



Christina-Brandywine Rivers Remediation, Restoration, Resilience Initiative (CBR4)

A Plan for Restoring Wilmington's Rivers

February 2023



Project Support – Sponsors and Partners

This plan was created through the collaboration of a group of people and organizations who came together after the 2019 Sediment Workshop for the Lower Christina and Brandywine Rivers. Inspired by the progress and opportunities presented at this workshop, the group set out to create a guide for how to proceed with remediation, restoration and resilience in a more coordinated way to make these urban rivers fully swimmable, fishable and potable in the shortest timeframe possible. This guide would articulate an inspiring vision with goals for the long term (15-20 years) while also identifying a set of tangible and feasible projects to pursue in the short term (next five years) as riverfront areas continue to develop. This plan is the result.

To support development of this plan, partners led by the Christina Conservancy and the Delaware Department of Natural Resources and Environmental Control (DNREC) committed the resources required to develop and leverage a successful grant proposal to the National Fish and Wildlife Foundation's Delaware River Watershed Conservation Fund in 2020.

CBR4 Team- Project Sponsors

American Rivers

BrightFields, Inc.

Christina Conservancy, Inc.

Delaware Department of Natural Resources and Environmental Control (DNREC)

Delaware Nature Society

Partnership for the Delaware Estuary

Sarver Ecological

Additional CBR4 Partners & Collaborators

Anchor QEA

Brandywine River Restoration Trust

City of Wilmington

Collaborate Northeast

Delaware Department of Transportation (DelDOT)

South Wilmington Planning Network

RK&K

Riverfront Development Corporation



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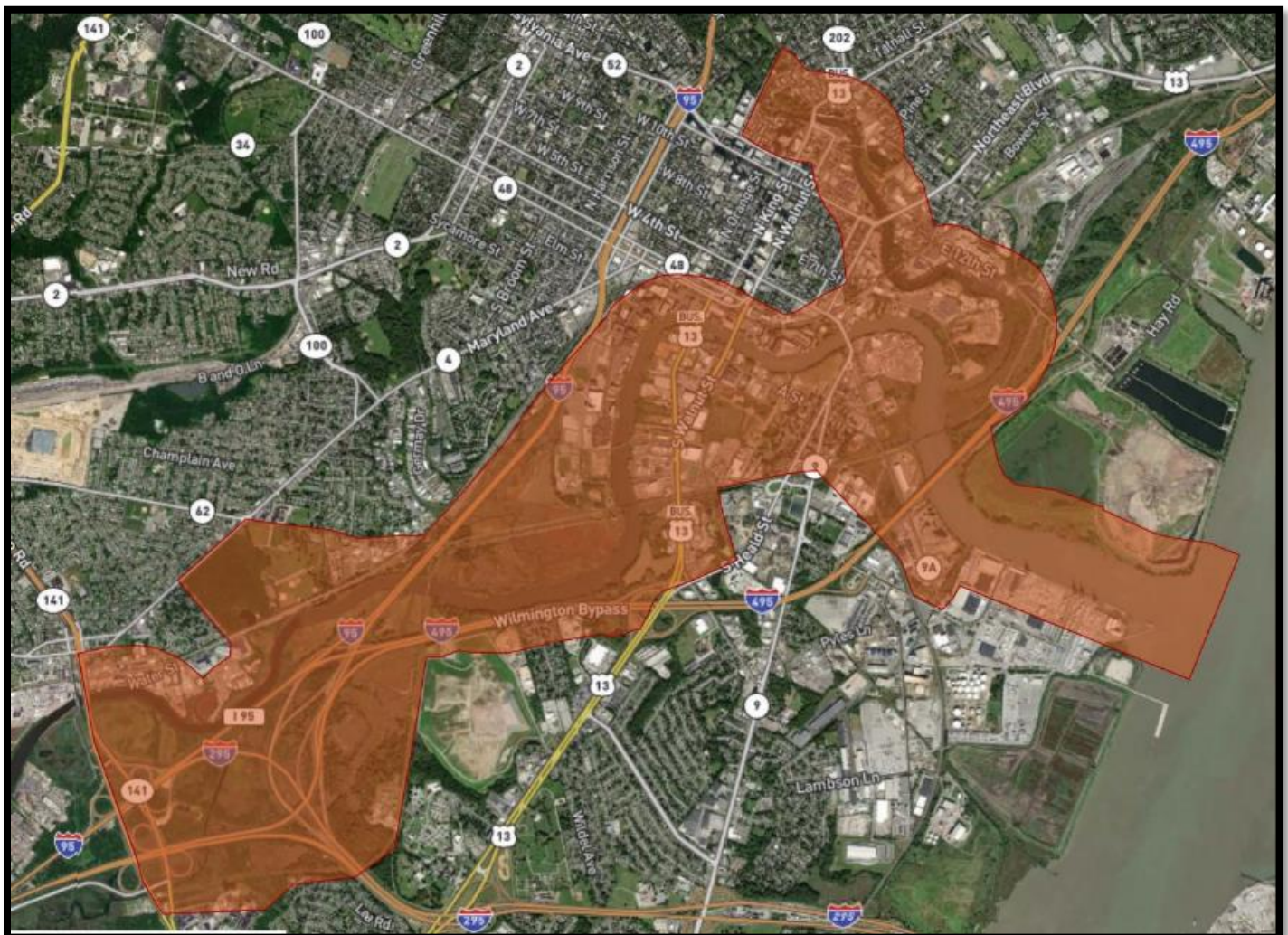


Introduction

After years of industrialization and neglect that left Wilmington Delaware's riverfronts abandoned and polluted, the lower Christina and Brandywine rivers are coming back to life. The City's, State's, and federal investments in the Wilmington Riverfront through economic development, environmental remediation, and reducing water pollution are bringing businesses and people back to the rivers. As a result, water quality is improving and fish populations are healthier and on the rise in conjunction with vibrant redevelopment of the waterfront including a Riverwalk open to the public.

What was formerly thought impossible is becoming possible. These urban rivers can be restored to health, and the Christina - Brandywine River Remediation, Restoration, and Resilience (CBR4) plan seeks to address the greatest remaining challenges to realizing that vision. The strategies and projects identified here aim to advance the cleanup of legacy toxic contamination in sediments within the waterways while protecting and restoring shoreline and riparian areas and providing recreational access as economic development continues. Thirty years ago, Governor Russell W. Peterson and the Task Force for the Future of the Brandywine and Christina put forth a bold vision for the Riverfront, and it's the success of that original vision that drives the opportunity and need for this new plan.

Figure 1: CBR4 Area



Planning Area

The “CBR4 Area” considered for planning is shown on Figure 1, primarily within the City of Wilmington and entirely within New Castle County, Delaware. It stretches from State Route 141 east to the Delaware River following the Christina River corridor and follows the Brandywine River corridor north to Brandywine Park. It also includes several large contiguous or nearly contiguous undeveloped areas adjacent to the river corridor that are important for ecology and/or recreation. While this area is defined for the sake of focusing our planning and implementation, aligned opportunities in adjacent areas will also be supported by the efforts of CBR4.

Ecology & Opportunities

The Christina-Brandywine Rivers system is ecologically rich. In the water and near-shore areas, habitat exists for fish, shellfish, and submerged aquatic vegetation that provide (or could again provide) macroinvertebrate communities of bivalves, worms, and amphipods, which are primary food sources for larger fish. These habitats are critical to sustain and rebuild Striped Bass, American Shad, and River Herring populations, among others. Water quality and habitat improvement in the Christina-Brandywine may also benefit migratory recreational species such as Striped Bass, River Herring and Atlantic Menhaden. With restoration and remediation, these waters could someday support the federally-listed Shortnose Sturgeon as well as Atlantic Sturgeon, which have yet to be documented within the project area, but are numerous in the nearby Delaware River .

The Christina and Brandywine Rivers along with their associated wetlands and riparian areas, also provide habitat for a variety of other species. The Christina River watershed harbors the only true freshwater tidal wetlands in Delaware, characterized by a number of plant species that are otherwise rare or absent in the state, like river bulrush (*Bulboschoenus fluviatilis*), horned pondweed (*Zannichellia palustris*) and spongy arrowhead (*Sagittaria calycina*). These wetlands are designated Habitats of Conservation Concern and are a Key Habitat in the Delaware Wildlife Action Plan. They support breeding Species of Greatest Conservation Need (SGCN) species like Least Bittern, Bald Eagle, and Virginia Rail. While much of the riparian forest corridor has been lost to urban development, some significant remaining forest patches host SGCN breeding birds, including American Redstart, Warbling Vireo, and Wood Thrush (a USFWS Priority Species), as well as numerous SGCN warblers and Rusty Blackbird during migration. The riparian zone habitats also support several SGCN moth species, and the river is home to the state rare Russet-tipped Clubtail dragonfly. The wetlands and riverside areas of the Lower Christina provide habitat for SGCN reptiles and amphibians, including Red-bellied Cooter, the newly described Atlantic Coastal Plain Leopard Frog, Wood Frog, Spotted and Eastern Box Turtles, and Rough Green Snake. The few remaining large riparian forest tracts are important for SGCN bats and may support the federally listed Northern Long-eared Bat.



The project area is also important culturally. Old Swedes Landing and the adjacent 7th Street Peninsula sit near the confluence of these two rivers and the area has tremendous historic and potential recreational value as part of the new First State National Historical Park in Delaware. These rivers and the entire Christina River Watershed are part of Lenapehokink, traditional homeland of the Lenape people for tens of thousands of years.

Today, some of Wilmington’s most vulnerable communities are located along the banks of the Christina and Brandywine Rivers, including the Southbridge neighborhood on the Christina, and the East Side and Northeast neighborhoods on the Brandywine. These neighborhoods have been heavily impacted by past industrial practices (including use and historic filling) and flooding, and are important potential beneficiaries and supporters of remediation, restoration, and recreation opportunities.

The Russell W. Peterson Urban Wildlife Refuge (PUWR; managed by DNREC Division of Fish and Wildlife), the DuPont Environmental Education Center (DEEC; managed by Delaware Nature Society) and other lands owned by the Riverfront Development Corporation (RDC) offer a variety of opportunities for public engagement and recreation, as well as restoration. City-owned properties, like the Southbridge Wilmington Wetlands Park (currently under construction and expanding) and the Diamond State Salvage Site (currently undergoing Brownfield site assessment), along with non-profit owned properties such as the Kalmar Nyckel Foundation, also provide opportunities for improving the quality of life of local residents in multiple ways.

Initial Planning Timeline

To take advantage of these opportunities the CBR4 project team embarked on a two-year planning process as shown in Figure 3. This process began with compiling, assessing and mapping existing “baseline” conditions in the project area, then developing goals based on those conditions, crafting strategies for meeting those goals, and identifying projects that are both impactful and feasible. Community and other key stakeholder involvement was sought at key times during this process and was guided by a communications plan developed and implemented with input from community partners.

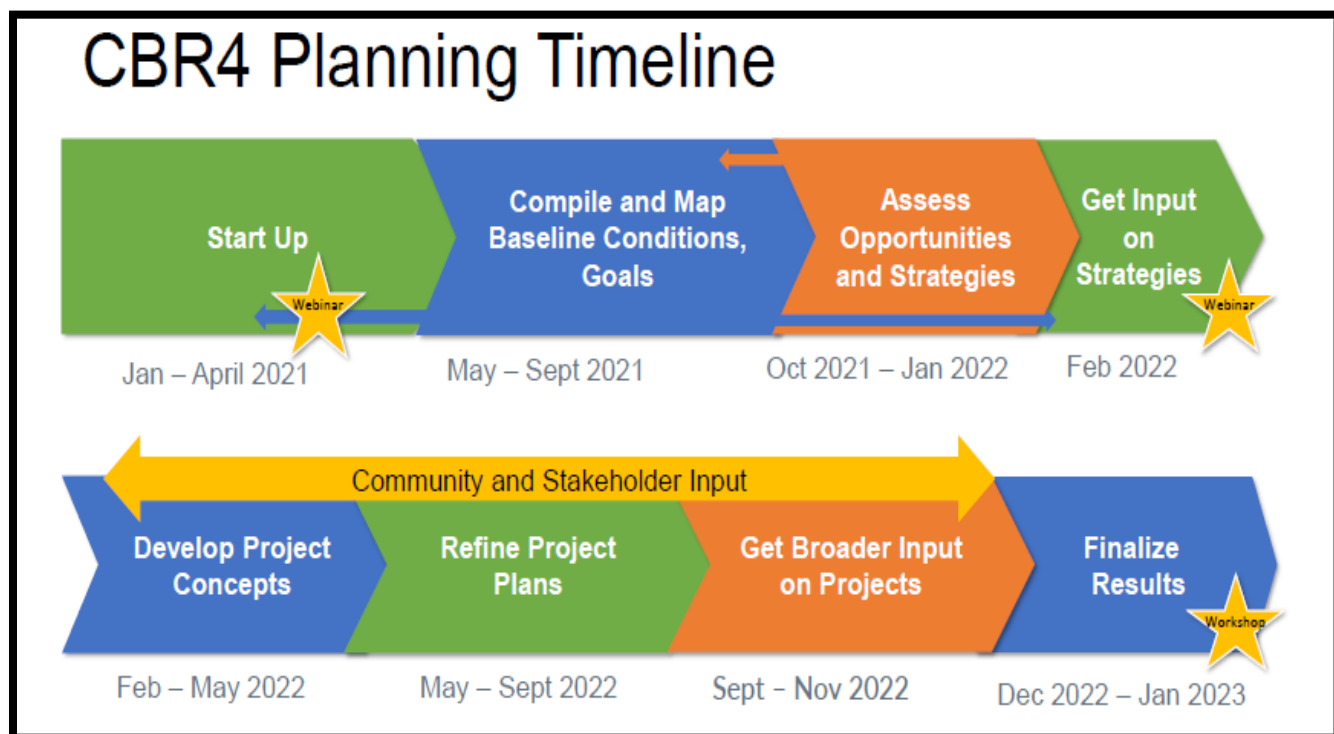


Figure 2: Initial CBR4 Planning Timeline

Current Conditions & Goals

The health of the Christina and Brandywine Rivers and resilience of nearby communities depends on several key natural and physical features and conditions. Resilient wetlands and shorelines ensure clean water and habitat for fish, wildlife and human recreation. The presence or absence of contaminants and features that prevent or mitigate negative impacts from climate change are also critical to the health of fish, wildlife and people living in these areas. Connections between these features and larger adjacent areas of habitat and refuge allow wildlife and people to move between them and are also critical to their health and wellbeing. The following maps and information depict key baseline conditions for the CBR4 area, the strategic goals, and tactical objectives established to restore health to these rivers and those who rely on them. These maps were created by Anchor QEA using the best available information from publicly accessible data sources, and ultimately collected and compiled in GIS format on a shared platform. Additional data on key resources was provided by CBR4 partners through data analysis and field observations. This information was used by the CBR4 Team, along with their own knowledge and expertise, to develop the goals and objectives expressed here, and in webinars and posters shared with key stakeholders during the planning process.



Restoration and Protection of Wetlands

The CBR4 Project Area includes between 1,000 to 1,800 acres of wetlands (depending on the measurement approach) most of which are or should be tidal freshwater. These wetlands are a globally rare and an ecologically valuable type of wetland. These include large areas of wetlands at the Russell Peterson Urban Wildlife Refuge, beneath the I-95/I-495 interchange, and the new Southbridge Wilmington Wetlands Park.

Goal: To protect, enhance and increase wetlands for habitat and water quality

Objective: Increase or achieve no net loss of wetland acreage and improvement in ecological function of wetlands in the project area.

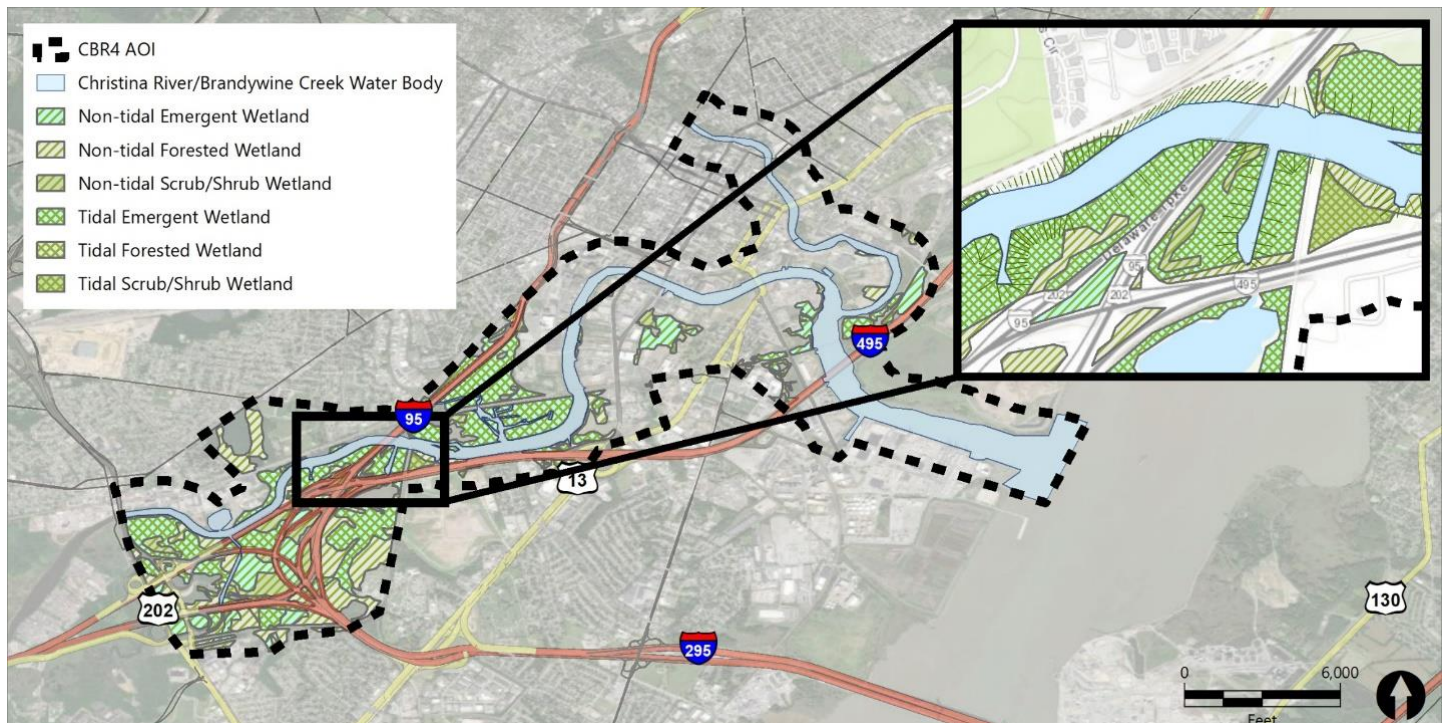


Figure 3: Wetlands Baseline Map

Restoration and Protection of Shorelines

The CBR4 Project Area includes over 110,000 linear feet of shoreline, 60% of which is “naturalized”. The remaining 40% is hardened, semi-hardened or undetermined, limiting the interchange between water and land that is valuable ecologically and for certain types of access.

Goal: To protect, enhance, and increase shorelines for habitat (fish and wildlife) and water quality

Objective: Improve ecological function and limit the loss of “naturalized” shoreline to those areas required for remediation or stabilization; “green up” as much of the hardened/semi-hardened shoreline as possible with nature-based features

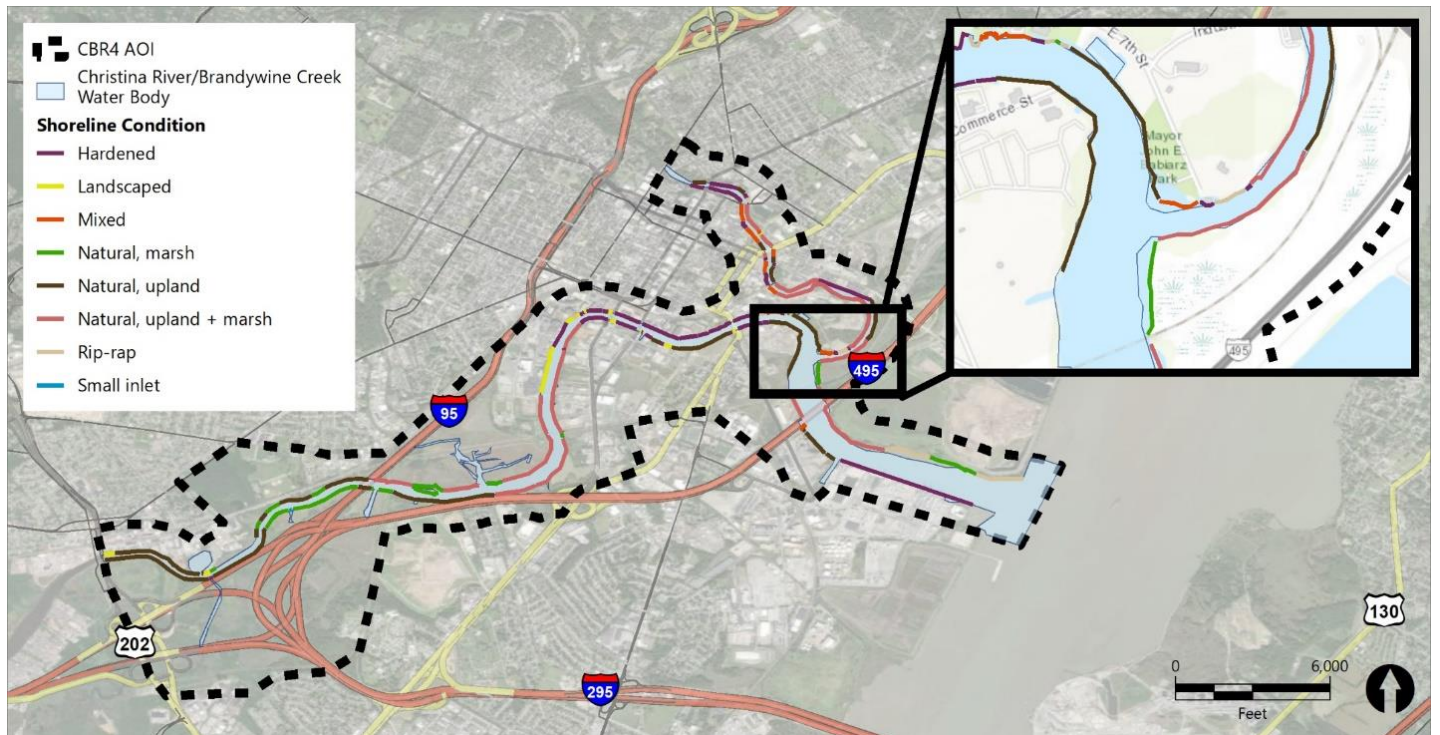


Figure 4: Shorelines Baseline Map

Restoration and Protection of Adjacent Habitats

The CBR4 Project Area includes areas of upland habitat (290 acres forested) that function to improve the water quality and ecological health of the river and riparian area. Over 536 of these acres (35%) are protected and over 267 acres (17.5%) are open to the public, making them valuable public amenities as well as habitats. In addition to larger areas like Banning Park, there are sizeable green spaces (over 1 acre) as well as smaller green spaces within close proximity (.5 km), which together can be valuable habitat for birds and insects.

Goal: To protect, enhance expand, and connect upland habitat in the project area.

Objective: Increase or achieve no net loss of open space particularly of forested open space; increase the natural habitat within and connect these areas, focusing on green spaces over 1 acre in size and the smaller spaces in close proximity to them; increase connections and access to the river.

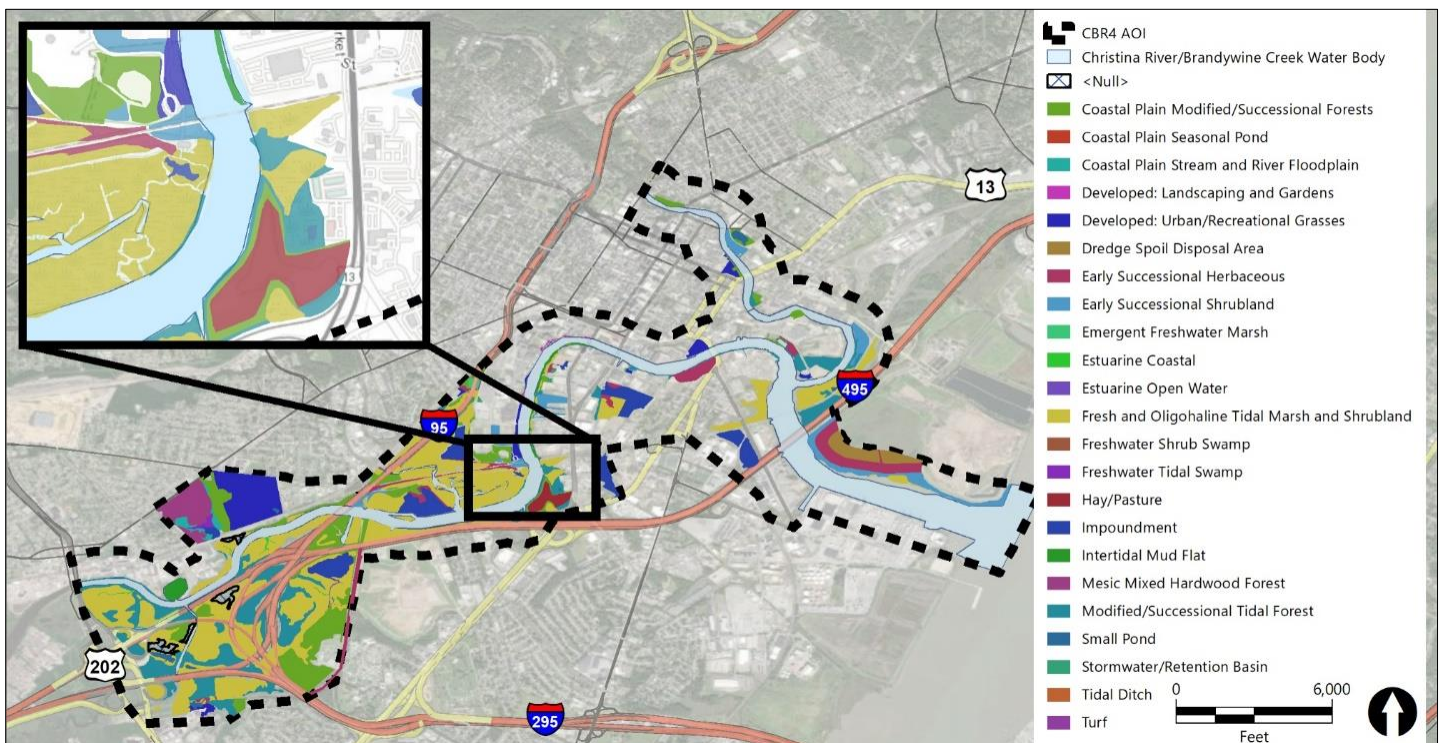


Figure 5: Adjacent Habitats Baseline Map

Remediation of Toxic Contaminants

The CBR4 Project Area includes over 530 acres of land and over 640 acres under the water (subaqueous land) where toxic contaminants have been or currently are located, and that need to be addressed through regulatory or cooperative action. The majority of upland contaminant sources along the rivers are controlled, and mass loading analysis shows a short list of priority sites. Assessment is underway to evaluate contaminant levels in subaqueous lands, which are (or could be in the future) critical habitat for fish and shellfish.

Goals: To remediate and eliminate loading of toxic contaminants to the rivers from known or newly discovered sites. To address and mitigate secondary sources of sediment contamination in the river for habitat (fish and wildlife), water quality, and recreational access including swimming. To ultimately reach fishable, swimmable and potable water quality in the shortest timeframe possible.

Objectives: Complete feasibility assessment and increase remediated acres (short-term). Reduce mass loading of contaminants to the rivers. Improve health in young-of-year fish (mid-term); Continue contaminant reduction in fish tissue contaminant levels. Reduce fish consumption advisories through in-river sediment remediation (long term).

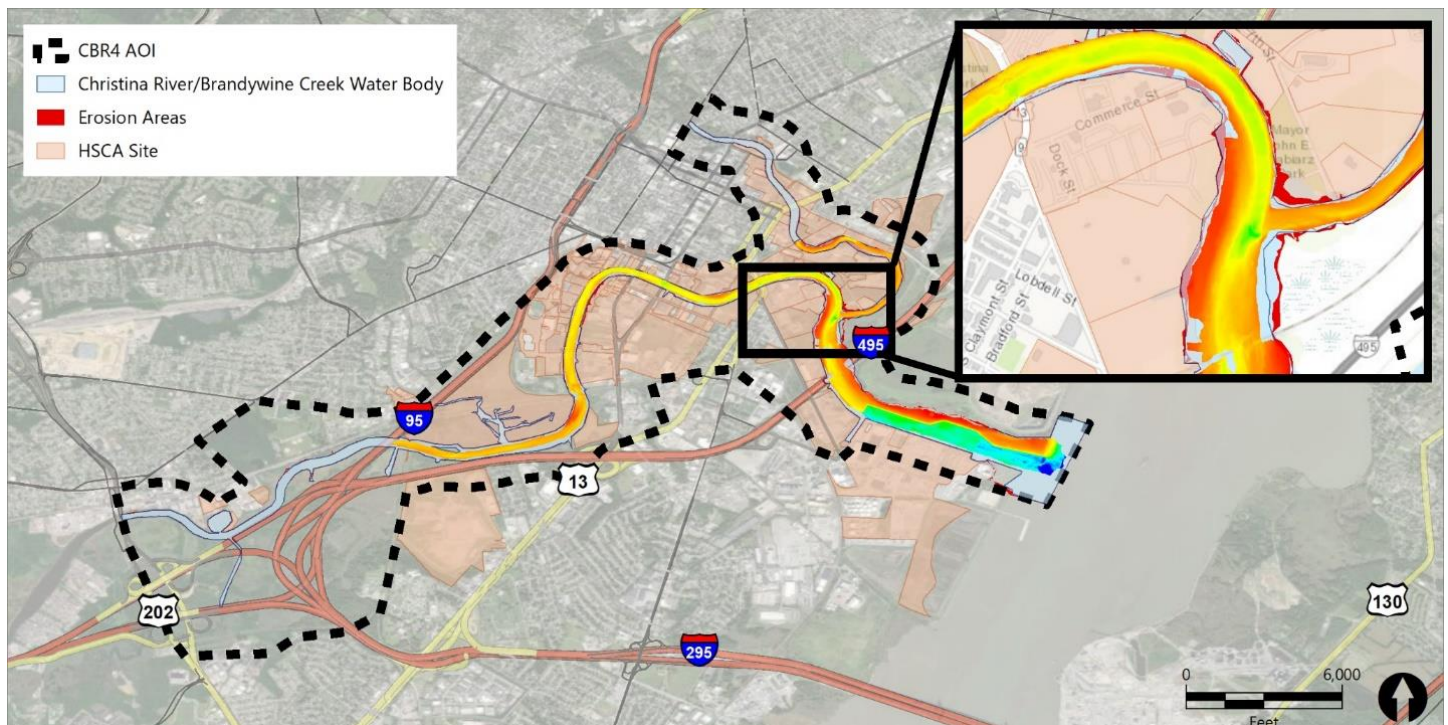


Figure 6: Remediation Baseline Map

Increase Community Resilience

The CBR4 Project area includes 7 acres of existing tree cover and roughly 700 acres of nearshore low-lying areas; these areas are vulnerable to flooding but may also offer opportunities for managing floodwaters if undeveloped. Trees and other plants are an important resource for absorbing water and cooling neighborhoods.

Goal: To improve the resiliency of habitats, infrastructure and communities to the impacts of climate change (flooding, sea level rise, warming, health/connection)

Objective: No net loss of low-lying areas currently in a semi-natural state (undeveloped and vegetated); increase tree cover and green infrastructure for managing stormwater while balancing the need for hard infrastructure in key places to protect people. Increase consideration of resilience as a key consideration for long term planning and in short term decision-making.

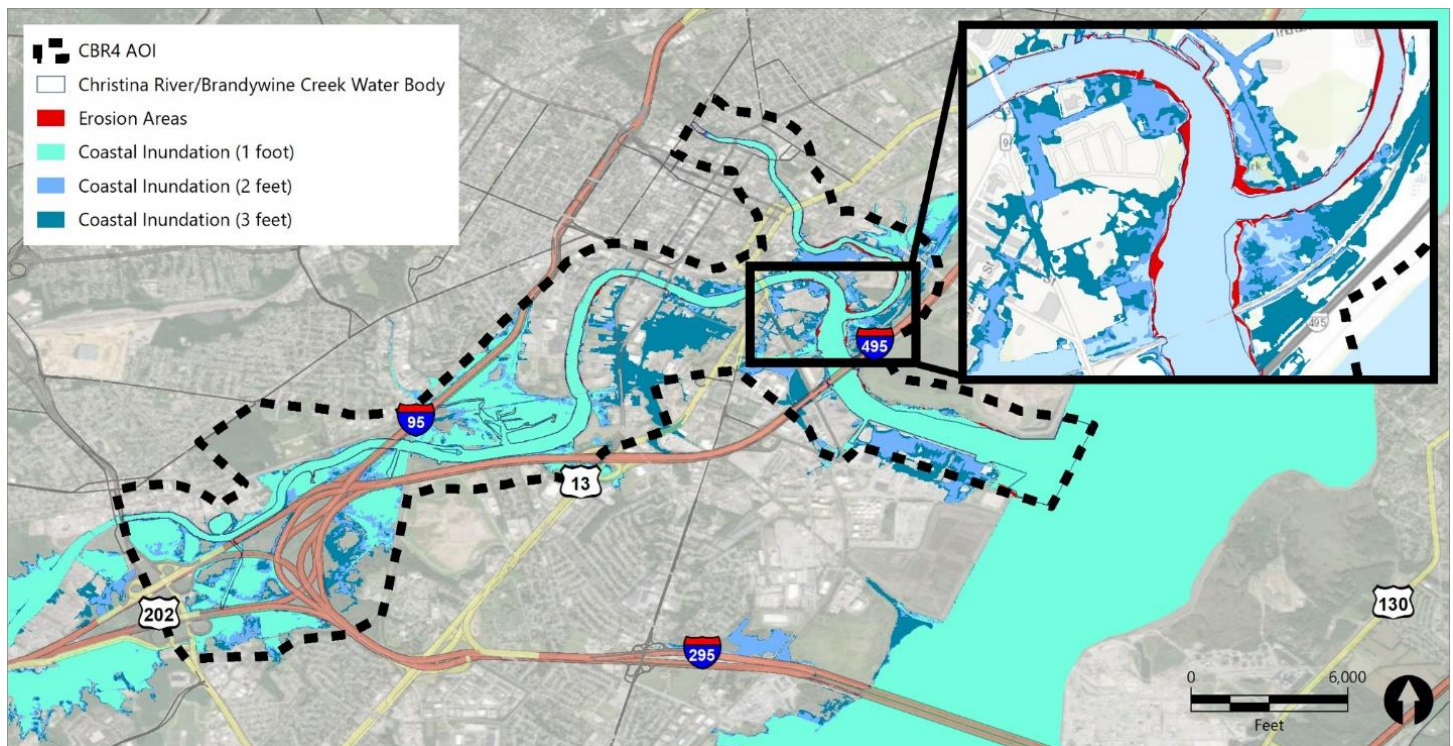


Figure 7: Resilience Baseline Map

Improve Community Access to Rivers

The CBR4 Project area includes roughly 1,400 acres accessible to the public including approximately 18,100 linear feet of riparian shoreline, 85,000 feet (~16 miles) of trails, and 7 locations open to the public where people can access the water directly, or from a pier or dock. Local communities value this direct access, as well as having areas with trees and seating near the water and a variety of views of the water.

Goal: To increase and improve access for education (signage, programs), health and recreation (trails, water access points) and daily interactions.

Objective: Maintain and promote the safe use of all access areas for enjoyment, education and awareness of natural and cultural resources. Increase trail connections between the community and rivers and between riverfront areas, and the number of access points to include 20 new locations that provide a mix of shoreline, viewing, launching and fishing access spread throughout the project area.

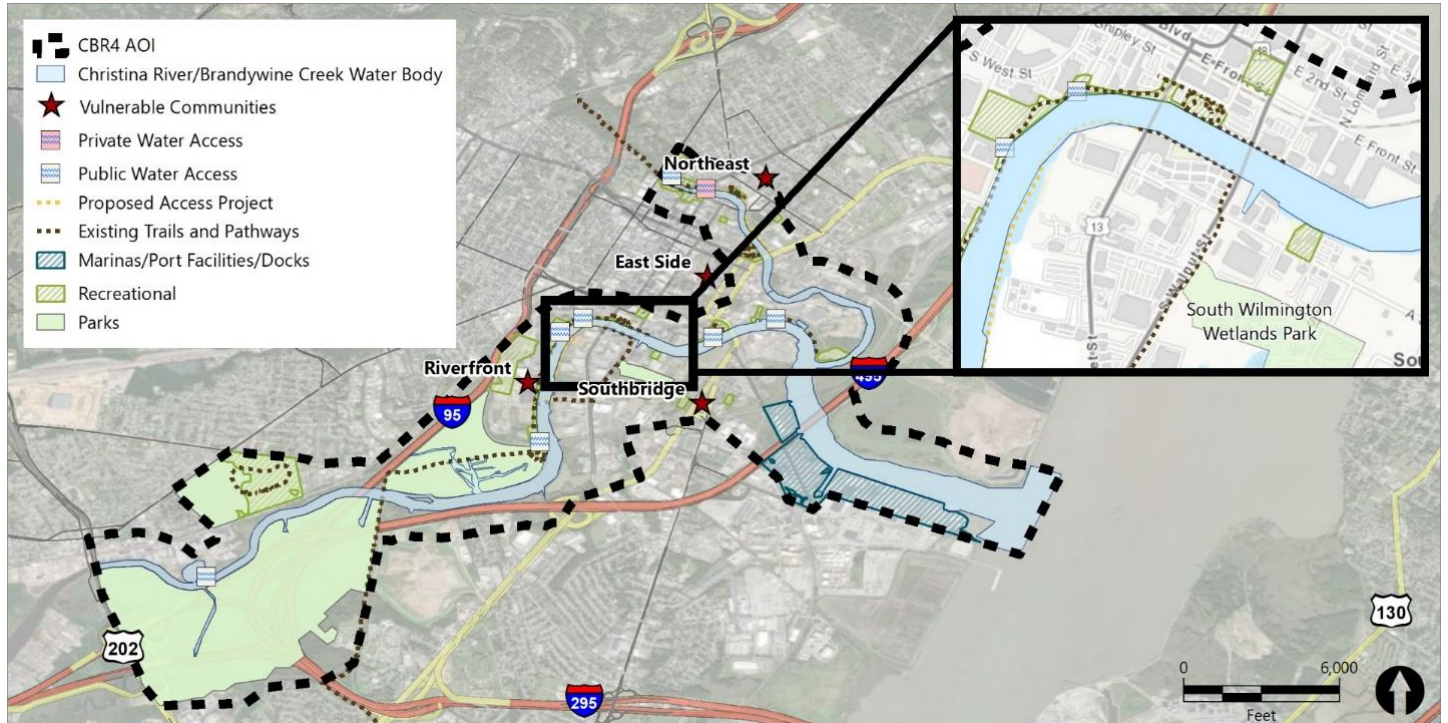


Figure 8: Access Baseline Map

Strategies

Using information on current conditions and goals, along with input gathered through a variety of community events and focus groups, the CBR4 team identified the following strategies. Draft goals and strategies were then presented via a webinar in March 2021 for additional input and fine-tuning from key stakeholders like city, county, non-profit and community partners. These strategies represent additional actions (beyond the core regulatory actions already being taken) needed to remediate and restore the Christina and Brandywine Rivers to health, while improving access and resilience in nearby communities. The strategies are categorized below for presentation purposes, but it is critical to recognize that the essence of CBR4 is that these strategies must be blended when implementing projects in order to reach our overall goals.

Restoration Strategies

- **Identify and implement projects to restore wetlands**, focusing on places where they were historically located, are not keeping pace with sea level rise, and/or have been lost or degraded by erosion, invasive species, loss of hydrology or tidal exchange, and where there are opportunities to pair restoration with remediation.
- **Identify opportunities for restoring key subaqueous habitats** for fish and shellfish through mapping of important subaqueous habitats for fish and shellfish spawning, feeding, and breeding in the study area and using results of the sediment remediation feasibility study.
- **Identify and implement projects to connect uplands, riparian areas, and wetlands** for improved habitat and access.
- **Develop and provide guidance to landowners and managers to improve ecological function and diversity**, including, watershed-appropriate native plant materials lists and seed mixes, guidelines for restoration, habitat creation and landscaping, as well as long-term maintenance
- **Create and use ecological or other goals and metrics** for implementation of restoration projects; continue monitoring of project locations for long-term progress toward reaching those goals; focus on services and consider social and economic factors as well as environmental ones.
- **Increase and improve monitoring of wetlands** for tracking ecological function over time; conduct modeling for the Christina River Basin to identify potential net changes to wetland habitats.
- **Develop and adaptively manage an inventory of restoration projects.**



Protection Strategies

- **Work with land protecting agencies to protect existing natural areas in the CBR4 project area**, prioritizing existing habitats that support multiple SGCN, unique freshwater wetland plant communities and potential suitable future habitat locations as sea levels rise.
- **Work with stakeholders and partners to collect seed material** from local plant populations to ensure that genetic diversity is captured in regional and national seed banks.
- **Ensure that regulatory enforcement mitigates appropriately for any wetland losses**; require or encourage mitigation on lands not already protected.
- **Manage existing wetlands** to sustain and improve ecological function, provide flood storage capacity, prevent erosion and habitat degradation, promote native species (control or eradicate invasives) in existing/future stormwater management areas to promote wetland plants and functions.
- **Identify, protect and connect small wetland, natural, greenspace, and undeveloped areas** through one or more common management plans for ecological benefits, particularly within existing riverfront areas and/or publicly managed areas.
- **Explore the concept of managing and maintaining shoreline as a comprehensive project** through a public-private partnership, utilizing available tools like zoning, easements or others in a creative way.



Remediation Strategies

- **Complete the sediment remediation Feasibility Study** that is currently underway to identify source(s) of contamination, where contaminants have impacted sediment and the remedial objectives.
- **Continue the investigation and cleanup of upland areas** polluted by legacy or ongoing industrial uses, dumping and chemical spills along the Christina and Brandywine Rivers, and identify responsible parties as they are redeveloped by certified brownfield developers.
- **Develop sustainable and resilient remediation state regulations** that minimize residual contamination following remediation, avoid mobilizing contaminants, identifies opportunities for stormwater infiltration, and encourages remediation innovation while promoting ecological restoration, including more undeveloped buffers between the river and development.
- **Create and use a toolkit with Best Management Practices** to incentivize actions during brownfield redevelopment that reduce impairments to the CBR4 area caused by legacy industrial use.
- **Develop innovative new technologies for remediation**, including ways to remove contaminants in soil at sites in sensitive areas as an alternative to leaving them in place and capping, ways to minimize biota disturbance or removal and other ecological impacts, ways to foster bioremediation when appropriate, including site specific studies and bioavailability studies, and passive systems and low-energy sustainable alternatives.
- **Continue the DNREC Watershed Approach to Toxics Assessment and Restoration (WATAR) fish tissue monitoring** program that incorporates the CBR4 project area to track progress on reducing contaminants.

Resilience Strategies

- **Identify areas where flood control measures or infrastructure (including green infrastructure) can be put in place to increase resilience**, recognizing the need to balance green and grey options. Create area-wide plans for high-development zones and stormwater management and coastal flooding plans for smaller areas that may be impacted more heavily. Utilize the results of current and recent planning and research to identify health benefits and areas that are key for containing flood waters.
- **Develop a tree-planting campaign** to increase tree cover for riparian/water benefits, community benefits, and resilience to climate change (supporting *Tree for Every Delawarean* goals) including a plan for planting trees within the 100-foot buffer, working collaboratively with landowners and the State Forestry program, and using conservation easements to ensure sustainability and education to overcome resistance and build local stewardship.
- **Identify feasible projects and areas for reducing impervious coverage.**
- **Conduct a hydrodynamic study for the CBR4 study area and influencing areas** to determine flood capacity, taking into account where studies have been done or are most needed.
- **Identify and advance key recommendations for CBR4 from the new *Resilient Wilmington* plan.**



Public Policy Strategies

- Identify and advance **policies to:**
 - **Incorporate restoration into infrastructure projects** to increase impact and leverage funding.
 - **Incorporate cumulative impact assessments** to implement across several agencies.
 - **Incentivize or mandate green space** as part of development, through local zoning and ordinances.
- **Support improvements to waterfront zoning and require conservation easements** as part of the development process to protect natural, vegetated shorelines, buffers, and public access wherever feasible.
- **Address and avoid gentrification impacts from redevelopment** and green infrastructure by empowering community organizations to develop Community Benefits Agreements especially in communities with identified equity concerns.
- **Update structure requirements (in building/zoning codes)** to include requirements for freeboard, base flood elevations, below building parking, etc. to improve resilience to sea level rise and flooding.

Education & Engagement Strategies

- **Create a Community Advisory Council** supported by a team of ecologists and landscape architects to provide a clear pathway and go-to place for partners and public input on projects and activities that impact the river at an early stage and ensure that every project done in and around the waterfront area is developed and reviewed with a CBR4 perspective.
- **Develop and implement a suite of river-focused educational programs**, emphasizing historic and cultural connections (like the new Harriet Tubman Trail), connections to wildlife, and the value and importance of trees and other vegetation. Connect with people through flagship species of interest (like monarch butterflies), youth programming, and human health impacts through the use of existing access areas, social media and other technology to promote programming. Develop and use place-specific educational materials.
- **Continue outreach to key organizations and agencies to get leaders actively engaged in advancing CBR4 goals** through planning, funding and implementation.
- **Create a grant application drafting team** to write grants for organizations to get funding to implement CBR4 strategies/projects.
- **Develop a monitoring program that engages experts, community members, non-profit and community groups** in documenting species and tracking project metrics using current and new access areas, learning/using iNaturalist and Seek apps, and engaging people through the Delaware Master Naturalist program and the Christina Conservancy bioblitzes.
- **Develop a RiverStar or similar program to engage corporations, landowners and developers as partners** in the cleanup of the river and in CBR4 projects using promotion to incentivize support and providing information and technical assistance for projects on their properties to help the river.
- **Engage permitting agencies early and as partners** in projects to best inform the efforts of CBR4 partners as targeted projects are implemented.
- **Promote CBR4 as a model** for collaborating on strategic planning and implementation for other waterways, to share with others doing similar projects for cleaner water in the Delaware River Watershed and for doing better remediation in other parts of the country.



Community Access Strategies

- **Improve the accessibility and safety of parks and other public access areas** using wildlife-appropriate lighting to minimize ecological impacts of artificial light at night (ALAN) on species and habitats while better connecting communities with ownership of their natural areas.
- **Develop and implement a water trail concept plan** connecting the Brandywine and Christina, including educational/safety signage.
- **Identify and create new access points**, including improving/formalizing the new access created by the dam removal on the lower Brandywine at select locations.
- **Work with local community members and organizations to implement projects from local plans** such as the South Wilmington Neighborhood Plan and Northeast Blueprint Implementation Plan that also help meet CBR4 goals for improving access and resilience.

Projects

Based on the goals and strategies developed and vetted with key stakeholders, the CBR4 Team identified a series of projects as some of the most critical and feasible to undertake over the next 5-10 years to improve health, resilience and access for the Lower Christina and Brandywine Rivers. Each of these projects will contribute to meeting multiple goals established for the CBR4 area for protecting and enhancing key features important to the health and resilience of these rivers and surrounding communities, including:

- **Wetlands** are important for many reasons- they provide habitat and food sources for fish and wildlife; act as incubators for baby fish; sequester carbon; filter and clean water; and act like a sponge to absorb heavy rainfall and help prevent flooding. With over 1,000 acres of wetlands in the project area, it's important to protect the wetlands we have, make them healthier, and where possible, create more. The project area has some unique opportunities for creating wetlands.
- **Shorelines** can support a wide array of plants, animals, and fish and act as natural water filters if maintained in a natural condition. There are over 20 miles of shoreline along the Christina and Brandywine Rivers in the project area. Where these shorelines have not been hardened with bulkheads or other structures, restoring living shorelines can provide natural habitat and help prevent erosion and flooding. A gradually sloping natural shoreline can also offer opportunities for people to view and interact with these natural areas and the water's edge.
- **Green Infrastructure** in and around the City of Wilmington and New Castle County includes parks like Banning Park as well as a variety of other preserved green spaces. These spaces are as large as a few acres or as small as a parking space. Any green, unpaved or unhardened space can help prevent stormwater runoff by letting water slowly seep into the ground. Additionally, even small green spaces that are close together can be important habitats for birds and insects.
- **Access** to rivers and public recreational spaces are shared resources that everyone should be able to enjoy. In the CBR4 study area, there are about 3.5 miles of publicly accessible areas along the rivers, 16 miles of trails, and at least seven places for people to get to the water. While it's a good start, with so much shoreline (20 miles) we could do even better. Access also needs to consider the idea of alternate transportation routes that lessen environmental impacts and promote healthy lifestyles.



Each of these projects will also contribute to:

- **Increasing resilience of the natural features and surrounding communities** to the impacts of climate change. An important part of the CBR4 planning process was identifying strategies and projects that could help address resilience. However, more detailed resilience studies for this area have only recently been completed or are just getting underway – thanks in part to the input and support of CBR4 team members and collaborators. Additional opportunities to meet ecological goals within resilience project planning will emerge as the plans and products needed to address climate change are advanced.
- **Supporting and complementing remediation of contaminants** in soils and sediments in the river and surrounding lands. An important part of the CBR4 planning process is a concurrent feasibility assessment underway by the DNREC WATAR program that informed the identification of strategies and projects in this plan. That assessment is still underway and its results will inform complementary approaches.



The projects described in this plan include those for which conceptual plans were developed as part of the CBR4 planning process (CBR4 Projects), as well as several critical projects already underway and funded by CBR4 partners and in need of additional or ongoing investment (CBR4 Partner Projects). The locations of these projects within the CBR4 project area are shown in Figure 9. By no means are these the only projects needed to restore Wilmington’s Rivers. For every project identified here, there were multiple others the CBR4 Team discussed and explored that were simply not ready to be presented in this way. The aim of articulating goals and strategies in this plan was not only to inform and advance the projects presented here, but to inspire and guide the many other activities and projects needed to restore Wilmington’s rivers.

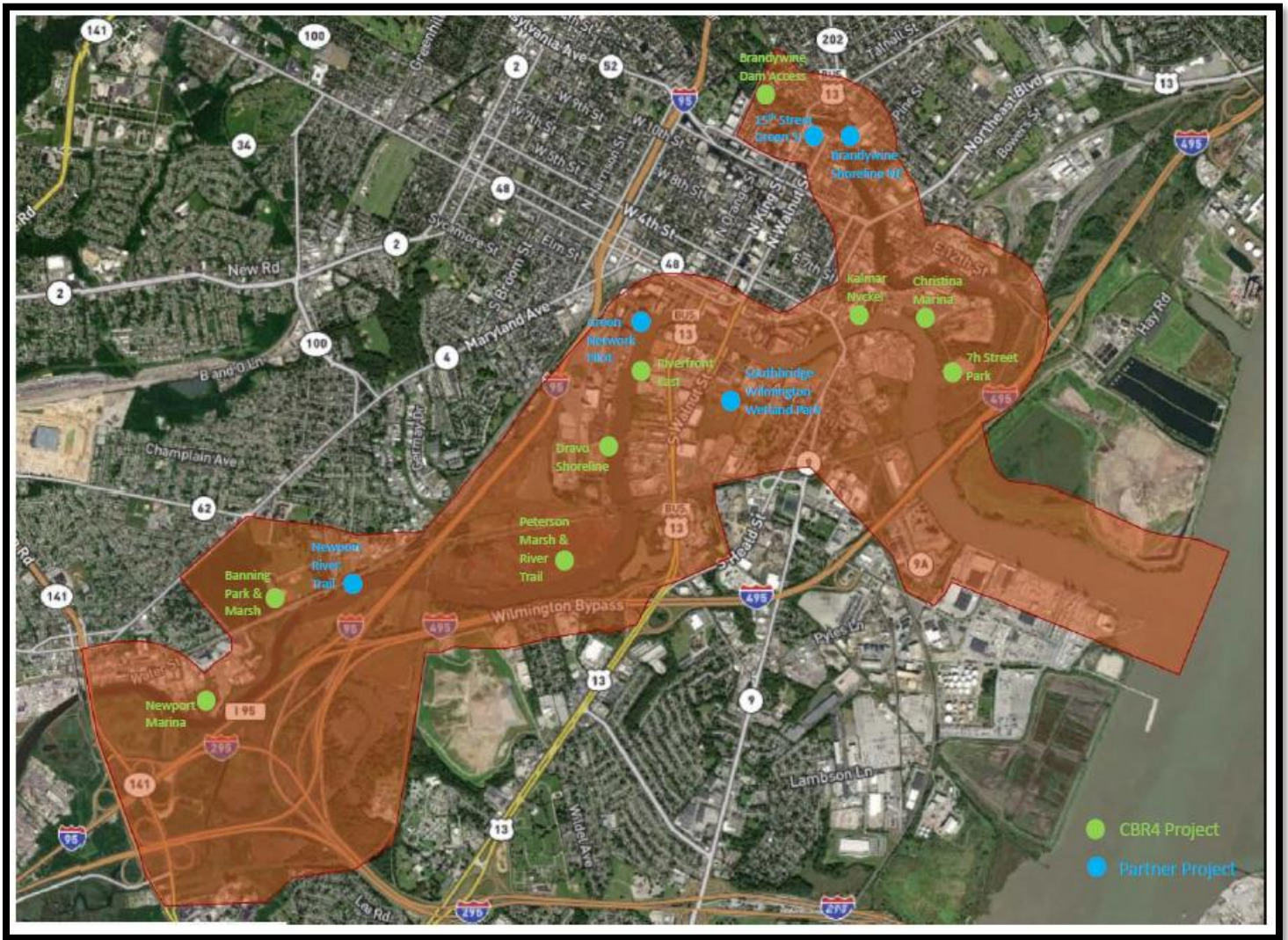


Figure 9: CBR4 Project Locations

CBR4 Project: Russell Peterson Urban Wildlife Refuge (RPUWR) Water Trail & Marsh Enhancement

The large freshwater tidal marsh at the Peterson Urban Wildlife Refuge is the largest and best quality example of this threatened habitat type in Delaware. Prior and ongoing restoration and trail development work led by DNREC has greatly improved habitat quality and paved the way for a proposed paddle trail and canoe / kayak launching facilities to improving site access.

As a result of prior restoration work, a large portion of the marsh is in generally good condition ecologically, dominated by native emergent wetland plant communities. Prior restoration work resulted in the creation of several wetland cells, separated from the tidal Christina by dikes, with tidal exchange via one or more concrete sill and riser board structures, which are currently fully open to tidal flow. It is unclear whether accretion rates within these cells are sufficient to keep pace with sea level rise and investigation of appropriate modifications to ensure sufficient tidal exchange and sediment supply are needed. The westernmost cell is heavily dominated by Phragmites, indicating that tidal flow regimes are likely insufficient to suppress this invasive.



The proposed water trail will add water access features connecting with an existing on-land trail system. Additional restoration work is needed to investigate and address future resilience issues including accretion rates of impounded areas and would be done in conjunction with access improvements. Proposed activities include:

- Investigate function of tide gate structures and evaluate for replacement and repair
 - Control/removal of invasive Phragmites and planting of additional native trees, shrubs, and plugs
 - Alignment of trail expansion to conserve existing and restored high-quality habitat
- Control Phragmites in western impounded cell and other problem areas to promote native wetland plant communities.
 - Modify timber and rock wall to increase drainage and water exchange
 - Vegetation plantings and potential mussel installation to improve habitat function
- Implement water trail improvements to provide public water access by canoe and kayak.
 - Construct upstream armoring to enhance protection from high-energy flows
 - Vegetation plantings and wood/rock structures to promote sediment trapping
- Whole Site: Develop education and recreation programs and signage to promote and utilize new on-river public access opportunities by development of a water trail and build awareness and support for wetland stewardship

Project at-a-glance:
PUWR Water Trail and
Marsh Enhancement



Target Habitats	Tidal impoundment, freshwater tidal emergent marsh
Signature Species	River bulrush (<i>Schoenoplectus fluviatilis</i>)
Total Focal Project Area (Acres)	40+
Restoration	Management of invasive Phragmites in the tidal wetlands combined with investigation and modification of impoundment water control structures
Remediation	The project will enhance sediment retention and potentially uptake of metals from wetland soils
Resilience	Improving marsh condition and species diversity will increase resilience of the system to future climate change effects, including salinity increases and severe weather events.
Public Access	Public access will be integrated into the design to encourage more positive interaction with the site.
Potential Project Partners	DNREC, Riverfront Development Corporation, City of Wilmington, New Castle County, Delaware Nature Society, Partnership for the Delaware Estuary
Cost Estimate	\$2,300,000
Design/Engineering Considerations?	Flow patterns will need to be modeled prior to final design. Still, the dynamic nature of the site may require adaptive management over time to adjust for unplanned sediment redistribution.

CBR4 Project: Kalmar Nyckel / Fort Christina

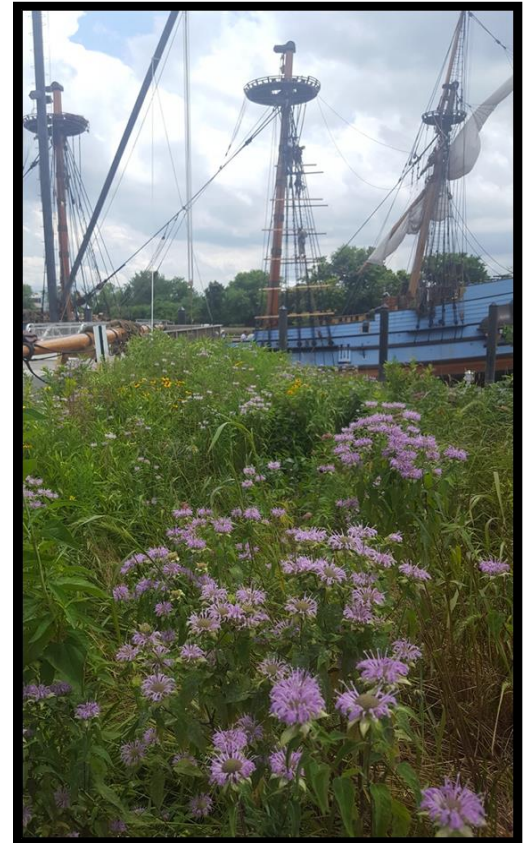
Upland swales surrounding the Kalmar Nyckel Foundation property and Fort Christina site have been the target of previous restoration efforts, but continued vegetation enhancement and new focus on habitat uplift in the intertidal region could provide further ecological resilience and educational opportunities for this location. The Kalmar Nyckel campus is a brownfield that was originally capped with a geotextile membrane and grassed stormwater swales that were more recently converted to native plant bioswales.

The riverbank along the Kalmar Nyckel docks is mostly rip-rapped, however, a large wetland swale sits between National Parks Service and State-owned land between the Kalmar Nyckel property and the Fort Christina site. A significant expanse of inter- and sub-tidal area also exists around the site, both in front of the State land and near the Kalmar Nyckel docking area. Although these areas have good stability and are protected from high-energy river flow, they are also relatively homogeneous and unvegetated.

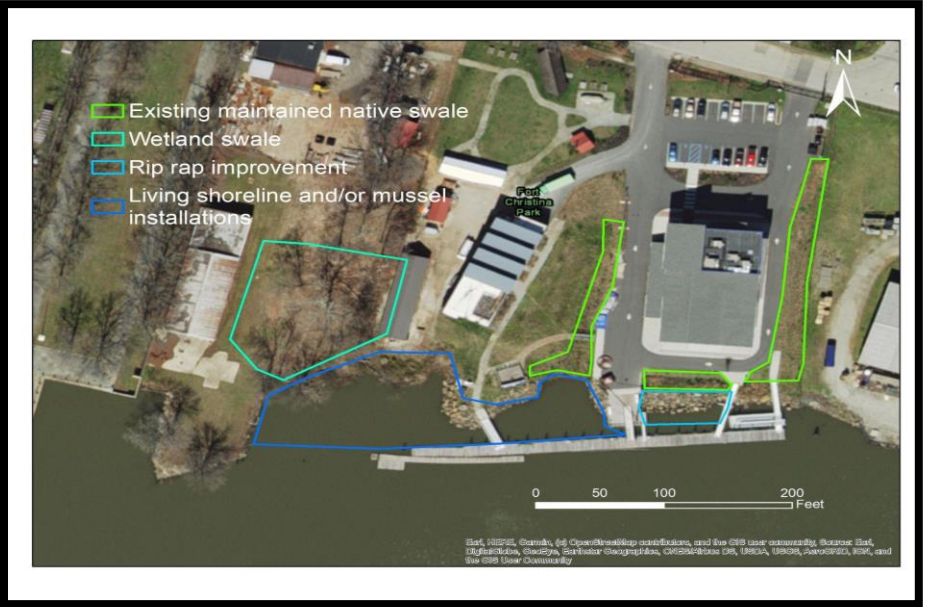
Although interactions between multiple stakeholders including two non-profits (Kalmar Nyckel Foundation and the Challenge Program), the State, and the National Park Service make planning for this area more complex, the historical significance of the Fort Christina site and the likely abundance of volunteer or tourist interest in site programming should make this location a priority for focus. Enhanced native plant swales completed by Sarver Ecological & partners with NRDAR remediation funds are currently providing habitat to critical species; monarchs, migratory birds, and numerous native bee species have increased in abundance since planting. These beds may still be vulnerable to encroachment by invasive species and additional plantings of native, pollinator-friendly species would help increase the diversity and robustness of the upland swales.

Vegetative stormwater swales would benefit from continued invasive species control and pollinator plant additions. Additionally, rip-rapped shorelines and relatively featureless tidal areas surrounding the site could be improved through vegetation plantings and, potentially, the installation of mussel habitat structures. Recommended restoration activities include:

- Preservation and continued uplift of upland and riparian habitats
 - Maintain and enhance existing native plant swales
 - Perform minor understory management and improvement of wetland swale
- Introduce living shoreline elements to inter- and sub-tidal areas
 - Stabilize shorelines and increase diversity through breakwater structure installation and intertidal vegetation plantings
 - Create engaging mussel housings that can be used either to grow out young individuals or support adult populations
- Whole Site: Ideal steppingstone for multiple restorations along the 7th street corridor that should also be aligned with future Riverwalk Trail extension plans. Education and volunteer opportunities will be particularly favorable at this site due to close interactions with neighboring non-profits, so outreach will be a goal of any ecological projects.



Project at-a-glance: Kalmar Nyckel / Fort Christina



Target Habitats	Intertidal mussel habitat, Native swales
Signature Species	Monarch (<i>Danaus plexippus</i>)
Total Focal Project Area (Acres)	1
Restoration	Further riparian improvement and new shoreline restorations can increase connectivity between land and water that is essential for estuarine species.
Remediation	Contaminants have already been assessed at the site and will be factored into project siting
Resilience	Mussel installations would help bring back lost ecosystem services and provide potential grow-out or source for recovering populations that will also filter water and provide a food source for local wildlife; living shorelines provide a nature-based solution to shoreline stabilization
Public Access	Public engagement is already a key part of site interactions; proposed projects will align with non-profit goals of improving urban ecology and environmental education in the area
Potential Project Partners	Kalmar Nyckel Foundation, Challenge Program, Riverfront Development Corporation, Delaware Nature Society, Partnership for the Delaware Estuary, Delaware Center for Horticulture, State of Delaware, DNREC, National Parks Service
Cost Estimate	\$200,000
Design/Engineering Considerations?	SHPO considerations, permitting and contaminant

CBR4 Project: Brandywine Dam One Removal Site

The project site is an access point for heavy equipment that was used to remove the first dam on the Brandywine Creek and is now an early successional area with a south-facing aspect that provides unique sunny riverine cobble habitat uncommon elsewhere on the lower Brandywine. Due to its current disturbed state, it provides both a natural public access opportunity and an opportunity to manage for early successional riverine edge habitat.



Photo Credit: Brandywine River Restoration Trust

The upland slopes of the site are dominated by several species of invasive plants, with a mix of native species establishing in the flat areas of the first and second bottom floodplain, including cut-leaf coneflower and bitternut hickory. Current slopes would require a ramp design to provide access to the creek area.

The recommended project aims to take advantage of new and unique site conditions to create a recreational and ecological amenity by:

- Creating an access point to Brandywine in an already disturbed site.
 - Riverview location
 - Potential access including, ADA access ramp
 - Key visual connection to the water
 - Alignment of ongoing trail work with site so as to preserve existing habitat
- Reforesting denuded upper areas of the north bank.
 - Plant canopy trees along the streetside and upper tier of the dam removal access area
 - Shrub and native seeding of the understory and slopes
- Restoring and preserving river cobble bar and early successional habitat on first bottom floodplain
 - Mimic early successional scour dynamics by removal of woody stems in first bottom, and management for herbaceous species and disturbance dependent shrubs like willow
- Whole Site: Work with DNREC State Parks to accomplish adaptive reuse of this site in a way that encourages community connection to the Brandywine while preserving the existing unique natural features of the site.

Project at-a-glance:
Brandywine Dam One
Removal Site



Target Habitats	Riverine cobble bar, riparian forest
Signature Species	American Shad (<i>Alosa sapidissima</i>)
Total Focal Project Area (acres)	0.5
Restoration	Restoration of a unique, high value riverine habitat that is uncommon in the project area.
Remediation	. Surface water quality of concern but no known soil contaminants, revegetation limits soil erosion
Resilience	Revegetation of banks will improve flood resilience and carbon sequestration.
Public Access	Physical or visual access to the Brandywine will be a featured element of this project.
Potential Project Partners	Delaware State Parks, Delaware Nature Society, Partnership for the Delaware Estuary, Brandywine River Restoration Trust
Cost Estimate	\$500,000
Design/Engineering Considerations?	Assess feasibility of river overlook or ADA ramp based on existing grades

CBR4 Project: Riverfront East

The Riverfront Development Corporation (RDC) is advancing a remediation and redevelopment plan for the area across from the current core of Wilmington Riverfront West. Plans include public open space and a riverwalk in addition to developed parcels. Key considerations will involve the preservation of current habitats that exist in the area. These upland and intertidal habitats provide aesthetic as well as ecological capital to the heavily utilized urban surroundings.

Like much of the urban Wilmington riverfront, the upland areas of Riverfront East have been artificially elevated above the historic floodplain by a combination of debris fill and bulkheading. The shoreline along Riverfront East is largely comprised of unvegetated mudflat with a band of spatterdock and phragmites near the mean tide line. Sediments in this area are relatively stable with some pilings and riprap but undoubtedly impacted by contaminants.

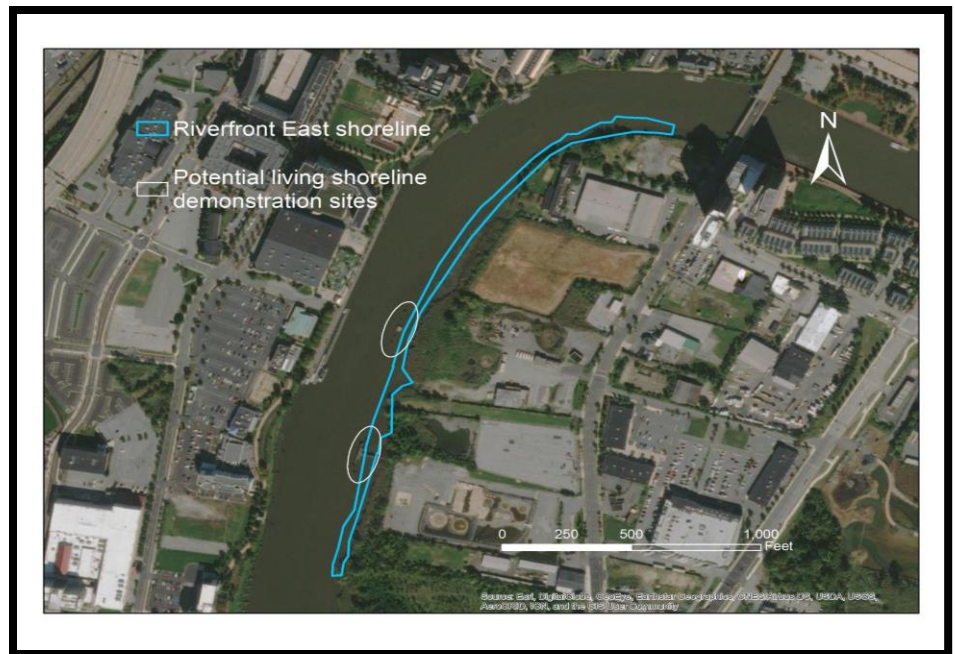
Interestingly, a large wetland area has developed on top of an asphalt pad near the center of the site. Asphalt berms around the site are holding water in the paved area, which now functions as a fishless wetland, hosting a number of native plant and animal species.

RDC plans will be restricted to upland areas (above the Mean Higher High-Water line) for development purposes, providing an opportunity for partnership in which living shorelines and other intertidal improvements can be utilized to enhance the visual appeal, ecological function, and stability of the land-water interface. Recommended restoration activities include:

- Stabilize and increase habitat value of intertidal shoreline area
 - Increase diversity of shoreline vegetation
 - Install stabilizing living shoreline elements (e.g., rocks, logs, shell gabions) to add stability and protection
 - Work in modular fashion to maximize mosaic functioning of habitats and allow for staggering of projects over time
- Voluntary mitigation for loss of upland habitats due to development
 - Create 1.2 acres of shallow water, fishless wetland or introduce equivalent green infrastructure offset
 - Enhance and create ~4 acres of riparian forest habitat at the southern end of the site
- Whole Site: Work with RDC to integrate upland development with restoration and mitigation tactics. Inclusion of elevated boardwalk would allow the public to view living shoreline features and diverse, uplifted habitats in a way not yet available along the Christina River. [OBJ]



Project at-a-glance: Riverfront East



Target Habitats	Intertidal shoreline, upland forests and wetlands
Signature Species	Spatterdock (<i>Nuphar advena</i>)
Total Focal Project Area (Acres)	2.6
Restoration	Reintroduction of intertidal ecosystem complexity will provide better resources and habitat to local species
Remediation	Movement of sediments will be less of a concern, but contaminants still need to be evaluated. Upland contaminants being evaluated through Brownfield redevelopment will require remediation
Resilience	Stabilization of shoreline and enhancement of plant communities will help protect upland developments
Public Access	Integration of boardwalks and continuation of Riverwalk will bring significant access to an uplifted and more visually appealing shoreline
Potential Project Partners	Riverfront Development Corporation, City of Wilmington, Partnership for the Delaware Estuary, Delaware Nature Society, DNREC
Cost Estimate	\$3,200,000
Design/Engineering Considerations?	Bathymetry and site energetics will need to be evaluated prior to finalizing site designs and selecting necessary materials

CBR4 Project: Banning Park & Marsh

This large county-owned public park is one of the last remaining core green spaces in the urban Christina River corridor. It provides a crucial core forest habitat for riparian and upland forest birds, insects, and amphibians and serves as a source population for smaller fragments.

The west half of the park consists of approximately 75 acres of mature oak-dominated mesic forest, including two small seasonal ponds with intact forested matrix. These ponds host breeding wood frog populations. A portion of the forest is seasonally wet flatwoods and is used regularly by migrating and wintering Rusty Blackbirds. The east half of the park is primarily used for active recreation, and includes turf grass, baseball and soccer fields, tennis courts, and other amenities and associated parking lots. Two stormwater systems are located in the developed area of the park, with the easternmost system targeted for improvement in this concept plan.

The recommended project aims to improve stormwater filtration from the eastern half of the site, while restoring meadow and forest habitat to create a new habitat block of approximately 12 acres on the east side of the park. The plan also includes creating an improved fishing access area and foot trail in the restoration area. In addition, approximately 10 acres of forest will receive understory restoration in the western forest block, improving the function and resilience of this key habitat area. Restoration activities include:

- Forest understory restoration and afforestation
 - Control/removal of invasive Phragmites, understory invasive woody vines and shrubs
 - Planting of additional native trees, shrubs, and seed
- Improve function and filtering capacity of stormwater basin and pond
 - Create large wet meadow / shrubland system to improve infiltration and redirect parking lot stormwater to this system.
 - Expand buffer around existing retention basin and consider lowering water levels to improve flow and combat eutrophication.
- Create new forest habitat
 - Install trees, shrubs, and native seed in existing turf grass area east of loop road to create new habitat block and provide visual / noise buffer from adjacent property
 - Install public trail through this forest patch leading to fishing access
- Whole Site: Work with New Castle County to continue to improve habitat quality and management techniques to maintain and improve ecological value of this heavily used urban park.



Project at-a-glance:
Banning Park



Target Habitats	Wet meadow, stormwater pond, forest
Signature Species	Rusty blackbird (<i>Euphagus carolinus</i>)
Total Focal Project Area (Acres)	18
Restoration	Restoration of forest understory (10+ acres), meadow creation (4+ acres), afforestation (4 acres)
Remediation	Improved filtration of sediment, nutrients and petrochemicals entering the Christina.
Resilience	Mitigation of high flow stormwater events via increased infiltration; carbon sequestration in new plantings, and increased forest resilience via understory restoration.
Public Access	Public access will be integrated into the design to encourage continued public use of the site, especially for fishing Improved fishing access and new accessible and educational habitat features.
Potential Project Partners	New Castle County, Delaware Nature Society, Partnership for the Delaware Estuary
Cost Estimate	\$2,000,000
Design/Engineering Considerations?	Detailed stormwater BMP design will be necessary prior to construction of the wet meadow system and pond buffers.

CBR4 Project: Dravo / Christina Shoreline

The Dravo area of the Christina River presents an ideal location for testing and showcasing wetland enhancement tactics. The area of interest stretches ~450 m of shoreline along a portion of the Wilmington Riverwalk near Dravo Plaza. Although the intertidal zone currently consists mostly of rip-rap or unvegetated mudflat, existing historical pilings have been densely colonized by a mix of native and non-native plant species.

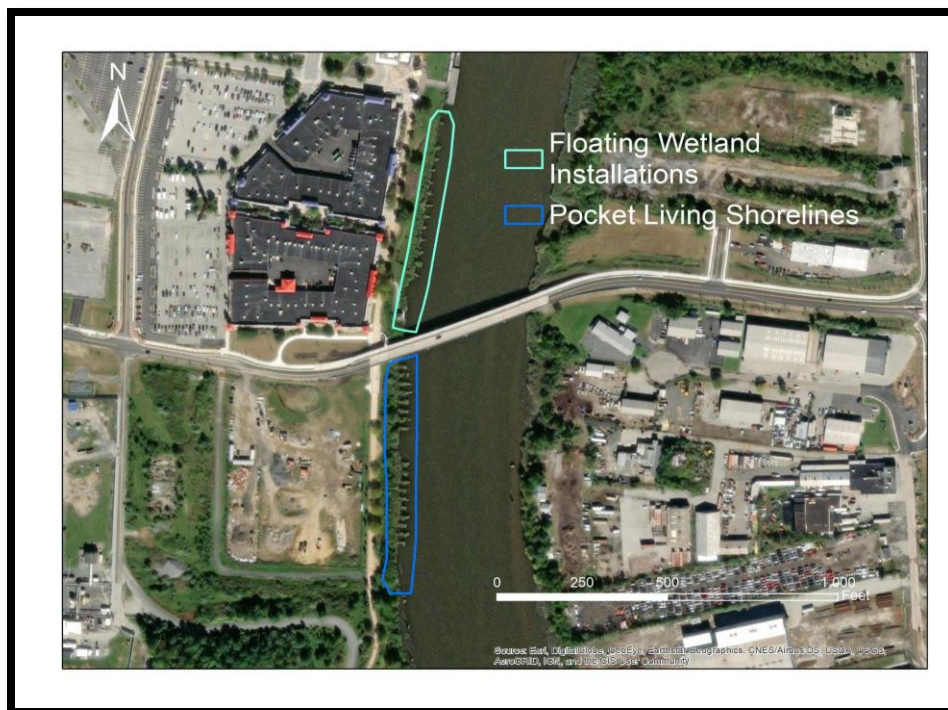
Historic shipways line the Dravo shoreline in relatively equal intervals on either side of the Margaret Rose Henry (New Sweden Street) Bridge, leaving about 3 m of bare intertidal area between each structure. Sediment accumulation atop these pilings has allowed for opportunistic colonization by a mixed community of non-native (e.g., purple loosestrife, reed canary grass) and native (e.g., dogwood, cardinal flower) shrubs and grasses. The southern end of the site is characterized by softer, but stable sediments and a more gentle slope compared to the northern end of the site, which is rip-rapped and steeper. Although the upland contains a drainage ditch and is regularly sprayed for phragmites control, there is not currently any functioning green infrastructure on site.

These existing structures present a favorable anchor point for floating wetlands or other protective installations. The upland pedestrian trail, which stretches between the DuPont Environmental Education Center and the main Wilmington Waterfront area, also offers built-in public viewing access to any enhancements. Here, goals will be to test new methods of habitat uplift while educating the public about the benefits of unique flora and fauna that can flourish in these ecosystems through:

- Management of existing vegetation
 - Control invasive species growing on structures and surrounding upland areas
 - Bolster native species populations with plantings of beneficial wetland plants
- Wetland habitat uplift
 - Northern half: install experimental floating wetlands between shipways, protect using log booms
 - Southern half: create stabilized living shoreline pockets between pilings that capitalize on existing structure
 - Install bird nesting platforms
- Whole Site: Offers great opportunity to pilot novel floating wetland and modular living shoreline concepts at a site that experiences considerable foot traffic. Educational signage will be a high priority at this location.



Project at-a-glance: Dravo/ Christina Shoreline



Target Habitats	Intertidal shoreline, upland drainage area
Signature Species	Juvenile striped bass (<i>Morone saxatilis</i>)
Total Focal Project Area (Acres)	2.5
Restoration	Management of invasives and maintenance of important native plant communities will benefit pollinators and aquatic species
Remediation	Less sediment disturbance necessary, but evaluations will still take place
Resilience	Floating wetlands and pocket living shorelines will contribute to cleaner, healthier waters
Public Access	Novel restoration tactics can be highlighted and used to educate the public in an area that already experiences considerable use
Potential Project Partners	Riverfront Development Corporation, Delaware Nature Society, Partnership for the Delaware Estuary
Cost Estimate	\$1,200,000
Design/Engineering Considerations?	Will need to evaluate nearshore bathymetry and model potential erosive forces to fully understand feasibility

CBR4 Project: Newport Marina

The lagoon adjacent to the Newport boat ramp is a low-lying, semi-enclosed embayment that offers a strategic opportunity for restoration to a tidal wetland. Though the area may have once been used as a marina, it has not been dredged or maintained in recent years. The boat ramp represents a key Christina River access point for the public; however, viewing of the nearby lagoon is mostly blocked by a line of trees. Additionally, the site does not encourage public interest due to sparse vegetation and an extensive mudflat that is not aesthetically appealing or, from an ecological standpoint, functional.



The lagoon by the Newport boat ramp is largely protected from the high-energy dynamics that characterize the main river system. The area may be slowly accreting and building elevation, but sediments have not yet accumulated enough to provide suitable habitat for vegetation. Indeed, although intertidal mudflats exist around the shoreline, these areas are unvegetated apart from some upland trees. The only vegetation in the lagoon consists of interspersed islands entirely composed of spatterdock. Reintroduction of habitat complexity, both in terms of vegetation and elevation, would greatly improve the habitat value of the site.



The Newport boat ramp could thus be improved through introduction of habitat complexity. Variation in elevation and vegetation would help to restore key wetland ecological services while providing a more-appealing feature for stakeholder viewing and access. Recommended restoration activities include:

- Restore lagoon to more-complex tidal wetland
 - Redistribute sediment material to enhance elevation complexity
 - Increase area near mean tide line for vegetation enhancement
 - Cut deeper channels and outflows for improved tidal exchange
 - Introduce greater diversity of wetland plants, chosen based on variable elevation ranges
- Improve Public access and interaction
 - Design observational boardwalk
 - Develop educational signage relevant to tidal wetland ecology
- Whole Site: Key access point for the river and connecting location between Lower Christina and Russel Peterson refuge that could represent a focal attraction along an educational water trail system.

Project at-a-glance: Newport Marina



Target Habitats	Freshwater tidal wetland
Signature Species	Wild rice (<i>Zizania aquatica</i>)
Total Focal Project Area (Acres)	10.7
Restoration	Creation of freshwater tidal wetland habitat allows for re-introduction of one of the most important but threatened habitats in the region
Remediation	May need to evaluate outside borrow sources depending on state of the sediment. Sediment will require contaminant investigation.
Resilience	Wetlands provide maximized flooding resilience compared to hardened shorelines
Public Access	Will emphasize viewing opportunities to serve as an educational example of the valuable habitats that once existed in abundance within the Christina system
Potential Project Partners	City of Newport, Delaware State Parks, Delaware Nature Society, Partnership for the Delaware Estuary, DNREC
Cost Estimate	\$5,300,000
Design/Engineering Considerations?	Geotechnical evaluation needed to assess material composition and thickness of unconsolidated layer. Material reuse depending upon contaminants

CBR4 Project: Christina Marina

The Christina Marina section of the 7th Street Peninsula is near a site owned by the Challenge Program and contains a 1.8-acre shallow water lagoon. The lagoon is man-made and was once used as a marina but is no longer dredged or maintained. This low-energy, protected embayment along the river provides a unique opportunity to restore tidal wetland habitat that can be easily accessed and viewed by the public.



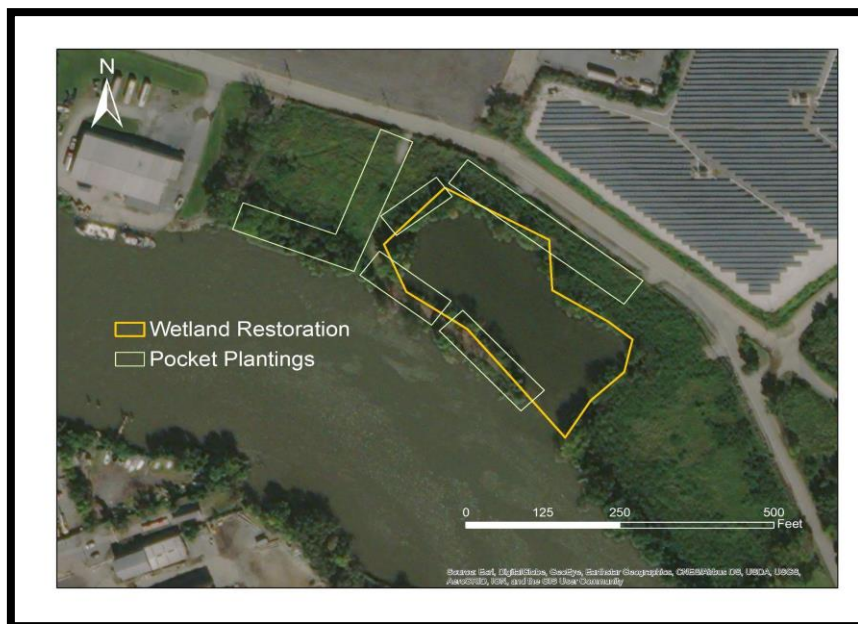
The Christina Marina lagoon and surrounding areas are currently providing species habitat, but ecosystem services, such as flood control, could be improved with restoration and better management. Native plants including box elder, black willow, sycamore, green ash, pin oak, slippery elm, leadplant, and buttonbush were found in the area of interest and a wide variety of odonates and breeding birds were observed as well. However, invasive species of plants were also noted and the proximity of habitats to a lot currently under construction may pose a potential threat to species if left unmanaged.

The Christina marina lagoon is a protected and low-energy embayment that allows for sediment deposition; there is currently a 1-2' thick layer of soft sediment throughout the basin. The upland shoreline slope is relatively gradual, though also generally soft and soupy. Remnants of marina activities including seawalls and pilings are also present and stormwater outfalls may need to be assessed.

As freshwater tidal wetlands are one of the most threatened, yet valuable, habitats in the watershed, restoration of this lagoon offers both ecological and educational benefits. Wooded and vegetated upland surrounding the lagoon and Challenge program area is also degraded and could be uplifted through invasive removal and planting of native species. Recommended restoration activities include:

- Restore lagoon to tidal wetland
 - Fill with sediment to elevation closer to mean tide
 - Potential layer of harder substrate to increase platform stability
 - Cut channels and introduce elevation variation
 - Vegetation plantings to increase robustness of shoreline and provide habitat
- Pocket Plantings
 - Invasive species control of upland patches
 - Native species plantings to promote better diversity and ecosystem function
- Whole Site: Work with Challenge Program and future developers to encourage engagement and preserve site access. Site can serve as an educational example of the valuable habitats that once existed in abundance within the Christina system.

Project at-a-glance: Christina Marina



Target Habitats	Freshwater tidal wetland, Riparian buffer
Signature Species	Northern Red-bellied Cooter (<i>Pseudemys rubriventris</i>)
Total Focal Project Area (Acres)	2
Restoration	Creation of freshwater tidal wetland habitat allows for re-introduction of one of the most important but threatened habitats in the region
Remediation	Due to history and possible redistribution across site, thorough assessment of sediment will be needed.
Resilience	Wetlands provide maximized flooding resilience compared to hardened shorelines
Public Access	Good opportunity to engage with local groups like Challenge Program and will include boardwalk for public viewing and interaction
Potential Project Partners	City of Wilmington, Challenge Program, Riverfront Development Corporation, Partnership for the Delaware Estuary, Delaware Nature Society
Cost Estimate	\$1,200,000
Design/Engineering Considerations?	Geotechnical evaluation needed to assess material composition and thickness of unconsolidated layer

CBR4 Project: 7th Street Peninsula Parks

The 7th Street Peninsula is an underutilized and vulnerable area that sits at the confluence of the Christina and Brandywine Rivers. An existing skatepark within Babiarz Park is cared for and actively used by the local community, but other structures, including a boat ramp and fishing pier, have been abandoned and are closed off from public use. Concerns in this area of interest include limited community access, poor local engagement, presence of invasive species, and vulnerability to frequent flooding.

The mudflat to the north of the abandoned fishing pier is protected along the riverward edge of the Christina by a reinforced rock wall which is currently limiting drainage from the area. The mudflat to the south of the pier is larger in extent and exposed to more direct flow from the Brandywine River. Sediments are generally softer in the Northern protected section and firmer in the Southern exposed section, although accretion may be occurring in both areas. Still, high-energy flow during storm events is likely to present highly erosive conditions.

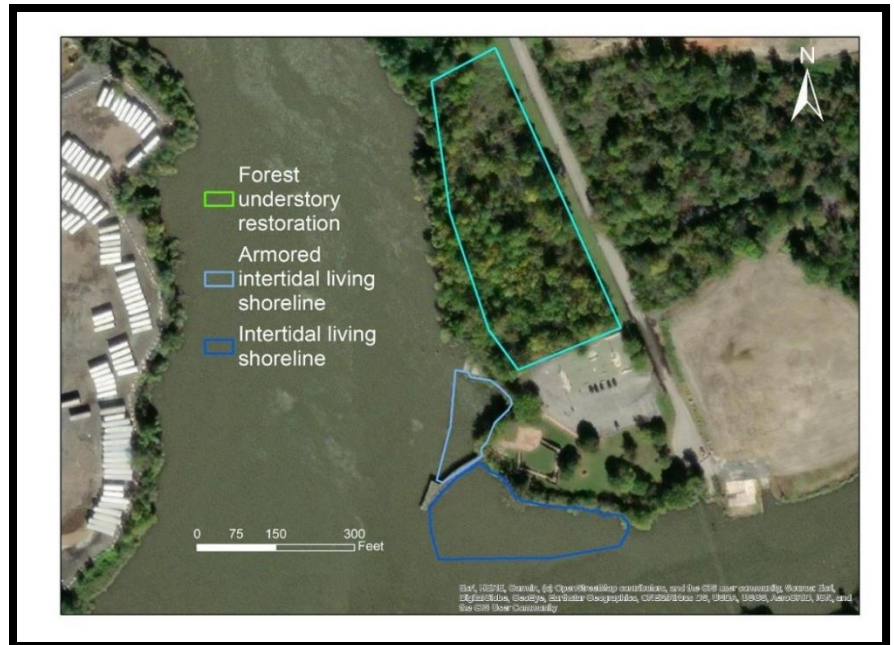
A 2.7-acre patch of forest habitat exists along the E 7th Street entrance to the peninsula. Although surrounded by invasive *Phragmites*, a high-quality palustrine wetland exists within the forest interior. Breeding American Redstart have been observed using this location in the past.

The recommended project aims to restore or enhance forest and intertidal habitats along the peninsula in a way that will both increase ecosystem resilience and encourage positive community interaction through:

- Forest understory restoration
 - Control/removal of invasive *Phragmites*
 - Planting of additional native trees, shrubs, and plugs
 - Alignment of trail expansion to conserve existing and restored high-quality habitat
- Armored intertidal living shoreline
 - Modify timber and rock wall to increase drainage and water exchange
 - Vegetation plantings and potential mussel installation to improve habitat function
- Intertidal living shoreline
 - Construct upstream armoring to enhance protection from high-energy flows
 - Vegetation plantings and wood/rock structures to promote sediment trapping
- Whole Site: improve access and add interpretive signage to facilitate education and engagement



Project at-a-glance: 7th Street
Peninsula Parks



Target Habitats	Intertidal mudflat, Palustrine Forest
Signature Species	Eastern Elliptio (<i>Elliptio complanata</i>)
Total Focal Project Area (Acres)	4
Restoration	Improved drainage, increased habitat diversity, and potential mussel installations will restore key intertidal ecosystem characteristics and functions.
Remediation	Sediments will need to be evaluated for contamination concerns before redistribution can take place; remediation or borrow from outside sources may be necessary. Upland soil evaluation may be needed if land disturbing is needed
Resilience	Will improve stability of high-energy confluence between Christina and Brandywine Rivers. If successful, living shoreline elements may help to mitigate upland flooding during storm events.
Public Access	Public access will be integrated into the design to encourage more positive interaction with the site.
Potential Project Partners	City of Wilmington, Riverfront Development Corporation, Partnership for the Delaware Estuary, Delaware Nature Society
Cost Estimate	\$750,000
Design/Engineering Considerations?	Flow patterns will need to be modeled prior to final design. Still, the dynamic nature of the site may require adaptive management over time to adjust for unplanned sediment redistribution.

Riverfront Development Corporation CBR4 Partner Project: Green Infrastructure Network Pilot at Constitution Yards

In response to strategies identified in the CBR4 planning process, the Riverfront Development Corporation (RDC) worked with (and joined) the CBR4 team to identify opportunities to improve ecological management of already developed areas along the Riverfront. Together they proposed a pilot to restore key ecological features in one key area along the Riverfront, while also providing ecological expertise and empower the RDC to restore and manage other similar areas along the Riverfront in a more ecologically-friendly way.

The project area (highlighted in yellow on the aerial map below) is approximately one acre of land that includes 3,000 linear feet of shoreline and 3,000 square feet of stormwater management in need of improved ecological management in a highly visible location of the Riverfront.



Lead Partner: Riverfront Development Corporation

Goal: To restore and enhance freshwater wetlands and pollinator habitat along the shoreline and in stormwater management areas for fish, wildlife, and engagement of visitors to the Riverfront

Activities:

- Develop and implement a planting plan that focuses on native species
- Convene and utilize an advisory committee of ecological experts and local stakeholders to ensure sustainability
- Provide technical assistance and hands-on training to RDC and contractors to build capacity
- Engage volunteers in planting and visitors through signage to raise awareness and support for stewardship

Cost: \$150,000

Status: Funds were secured through a NFWF Delaware Watershed Conservation Fund award to the RDC in 2021. Project ready to start in early 2023 and expected to take approximately one year.

City of Wilmington CBR4 Partner Project: Southbridge Wilmington Wetlands Park

In 2022 Phase 1 of the Southbridge Wilmington Wetland Park was completed and opened to the public providing a beautiful new amenity for residents and visitors to south Wilmington. The Park is designed to provide a variety of natural habitats including upland meadow, emergent wetland, forested swamp, upland forest, forebay, shrub meadow and evergreen forest. It is also designed to manage stormwater from surrounding areas in combination with a storm sewer separation project currently underway. A public walkway provides access for recreation within the park with educational signage and connect the Southbridge neighborhood with the Riverfront and Jack Markell Trail. Phase 2 of the Wetland Park will expand the area of the park and its functions.



Lead Partner: City of Wilmington

Goals: Expand and complete the Southbridge Wilmington Wetlands Park for a total of 22 acres of restored wetlands, providing additional improvements in natural habitat, stormwater management, recreation and connections to nearby areas. Develop and foster the model for CBR4 by leveraging skillsets and funding to create strong partnerships for the future.

Activities:

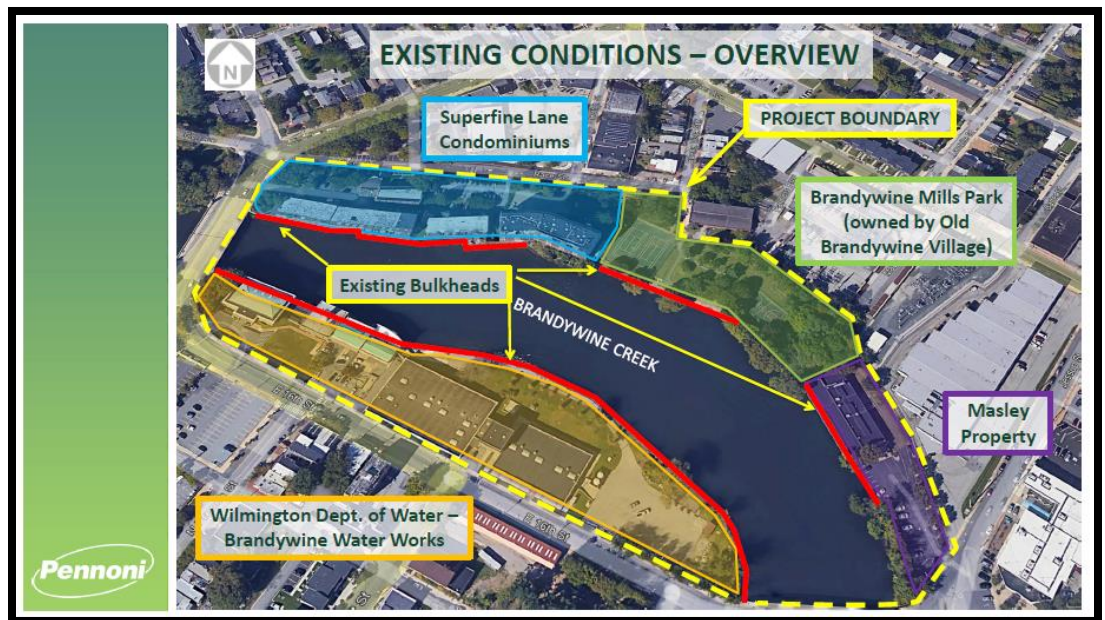
- Parcel purchase
- Wetlands design
- Flood capacity engineering
- Community engagement
- Implementation of Special Area Management Plan (SAMP) goals
- Remediation
- Construction

Cost: \$43,300,000 total (Phase 1 and 2)

Status: Phase 1 completed, with Phase 2 underway. Funds secured for parcel purchase (\$750k from private sources), remediation (\$500k from DNREC), and wetland design (\$500k from the National Fish and Wildlife Foundation) as well as additional funds committed for construction (TBD from DelDOT).

Collaborate Northeast CBR4 Partner Project: Brandywine Riverfront Northeast

The project area encapsulates a riverfront corridor along the northern and southern shorelines of the Brandywine River between Market Street, 12th Street, 16th Street and Superfine Lane and includes portions of Brandywine Mills Park and Wilmington Water Works within the City of Wilmington. This area (shown below) is a critical link between the City of Wilmington's Brandywine



Park to the immediate west and an area for which an EPA Area-Wide Brownfields Plan proposed restoration of an area for public recreation and living shorelines along the Brandywine River. Collaborate Northeast worked with Pennoni Associates to prepare a conceptual plan of environmental and other site improvements to be proposed within the project area as part of the Brandywine Riverfront Northeast Site Assessment, Environmental Enhancement & Concept Planning project completed in June 2022. Site and environmental enhancement improvements proposed included: floodway dredging & riverbed restoration, living shoreline and vegetation enhancements, bulkhead repair/replacement, greenway trail connections, park and greenspace improvements, sports court and active recreation area improvements, streetscape enhancements, lighting and landscape improvements, stormwater management improvements and misc. other site improvements.

Lead Partner: Collaborate Northeast (CNE)

Goals: Improve shoreline stabilization and water quality, mitigating flooding, provide better access to the river, meet community needs, and fit in with other future projects planned for the Brandywine shoreline in the Northeast.

Activities:

- Complete concept plans with cost estimates for three focus areas or phases: the Brandywine River Floodway (shoreline to shoreline included bulkheads), the North Shore/Brandywine Mills Park/Superfine Lane, and the South Shore/Water Works property/16th Street right-of-way
- For each area/phase, identify costs for general improvement items such as: demolition and removals, earthwork, erosion and sediment control, proposed pavements, trails, sidewalks, landscaping, lighting, utilities, site furnishings and amenities, etc.

Cost: \$33,000 for planning and design (concept plans with cost estimates)

Status: Concept plans created in 2022 (\$25,000 from DNREC; \$5,000 from CNE); additional \$5,000 needed to prepare Conceptual Opinion of Estimated Construction Costs

City of Wilmington CBR4 Partner Project: 15th & Walnut Streets Green Stormwater Infrastructure

The City of Wilmington Department of Public Works (DPW) has teamed up with CityFest to rehabilitate and repurpose a city-owned property that was once the site of stables for the City's fire department into an indoor/outdoor cultural center and performance venue that includes collaborative workspace, an outdoor performance stage, and public greenspace. DPW will support this effort by creating surface features and site improvements employing Green Stormwater Infrastructure (GSI).

The 15th and Walnut GSI project will improve water quality in the Wilmington watershed by disconnecting stormwater runoff from the Combined Sewer Overflow (CSO) system from the two recently built housing projects and portions of the adjacent Walnut Street, 15th Street, and 16th Street rights-of-way. The project will re-route runoff to go through proposed GSI Best Management Practices (BMP's) to be located within the park. The goal of the proposed BMP's is to capture the first 1 to 2 inches of precipitation using a combination of rain gardens, bioswales and subsurface modular storage units. This in turn will reduce the quantity and improve the quality of the stormwater runoff prior to discharge into the nearby Brandywine Creek. The resulting park will not only be a cultural venue and greenspace but will also serve as an important resource to the City for community outreach and education about local watersheds and the importance of GSI. Informational signage will help to strengthen public buy-in of the City's commitment in its Final Long-Term Control Plan to install GSI as a means of source reduction in the CSO system. By collaborating across departments and organizations the park will perform an important role in serving the public and keeping Wilmington's waterways clean.



Lead Partner: City of Wilmington

Goals/Activities:

- Remove stormwater from the City's CSO system, reducing quantity and frequency of CSO discharging into the Brandywine River
- Mitigate both the quantity and quality of stormwater discharged to the Brandywine River
- Create a greenspace that will benefit the local community and the surrounding communities
- Reinforce the mission and outreach of CityFest and the Urban Artists Exchange

Cost: \$1,600,000

Status: Funding secured through a loan from the Clean Water State Revolving Fund; work is underway with project completion anticipated in 2023.

New Castle County CBR4 Partner Project: Newport River Trail

As part of its Connecting Communities Initiative, New Castle County, in collaboration with the Town of Newport, DelDOT and key stakeholders, completed a feasibility study to create a trail along the north bank of the Christina River. The 1.95-mile trail was first identified as a concept in 2014 and connects downtown Newport to the Jack A. Markell Trail (JAM) and the East Coast Greenway. When complete it will also serve as an exceptional resource for walking and bicycling, provide low-stress and safe active transportation to highly populated areas, provide access to the Christina River waterfront, river viewsheds, open space, and wildlife areas, connect new areas to the DuPont Environmental Education Center and Peterson Urban Wildlife Refuge, and be built for all ages and abilities and to ADA standards.

The 2020 feasibility study identified potential alignments as feasible but included some constraints. The study area is bounded by significant geographical features. On the south, immediately adjacent to the trail, the Christina River flows from west to east and is where the Newport Boat Ramp is located but is cut off from the Town of Newport by rail lines. The project is now moving into final design.

Lead Partner: New Castle County

Goals: To connect existing trail networks and population centers and improve access the Christina River waterfront and associated views, open space, wildlife areas and educational resources.

Activities:

- Continue public and private partnerships to complete final design in 2024.
- Secure funding to complete construction in 2024-2025.

Cost: \$27,000,000

Status: The project is in its final design phase (funded by the County and the State Bond Bill) and the County has submitted a RAISE grant to fund its construction in 2024-2025.



Companion Products

There are several additional products developed during the CBR4 planning process (or still under development) to serve as resources for implementing this plan.

Project Compendium

More detailed descriptions of the CBR4 Projects identified here have been compiled in a project compendium to be used by CBR4 partners to seek support for and guide implementation of these projects over the next five years. This compendium includes more detailed concept plans and cost estimates developed by Anchor QEA in conjunction with Sarver Ecological and Partnership for the Delaware Estuary and input from others on the CBR4 Team. The compendium will serve as a pipeline of potential projects for CBR4 partners and others to use and adapt moving forward to reach shared goals. For every project included in the compendium there were multiple other projects considered but not at the stage where conceptual plans were appropriate/feasible, and the CBR4 Team will continue seeking opportunities to further develop those in the future.

Communications Plan and Stakeholder Input

Early in the project a communications strategy was developed by DNREC Coastal Management Program in consultation with representatives from CBR4 and local partners including Delaware Nature Society, Collaborate Northeast, and the South Wilmington Planning Network as guidance for outreach to key audiences/stakeholders. Input was sought in a variety of ways, including through meetings with specific focus groups (such as neighborhood groups or civic associations), displays at public events within and near the project area, and an informal survey. Over 100 stakeholders provided input via the survey starting at the beginning of April 2022 through the end of July 2022 and there were over 300 people engaged in meetings and events from January 2021 through January 2023. This input helped to inform the strategies and projects included this plan and a summary of activities and results was added to the communications strategy to serve as a resource for CBR4 partners to guide implementation.

Species Data and Plant Lists

As part of baseline data collection for the project, two bioblitzes were led by Sarver Ecological to collect information on plant and animal species and an iNaturalist project area was established to document this information. Sarver Ecological utilized this information (along with their own expertise) to compile plant lists as a resource for land owners and managers in the project area to encourage more ecologically-beneficial planting, management, and restoration.

CBR4 Web-Based Products

There are two primary places online where CBR4 information has been shared throughout the planning process and that will now host this plan and results. Both the [DNREC website](#) and the [Christina Conservancy website](#) have pages dedicated to CBR4 where this plan is made available to the public. In addition to posting the plan itself, both pages include links to a public-friendly Virtual Information Room and GIS Story Map with interactive features, created by Anchor QEA and RK&K as part of the public outreach process. The DNREC website also includes links to products of the Sediment Remediation Feasibility Study (further described below) as they become available.

Sediment Remediation Feasibility Study for the Christina and Brandywine Rivers

Part of CBR4 planning effort has been identifying and integrating restoration elements into remediation activities and vice versa (remediation elements into restoration activities) utilizing information and analysis from a concurrent feasibility study for sediment remediation. This element of CBR4 planning is being undertaken by DNREC with contractual

support from BrightFields, Inc. and Anchor QEA thanks to additional sources of funding and has a longer timeline for completion. The Sediment Remediation Feasibility Study for the Christina and Brandywine Rivers started in 2020 along with other CBR4 planning efforts and is expected to be completed in 2025. The initial phases of this work were especially crucial for assessing baseline conditions and identifying where restoration projects could be complementary to (and not in conflict with) remediation needs.

Environmental Remediation on Uplands Bordering the Rivers

As indicated by baseline conditions mapping, almost all of the lands adjacent to the lower Brandywine and Christina Rivers are sites on Delaware's Hazardous Substance Cleanup Act (HSCA) list. This is because industry started along the rivers and prospered and grew due to water power from the Brandywine and ease of transportation via the Christina. Unfortunately, the rivers, their tributaries, and the floodplains that lined them also served as disposal sites for industrial wastes.

Over the past 25 years, many different environmental remediation approaches have been used on lands bordering the rivers in order to clean up and redevelop these brownfields into useful parcels for commerce, housing, and recreation. Depending on the type and concentration of contaminants, these remedial approaches have included excavation and off-site disposal of "hot spots" contaminated with lead, arsenic, chromium, PCBs, naphthalene, petroleum, and/or volatile organic compounds; consolidation and capping of PCBs in accordance with the Toxic Substances Control Act (TSCA); in-situ stabilization of manufactured gas plant residues; soil vapor extraction of petroleum compounds; and soil/concrete/asphalt capping of low-level contaminants. As the Christina Riverfront brownfield lands were successfully redeveloped, buildings were constructed, and people moved in, an entire new area of the City of Wilmington was reclaimed for productive use.

DNREC's WATAR Program – DNREC Remediation and Watershed Assessment and Management Sections

On a parallel path to the upland environmental investigation and remediation, DNREC continues to characterize the health of Delaware's creeks and rivers through their WATAR Program (Watershed Approach to Toxics and Restoration), a watershed-scale approach to evaluating where contamination comes from, how it gets into Delaware's waterways and water bodies, and what effects it has on watershed health. This approach that was formalized in 2012 has provided DNREC with data-based mechanisms and decision-making towards a goal of fishable, swimmable and drinkable surface water in the shortest timeframe possible.

In addition to sampling and analyzing river water, sediment, and fish tissue, DNREC worked in conjunction with the Delaware River Basin Commission on their Pollutant Minimization Plan, including the PCB track-back program, to detect PCBs in creeks and sewers and track them back to their uncontrolled upland sources.

DNREC also commissioned PCB Mass Loading Studies at Hazardous Substances sites to evaluate how PCBs enter surface waters from hazardous release sites around the state. Although the presence of PCBs can pose a potential risk to people and wildlife that visit unremediated hazardous substances sites, the release of PCBs can result in especially high risks when these chemicals enter adjacent surface waters and bioaccumulate in fish and other aquatic life. Bioaccumulation is the process where a chemical builds up in fish to levels far greater than in the water itself. Once PCBs are in the fish, people who regularly eat the fish are at greater risk of various adverse health effects. In addition, birds that consume fish – such as ospreys, bald eagles, and herons – as well as other fish-eating animals such as otters are also at risk when they consume fish containing PCBs.

The PCB Mass Loading studies are a critical step in a much larger project that aims to link upland sources of PCBs with their primary impact in surrounding waterways. The information gathered will allow DNREC to look at the cumulative impact of PCBs in the area. This brings a new and more holistic perspective to the problem, which in turn can lead to innovative management solutions and to eventual remediation of the upland sources and the rivers.

Example Remediation Projects on Subaqueous Lands

Of the PCB and other contaminant sources found during these investigations, several areas of subaqueous lands have since been remediated, using both proven and innovative technologies. Cleanup and monitoring of these sites for long term efficacy contributed valuable information to the CBR4 feasibility study. Three of these sites (Little Mill Creek/Meco Drive, former Kreiger Finger Landfill and A Street Ditch) are within the CBR4 project area.

At Little Mill Creek/Meco Drive, oil containing polychlorinated biphenyls (PCBs) and polynuclear aromatic hydrocarbons (PAHs) was seeping into a storm water ditch on Meco Drive. The Meco Drive Site was on Delaware's Hazardous Substance Cleanup Act list of contaminated sites, due to the presence of free-phase petroleum in the fill material below the industrial park; oil was seeping into the stormwater ditch and making its way downstream, approximately one mile, to the Christina River and the Russell W. Peterson Urban Wildlife Refuge. DNREC used high resolution PCB laboratory analysis to determine that the Meco Drive Site was one of the PCB contamination sources driving the fish consumption advisory on the Christina River.

DNREC developed remedial solutions over several years to remove the ongoing release to the environment and coordinated the environmental remediation work with the New Castle Conservation District and the Army Corps of Engineers (USACE) who were deepening and widening the Little Mill Creek channel to alleviate flooding.

In late 2012, DNREC's contractor excavated and properly disposed of the PCB-contaminated sediment from the ditch and replaced it with CETCO Reactive Core Mat (an activated carbon/bentonite barrier) to prevent any residual migration of contaminants into the ditch. This eliminated a large source of the PAHs and PCBs that were adversely impacting the health of the creek and the entire waterway. However, some residual PAH and PCB contamination remained in an area of the creek that was not included in the excavation. To help remediate this area, DNREC worked with the Army Corps of

Engineers and their contractor who applied 6,500 lbs. of activated carbon along the banks to sequester these toxic contaminants.

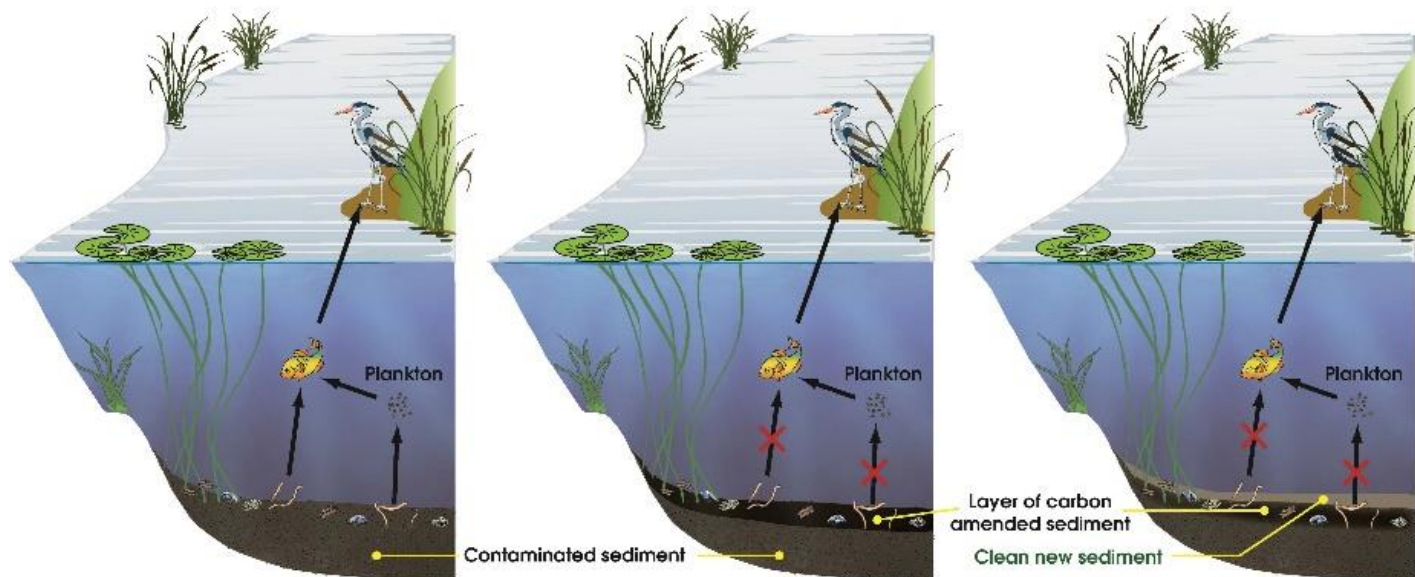


USACE deepened Little Mill Creek by about three feet and widened it to a minimum bottom width of 40 feet for a total length of about 2,170 feet, extending downstream to the Amtrak railroad bridge. Following the excavation, riprap and erosion control matting were placed on the new creek bottom, and a vegetative cover was planted to stabilize the creek banks, slow floodwaters and improve the natural ecosystem.

During an operation and maintenance inspection, petroleum sheen was noted in Little Mill Creek originating from a previously unremediated section at a corrugated steel stormwater drainage pipe. The corrugated steel pipe had degraded at depth and was providing a preferential pathway for subsurface petroleum from within the remediated section of the Meco Drive site. DNREC scoped and implemented a project to replace this pipe, remove any subsurface petroleum in the work area and raise the discharge point of the pipe to above the tidal wash zone. This project was completed using state Hazardous Substance Cleanup Act funds in 2020 which served as part of the match for the National Fish and Wildlife Foundation award for developing the CBR4 plan.

The coordinated efforts among county, state and federal agencies ensure that the Little Mill Creek Flood Risk Mitigation project is a longstanding solution for both flooding and legacy contaminant issues. The project is an excellent example of how strong partnerships at all levels of government, and innovative remedial technology, can help restore Delaware's waterways and water quality.

At **Mirror Lake**, in Dover, DE, PCBs leaking from an upstream source, contaminated the fish and resulted in a posted health advisory against consuming fish from the lake. In 2014, DNREC WATAR collaborated with researchers at the University of Maryland Baltimore County to use an innovative technology, SediMite™, a pelletized activated carbon material. The SediMite had previously been tested in the laboratory and in small scale applications. The Mirror Lake project was a full-scale test case, where 80 tons of SediMite™ pellets were applied to the lake and settled into the bottom sediments. The goal was to sequester PCBs, remove them from the water column and from successive generations of fish, and to lift the fish advisory.



The project was a success and is featured in an article co-authored by several project participants, including two DNREC scientists, and published in the *Journal of Environmental Engineering*. The article, titled “Full-Scale Application of Activated Carbon to Reduce Pollutant Bioavailability in a 5-Acre Lake” presents a summary of the monitoring data collected at the site between 2013 and 2018. Highlights include an approximate 80% reduction in PCB concentrations in sediment porewater, which is the water trapped between grains of sediment in the bottom of a water body. The study also found an approximate 70% reduction in PCB concentrations in Mirror Lake’s resident fish.

The Mirror Lake success story provided proof of concept that the application of the Sedimite can address PCB contamination in sediment in a tidal reach of a coastal plain waterway. Mirror Lake data were used to justify the application of Little Mill Creek / Meco Driver Sedimite and then the example below at A Street.

The **Former Kreiger Finger Landfill** in Wilmington was formed in the 1980s when a contractor removed PCB-contaminated soil from an Amtrak yard and dumped it into a low-lying area with a “clean fill wanted” sign. Some 25 years later, when the City of Wilmington expressed interest in purchasing the property to build a wetland, this landfill needed to first be remediated. Through a complicated legal settlement, Amtrak and their contractors developed a remedial action plan to excavate and dispose soil containing PCBs above 25 mg/kg, to cap the remaining PCBs with several feet of soil, and to revegetate the cap. The plan was approved by USEPA and DNREC and was performed successfully, based on confirmatory samples. The area is now an upland meadow. Years later, during the construction of the adjacent Southbridge Wilmington



Wetland Park, DNREC, the City of Wilmington and their contractors applied a supplemental band of activated carbon along the south edge of the capped landfill as additional protection for the new wetland.

Leading into the A Street project, a large former metal recycling facility which had been heavily impacted by PCB contamination was remediated through DNREC's Brownfield redevelopment process. The surface and subsurface soil at the site recorded some of the highest concentrations of PCBs which had been loading to the A Street ditch and then the Christina Rivers. Using sampling, mapping and innovative remedial actions DNREC and USEPA were able to approve a complex plan to remove extensive soil contamination and consolidate residual PCB contamination to eliminate site loading. The work was completed in 2008 with the redevelopment of a grocery store anchored retail complex but more importantly implemented upland PCB control which provides the opportunity for downstream remediation in A Street Ditch.

At the **A Street Ditch**, PCBs from a former salvage yard at the Howard Street site had contaminated the ditch via underground stormwater drains and minor overland flow. The A Street Ditch project became a focus for DNREC's WATAR Team after samples confirmed that drainage ditch sediments were a continuing source of PCBs to the Christina River. The project, in coordination with remediation and construction of the adjacent Southbridge Wilmington Wetland Park, provided an opportunity to evaluate an enhanced carbon sequestration technology developed by DNREC's partners at the University of Maryland Baltimore County (UMBC).

The enhanced technology involves the use of SediMite™ with the addition of PCB-destroying micro-organisms (inoculant). The activated carbon is expected to sequester PCBs, as shown in Mirror Lake. However, the micro-organisms (which exist naturally in the environment in much smaller numbers) will effectively degrade the PCB molecules over time. Initial results, collected only 5 months after eight tons of inoculated SediMite™ were applied to the ditch sediments, show that total PCB concentrations in the top layer of sediments across the A Street Ditch study area dropped by an average of 25%. In addition, surface water PCB concentrations across the site dropped by an average of 35%. Most impressive is that concentrations of total PCBs in sediment porewater dropped by an average of 64%. Additional monitoring occurred in July 2020, and again in July 2022. Results show the treatment appears to be effective in reducing both PCB concentrations in sediment and PCB bioavailability, but the A Street Ditch is being impacted by surrounding conditions.



For a more long-lasting treatment effect, ongoing sources need to be controlled and the footprint of treatment potentially needs to be larger, possibly extending into contaminated sediment areas within the Christina River.

In summary, sequestering or destroying legacy PCBs – the primary risk driver for most of the fish consumption advisories issued by DNREC and the Delaware Division of Public Health – prevents these contaminants from migrating to waterways and then entering the food chain. With increasing confidence in these innovative sediment remediation technologies, DNREC is planning for larger-scale projects, like CBR4, in key watersheds across Delaware, with similar water quality impairments. The information obtained during these environmental remediation projects, and the data collected through their long-term monitoring are being directly applied to the CBR4 toxic contaminant remediation planning process.

Sustainable Resilient Remediation Strategy for CBR4 (NOAA Coastal Zone Enhancement Program Project of Special Merit- PSM)

Part of this initial planning effort has been identifying opportunities to increase resilience to climate change through CBR4 goals, objectives, strategies and projects. The DNREC Delaware Coastal Management Program (DCMP) and Remediation Section (RS) identified the need for greater information and understanding of the impacts of climate change on the investigation, remediation, and long-term stewardship of hazardous substance release sites particularly within the CBR4 project area and statewide.

DCMP has been collaborating with the Remediation Section since the 2006 Special Area Management Plan (SAMP) to help solve wide-spread flooding within the Southbridge community and ultimately resulted in the creation of the Southbridge Wilmington Wetland Park. The partnership between DNREC DCMP and RS was reinvigorated at the 2019 Sediment Workshop and DCMP was able to secure a source of ongoing funds for the CBR4 project, which has resulted in the communication plan and much of the organization stability for the project. In 2022 DCMP successfully proposed and was awarded funds for a NOAA Coastal Zone Enhancement Program Project of Special Merit (NA22NOS4190017) to meet the need for a more detailed sustainable resilience remediation strategy for CBR4 which may ultimately be transferrable statewide and may be incorporated into the Hazardous Substance Cleanup Act (HSCA).

This Project of Special Merit aims to increase the resiliency of remedial actions approved by the State and/or reimbursed by the State's Brownfield Program, planning and mitigating the ongoing and future climate and sea level rise impacts on contaminated sites within the CBR4 project area, and incorporating the input of the surrounding community and strengthening stakeholder involvement within the remedial process. It will involve conducting a vulnerability assessment of contaminated sites to climate change, including the impacts to disproportionately affected populations; evaluating mitigation approaches to address the impacts of climate change at contaminated sites within the CBR4 project area; and developing a strategy to build resiliency into environmental remediation and restoration within the CBR4 Project Area. Funds for this work were awarded by NOAA in 2022 and it is expected to kick off in Spring 2023, with estimated completion in March 2025.

A river is more than an amenity, it is a treasure.

-Oliver Wendell Holmes

This *Plan for Restoring Wilmington's Rivers* is the first step in what the CBR4 Team hopes will be the final push to not only clean up the lower Christina and Brandywine Rivers, but to bring these rivers back to their full life and potential as a healthy place for fish, wildlife and people to thrive.

