other funding sources, the reserve has benefited from the following:

Black Bird Creek—all properties are managed by the reserve.

- Jacobs Property (2.37 acres) acquired in 2011 was incorporated into the reserve boundary.
- McKinley-Merritt Property (67.4 acres) is immediately adjacent to the Jacobs Property

and was acquired in 2015. It includes a headwaters stream to the Blackbird Creek and forested wetlands. Hunting is permitted on this parcel.

- Norris Property (42.6 acres) acquired in 2016 is part of the reserve boundary core area. There is an agricultural lease on the property.
- Unruh Property (32 acres) acquired in 2015 improves access to the original state-owned parcel within the Blackbird Creek Reserve component. There is an agricultural lease on the property.
- Manwaring Property (16.3 acres) acquired in 2017 is part of an infill project.

St. Jones Reserve—property is managed by the Delaware Division of Fish and Wildlife.

- Morris Property (747 acres) acquired in 2013 includes land within the reserve’s core boundary and all land is within the St. Jones River watershed.

The reserve made significant improvements in public access over the evaluation period. In 2013, the reserve initiated a major update of its St. Jones Visitor Center and Coastal Training Program Conference Center, also known as “the barn.” The conference center is popular with partners and the community as a meeting spot, and reserve staff realized it would be beneficial to have exhibits that could provide a clear picture of the reserve’s mission and work. The reserve then obtained a NOAA Procurement, Acquisition, and Construction award to update the 1990s exhibits in the main visitor center. The new exhibits highlight estuary habitats, current and future research, and human uses.

The reserve trail system in the Blackbird Creek component was expanded to include a new 1-mile, 2-kilometer, and 5-kilometer loop. The trails are self-guided with maps in kiosks, interpretive waysides, and bird-watching benches to provide areas for individuals to rest. A new launch for canoes and kayaks was also installed. In 2016, the Delaware Bayshore Initiative funded a project to create a parking area, with handicap-accessible restrooms and education pavilion.

The reserve has worked to address public use conflicts between hunters and hikers. In the past, the public would become concerned when hunting signs were placed along the trails, and it would deter them from using the trails, even beyond hunting season. Through discussions with the Delaware Division of Fish and Wildlife, public use trails are now confined to the 801 Blackbird Landing Road property, and hunting is limited to specific properties of the Blackbird Creek Reserve to eliminate conflicting uses. The reserve is planning to conduct an assessment of public use in the near future, and the NOAA Office for Coastal Management encourages this assessment to inform future management efforts.

**Accomplishment:** The Delaware Reserve’s numerous public access improvements, including trails, updates to its facilities and visitor center, and the state’s acquisition of over 900 acres facilitating conservation, provide visitors with enhanced educational and recreational opportunities and allow the reserve to better protect, manage, and restore its estuarine ecosystems.

## **Sectors**

### *Education and Outreach*

The reserve has a robust education and outreach program. The Blackbird Creek Fall Festival, a signature reserve event, was mentioned by almost every stakeholder the evaluation team met with. The event celebrates the richness of estuaries and Delaware's cultural traditions through activities such as canoeing and kayaking, learning to cast a fishing line, guided hikes, hayrides, and bird-watching. The reserve's Make a Splash event and horseshoe crab spawning surveys were also among the reserve's highly praised events.

The reserve's K-12 education programming incorporates the K-12 Estuarine Education Program (KEEP) into its education activities for schools and teacher workshops. Educational programming includes the use of System-Wide Monitoring Program data, hands-on activities, and experiential learning. Following the 2010 Market Analysis and Needs Assessment, the reserve found that teachers needed field trips that could accommodate every student in a grade. The reserve updated its curriculum and partnered with the John Dickinson Plantation, allowing both organizations to host larger groups of students. The education coordinator is currently working on updating the reserve's curricula to ensure it aligns with the state's Next Generation Science Standards adopted in 2015. The reserve reached an average of 1,891 students between fiscal years 2011-18 and an average of 3,110 members of the public through conservation action programs and public outreach activities between fiscal years 2011-19.

The reserve also conducts teacher trainings and continues to offer, often in partnership with other reserves, its popular and award-winning Green Eggs and Sand multi-day workshops. Workshop participants are able to learn from top researchers and natural resource managers about the issues and controversies concerning horseshoe crabs and shorebirds, the science, and current management efforts. The reserve trained an average of 89 teachers a year during fiscal years 2011-19.

The Teachers on the Estuary (TOTE) program is a national initiative, and reserves receive a small amount of funding annually to implement the program. TOTE provides local teachers with the opportunity to interact with local scientists and experienced coastal educators and learn hands-on field activities highlighting National Estuarine Research Reserve System estuary education. Throughout the evaluation period, the reserve has offered high quality teacher trainings, including TOTE workshops in 2018 and 2019. In recent years, the reserve has struggled to attract Delaware teachers to TOTE trainings, because teachers are able to meet all their professional development credit needs in-house. In order to help define the reserve's niche in the state, the reserve used fiscal year 2019 funds to complete an update of the education program's market analysis and needs assessment. The updated analysis and assessment were provided to NOAA in October 2020. Since the evaluation site visit, the education coordinator worked to have TOTE added to the Delaware public school-approved professional development list, which should enable the reserve to successfully recruit teachers from Delaware. For May 2021, the reserve planned a modified TOTE with a small group of Delaware teachers that aligns

with the modified programmatic TOTE requirements for 2021. The reserve is encouraged to work with NOAA staff to continue to help identify new opportunities to provide Delaware teachers with TOTE training if necessary, such as partnering with a teaching program at a university.

**Necessary Action:** The Delaware Reserve must meet its task in its annual federal assistance award, of hosting a Teachers on the Estuary training for Delaware teachers. The reserve must report annually on this necessary action until it meets this requirement for two consecutive years.

### *Research and Monitoring*

The Delaware Reserve's research and monitoring program conducts research and monitoring that advances scientific knowledge and has been used to support coastal management, especially in the area of habitat restoration. The reserve continues to implement the System-Wide Monitoring Program with a commitment to abiotic, biotic, and habitat monitoring and has expanded its monitoring program. Reserve data are also available to decision makers. For example, the snowfall sensor on the Blackbird Creek meteorological station is used by the Delaware Department of Transportation to determine community reimbursement for snowplowing expenses. The Blackbird Creek and St. Jones weather stations are also available on the Delaware Environmental Observing System and used by local stakeholders for emergency management and crop irrigation-decisions.

The reserve completed its Sentinel Site Plan in 2017. The plan details how the reserve will continue to collect water quality, weather, and nutrient data, along with continuing vegetation biomonitoring and surface elevation tables, and maintain a vertical reference network continuously into the future. The research program has also made improvements in administration, implementing a "research request" protocol for all visiting researchers that includes an in-person meeting to help identify the researcher's needs for a successful project. An example of the benefits of this approach is a collaboration to install a research tube that allows researchers to place additional monitoring sensors at a System-Wide Monitoring Program station to collect complementary water quality data such as the partial pressure of carbon dioxide.

The reserve held its first research symposium in 2013. The Coastal Training Program and research coordinators brought together local scientists and decision makers to promote research at the reserve, to network, and to establish collaboration opportunities to advance research priorities. The symposium was held again in 2017 and 2019. In 2019, the event expanded to share additional applied science projects from the coastal program. The symposiums have featured traditional oral presentations, breakout sessions to foster discussions aimed at engaging the local research community in identification of future research priority areas, and poster sessions to increase networking opportunities, which fosters future research collaboration.

### *Stewardship*

The reserve stewardship activities have significantly benefited from the creation of a half-time stewardship coordinator position. A stewardship team composed of the reserve manager, research coordinator, stewardship coordinator, and conservation technicians guides and implements activities. For new properties that the reserve acquired and actively manages, the team developed a plan to ensure that invasive species are controlled and any process for demolishing buildings was followed.

The reserve completed its habitat maps in 2020. These maps have been used by land managers to denote protected areas and by scientists to plan areas where research activities could be allowed with the right permissions and permits. The reserve was also able to provide the maps to the permitting agencies and to show habitat for the marsh birds and the need for low-impact construction because of the impacts to key Delaware species.

### *Coastal Training Program*

The reserve implements a successful Coastal Training Program and held 48 trainings for coastal decision makers from fiscal years 2012 to 2019. The Coastal Training Program has provided leadership for the reserve and coastal program in moving both programs forward on climate resilience and helps support habitat restoration efforts. The Coastal Training Program's workshops have addressed living shorelines, invasive species, the use of sentinel site data, risk communications, and watershed tours for Delaware coastal decision makers. In one successful series of trainings, the Coastal Training Program coordinator, the coastal program, Delaware Sea Grant, the University of Delaware Institute for Public Administration, and the Delaware Emergency Management Agency developed a partnership to deliver an annual comprehensive training for community leaders on the multiple sources of flood risk. Between the start of the program in 2013 to 2019, approximately 150 individuals have participated in the training.

## **Coastal Resilience**

### ***State and Local Communities***

In 2010, the Department of Natural Resources and Environmental Control convened a newly established Sea Level Rise Advisory Committee. Over the next three years, the research coordinator led the technical committee in the development of sea level rise planning scenarios that provided a framework for the committee's work. From the scenarios, GIS maps were developed to show inundation areas statewide, which supported vulnerability assessments conducted on the state's natural resources, infrastructure, business, and economy. The reserve led and facilitated public workshops and outreach events. In 2013, the committee completed its work, providing the secretary of the Department of Natural Resources and Environmental Control with a report, *Preparing for Tomorrow's High Tide: Recommendations for Adapting to Sea Level Rise in Delaware (2013)*, which includes 55 recommendations to improve the state's capacity to adapt to sea level rise. The research coordinator and reserve staff worked to implement several of the adaptation measures involving monitoring and research.

***Case Study: Resilient and Sustainable Communities League***

In 2015, the Coastal Training Program coordinator co-led the development of the Resilient and Sustainable Communities League, or RASCL. The coordinator provides coordination support and outreach expertise. The league is a collaborative network made up of 18 state agencies, nongovernmental organizations, and universities working to promote resilience and grow the capacity of communities by providing actionable information. State partners noted the value the group had brought in helping the state maximize resources and share and build expertise. The Delaware Department of Transportation is a good example of a state agency that was able to use the tools and information that the coastal program and reserve put together, including sea level rise maps, projections, and vulnerability assessment; training; and research on green infrastructure to develop a climate change plan that the agency is now implementing. In 2017, the league held its first annual summit, bringing together resilience practitioners, elected officials, government agencies, and community members to discuss and learn about resilience and sustainable communities.

The Resilient and Sustainable Communities League serves as a bridge between state and local government. Delaware has 57 municipalities, most with no paid planning staff and high staff turnover. The league holds regular “coffee hours” that provide information, training, and connections. The league’s training and networking allows new state and local staff instant access to institutional knowledge. One participant described the league as a “force multiplier” that connected staff to information and resources. Members have worked together to help local governments address climate impacts through a variety of projects and initiatives. State and local stakeholders stressed the importance of the facilitation, coordination, and technical support provided by the reserve and Coastal Training Program in helping state and local governments move forward with incorporating climate resilience into their work.

***Case Study: Resilience Communities Partnership Program and Resilience Grants***

The Coastal Training Program coordinator provided support to communities selected for coastal program resilience grants from 2011 to 2015. For example, the coordinator and coastal program supported the Town of Laurel’s comprehensive drainage study and environmental assessment to determine feasibility of green infrastructure flood abatement techniques at “The Ramble,” a linear community park along Broad Creek. The assessment resulted in recommendations and designs for green infrastructure that took into consideration sea level rise. The coordinator and coastal program also assisted the Town of Little Creek with mapping sea level rise and flood vulnerabilities. The town used this information to evaluate and prioritize options for sea level rise adaptation for inclusion in its comprehensive development plan.

The Coastal Training Program assisted the coastal program in developing a new Resilience Communities Partnership Program that was launched in 2015. Instead of providing small grants to several towns, the program provides a larger amount of money and technical assistance to one town a year to support projects of larger significance. The Coastal Training Program coordinator served as the technical assistance lead and worked with reserve and coastal program staff to address the needs of selected communities. The research coordinator has also

helped coordinate reserve and coastal program science staff in the collection of data needed for projects. The Coastal Training Program coordinator was also able to use this experience to plan outreach and communication programs to share information and best practices from projects with other communities and coastal decision makers throughout Delaware in the form of workshops, webinars, and newsletters.

The first community selected, the Town of Slaughter Beach, routinely experiences property and street flooding during high tides and is at risk from more extreme flooding events caused by storm surges during nor'easters and tropical storms. The town's only two access roads often flood for up to three days at a time, posing risks for evacuation. The Coastal Training Program coordinator and coastal program staff worked with the town to conduct a comprehensive vulnerability assessment. The research sector staff helped collect water level data within Slaughter Beach to help better understand inundation patterns and flooding vulnerabilities. A community-wide survey was conducted, focus groups were held, and residents and stakeholders were invited to three public workshops. The effort resulted in a Coastal Vulnerability Assessment and Adaptation Options Report for Slaughter Beach. The town, in partnership with the Delaware Departments of Natural Resources and Environmental Control and Transportation, is already implementing recommendations, and completed installation of a real-time flood warning system for its two evacuation routes in 2018.

The second community selected, the City of New Castle, is a National Landmark Historic Area with the nation's oldest levees shielding it from the Delaware River. The city is vulnerable to sea level rise, upstream flooding, and downstream tidal surge. The Coastal Training Program coordinator and coastal program began working with elected officials and city staff members to conduct a comprehensive vulnerability assessment of risks from coastal storms, sea level rise, and extreme tides. The Resilient and Sustainable Communities League was a strong supporter of the project, and other state agencies were able to provide technical assistance as well. Through public engagement in several workshops led by the Coastal Training Program and taskforce meetings, residents and stakeholders had the opportunity to contribute and brainstorm strategies for addressing these risks. This assessment informed the development of an adaptation plan with 31 recommendations that the city is actively addressing. The city has also been able to successfully compete for funding to initiate some of the identified measures. The city is continuing to rely on the partnerships made as part of the program as it moves forward with implementing the adaptation plan.

The reserve's efforts throughout the evaluation period have helped the state improve its climate resilience. There continues to be a growing need for support in helping communities and the state build resilience. Recently the coastal program was able to hire an additional staff person to focus on coastal resilience to help meet the demand for assistance and work with the Resilient and Sustainable Communities League, which will allow the state to expand its coastal resilience efforts. This also helps address the workload burden on the Coastal Training Program coordinator and allows for new opportunities going forward.



### ***Outreach and Education***

In response to the growing concerns of climate change and the release of the Delaware Climate Change Impact Assessment in 2014, the education program has taken multiple steps to address education needs. To prepare staff for communicating climate change, the education and Coastal Training Program coordinators participated in a National Network for Ocean and Climate Change Interpretation study circle in 2016. The training provided the coordinators with strategic framing skills on the topic of climate change that they used to update educational programs, communications, and reserve exhibits.

The education program began offering programming on climate change, sea level rise, and ocean acidification. In one successful example, the education program created a three-part educational experience with high school students on the topic of climate change. Education staff visit the students' classroom two times to provide outreach activities on climate change, and then the students make a field trip to the reserve to tie together the activities and topics covered.

The education coordinator held an active membership in Maryland and Delaware Climate Change Education Assessment and Research (MADE CLEAR), a National Science Foundation-funded project that finished in 2018. As part of this project, the reserve was awarded a one-time grant of \$900 to host a teacher professional development workshop in Delaware on climate change. The workshop was a success, with ten participants in attendance from a variety of both formal and informal education programs. The partners have continued beyond the grant period with a community of practice named "Partners Advancing Climate Change Education," in which the education coordinator is an active member. The education coordinator also served on the planning committee for the Mid-Atlantic Climate Change Education Conference which was held virtually in June 2020 with 200 educators in attendance.

### ***Monitoring***

The coastal program and University of Delaware were interested in monitoring water level conditions in other areas of the state and were able to learn methods and about the technology from reserve staff. These data are contributing to a study of Delaware bays to enable better tidal predictions for vulnerable communities.

The reserve contributes weather station and System-Wide Monitoring Program data to Delaware's Environmental Observing System. As the observing system expands, there is potential to add more of the reserve's data to the system. The research coordinator and environmental scientist are members of the Delaware Environmental Monitoring Council and are helping to bring together organizations doing monitoring to leverage each other's data abilities.

### ***Research – Blue Carbon***

The reserve, with support from the coastal program and three NOAA Hollings Scholars, has been conducting blue carbon research to better understand the role of Delaware’s salt marshes in storing carbon. The research will provide Delaware-specific values of carbon density, carbon concentration, and sediment dry bulk density in relation to different salinities and vegetation coverages. Having an inventory of local carbon stock data will allow for more accurate carbon mapping as well as a better understanding of how much stored carbon could be released if tidal wetlands continue to lose ground to sea level rise, pollution, and human activity.

The research coordinator also serves as the blue carbon and tidal wetland expert on the state’s Natural and Working Lands team. This working group is part of the U.S. Climate Alliance. Delaware is one of 25 states that has signed on to uphold the Paris Agreement and reduce greenhouse gas emissions. The reserve is providing expertise and data to help understand how the greenhouse gas reduction goals could become more difficult to obtain if tidal wetlands are lost, resulting in a loss of carbon sequestration and a release of carbon dioxide.

**Accomplishment:** The Delaware Reserve has continued to build on its early groundwork to increase the state’s coastal resilience. The reserve

- brought together state agencies and other partners to collaborate through the Resilient and Sustainable Communities League;
- supported communities’ efforts to build resilience through leadership, coordination, and technical assistance, including identifying resources;
- provided educational and outreach opportunities to build capacity throughout the state; and
- supported research to inform decision-making.

### ***Opportunities***

The Delaware Reserve’s leadership in coastal resilience has brought state and local government staff together to help prepare the state and communities through vulnerability assessments, planning, and implementation of projects that build coastal resilience. The reserve’s stakeholders and partners and the evaluation team appreciate the reserve’s efforts and identified additional opportunities the reserve may wish to consider going forward.

- Conducting additional outreach to researchers to bring in, and expand, the number of researchers using the reserve and ensure both components are serving as research hubs. The reserve may wish to reach out to other reserves within the system for recruitment ideas. For example, Waquoit Bay has recently undertaken extensive outreach to researchers to increase the use of the reserve.
- Stakeholders noted a need for more coordination and venues for outreach and sharing of coastal research activities and results. With the creation of new Resilient and Sustainable Communities League committees, and reserve staff expertise, the reserve is well positioned to work with partners to help fill these gaps, potentially through webinars, building on the annual symposium and other venues. The research coordinator is an active member in several workgroups already, helping provide

statewide perspective and, if staff time allows, the reserve could further grow its role in coordinating relevant climate resilience research.

- The reserve's monitoring capacity is valuable and additional support for monitoring could have a large impact.
- The reserve leases some of its land to farmers and is well positioned to work with the local farming community on areas of mutual interest, such as the impacts of saltwater intrusion and potential adaptation strategies. The reserve's monitoring and research could be of interest to farmers, and the reserve may benefit from understanding yield and lidar data from farmers as well. In the past, the reserve also helped facilitate educational farm tours, which if reinvigorated may be an opportunity to build relationships. A partnership with farmers could help answer landscape-scale questions such as monitoring and modeling saltwater intrusion, marsh migration, and carbon storage in working lands. There are opportunities to engage the Natural Resources Conservation Service, U.S. Fish and Wildlife Service, and other potential partners and to leverage NOAA Science Collaborative funding to answer landscape-scale questions.

## **Habitat Restoration**

### ***Land Management***

The reserve's sectors contribute to conducting habitat restoration and associated research and monitoring, coastal training programs, and education to support habitat restoration within the reserve and coastal Delaware. The reserve often partners with the coastal program on habitat restoration, and the reserve's research and monitoring data are used by the Department of Natural Resources and Environmental Control to inform permitting and to promote policy changes for wetland protection.

In 2019, the reserve completed the "Delaware National Estuarine Research Reserve Stewardship Plan" to guide future restoration activities. The plan covers the 483-acres at Blackbird Creek managed by the reserve and will guide short- and long-term restoration efforts. Staff also updated the reserve's land management system for easier tracking, assigning numbers to all reserve-managed tracts.

The reserve has also looked at opportunities to restore habitat and reduce workload by limiting the amount of mowing on property grounds. As a trial, the reserve prioritized mowing trails used by the public and around the buildings. This has allowed for the beginning of successional habitat, such as small trees and milkweed to establish at the reserve. These areas are being monitored for invasive species. The reserve also supports addressing invasive species through the Delaware Invasive Species Council. The Coastal Training Program coordinator served as the council's Education and Outreach Committee co-chair and partnered with the council to host its annual conference from 2011 to 2016.

The reserve took over management of the native plant nursery located at the St. Jones Reserve. The reserve is now able to grow trees and prepare them for planting reducing the need for tree

tubes, improving the trees' success rates. The reserve also hosts an annual volunteer Earth Day where volunteers pot native tree seedlings.

The reserve's largest on-site restoration project was the conversion of an open farm field to a reforested area of trees near the Blackbird Creek Stewardship Center in 2010 as part of a University of Delaware project, "Studies of Reforestation and Soil Conservation on Devastated Delaware Farmland." The area has been monitored to look at the effectiveness of natural-accommodated reforestation and soil conservation techniques. Reserve staff have had to perform additional maintenance, hands-on management, and replanting. The reserve has also added educational signage and created an area for the public and education groups to use this site as a living laboratory. The reserve is currently working on upland reforestation and invasive species management in small sections of the Blackbird Creek Reserve. As part of this project, local volunteers and Boy Scout groups planted over 4,000 native trees.

The reserve added three major biological monitoring efforts: emergent vegetation monitoring, marsh bird monitoring at the St. Jones Reserve, including nest boxes, and nekton monitoring at the Blackbird Creek Reserve. These multi-year and continuous biological data sets will act as sentinels of underlying marsh health and will help inform research and future restoration activities. Additionally, the reserve is in the process of installing phenology cameras for vegetation monitoring. Assessing changes in species abundances and diversity will help in better understanding how anthropogenic stressors including toxins, eutrophication, and noise pollution affect organisms.

To support wetlands and habitat restoration, the Department of Natural Resources and Environmental Control's Wetland Monitoring and Assessment Program and the Coastal Training Program have led a biennial wetland conference for Delaware Bay. The conference is a full two-day event that focuses on the importance of wetlands across the Mid-Atlantic region. More than 350 wetland experts, planners, and other interested parties from the area gathered at the 2020 biennial conference to share the latest innovations in wetland research, outreach, and conservation programs. Conference attendees gave the conference an excellent rating.

In 2014, the reserve installed a rain garden at the St. Jones Reserve as part of a Coastal Training Program workshop. The rain garden improves the use of water runoff from the main building at the St. Jones Reserve and serves as a demonstration site for all visitors that use or visit the facilities.

The reserve has worked to support living shoreline development in the state and is an active partner in the Delaware Living Shorelines Committee, a work group dedicated to facilitating the understanding, peer review, and implementation of living shoreline tactics within the State of Delaware. In 2015, the reserve worked with the department's Wetlands Assessment and Monitoring Program to install a living shoreline at the Blackbird Creek Reserve near the canoe and kayak launch. The living shoreline serves a demonstration site for shoreline stabilization. As part of the project, the Coastal Training Program coordinator assisted with the development of

public and stakeholder outreach goals and the creation of technical workshops, a GIS-based story map of living shoreline projects, and coordinated outreach. The coordinator also serves on the Delaware Living Shoreline Committee and Outreach sub-committee.

The reserve has also been able to conduct research to look at key questions for the Living Shorelines Committee. For example, when partners in the state's Living Shorelines Committee raised the question, could biochar be added to living shorelines to help reduce nutrients, the reserve with support from the coastal program conducted a six-week marsh and laboratory-based biochar study at the reserve to look at its potential to reduce nutrient runoff. The study measured if pore water nitrogen would decrease between different biochar additions. While more research is needed, the study found that biochar additions were correlated to increases in pore water total dissolved nitrogen and thus did not appear to be a viable nutrient reduction pathway.

***Case Study: Prime Hook National Wildlife Refuge Restoration***

The reserve's monitoring network and knowledge of local hydrology contributed to the success of the 4,000-acre Prime Hook National Wildlife Refuge marsh restoration project, one of the largest ever in the eastern U.S. In the early 2010s, several storms caused minor breaches in the freshwater impoundments along the Delaware Bay, and then in 2012, Superstorm Sandy destroyed large sections of the dunes, essentially converting the impoundments into a tidal bay.

Federal recovery funding enabled the Prime Hook Refuge to undertake a major restoration project with extensive monitoring. The reserve provided data and technical expertise to assist the refuge with scoping out options for restoration. Refuge staff stated that the reserve's expertise and reputation were very helpful, "providing legitimacy" during stakeholder discussion as to why the project design plan was chosen. The refuge developed monitoring protocols and training based on the research reserve's System-Wide Monitoring Program and contracted with the reserve to conduct monitoring. As part of the monitoring effort, the reserve maintained seven water quality sondes which continuously measured changes in the water level, salinity, temperature, and turbidity. Additionally, the reserve maintained four acoustic Doppler current profilers and conducted nutrient grabs at multiple locations to understand the sediment fluxes and budget. These long-term data were used to observe and understand the refuge as it changed from managed freshwater impoundments to a brackish system with fluctuating tides. Reserve data have been used by University of Delaware researchers, who have conducted numerous applied science studies including establishing sediment budgets, monitoring marsh birds, and modeling the hydrodynamics. The continuous and extensive monitoring allowed the refuge to understand how the marsh was responding to the changes and to make adjustments as needed. In 2014, the U.S. Fish and Wildlife Service removed gates in several water control structures but found that increased connectivity was still needed; the full structures were then removed.

The reserve has facilitated a large portion of the post-restoration monitoring directly through maintaining and providing quality assurance and quality control for water-quality monitoring

equipment and by supporting partners such as the University of Delaware and the Department of Natural Resources and Environmental Control's Wetland Monitoring and Assessment Program. Refuge staff noted that the reserve's monitoring reports summarizing the data were a valuable resource and that they referred to the data all the time. They also discussed that through their work with reserve staff and the restoration effort they had learned more about the physical processes occurring in the refuge. Prime Hook is now used as a case study in the U.S. Fish and Wildlife Service's National Conservation Training Center course. Training staff talk about the project throughout the week from the policy, monitoring, and partnerships to lessons learned and success.

In 2020, the U.S. Fish and Wildlife Service was transitioning to taking over monitoring at Prime Hook, although reserve staff continue to help troubleshoot any issues. Going forward, there are continuing opportunities for the reserve to work with the refuge at Prime Hook and also new opportunities to help address wetland loss at Bombay Hook Refuge and to look at marsh migration in the refuge.

### ***Case Study: Power Line Replacement***

In 2013, Pepco Holdings Inc. notified the state that it needed to conduct an emergency pole replacement project to prevent a leaning H-frame pole from collapsing. The proposed project went through the St. Jones Reserve vegetation biomonitoring area. Reserve research staff proposed this as an opportunity to study the resilience of wetland ecosystems to low-impact construction. The state permitting agency was very interested in the data that would come out of such a study. The reserve worked with the Division of Fish and Wildlife, the Division of Water, Wetlands and Subaqueous Lands Permitting Section, and Pepco to plan the pole replacement project to minimize impacts to the marsh. In 2015, Pepco used a helicopter to install the poles at each location, instead of using heavy machinery. An airboat and an amphibious tracked vehicle were used to transport construction workers and minimize impacts. No wetland restoration was done. The reserve continues to monitor the site annually for vegetation coverage and type and the bearing capacity of the soil. As of 2019, the area has recovered fairly well. The findings show that some areas of the power line replacement have changed to provide new habitats, for example in heavily trafficked areas during the construction, new mudflats have created foraging habitat for marsh birds. The reserve has also documented how different impacts such as tire tracks change over time. The monitoring has shown that areas that have not recovered as quickly have significant water flow in the construction area. State permittees now have additional data to inform decision-making and can guide applicants in avoiding or maneuvering around streams or channels to minimize impacts to wetlands. The research also helps inform permitting agencies and others on how long it will take a marsh affected by a major disturbance to naturally recover.

### ***Research – Toxics***

The reserve and coastal program, in coordination with the Watershed Approach to Toxics Assessment and Restoration team, conducted a study to measure polycyclic aromatic hydrocarbons at five sediment sites in the St. Jones River. The sediments were also tested for

toxicity using the amphipod *Hyaella azteca*. The reserve and many Delaware Fish and Wildlife properties are downstream of the Dover Gas light Company Superfund Site. In this 2018 study, three of the five sediment sites were repeated sampling sites from a team survey conducted in 2013, allowing for a site comparison over time. Going forward, the reserve plans to establish long-term sediment toxicity monitoring stations and anticipates measuring results on a 5-year cycle. This information has informed a feasibility study to better understand how to remediate the legacy of organic contaminants. The study found that polycyclic aromatic hydrocarbons had decreased but that concentrations were still elevated upstream in the urbanized areas.

**Accomplishment:** The Delaware Reserve's research and monitoring of habitat restoration and recovery from impacts is providing valuable insights that are being used for project design, adaptive management, and informing permitting decisions. Examples include the reserve's monitoring of the 4,000-acre Prime Hook National Wildlife Refuge restoration project and the St. Jones Reserve power line replacement project.

## Evaluation Metrics

Beginning in 2012, reserves began tracking their success in addressing three evaluation metrics specific to their programs. The evaluation metrics include a five-year target and provide a quantitative reference for each program about how well it is meeting the goals and objectives it has identified as important to the program. In 2017, reserves began a new five-year period and set targets specific to their programs based on measures from existing National Estuarine Research Reserve System performance measures.

### ***Evaluation Metrics: 2012-2017***

#### **Metric 1**

**Goal:** National Estuarine Research Reserve System (NERRS) education and training increases participants' environmental literacy and ability to make science-based decisions related to estuaries and coastal watersheds.

**Objective:** Improve the capacity and skills of coastal decision makers to use and apply science-based information in decisions that affect estuaries and coastal watersheds by 2017.

**Strategy:** The reserve's Coastal Training Program will hold targeted workshops promoting the understanding and use of scientific information and the formulation of research activities to address priority coastal management issues within the State of Delaware as outlined in the most current NOAA approved Coastal Training Program Strategy. The current approved Coastal Training Program Strategy is dated 2009-2012. When revised strategies are approved during the five-year data collection period, the reserve will notify NOAA if there are any changes to the priority coastal management issues identified in a revised strategy through the performance measurement reporting process.

**Performance Measure:** Between 2012 and 2017, number of targeted workshops held that build coastal decision-maker capacity and promote the use of recent research results that address

priority coastal management issues as outlined in the most current NOAA-approved Coastal Training Program Strategy for the State of Delaware.

**Target:** Between 2012 and 2017, 25 targeted workshops held that build coastal decision-maker capacity and promote the use of recent research results that address priority coastal management issues as outlined in the most current NOAA approved Coastal Training Program Strategy for the State of Delaware.

**Results:** Year 1 = 8 workshops  
Year 2 = 9 workshops  
Year 3 = 9 workshops  
Year 4 = 7 workshops  
Year 5 = 5 workshops  
**Total:** 38 workshops

**Discussion:** The reserve was able to significantly exceed its targets and held numerous workshops in support of habitat restoration and climate resilience.

## **Metric 2**

**Goal:** NERRS education and training increases participants' environmental literacy and ability to make science-based decisions related to estuaries and coastal watersheds.

**Objective:** Enhance the capacity and skills of teachers and students to understand and use NERRS data and information for inquiry-based learning by 2017.

**Strategy:** The reserve's Education Program will hold workshops targeted to formal and non-formal educators (teachers) in order to provide workforce development opportunities to increase understanding of the ecological, economic, historical, and cultural importance of estuarine and coastal resources in support of the NOAA Education Strategic Plan 2009-2029 Goals for Environmental Literacy and Workforce Development.

**Performance Measure:** Between 2012 and 2017, number of workshops held that provide professional development to formal and non-formal educators on the ecological, economic, historical, and cultural importance of estuarine resources.

**Target:** Between 2012 and 2017, 20 workshops held that provide professional development to formal and non-formal educators on the ecological, economic, historical, and cultural importance of estuarine resources.

**Results:** Year 1 = 6 workshops  
Year 2 = 8 workshops  
Year 3 = 4 workshops  
Year 4 = 3 workshops  
Year 5 = 5 workshops  
**Total:** 26 workshops



**Discussion:** The reserve exceeded its targets and provided high-quality professional development opportunities to coastal educators, particularly its Green Eggs and Sand trainings.

### **Metric 3**

**Goal:** NERRS scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds.

**Objective:** By 2017, improve understanding of the effects of climate change and coastal pollution on estuarine and coastal ecology, ecosystem processes, and habitat function.

**Strategy:** The reserve will implement the National Estuarine Research Reserve System's System-Wide Monitoring Program following standard procedures and protocols as outlined in the System-Wide Monitoring Program Plan (September 2011). Data will have quality assurance and quality control (QA/QC) and be submitted to the Centralized Data Management Office in a timely manner.

**Performance Measure:** Between 2012 and 2017, percent of data sets from Delaware Research Reserve successfully submitted annually to the Centralized Data Management Office that meet the established standards for QA/QC.

**Target:** Between 2012 and 2017, 85 percent of System-Wide Monitoring Program data sets from Delaware NERR Research Reserve successfully submitted annually to the Centralized Data Management Office that meet the established standards for QA/QC.

**Results:**

- Year 1 = 100% of data sets met QA/QC standards
- Year 2 = 100% of data sets met QA/QC standards
- Year 3 = 100% of data sets met QA/QC standards
- Year 4 = 100% of data sets met QA/QC standards
- Year 5 = 100% of data sets met QA/QC standards

**Total: 100%** of data sets met QA/QC standards

**Discussion:** The reserve was diligent in ensuring that its data met QA/QC standards.

### ***Evaluation Metrics: 2018-2023***

#### **Metric 1**

**Goal:** NERRS Strategic Plan, Educating Communities Goal: Advance environmental appreciation and scientific literacy, allowing for science-based decisions that positively affect estuaries, watersheds, and coastal communities.

**Objective:** NERRS Strategic Plan, Educating Communities, Objective 1: Coastal residents and visitors will increase their awareness and ability to improve stewardship of estuaries, coastal watersheds, and their communities.

**Strategy:** Engage individuals and communities and enhance their participation in activities that conserve, restore, and protect natural resources. The education program will execute a wide

range of activities to provide the public with an array of educational opportunities to learn about conservation, natural resources, and the role of coastal ecosystems, including estuarine habitats and the Delaware Bay. The education section will work with fellow reserve sections to provide opportunities in stewardship and research that help restore our watershed and better understand human effects on natural resources. Engaging citizens in a variety of platforms will help achieve our target by 2022, and includes both large and smaller scale projects and activities, including estuary exploration by boat, kayak, and canoe, indoor and outdoor classroom experiences, tree planting and restoration, and large community events with representation from local communities.

This measure is the Public Served Index (Derived from the total numbers served in four other measures: public presentations, public/outreach activities, conservation action education participants, and walk-in visitors).

**Performance Measure:** From 2017 to 2022, the number of members of the public served by the Delaware National Estuarine Research Reserve.

**Target:** From 2017 to 2022, 15,000 members of the public served by the Delaware National Estuarine Research Reserve.

**Results:** Year 1 = 4,135 members of the public  
Year 2 = 3,798 members of the public  
Year 3 = 2,866 members of the public

**Total to Date = 10,799 members of the public**

**Discussion:** The reserve set a target to exceed previous performance by 17% and is on track to meet its target.

## **Metric 2**

**Goal:** NERRS Strategic Plan, Educating Communities Goal: Advance environmental appreciation and scientific literacy, allowing for science-based decisions that positively affect estuaries, watersheds, and coastal communities.

**Objective:** NERRS Strategic Plan, Educating Communities, Objective 2: Educators and students will better understand and use the reserve system and NOAA resources for place-based and inquiry-based learning.

**Strategy:** The education sector will provide multiple classroom and outdoor experiences to students and teachers in grades K-12 to increase estuary literacy and stewardship. A variety of public programs targeting different education levels will be provided on-site throughout the year. Additionally, individual school groups will schedule visits to the reserve to learn about estuary science at our facility. Our education staff also provides classroom lessons to requesting schools throughout the Delaware Bay estuary.

**Performance Measure:** Number of P-12 students reached by the Delaware National Estuarine Research Reserve Education Program

**Target:** From 2017 to 2022, the Delaware National Estuarine Research Reserve Education Program will reach 10,000 P-12 students.

**Results:** Year 1 = 2,171  
Year 2 = 1,870  
Year 3 = 322

**Total to Date = 4,363**

**Discussion:** The reserve set a target to exceed previous performance by 7%. The reserve is not on track to meet this measure because of a decrease in students reached during Year 3 due to COVID-19 impacts and school closures.

### **Metric 3**

**Goal:** NERRS Strategic Plan, Educating Communities Goal: Advance environmental appreciation and scientific literacy, allowing for science-based decisions that positively affect estuaries, watersheds, and coastal communities.

**Objective:** Coastal decision makers and environmental professionals will understand and effectively apply science-based tools, information, and planning approaches that support resilient estuaries and coastal communities.

**Strategy:** The Coastal Training Program will engage with coastal decision makers and communities through training and technical assistance to ensure they understand resilience and how it applies to residents of Delaware. Training attendees and those who receive technical assistance will better understand what constitutes a resilient community and how to implement strategies that increase their preparedness. In past years, the Delaware Research Reserve has provided five relevant trainings per year both independently and in sponsorship with partner programs or events. Plans to maintain this high level of output over the next five years is reflected in the target below.

**Performance Measure:** Number of climate resilience training events delivered by the Coastal Training Program.

**Target:** From 2017 to 2022, the Coastal Training Program will deliver 15 climate resilience focused training events.

**Results:** Year 1 = 7 training events  
Year 2 = 4 training events  
Year 3 = 5 training events

**Total to Date = 16 training events**

**Discussion:** The reserve set a target under the previous 5-year evaluation metric cycle of 22 climate resilience training events. The reserve has already exceeded its five-year target in Year 3 and continues to offer a significant number of trainings annually.

## Conclusion

For the reasons stated herein, I find that the State of Delaware is adhering to the programmatic requirements of the Coastal Zone Management Act and its implementing regulations in the operation of its approved Delaware National Estuarine Research Reserve.

These evaluation findings contain two necessary actions and two recommendations. The necessary actions must be addressed by the dates given. Recommendations must be considered before the next regularly scheduled program evaluation but are not mandatory at this time. Recommendations that must be repeated in subsequent evaluations may be elevated to necessary actions.

This is a programmatic evaluation of the Delaware National Estuarine Research Reserve, which may have implications regarding the state's financial assistance awards. However, it does not make any judgment about or replace any financial audits.

*signed by Jeffrey Payne*

Jeffrey L. Payne, Ph.D.  
Director, NOAA Office for Coastal Management

*dated June 2, 2021*

Date

## **Appendix A: Response to Written Comments**

No comments were received.