Regional Restoration Initiative

Blueprint for the Delaware Estuary

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Authors:
Jennifer Adkins, Executive Director; Partnership for the Delaware Estuary
Danielle Kreeger, Science Director; Partnership for the Delaware Estuary
Priscilla Cole, Science and Policy Fellow, Partnership for the Delaware Estuary

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Established in 1996, the Partnership for the Delaware Estuary is a non-profit organization based in Wilmington, Delaware. The Partnership manages the Delaware Estuary Program, one of 28 estuaries recognized by the U.S. Congress for its national significance under the Clean Water Act. PDE is the only tri-state, multi-agency National Estuary Program in the country. In collaboration with a broad spectrum of governmental agencies, non-profit corporations, businesses, and citizens, the Partnership works to implement the Delaware Estuary's Comprehensive Conservation Management Plan to restore and protect the natural and economic resources of the Delaware Estuary and its tributaries.

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Executive Summary

Since 2007, the Partnership for the Delaware Estuary (PDE) has been engaged in developing a regional approach for prioritizing restoration, protection and enhancement projects in the Delaware Estuary. In our region, we have the expertise, resources, and shared sense of priorities to make such an effort successful. By utilizing these resources, and incorporating a natural capital approach, we can provide valuable insight into decisions about where to invest in the Estuary. Participation and support from multiple sectors and stakeholders will be needed to make such an effort successful.

The regional approach described here places a new emphasis on broadening stakeholder involvement and incorporating a science-based approach in setting priorities for the Estuary. The foundation of this approach is a consensus-based evaluation of restoration priorities, based on sound science and criteria, to assess and rank potential projects. A preliminary set of priorities is put forth here as a starting point, to be refined through science and partner input over time. Based on our Comprehensive Conservation Management Plan (CCMP), and input from partners and stakeholders, we have identified the following initial Regional Priorities:

Regional Priorities

- Signature Estuary Species
- Forested Headwaters and Riparian Corridors
- Tidal Wetlands
- Urban Waterfronts

These Regional Priorities may be modified as the process is developed to assure consensus, stakeholder support, and scientific integrity. They represent cases where there are multiple "stacked" resource values and strong partnership interests. We have identified them as the initial basis for developing a regional strategy of restoration, protection and enhancement that will be further refined and developed over time through mutually supportive assessment structures.

A two-track process has been developed for this approach because it is critical that the identification of priorities for the Delaware Estuary be both stakeholder driven and science based. The PDE Alliance for Comprehensive Ecosystem Solutions (Alliance) will engage key stakeholders, decision-makers, and funders in the Estuary to identify priorities and the top tier projects that best support those priorities (Track 1), utilizing science-based tools developed by a Regional Restoration Workgroup affiliated with PDE's Science and Technical Advisory Committee (STAC) (Track 2.) This Alliance will include selected agencies and decision-makers, along with representatives of the funding, corporate, and non-governmental community. The goal of this track is to cultivate a shared sense of estuary priorities that benefits from the best available scientific expertise to maximize investment in the natural capital of the Estuary. The Alliance will also build support for project needs and opportunities, evaluate success, and explore new financing tools as opportunities arise.

The Regional Restoration Workgroup (Track 2) was formed as a workgroup of the STAC including representatives of the academic, governmental and non-governmental communities. The goal of this workgroup is to develop science-based decision-making tools that identify high value restoration activities and rank priority projects to maximize the natural capital outcomes from investments. These tools will allow for comparison across regions, resource types and ecological needs. They will consist of:

1) Basic decision-making matrices linked to a project registry to compare signature or ecologically important natural resources with protection and enhancement opportunities, and geographic locations;
2) Advanced decision-making matrices that incorporate natural capital values that can be used to identify and compare high value activities and select priority projects.

Updated versions of these products are expected to become further refined over time as the strategy moves into the future, with the first iteration anticipated in early 2010.

The Partnership has already taken the initial steps necessary to advance both tracks of the process described here. However, the pace at which we can proceed in both arenas will rely heavily on securing support, resources, and partner involvement. The Implementation Section of this document outlines how the Regional Restoration Initiative is anticipated to move forward.

The following sections provide additional detail on the Regional Restoration Initiative:

I. Introduction and Background to Regional Restoration
II. Regional Priorities
III. Project Evaluation: A Two-Track Process
   - The Alliance for Comprehensive Ecosystem Solutions
   - The STAC Regional Restoration Workgroup
IV. Implementation

I. Introduction & Background to Regional Restoration

Healthy estuaries depend on a complex mix of habitats, each providing unique biological, chemical and physical functions and processes important for maintaining the watershed's ecosystem. As these habitats are lost or degraded, biodiversity and functional services are lost at a great cost to our region.

Hundreds of thousands of acres of natural habitats have been destroyed or significantly altered in the Delaware Estuary watershed. 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. The Comprehensive Conservation Management Plan (CCMP) requires that restoration, protection and enhancement of natural habitats be a primary program objective of the Partnership for the Delaware Estuary.

Today, hundreds of agencies and environmental groups are working on habitat issues in the Delaware Estuary, with many successes. These projects are mostly implemented opportunistically, in response to accidents, mitigation requirements, or local preservation needs. Through 2001, PDE reported over 28,000 acres in the Estuary restored/protected/enhanced by PDE partners and partnerships.* In 2005-2006 in the Schuylkill River Watershed alone, the Philadelphia Water Department estimates that over $25 million was invested in green infrastructure water quality improvement projects by various agencies and organizations.** Because of the piecemeal way in which most projects are identified, selected, funded, implemented, and monitored, there is little or no assessment of their individual and/or collective impacts to the Estuary as part of the implementation process.

What is lacking is an effective way of tracking, prioritizing, and implementing projects across the Estuary that targets the most critical needs for maintaining estuarine functions (PDE 2005, 2007, Kreeger et al. 2006). The Delaware Estuary Regional Restoration Initiative (RRI) seeks to meet this need. The RRI will function as a comprehensive, multi-jurisdictional effort to identify and promote the restoration of ecologically significant species and habitats. Ecologically significant is a designation given to natural resources which supply critical ecosystem services, are functionally dominant, or if they are rare, threatened or hallmark features of the Delaware Estuary. The RRI will identify partnering and collaborating opportunities for advancing and coordinating restoration, protection, and enhancement efforts in the Delaware Estuary. Finally, the RRI will prioritize projects according to measurable ecosystem benefits, which stakeholders can use to select restoration projects.

*Reported by Pennsylvania, Delaware, and New Jersey, City of Philadelphia and projects funded through the National Fish and Wildlife Foundations Delaware Estuary Watershed Grants Program to the Partnership.
** Recent analysis by the Philadelphia Water Department for the Schuylkill Action Network.

The purpose of the Regional Restoration Initiative is to achieve a more holistic and strategic methodology for investments in restoration without duplicating the existing and ongoing efforts of other groups. The Delaware Estuary encompasses three states, two regions of the US Environmental Protection Agency and a diverse array of other federal and local governmental entities, making coordination of efforts both paramount and challenging.

Key elements of the RRI include:

- **Coordination**: The RRI will connect partners to increase implementation efficiency, for larger and more ecologically significant restoration projects. Smaller projects may be bundled together into project packages to be eligible for larger pots of funding.
- **Comprehensiveness**: A range of ecosystem components and habitat types, ranging from the headwaters and uplands in the north to the mouth of Delaware Bay in the south, will be considered in the RRI.
- **Inclusiveness**: Any participants or project will find a place within the RRI framework. Projects can be submitted to a PDE project registry by any environmental stakeholder in the region.
- **Credibility**: The RRI will engage the most respected resource managers, academics and institutional professionals from throughout the region to develop decision-making tools and processes.
- **Prioritization**: Restoration needs and project merits will be prioritized using decision tools based on best scientific judgment and using a diverse suite of natural resource value considerations.

Stakeholder involvement is a key element of RRI development that helps to ensure all of the above. There were two initial sources of stakeholder input used specifically to inform the RRI: a Regional Restoration Workshop held by PDE at the Academy of Natural Sciences in Philadelphia in September 2007, and a high-level Agency Stakeholder Assessment commissioned by the DuPont Corporation and completed with PDE input/collaboration in 2007. RRI priorities were additionally shaped by electronic polling conducted with over 100 attendees at the 2009 Delaware Estuary Science and Environmental Summit. Furthermore, stakeholder input to the RRI was also provided by the PDE Board of Directors, Estuary Implementation Committee, Science and Technical Advisory Committee, and Regional Restoration Workgroup, together which represent stakeholder groups from across all major sectors and regions of the Delaware Estuary.

Regional Restoration Workshop – September 2007

PDE hosted a one-day workshop called "Smart Ecosystem Restoration for Tomorrow's Delaware Estuary" at the Academy of Natural Sciences in late September 2007. Attendance far surpassed expectations with more than 120 participants, representing all sectors. Funding was provided by DuPont's Clear into the Future Program and the National Fish & Wildlife Foundation.

The workshop aimed to learn about regional restoration activities occurring elsewhere and to determine stakeholder interest for participating in a regional restoration effort in the Delaware Estuary watershed. Presentations were made on regional, national and international perspectives restoration, natural capital valuations, market-based trading applications and targeting corporate involvement. A panel discussion took questions from the audience, and a survey was used to solicit stakeholder feedback.

EPA and NOAA provided funds to hire a workshop facilitator to assemble proceedings base on the presentations, discussions and feedback surveys. The regional restoration approach described here was formed based on verbal and written feedback provided by workshop participants. The following are some key needs conveyed:

- **A One-Stop-Shop Project Registry –** Participants recognized the value of current project directories maintained by different groups, but identified the need for a more centralized project bank that could draw upon the existing directories. This more centralized registry would not replace existing efforts, but rather increase the efficiency of matching projects with funding opportunities. Building a comprehensive registry to capture habitat and resource needs in the whole Estuary was not seen as duplicative of existing directories.

- **Continued Stakeholder Input in Shaping a Regional Restoration Approach -** Many participants expressed interest in continued participation following the workshop. The group encouraged taking an affirmative stance towards building upon existing restoration successes, while working to address gaps in the region.

- **Expanded Funding**. A regional restoration strategy was identified as a tool that could lead to increased partnering and leveraging opportunities within the region and also help boost national investment in the Delaware Estuary. Increased funding could address priorities that are not being met by current funding sources/mechanisms.

The work shared at the Regional Restoration Workshop ranged from new advances in regional restoration planning from the local region (such as the New Jersey Natural Capital assessment) and other parts of the country (such as Louisiana and Michigan), to local expert views on priorities and approaches for restoration in the Estuary. The ideas captured from the workshop provided the Partnership with critical leads for conducting additional research and investigation into tools, techniques, priorities, and applications most appropriate for a regional restoration effort in the Delaware Estuary. The regional priorities and technical/science track elements of

the RRI described later in this report are a direct result of the workshop and research/ideas precipitated by it.

High-Level Agency Stakeholder Assessment

In 2007, PDE became aware of efforts by The DuPont Corporation to get input from the leaders of regional environmental agencies on the most critical Estuary environmental issues. DuPont was working with the Global Environment & Technology Foundation (GETF) and McCabe & Associates. During those consultations, all groups expressed an interest in a needs assessment, and saw value in participating in follow up efforts. They conducted stakeholder assessments to gather information on interest and capacity.

One of the top needs identified in these meetings was a structured, science-based process to help decision-makers identify priority restoration projects. PDE was described as one of the best-positioned entities to lead an effort for restoration prioritization and coordination. Agency stakeholders felt that many more funds could be leveraged from corporate social responsibility projects from this type of effort, and that providing a scientifically defensible framework for green investments could lead to greater collaboration with the region's corporate community.

It was recommended that a watershed-based approach be developed to address the multi-faceted challenges and opportunities in the Estuary. It was during these discussions that the concept of the Alliance for Comprehensive Ecosystem Solutions (Alliance) was born as a way to engage a wide range of stakeholders to identify and promote Estuary priorities. In 2008-2009, the Partnership formed a working group to further develop the Alliance concept. This workgroup, made up of members of the PDE Board of Directors, Estuary Implementation Committee, and other PDE partners and funders, developed the structure, methodology, and framework for the policy/consensus track of the RRI described later in this report.

II. Regional Priorities

Four Regional Priorities were selected to focus the initial stages of the Regional Restoration Initiative (RRI). Sub-workgroups of the STAC Regional Restoration Workgroup have been formed to address each of these Regional Priorities. Each of the four provides multiple services for people and the environment, as indicated by the lists of "Stacked Services" in the sections below. The four Regional Priorities represent some of the most critical living resources, habitats, and geographic areas for restoration, protection, and enhancement in the Delaware Estuary.

Signature Estuary Species

Signature estuary species are fauna and flora which are elevated because of their combined ecological, economic, and historic importance to the Delaware Estuary region. Among these are horseshoe crabs, which play an important role in supporting shorebird migration, unique to Delaware Bay. Fish species like shad and sturgeon are signature species that helped to shape the history and economy of our region, which sadly now face grave threats. The eastern oyster is a similar signature species – one that was historically a tremendous economic and food resource to the region. Since it is also one of the best understood, ecologically significant, and economically important signature species in the Delaware Estuary, the eastern oyster (and other bivalve shellfish) was chosen as the initial focus of this case study to develop decision tools that can be applied to other signature species.

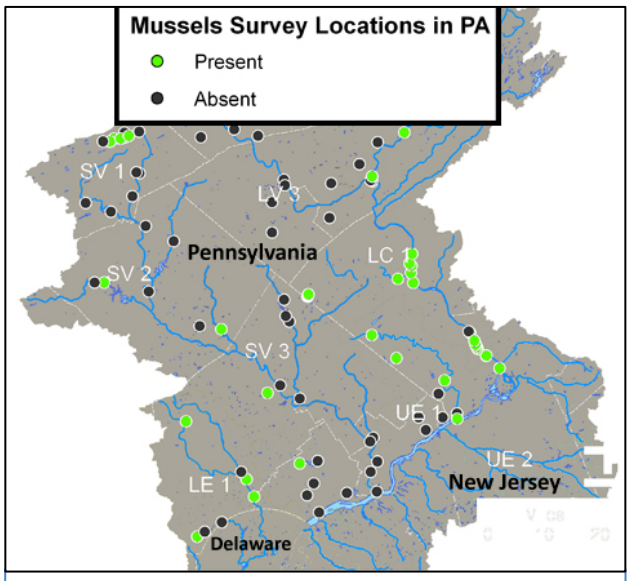


Figure 1: Freshwater Mussel presence in Pennsylvania streams & Delaware River.

Freshwater and estuarine bivalves represent some of our best sentinel indicators of ecosystem conditions. They also furnish important ecosystem services by forming complex habitats, stabilizing bottom sediments, and filtering water. Oysters provide important ecosystem services by creating reef habitats for fish, filtering water, and recycling nutrients. Oysters are also commercially and historically important, sustaining a multi-million dollar industry in this system. Although lesser known and studied, many other bivalve species inhabit the Estuary. These other bivalves are ecologically significant because they increase habitat complexity, decrease erosion, filter water, and are sensitive indicators of water quality and habitat conditions over long time periods. Freshwater mussels are also the most imperiled taxa in the United States which adds even greater value to their restoration. Declines in bivalves come from water-quality degradation, habitat loss or alteration, overharvesting, and disease. The losses will only intensify with new pressures from development, climate change and other stressors like non-native species introductions. Restoration activities such as shell-

Bivalves Stacked Services

- Hatcheries
- Oyster Industry
- Jewelry and Cultural Uses
- Sediment Stabilization
- Storm Protection
- Filter Water
- Recreation
- Disease Research
- Primary School Education
- Water Cycling
- Biogeochemistry
- Pollution Control

planting and seeding juveniles are crucial to maintaining and restoring bivalve populations, as well as building overall ecosystem resilience. A coordinated, watershed-based approach to bivalve shellfish restoration with linkages between fresh- and salt-water species restoration will yield the best natural capital outcomes. Science-based restoration can be strategically positioned to provide pollutant interception, erosion control, or sustainable harvests in the case of oysters. The Partnership has several ongoing bivalve restoration projects, including the Delaware Bay Oyster Recovery Program, where oyster reef shellplanting helps to sustain the industry and ecosystem services. The Delaware Estuary Living Shorelines Initiative builds shellfish-based intertidal reefs for marsh erosion control. The Freshwater Mussel Restoration Program restores mussel beds for water quality and species conservation.

Forested Headwaters and Riparian Corridors

Headwaters Stacked Services

- Habitat
- Carbon Sequestration
- Flood Control
- Stormwater Management
- Cool Water Fisheries Support
- Recreation (Hunting, Fishing, etc.)
- Riparian Buffers
- Wildlife Corridors
- Nutrient Uptake & Cycling
- Maintain Water Quality
- Drought Resilience

All the streams feeding the Estuary begin in the headwaters, setting the stage for water quality downstream. Forested headwaters and riparian corridors exist in the upper reaches and tributaries of Delaware Estuary watershed, providing opportunities for protecting water quality. These source waters are key habitat areas for the upland zones of the Estuary. Stream buffers provide import floodplain services, protect against the effects of storms and flooding, and prevent erosion. Headwaters are key recreational areas for hunting,

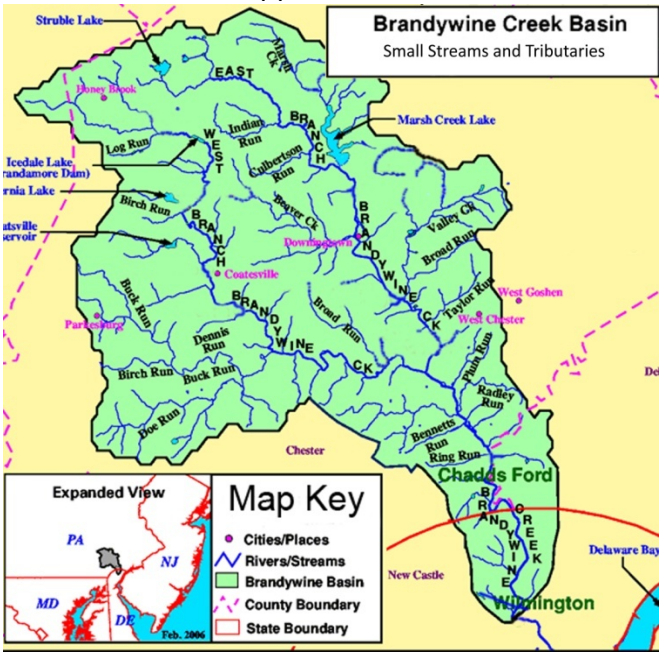


Figure 2: Smaller streams carve through every watershed of the Estuary, like in Brandywine Basin. (Credit USGS)

fishing and hiking and are the Estuary's last remaining cold-water fisheries. They also provide habitat blocks and corridors critical for bird species and bird-watching tourism. Forested areas also provide heat sinks and capture carbon. These areas often border agricultural land and are some of the last undeveloped lands in the Delaware Estuary's highly urbanized corridor. The introduction of development, pavement and other impervious surfaces rapidly degrade water quality. Unfortunately, many headwaters and stream corridors are degraded, making them prime candidates for restoration. Protecting and restoring the headwaters and stream buffers are crucial for improving the overall health of the Delaware Estuary, and maintaining the quality of life in our region.

Tidal Wetlands

Coastal wetlands are one of the Delaware Estuary's most important and characteristic habitats, and they are a premier environmental indicator for the area's ecosystem. The Estuary has one of the largest freshwater tidal prisms in the world running from Trenton, New Jersey, to approximately Wilmington, Delaware. The gradual transition from fresh to salt water allows for abundant and rare freshwater tidal wetlands in the Upper Estuary, brackish marshes in the Middle Estuary, and salt marshes surrounding Delaware Bay. Together, these marshes form a nearly continuous perimeter fringing the tidal system, at least in the mid-lower part of the Estuary, as shown in Figure 3.

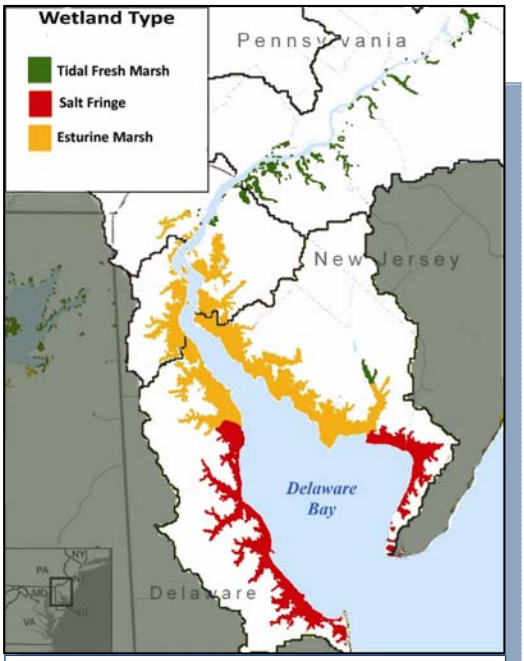


Figure 3: Estuary tidal wetland fringe.

Wetlands Stacked Services

- Fisheries Support
- Carbon Sequestration
- Sediment Stabilization
- Storm Protection
- Water Quality
- Recreation (ie. Bird Watching)
- Research Sites
- Aesthetic Value
- Habitat: Wildlife , Shellfish, Insects, etc.
- Biodiversity
- Primary Production
- Nutrient Cycling
- Cultural & Native American Uses
- Stock of Fiber and Fuel
- Pollution Control
- Flood Control

Tidal wetlands furnish essential spawning, foraging, and nesting habitat for fish, birds, and other wildlife. These wetlands function like the ecosystem's "kidneys," absorbing contaminants, nutrients, and suspended sediments. Other scientists regard them as "fish factories" that are crucial to the success of important finfisheries. They sequester more carbon than any other habitat in the watershed. And, they represent a first line of defense against storm surge and flooding. Acre for acre, tidal wetlands likely provide more ecosystem services than any other habitat type in the region.

Fifty percent of the natural Estuary marshes have been lost to development and degradation associated with human activities. Losses are most severe in the urban corridor where perhaps only five percent of pre-settlement acreage of rare freshwater tidal marshes remain. Marsh acreage and condition continue to be lost from human-caused impairments, land uses, and sea level rise. If marshes cannot keep pace with increasing sea level rise or migrate inland, then wetlands will continue to disappear. Tidal marsh buffers are important to protect to facilitate the landward transgression of marshes.

PDE, in cooperation with Rutgers University, has pioneered techniques for tidal wetland restoration and protection through the Living Shoreline project. However, erosion of the wetland seaward margins is an unaddressed issue, where PDE is interested in pursuing measures to ensure marsh accretion. PDE's new Wetland Monitoring & Assessment Program will help scientists to better understand the health of the tidal marshes and erosion. The integration of these restoration activities along with new developments could protect hundreds of acres of wetlands from development and climate pressures.

Urban Waterfronts

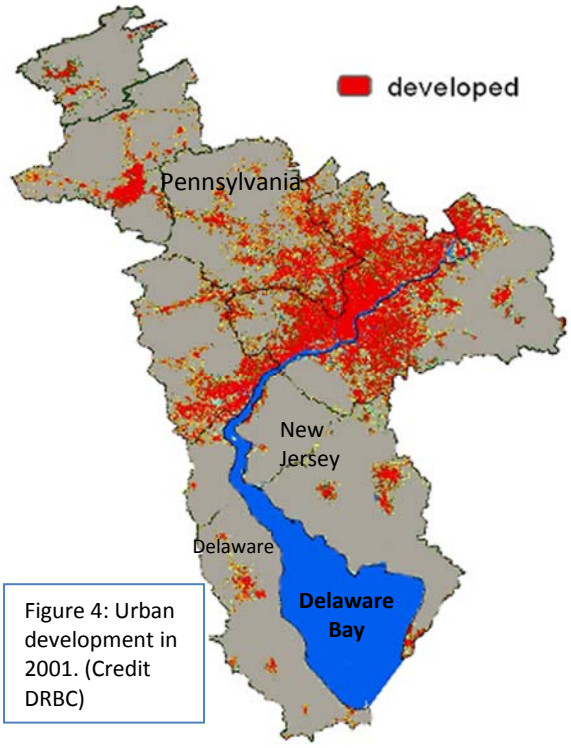


Figure 4: Urban development in 2001. (Credit DRBC)

By the 1840s, the deepwater ports of the Estuary had become major manufacturing centers. By the end of the 19th century, fisheries were in decline, drinking water contaminated, and recreational use plummeted. By the 1940s, the upper Estuary's fisheries were all but destroyed. By 1950, the urban-reach of the Delaware was one of the most polluted in the world, with essentially zero dissolved oxygen in the water during the warmer months of the year. Environmental legislation in the 1960s and 1970s led to dramatic improvements in the Delaware Estuary's water quality, but we still have a long way to go.

Urban Waterfronts Stacked Services

- Public Access
- Viewsheds/ Aesthetics
- Recreation
- Tourism
- Riparian/Wetland Habitat
- Buffers
- Intertidal Habitats
- Toxics Remediation
- Community Revitalization
- Sediment Control
- Brownfield Reclamation
- Water Quality Improvement

Today Urban Waterfronts are being transformed into hotspots for recreation, open space, and tourism. In addition to these new parks and trails, PDE is exploring opportunities to create bird and fish habitat and to restore other ecosystem services such as groundwater

recharge and nutrient sequestration. Urban waterfronts provide restoration opportunities in places where they are most needed, and can be combined with redevelopment to provide a wider range of benefits to people and the environment, including brownfields remediation and neighborhood revitalization. Urban waterfronts are challenging landscapes in which to do restoration work, but where successful, functional ecosystems in urban landscapes are some of the highest natural capital areas, and have high rewards for people and the environment.

III. Project Evaluation: A Two Track Process

The RRI's process for evaluating projects consists of two operational tracks:

- A Policy/ Consensus Track implemented by the PDE Alliance for Comprehensive Ecosystem Solutions (Alliance)
- A Technical/ Science track implemented by the Regional Restoration Work Group (RRWG) affiliated with the PDE STAC.

Figure 5 shows the interaction of these two tracks on an annual cycle. Projects will continuously come into the Project Registry through a web-based platform. These projects will be periodically reviewed, valued and ranked by the Regional Restoration Workgroup (RRWG) of PDE's Science and Technical Advisory Committee (STAC). The Project Registry will be publicly available, and the RRWG will have options for how to promote these projects. Then once a year, the Alliance will ask the STAC RRWG to prepare summaries of a subset of projects that best address Regional Priorities, initially as few as 15 projects. The Alliance will choose a select number of these (initially as few as 3-5) for Gold and Silver Level designations.

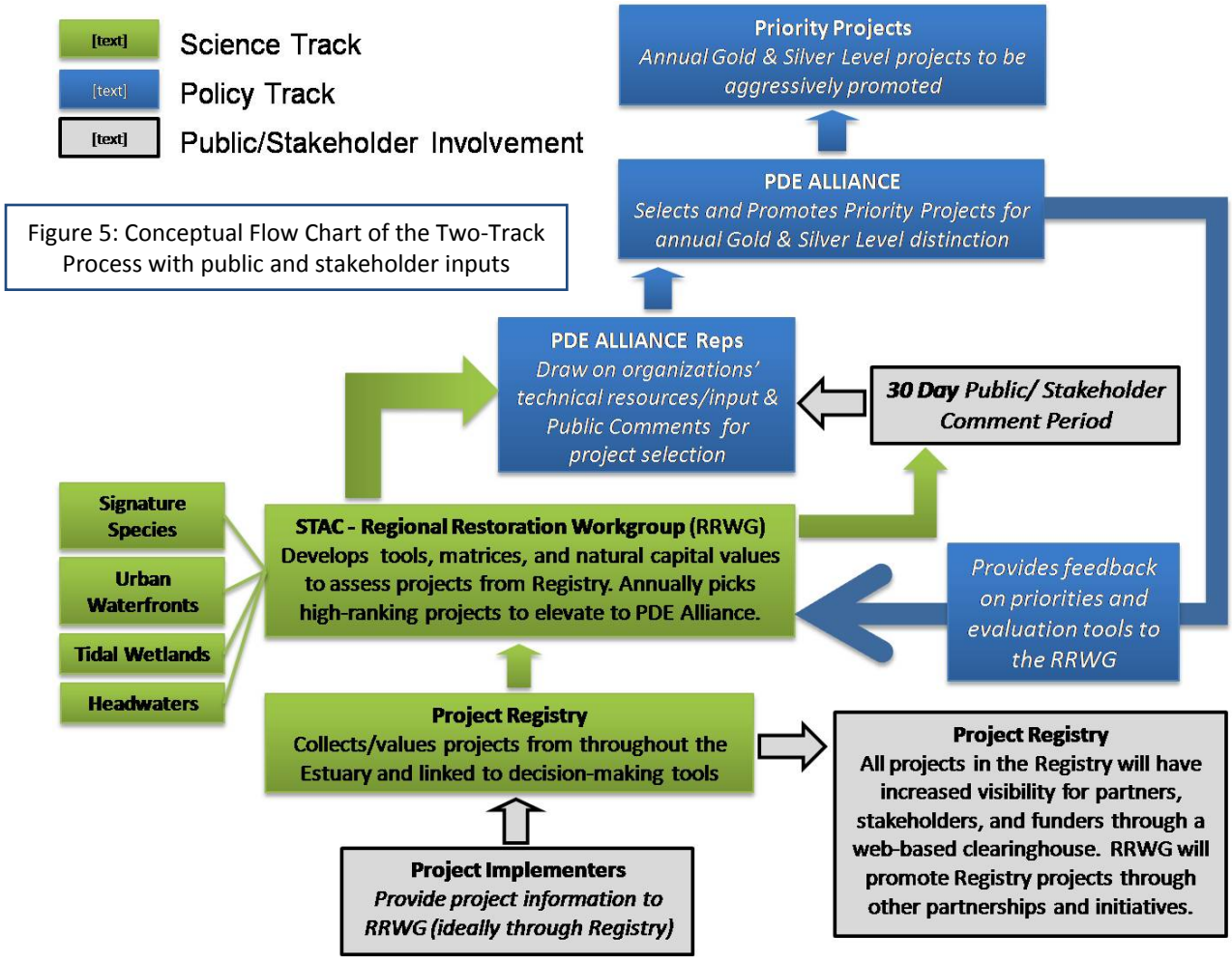


Figure 5: Conceptual Flow Chart of the Two-Track Process with public and stakeholder inputs

The Alliance is only one avenue of promotion, marketing, and fund seeking for projects in the RRI. Remaining projects will have visibility through the Project Registry, which can be used by funders and partners to find projects that match their needs.

Policy and Consensus Track: Alliance for Comprehensive Ecosystem Solutions

The PDE Alliance is an alliance of government, business, and non-profit leaders devoted to restoring, protecting, and enhancing the Delaware Estuary through projects that maximize the net environmental and economic benefit to the Estuary.

After developing criteria through a multi-stakeholder process to establish a priority listing of projects for the restoration, protection and enhancement of the Delaware Estuary, the Alliance will look for opportunities for public and private funding mechanisms to facilitate implementation of high priority projects.

The objective of the Alliance is to establish and promote a **short list of desirable projects** that have broad stakeholder support and have been evaluated and endorsed by the Alliance as a representative group of key Estuary stakeholders. The Alliance seeks to provide collaboration among major interests in restoration, protection and enhancement in the Delaware Estuary and its watershed and an operating plan/process for identifying and gaining support for shared priorities based on sound science and consensus among group members.

The Alliance aims to place new emphasis on broadening stakeholder involvement and support for setting priorities for restoration, protection, and enhancement projects in the estuary and its watershed. The foundation of this approach is the multi-dimensional commitment to an ongoing process for the consensus-based identification and evaluation of high priority projects for Estuary restoration, enhancement and protection based on research, sound science and objective criteria developed by the Alliance to assess and rank candidate projects. This collaborative effort is designed to develop strategies for achieving meaningful improvements to the Delaware Estuary.

The initial Regional Priorities set by the Alliance are outline in Section II of this document. The Alliance will depend on science analysis tools provided by the RRWG to evaluate incoming projects for their real ecosystem gains, in order to meet the most pressing ecosystem needs. The interaction of the RRWG with the Alliance will allow for smarter investments.

Policy and Consensus Track: PDE Alliance Membership

The Alliance is composed of representatives of key agencies, organizations and interest groups with an interest in restoring, protecting, and enhancing the Delaware Estuary. Its structure is intended to be manageable in size while diverse in composition.

Recommended members of the Alliance include:	
Members of the PDE Steering Committee	• The Regional Administrator from EPA Regions II & III • Secretary or Commissioner from DNREC, PADEP and NJDEP • The Commissioner of the Philadelphia Water Department • The Executive Director of the Delaware River Basin Commission • The Chairman of the Board of Directors of the Partnership for the Delaware Estuary
Up to six (6) other non- agency members selected by the PDE Board, from the following sectors:	• Academia • Environmental NGO • Science • Industry • Development • Economic
Others	• Representatives of additional federal agencies such as the US Army Corps of Engineers, the US Coast Guard, NOAA, USFWS, if determined useful and/or necessary by the Alliance • Executive Director of the Partnership for the Delaware Estuary

The PDE Board of Directors will be responsible for appointing the 6 non-agency seats to the Alliance. These 6 seats will have terms of 3-years with the possibility of one re-appointment.

Policy and Consensus Track: PDE Alliance Project Selection Process & Criteria

The Alliance would consider all types of projects including restoration, protection, and enhancement that fall within the four Regional Priorities outlined in Section II:

- Signature Estuary Species
- Forested Headwaters and Riparian Corridors
- Tidal Wetlands
- Urban Waterfronts

Alliance projects will be funneled through the Regional Restoration Work Group (RRWG) and then to STAC for review and evaluation. Projects will be evaluated based on the PDE Alliance Project Criteria (Figure 6), using the best available information, tools, and scientific expertise. Additional tools will be incorporated in this evaluation as they are developed by the RRWG, such as the proposed Natural Capital Tools, Restoration Matrices, and Project Registry

described in the next section. These tools are scheduled to be available in late 2009 or early 2010.

Each year, the STAC RRWG will prepare a package of multiple single page summary evaluations for the year's top projects. The package of project summaries will be submitted to the Alliance members for their review and evaluation. Alliance members will evaluate projects based on the information provided by the STAC RRWG, any additional information provided by their own internal resources/expertise, and their knowledge about current opportunities for implementation and funding. The Alliance Chair together with the Alliance members will provide necessary technical and/or administrative support for evaluation.

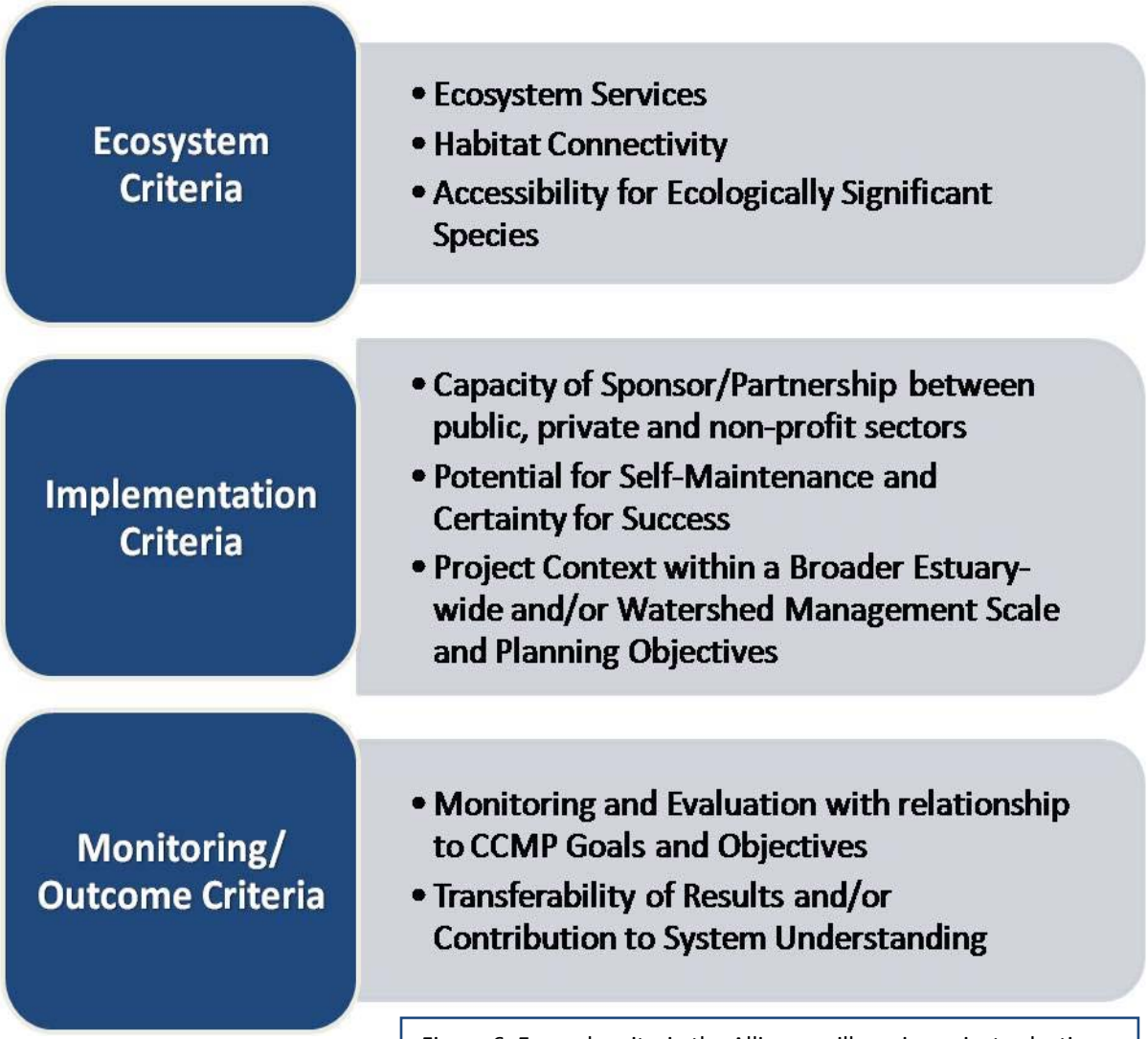


Figure 6: Example criteria the Alliance will use in project selection.

The Alliance will convene for a meeting (1-2 days) once per year for the purpose of selecting a short list of priority projects from those forwarded by the STAC RRWG. This annual Alliance meeting will be advertised and open to the public as part of the transparent Alliance process.

The Alliance will accept public comment on the proposed projects and other topics within the purview of the Alliance as it determines. The short-list of the top yearly projects will be posted on participating agency, NGO, higher education and private sector websites and made available for public review and comment for 30 days.

The Chair and Alliance may consider all submitted comments prior to finalizing and issuing a final list of "Priority Projects for the Delaware Estuary", which may be assigned Gold and Silver Level designations. This announcement would be scheduled for a time and location in order to maximize media coverage and public attention to the final Priority Project list. Projects selected for the initial list should be implementation-ready.

Policy and Consensus Track: PDE Alliance Priority Projects List

The Alliance will endorse a tiered list of "Priority Projects for the Delaware Estuary" such as, but not limited to:

- ***Gold level*** projects that when implemented have the highest potential to produce measureable significant environmental benefits
- ***Silver level*** projects that when implemented have a high potential to produce, or contribute to the production of measurable environmental benefits that are likely to be of a smaller scale than Gold Level projects and/or take longer to produce environmental benefits.

This list will include at least one project in each of the three Estuary states of Delaware, New Jersey, and Pennsylvania.

The priority projects endorsed by the Alliance will reinforce the commitment to an ongoing, multi-stakeholder process that identifies, evaluates and selects a priority list of restoration, protection, and enhancement projects based on research, sound science and objective criteria. The Alliance will work both collectively and individually, through the venues available to each member, to advance implementation of the "Priority Projects for the Delaware Estuary"by:

- Identifying opportunities for implementation of these projects;
- Garnering media attention and spreading awareness of these projects and their importance to the Delaware Estuary;
- Pursing funding mechanisms.

This collaborative effort is designed to accelerate the implementation of meaningful improvements to the Delaware Estuary and its watershed.

Science and Technical Track: Regional Restoration Workgroup (RRWG)

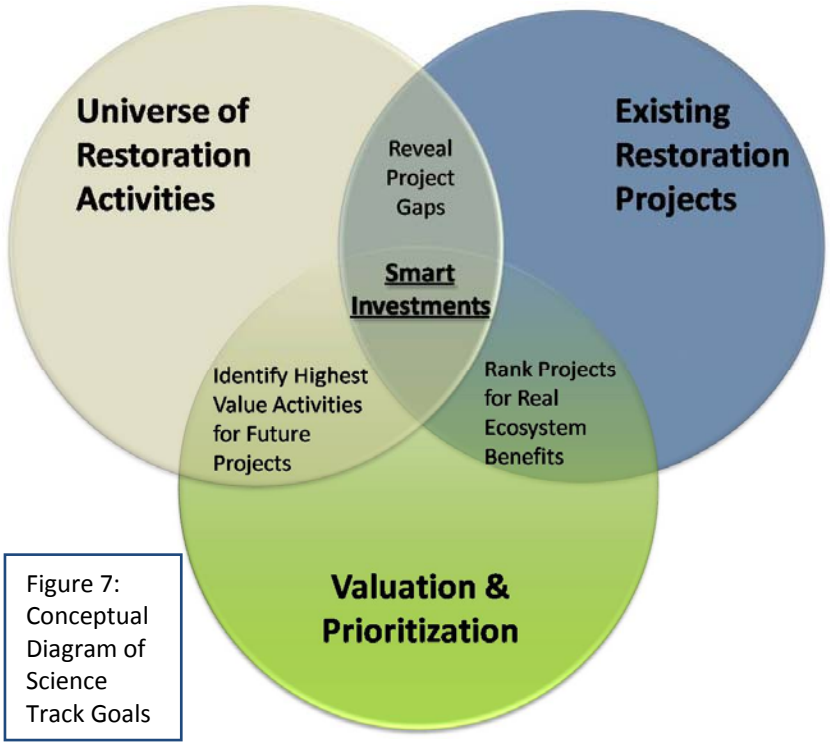


Figure 7: Conceptual Diagram of Science Track Goals

The purpose of the RRI science track is to target the most critical ecological needs of the Delaware Estuary, to identify the restoration activities with the greatest natural capital outcomes, and to match these opportunities with the most *effective & efficient* proposed projects.

Funding is always limited for restoration work. Therefore, good projects must be vetted and elevated early so that they sit at the top of the list when opportunities arise. Candidate projects will be judged according to their ecosystem benefits using new analysis tools. Developing these tools is a primary task of the RRWG in 2009. Until these tools are developed the RRWG will rank projects using the best available science and technical information and expertise.

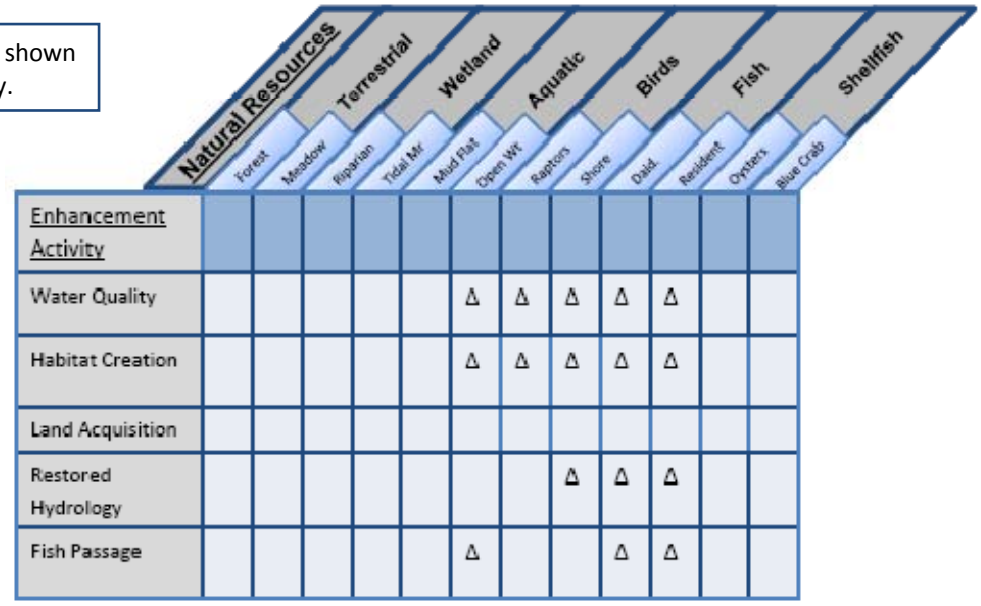
The RRWG of the STAC will use Natural Capital valuation and other tools to prioritize the universe of potential restoration activities within the identified Regional Priorities. Where high value activities are not addressed by pending projects, the RRI will identify gaps and cultivate/develop projects to fill those gaps. Together these efforts will lead to smarter restoration decisions in the Delaware Estuary, as activities are prioritized to maximize the health and function of the Delaware Estuary system, while still maintaining the human economy.

The RRWG will develop this matrix-based system for tracking values and benefits gained from restoration activities. A matrix-based system was identified as the most appropriate evaluation method for assessing priority projects because it compares high-value restoration activities with pending projects, while also identifying unfilled niches for restoration project development. "Restoration Matrices" will look at the most ecologically significant resources, in order to cross-compare the universe of restoration activities to restoration opportunities. These analysis tools will be flexible to adjust for funders' needs and resource manager priorities.

Science and Technical Track: Basic Decision-Making Tools

The RRWG formed in late 2008 with the beginning task of developing Basic Restoration Matrices (BRM) and a project registry. These basic matrices contain a straightforward three-way comparison of: 1) natural resources, 2) restoration opportunities, and 3) geographical location. Ecological needs must be articulated in various spatial and temporal scales, while also hitting other significant parameters such as functional dominance, and human well-being. Below is an example of a prototype BRM, which illustrates how many different types of natural resources can be improved through restoration of a fictional site.

Figure 8: This BRM Matrix is shown for illustrative purposes only.



A Project Registry is being developed by PDE to support the tracking of restoration projects, activities and need areas, in addition to the matrices. The BRMs will be cross linked with this Project Registry for efficient data management and queries. The Project Registry will only contain basic project metadata in order to avoid redundancy with other project directories. A number of organizations currently maintain project directories in our region.

Examples of Existing Project Directories

- NOAA's Delaware Estuary Watershed Data and Mapping Project
- American Littoral Society – Habitat Restoration Inventory
- Philadelphia Water Department's registry of priority stream and restoration projects
- PDE's restoration project database

The RRI Project Registry will serve as a "one-stop-shop" for fundable projects and opportunities. By participating in the Project Registry, agency and NGO partners will attract added attention for their projects. PDE will work with partners to select appropriate directory fields and a protocol for maintenance and distribution of the registry. Information that is sensitive, such as endangered species locations, will be protected as requested by project contributors. Appropriate project information will be made available through an interactive, web-based platform housed at PDE and linked to the Delaware Estuary Information Gateway. A list of likely information to be collected in the Project Registry can be found in the table below.

Project Registry	Examples of Information in Project Registry
General Information	• Project Status • Implementation start date • Size of area directly manipulated • Size of area being monitored • CCMP Action
Contact Information	• Name, address • Agency/Organization/Project website • Confidentiality
Geographic Location	• State/County/City • Hydrological Unit Code • Longitude/Latitude • USGS Topographic Quad • Watershed Subregion • GIS layer showing the restored area
Habitat Types and Acreage Restored	• Wetland, Headwater, Urban Waterfront, etc. • Habitat Activity Type (Enhancement, Protection, Establishment, etc.) • Scale (acres, miles, linear feet, etc.) • Species Affected
Project Budget	• Original proposed project cost estimate • Total cost estimate for monitoring

Together, the Project Registry and BRM's will work to collect viable projects into a one stop resource, which will match up projects with ecological needs in the Delaware Estuary.

Science and Technical Track: Advanced Decision-Making Tools

The RRWG is also tasked with developing advanced decision-making tools, including Natural Capital Value Assessments and Value-Added Restoration Matrices (VARMs). The latest science on natural capital and ecosystem service valuations will be incorporated into "Value-Added Restoration Matrices," (VARM) that will be used to score each project in the Registry according to its ability to target key ecological needs.

For the purpose of this report, Natural Capital is used as a broad concept covering a whole range of ecosystem services, economic benefits, and additional values. While some resources are crucial for the human economy, others are of higher value for the functioning of ecological processes and habitat. Other values are associated with opportunity for action and signature resources specific to the Delaware Estuary. A Natural Capital Team has been formed as a team of the RRWG to calculate natural capital values. A broad range of tools are being employed by the Natural Capital Team, including NOAA's Habitat Equivalency Analysis, InVEST and other traditional economic methods.

The starting point for identifying categories of natural capital is The Millennium Ecosystem Assessment (MEA) report. The MEA's four major categories are internationally recognized, and include Provisioning, Regulating, Supporting, and Cultural. These categories can be broken out to more precise layers of ecosystem services. It is up to the RRWG scientists to develop layers of ecosystem services and natural capital values for specific natural resources.

Figure 9: Types of Natural Capital Values

Figure 9 gives a general layout of the MEA services and additional categories which will be considered by the Natural Capital Team. Once the services are identified, RRWG subgroups can work with the Natural Capital Team to assign weights to the relative impact on the environment

and economy, as in Figure 10 (next page). These values will populate the VARMs. These figures are prototype for how natural capital values might be classified and scaled for three bivalves in the Delaware Estuary. Figure 10 shows pound per pound comparisons of natural capital between these three types of bivalves, relative to other species. The top part of Figure 10 reflects the MEA's established natural capital categories, and the bottom part shows additional values being considered.

As seen in the first row of Figure 10, oysters have high commercial value compared to the other bivalves. Freshwater mussels have a very small commercial value, and marsh mussels have no marketable product features. In contrast, freshwater mussels have very high conservation importance. All bivalve species have very high bio-filtration services contrasted with other filter feeding animals. Once natural capital components are identified and weighted like this, quantitative (stacked) natural capital values can be applied. These numbers will be the basis of valuation in the VARMs where applicable.

For most purposes, the relative weighting will place principal emphasis on life-sustaining ecosystem structure and function, and a secondary emphasis on preserving native species and habitats. Supplemental weights will be assigned to factors such as lack of opportunity, historical losses, socio-historical values, and other characteristics. A non-monetary "value credit" system will be adopted to compare natural capital values. Value-credits will be weighted (as seen in the bivalve chart), recognizing that relative importance differs among scoring categories. Summing across the categories yields an overall "importance score" which considers all stacked natural capital values. These "importance scores" will be the basis for comparing the relative merits of various activities and projects.

The matrices and valuation structure provide standard units for cross-comparability of vetted projects, across the watershed. Over time, these tools are expected to grow in sophistication with new scientific information and decision tool development. However, decision support can be provided in the interim by the science track, while these tools are continuously improving.

Bivalve Natural Capital		Oysters	Marsh Mussels	FW Mussels
Millennium Ecosystem Assessment Categories	*Specific Services/Values*	*Relative Importance Scores*		
Provisioning: Food & Fiber	*Dockside Product*	✓✓✓		✓
Regulating	*Shoreline & Bottom Protection*	✓✓		
	Shoreline Stabilization	✓✓	✓✓✓	✓✓
Supporting	*Structural Habitat*	✓✓✓	✓✓	✓✓
	Biodiversity: Imperiled Species			✓✓✓
	Bio-filtration	✓✓✓	✓✓✓	✓✓✓
	Biogeochemistry	✓✓	✓✓	✓✓
	Prey	✓	✓✓	✓
Cultural/ Spiritual/ Historical/ Human Well Being	*Waterman Lifestyle, Ecotourism*	✓✓		
	Native American	✓✓		✓✓✓

Additional Values		Oysters	Marsh Mussels	FW Mussels
Additional PDE Value Categories		*Relative Importance Scores*		
Functional Dominance		✓✓✓	✓✓✓	✓✓
Lack of Opportunity		✓	✓	✓✓✓
Impaired Habitats & Assemblages		✓	✓	✓✓
Public Interest		✓✓✓		✓
Signature Type		✓	✓	✓
Bio-Indicator	Watershed Indicator	✓✓✓	✓✓	✓✓✓
	Bio-Assessment	✓✓✓	✓✓	✓✓✓

Figure 10: Millennium Ecosystem Assessment and other values, broken down for three DE Estuary bivalves.

Science and Technical Track: Additional Functions of the RRWG

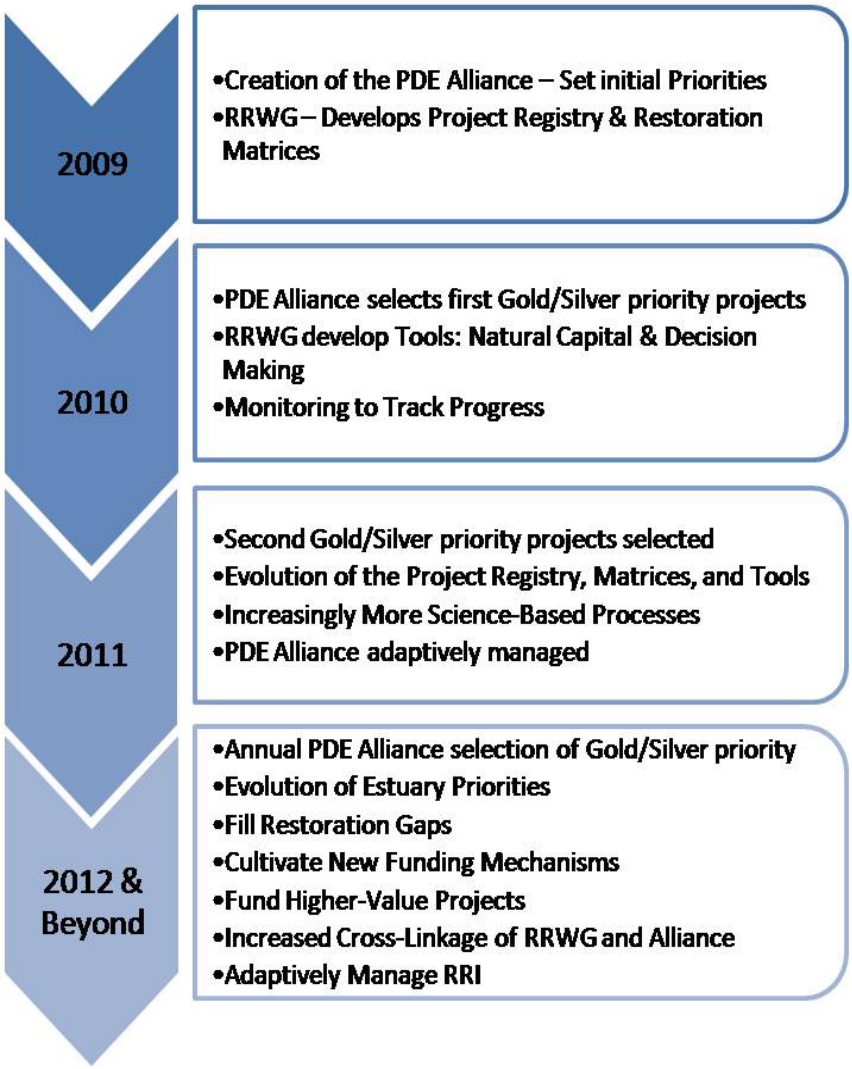
The RRWG's initial focus is on developing the project registry, tools and providing the necessary services to the Alliance process. The aggressive timeline for creation of the Alliance will force the RRWG to focus primarily on providing expedient project selection, summaries, and rankings for the Alliance by the March 2010 deadline.

This collaborative process with the Alliance will be repeated on an annual basis, but it is not the sole purpose of the RRWG. The Project Registry, restoration matrices, gap analysis opportunities, and decision making tools described above also have utility beyond the Alliance process. The Alliance will evaluate only a subset of the total projects to be collected and evaluated in the Project Registry. The additional project information in the Registry may be used by many other funders and stakeholders. The RRWG's tools will serve other purposes such as in adaptation planning, decision making, and setting future priorities for PDE and its partners. An analysis of gaps in the Project Registry will help to expose where current projects do not meet the Estuary's ecological needs, so that new projects can be cultivated. The RRWG is a capable body of restoration experts, able to perform peer review functions and coordinating roles for larger initiatives. The RRWG has intimate knowledge of the policy challenges facing restoration, which will allow them to recommend policy changes necessary for the smooth implementation of restoration activities.

IV. Implementation

The Regional Restoration Initiative (RRI) is intended to guide PDE in future decisions on restoration, protection and enhancement, with support from the regional science and management community. With the formation of the PDE Alliance and the RRWG, the basic structure will be in place for implementing a regional restoration decision-making process based on best available information and scientific judgment. Over time, information and tools will be continually improved by new RRWG developments.

With the dedication of NEP funding to RRI startup activities in FY09 and FY10, the PDE is well on its way to implementing RRI, as indicated in the following project timeline.



In the first stages of the RRI (2009), the RRWG is working to develop the Project Registry, technical decision tools, and restoration matrices. The Project Registry will initially be stocked with a bank of pre-existing unfunded projects. The RRGW has begun to develop the basic restoration matrices (BRMs) for the four initial Regional Priorities. Once BRM's and VARM's have been successfully developed for the initial Regional Priorities, and their utility tested and showcased, these products can be developed and applied to other priority resources and geographic scales in the Delaware Estuary ecosystem. By early 2010, the RRWG will have developed BRM's for the four initial Regional Priorities and have an initial Project Registry completed for the whole estuary using selected pre-existing directories. A web-based project submission platform will be established to support growth in the Project registry by the middle of 2010. By the end of 2010, the RRWG will have VARM's completed for the case studies and have a framework for completing additional VARMs for the Delaware Estuary (contingent on funding.)

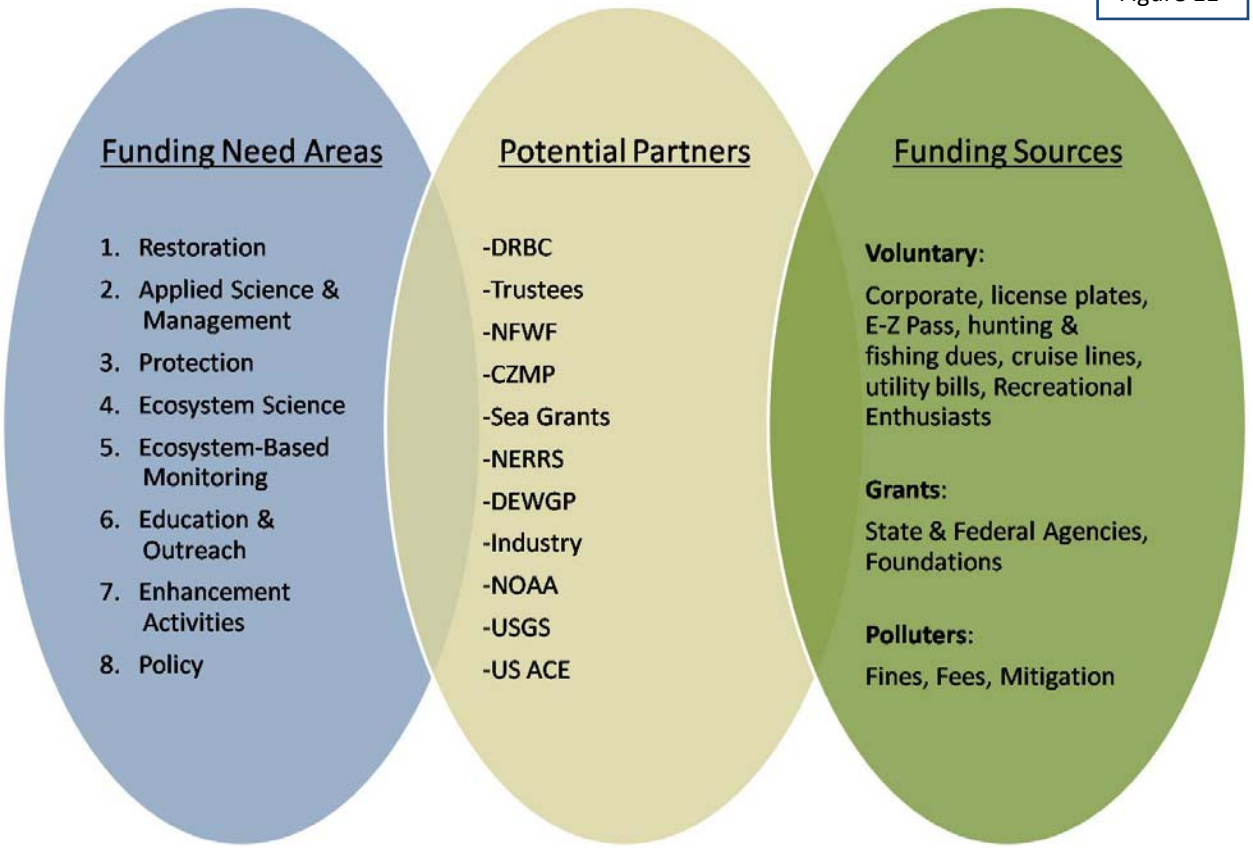
Successful implementation and utilization of the RRI will require commitments beyond PDE, including:

- The commitment of partner/funder time and resources at a high level to the PDE Alliance;
- Expert engagement in the RRWG and its subgroups to ensure that tools are firmly based in best available science;
- Implementer engagement in use of the Project Registry as a central repository for projects in the Delaware Estuary;
- Continued/Additional capacity for PDE to grow and manage the RRI system;
- Availability of funding to support priority projects identified through the RRI process.

Vision for Sustainable Funding

Funding is always a critical issue with both small and large restoration activities. There are a number of current efforts (PDE and others) to increase funding to the Delaware Estuary and its watershed, but these generally fall short of the total need. Developing a sustainable funding source would help to meet regional restoration goals and fill science gaps. Creation of a Science & Restoration Trust is one way to provide new capital monies needed for restoration priorities and scientific research.

Figure 11



The general concept of a Delaware Estuary Science and Restoration Trust has been part of PDE's long-term vision for the Delaware Estuary for a number of years (e.g. Kreeger et al. 2006). This vision was originally developed based on work by the Delaware Community Foundation, expanded with a study of financing options by the Environmental Finance Center in 2006, then informed by the work of the Global Environmental Technologies Foundation and the Keystone Conservation Trust assessing corporate interests in 2007-2008.

The basic vision is of a Trust that would address a broad array of restoration and science needs in an ecosystem-based framework to maximize environmental impacts in the Delaware Estuary and grow overall investment in this watershed of strategic national importance. The Delaware Estuary is the largest of the 28 National Estuary Programs and is home to about 7 million people (about 40% that of the Chesapeake.) And yet, despite its commercial and ecological prominence, funding directed at environmental science, monitoring and restoration in this watershed is just a small fraction of that invested in other large American estuaries. Unlike most other large estuaries, the Delaware Estuary watershed does not have a watershed-based fund that can be used to address broad science, management and restoration priorities. If created, the Trust would provide a new vehicle for accepting and pooling funding from a variety of sources to potentially meet diverse needs and/or support a variety of PDE and partner efforts and activities, including priority projects elevated through the RRI. The Trust could be created with a specific operating center for RRI operation and project implementation to ensure that contributions could be directed specifically in support of the RRI. Thus, the Trust would become not just a funding source, but a mechanism for wise investments in the future of the Estuary.

The Figure 11 summarizes the RRI funding need areas that could be addressed by a Trust, potential sources of funding for a Trust, and the potential partners that could benefit from the Trust. The goal would be make the Trust as flexible as possible to accept funding from many sources and provide money to many needs/activities. The support of many partners would be necessary to make the Trust a successful reality. PDE will continue to work with partners to explore new funding mechanisms and opportunities to further develop the Trust concept.

References

PDE. 2005. Proceedings of the First Delaware Estuary Science Conference. D. A. Kreeger (ed.), Partnership for the Delaware Estuary, Report #05-01. 110 pp.
http://www.delawareestuary.org/scienceandresearch/datasetsandreports/localandregional.asp

PDE 2007. Program for the Second Delaware Estuary Science Conference and Environmental Summit. Partnership for the Delaware Estuary, Report #07-01.
http://www.delawareestuary.org/scienceandresearch/Science_Conf/Scnc_Conf_Main.asp

Kreeger, D., R. Tudor, J. Sharp, S. Kilham, D. Soeder, M. Maxwell-Doyle, J. Kraeuter, D. Frizzera, J. Hameedi and C. Collier. 2006. White paper on the status and needs of science in the Delaware Estuary. 2006. Partnership for the Delaware Estuary, Report #06-01. 72 pp.
http://www.delawareestuary.org/scienceandresearch/datasetsandreports/localandregional.asp

List of Acronyms

Alliance – Alliance for Comprehensive Ecosystem Solutions (sometimes called ACES)
BRM – Basic Restoration Matrix
CCMP – Comprehensive Conservation and Management Plan
CZMP – Costal Zone Management Program
DEWGP – Delaware Estuary Watershed Grants Program
DRBC – Delaware River Basin Commission
EPA – U.S. Environmental Protection Agency
FY – Fiscal Year
GETF – Global Environment & Technology Foundation
InVEST – Integrated Valuation of Ecosystem Services and Tradeoffs (Tool developed by the Natural Capital Project, a joint venture of Stanford University, The Nature Conservancy, and World Wildlife Foundation)
MEA – Millennium Ecosystem Assessment
NEP – National Estuary Program
NEERS – New England Estuarine Research Society
NGO – Non-Governmental Organization
NFWF – Nation Fish and Wildlife Foundation
NOAA – National Oceanographic and Atmospheric Administration
PDE – Partnership for the Delaware Estuary
RRI – Regional Restoration Initiative
RRWG – Regional Restoration Work Group
SAV – Submerged Aquatic Vegetation
STAC – Science and Technical Advisory Committee
US ACE – U.S. Army Corps of Engineers
USGS – U.S. Geological Survey
VARM – Value Added Restoration Matrix

Supplemental Materials

Supplemental Materials are Available Online

1. 2007 RRI Workshop Survey Results
2. 2009 Delaware Estuary Environmental Summit – Audience poll results on Estuary priorities
3. List of Available Registries
4. Keystone Conservation Trust results of assessment of corporate interests in 2007-2008.
5. *Partnership for the Delaware Estuary Financing Feasibility Study* Final Report by the University of Maryland Environmental Finance Center, 2006.