Opportunity: Restoring Shorelines



Shorelines where the river meets the land can support a wide array of plants, animals, and fish and act as natural water filters if kept and managed in a natural way.

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.

Which CBR4 goals does this opportunity meet?



Restoration and Protection of Wetlands



Restoration and Protection of Riparian Areas



Restoration and Protection of Shorelines



Increase Community Resilience

Improve Community Access to Rivers

Restoration and Protection of Adjacent Habitats

CITY OF WILMINGTON BRANDYWINE RIVERFRONT NORTHEAST SHORELINE ENHANCEMENTS







16TH STREET STREETSCAPE & STORMWATER BMP CONCEPT



BRANDYWINE MILLS PARK REHABILITATION CONCEPT



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Which CBR4 goals does this opportunity meet?



Restoration and Protection of Wetlands





Restoration and Protection of Shorelines

Remediation of Contaminants



Increase Community Resilience



Improve Community Access to Rivers

Restoration and Protection of Adjacent Habitats

Restoring Shorelines: 7th St. Peninsula



Summary: Skate park and old boat ramp with sites of ecological interest

Existing Conditions: Characteristic mudflats with varying levels of protection that may be accreting, wetland forest with fringing *Phragmites*



Restoring Shorelines: 7th St. Peninsula

SITE KEY LEGEND Existing stone shoreline Proposed living shoreline structural element (e.g. rock, coir logs, oyster shell-based material) \$ Low marsh area High marsh area Create tidal pools for habitat variabilit and utiliz oved materials for Intertidal pool tion planting areas 100 Subtidal pool 0 Proposed living shoreline earthen element (e.g. vegetated berm or other "soft" feature) Mudflat Establish meadow (invasive N species control and meadow seed mix application Invasive species control area Retain existing stone shoreline Potential restoration material source Place borrow material and plant to create low marsh and high marsh Christina River Create gaps in existing stone shoreline and install weirs to control tidal exchange Meadow Freshwater mussel habitat Freshwater mussel habita Install living shoreline earthen eleme Control existing woody invasive species and vines; replant with containerized woody plants and reseed with custom seed mix nstall living shoreline structural element to promote sediment accretion and expansion of marsh 17 Install living shoreline structural element to allow tidal exchange. Potentially install freshwater mussel cages or other rigid and permeable ecological features. Site specific hydrodynamic modeling will inform final design 17 xisting ssible restoration material borrow source. Potential for use in marsh creation will rmwater outle require further understanding of current habitat uses, hydrodynamic impacts, and her environmental implications of removal Notes: 1. Aerial Source: Google Earth Imagery dated February 8, 2019. 2. Site Key Source: USSS National Map dated 2019. 3. The restoration features shown on this figure are conceptual in nature and are subject to future alterations resulting from stakeholder input, conditions at the site, or other constraints. Brandywine River ers_CBR4_Data_Mapping\ConceptualDesign\ConceptualGraphics\Indesign\7thStreet_34x22.indd



Figure 2 7th Street Park - Plan View

Restoration Concept Plans Christina Brandywine River Remediation Restoration Resilience (CBR4) Project Wilmington, Delaware

Restoring Shorelines: 7th St. Peninsula

Project Features:

- 1. Wetland forest understory restoration
- Control invasive
 Phragmites
- Plant native vegetation
- Trail alignment



Restoring Shorelines: 7th St. Peninsula

Project Features:

1. Wetland forest understory restoration

2. Armored Intertidal living shoreline

- Increase tidal exchange
- Vegetation plantings and mussel installations



Restoring Shorelines: 7th St. Peninsula

Project Features:

- 1. Wetland forest understory restoration
- 2. Armored Intertidal living shoreline

3. Intertidal living shoreline

- Upstream protection
- Plantings or structures



Restoring Shorelines: 7th St. Peninsula

<u>R</u> estoration	Improved tidal exchange, increased habitat diversity, and potential mussel installations will restore key intertidal ecosystem characteristics and functions
<u>R</u> emediation	Sediment evaluation needed prior to redistribution; consider borrow material sources.
<u>R</u> esilience	Improving stability at high-energy confluence, potential flood mitigation
*Public Access	Public access will be integrated into the design to encourage more positive interaction with the site



Signature Species

Eastern Elliptio



Eastern Elliptio is a freshwater mussel. It filters and improves water quality and serves as food for other species like fish, raccoons, otters, and birds.

Restoring Shorelines: Dravo Shoreline



Summary: Stretch of historic pilings

Existing Conditions:

- Vegetation growing atop pilings
- North end rip-rapped and steeper
- South end characterized by softer, but stable sediment and gentler slope



Restoring Shorelines: Dravo Shoreline

SITE KEY LEGEND Floating wetland Invasive species control area Proposed living shoreline structural element (e.g. rock. coir logs, oyster shell-based materia Proposed living shoreline earthen element (e.g. vegetated berm or other "soft" feature) Floating log boom A Nesting platform Surger Streets in Baltimore Harbor 0 Baltimore, Maryland Aquarium/Baltimore QEA, 2018 Jack A. Markell Trail VIIII loating log boom to reduce energy on shoreline feature: nd allow drainage from existing stormwater outfalls loating wetland anchored to existing piles Invasive species control and vegetation enhancement area Christina River Osprey nesting platform Notes: 1. Aerial Source: Google Earth Imagery dated February 8, 2019. 2. Site Key Source: USGS National Map dated 2019. 3. The restoration features shown on this figure are conceptual in nature and are subject to future alterations resulting from stakeholder input, conditions at the site, or other constraints.

> Figure 6 Dravo Shoreline - Plan View

Restoration Concept Plans Christina Brandywine River Remediation Restoration Resilience (CBR4) Project Wilmington, Delaware

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Restoring Shorelines: Dravo Shoreline

Project Features:

- 1. Management of existing vegetation
- Control invasive species
- Bolster native plant populations





Figure 6 Dravo Shoreline - Plan View Restoration Concept Plans Christina-Brandywine River Remediation Restoration Resilience (CBR4) Project Wilmington, Delaware

Restoring Shorelines: Dravo Shoreline

Project Features:

1. Management of existing vegetation

2. Wetland habitat uplift

 <u>Northern half</u>: experimental floating wetlands



Restoring Shorelines: Dravo Shoreline

Project Features:

1. Management of existing vegetation

2. Wetland habitat uplift

- <u>Northern half</u>: experimental floating wetlands
- <u>Southern half</u>: stabilized, modular living shoreline pockets



Restoring Shorelines: Dravo Shoreline

<u>R</u> estoration	Management of invasives and maintenance of important native plant communities will benefit pollinators and aquatic species
<u>R</u> emediation	Less sediment disturbance necessary, but evaluations will still take place
<u>R</u> esilience	Floating wetlands and pocket living shorelines will contribute to cleaner, healthier waters
*Public Access	Offers great opportunity to pilot novel floating wetland and modular living shoreline concepts at a site that experiences considerable foot traffic.



Signature Species

Juvenile Striped Bass



Young striped bass live and forage in estuarine environments before they grow large enough to migrate; they receive protection and abundant food from complex vegetated habitats