URBAN FLOOD AND HABITAT RESILIENCE FEASIBILITY STUDY FOR LOWER DARBY CREEK WATERSHED

ROADMAP



The Nature Conservancy

U.S. Fish & Wildlife Service

Department of the Interior

PH Princeton Hydro

Photo taken by Lamar Gore



Photo from Hurricane Isaias Flooding at John Heinz Wildlife Refuge, August 2024.

INTRODUCTION

Executive Summary

The Eastwick and Tinicum neighborhoods face persistent and increasing flood risk due to low-lying topography, proximity to tidal waterways, and more frequent extreme precipitation. Nature-based solutions offer a promising approach to reduce flood risk while delivering additional benefits such as improved water quality, habitat enhancement, and community amenities. This roadmap identifies and prioritizes opportunities for nature-based solutions throughout the Lower Darby Creek Watershed based on a comprehensive inventory and evaluation of potential sites, informed by physical conditions, land use, and feasibility considerations.

The effort was shaped through coordination with the community and stakeholders to reflect local priorities and implementation realities. In parallel, hydrologic and hydraulic modeling was evaluated and developed to better understand flood dynamics and assess how different strategies can mitigate flood risk at both site and neighborhood scales. The analysis also underscored that grouping and implementing complementary projects can provide greater cumulative flood reduction benefits than individual projects implemented in isolation, resulting in more effective watershed-scale resilience. Together, these efforts establish a data-driven, community-informed framework to guide future investments in nature-based flood resilience and maximize long-term flood mitigation outcomes.

Acknowledgments

This roadmap was made possible by and developed through the on-going collaboration of community members, the U.S. Fish and Wildlife Service, The Nature Conservancy, Friends of Heinz Refuge, and the Flood Mitigation Council of Eastwick (FMCE). Contributers provided an unbounded amount of knowledge, dedication, time, and lived experience to help shape the direction of this project. Their commitment and participation were essential to developing a shared vision for a safer, healthier, and more resilient future for the Lower Darby Creek Watershed.

The team also consulted with the City of Philadelphia's Office of Sustainability, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency.

Support for this project comes from the National Oceanic and Atmospheric Administration (NOAA) and the National Fish and Wildlife Foundation (NFWF). The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government or the National Fish and Wildlife Foundation and its funding sources. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Government, or the National Fish and Wildlife Foundation or its funding sources.



Photo from a Community Meeting on Flood Strategies at the John Heinz National Wildlife Refuge, 2026.

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GLOSSARY

Built Environment
The built environment refers to the human-made surroundings where people live, work, and recreate. It includes buildings, transportation networks, utilities, parks, and other developed landscapes that have been modified or constructed by humans.

Berm
A raised ridge or mound of earth, either natural or constructed, that is used to direct, retain, or slow the movement of water, provide screening, stabilize slopes, or create landscape features.

Levee
A levee is an engineered embankment, typically built parallel to a river, stream, or shoreline, that is designed to prevent floodwaters from inundating adjacent land.

Dike
A dike is an embankment or barrier constructed to control, retain, or exclude water. Dikes may be used to impound water in ponds, reservoirs, and wetlands, or to protect land from flooding along coasts and waterways.

Culvert
A culvert is a structure, typically a pipe, or box that conveys water beneath a roadway, railroad, trail, embankment, or other obstruction while maintaining the flow of a stream, drainage-way, or stormwater runoff.

Constriction
In hydrology, a constriction is a location where the flow path narrows or becomes restricted, reducing the area available for water movement, thereby reducing the rate of flow downstream and elevating the water surface upstream. Constrictions can occur naturally or be caused by infrastructure, such as bridges, culverts, and landfills.

Ecological function
The natural processes that keep an ecosystem healthy and stable. For example, photosynthesis, soil formation, and the cycling of nutrients.

Ecosystem services
The benefits that ecosystems provide that support human health, livelihoods, and long-term environmental stability.

Flooding
- **Coastal Flooding:** Coastal flooding occurs through tidal shorelines when water levels rise above normal condition. This is often associated with storm surges, high tides, and sea level rise.

- **Riverine Flooding:** Riverine flooding occurs when a river, stream, or creek exceeds its capacity overtopping the banks and inundating adjacent areas.

- **Surface Flooding:** Also called pluvial flooding, occurs when rainfall exceeds the capacity of the infrastructure system designed to absorb or convey stormwater runoff.

Gray Infrastructure
Gray infrastructure refers to traditional stormwater and water management systems that rely on materials such as concrete, steel, asphalt, and pipes to convey, store, or treat water. Examples include storm sewer pipes, culverts, and concrete channels.

Hydraulics
The study of how water flows through a system, such as rivers, streams, and culverts, including how fast, how deep, and with how much force it moves.

Hydrology
The study of how water moves through and is stored in the environment, including rainfall, water soaking into the ground, evaporation, and runoff.

HEC-RAS
Short for Hydrologic Engineering Center River Analysis System. This is software developed by the U.S. Army Corps of Engineers that simulates how water flows through rivers, streams, and channels. It helps engineers predict water levels and how sediment moves during floods and other events.

Nature-based solutions
Actions that work with nature to solve environmental and community problems by protecting, restoring, or copying natural processes to the benefit of both people and wildlife.

Resilience
An ecosystem's ability to withstand, adapt to, and recover from disturbances like storms, droughts, or pollution. A resilient ecosystem can weather and/or adapt to disturbances while still performing its essential functions.

THE BIG PICTURE

Community Framework and a Shared Vision

We started our Feasibility study by spending time listening to community members voicing their concerns and describing the flooding problems they have witnessed in their neighborhood. We shared preliminary ideas about possible nature-based solution projects that could be implemented in and around the John Heinz National Wildlife Refuge and the ways in which those projects might help with flooding as well as provide other community benefits around community health, recreation opportunities and neighborhood beautification. Through a series of monthly meetings with the FMCE, site tours to visit potential project sites, and talking to the wider community at public events like Eastwick Community Day, our team exchanged ideas and built relationships with Eastwick residents to co-develop a suite of project ideas to consider for feasibility and implementation.

This roadmap is an opportunity to provide community members, partners, and decision-makers with a clear picture of how the project has evolved, where it stands now, and what steps are necessary to move forward into a safer, healthier future. It is centered on three overarching goals:



1
Mitigate chronic and catastrophic flooding.



2
Enhance and improve the ecological function of natural systems.



3
Strengthen ecosystem services to protect the built environment.

This roadmap highlights the benefit of nature-based solutions in addressing flooding and a changing climate while underscoring that the most effective long-term solutions must not rely solely on traditional, structural infrastructure. While these structures can play an important role, they are often expensive, limited in scope, and unable to keep pace with the increasing intensity of storms. Instead, this roadmap emphasizes a holistic approach that restores the natural functions of local ecosystems—such as wetlands, floodplain reconnection, and connected waterways. These nature-based solutions absorb stormwater, buffer communities from storm surges, and improve water quality, all while supporting wildlife and recreation.

By investing in nature-based solutions, multiple benefits can be achieved at once: flood risk reduction, healthier ecosystems, and new opportunities for social connection, while also serving as natural defenses against climate-driven challenges, ensuring a resilient future for the Eastwick and Tinicum communities.

In coordination with the City of Philadelphia's Office of Sustainability, this project complements the Eastwick Flood Resilience Strategy which aims to reduce current and future flood risks to the Eastwick community.

Community Voice

In 1999 the flood from Hurricane Floyd destroyed life as we knew it and traumatized the entire Eastwick community. We all stood frozen in time with no direction forward. The rest of the world went on with business as usual. Jobs, school, life and medical conditions still had to be managed. No one else could understand how disoriented our lives had become except the other members of the flood victim club that none of us had intended to join.

In 2020 on August the 4th Hurricane Isaias hit the neighborhood. Thank God the City of Philadelphia's Office of Sustainability got involved this time. The beginning meetings were venting sessions, however, finally there was somebody to validate our experience, hear our pain and get us a seat at tables where decisions were being made about our plight without our input. Government agencies, the John Heinz National Wildlife Refuge, and our elected officials heard the voices and the values of the residents.

We stopped rearranging the chairs on the Titanic and began to look at a bigger picture to fix the situation. We gained knowledge of the ecosystems, and they gained the knowledge that these properties were homes, not just real estate. Our voices mattered, our values mattered, our choices mattered and that has made all the difference. We now had a voice in our destiny and our dignity was restored. We are now part of the solution and not just considered a problem.

In June of 2021, so many of our neighbors showed up to say, "enough is enough" by making our voices heard to the City, State and Federal agencies that we need a plan to fix this problem, if not mitigate the flooding in the area. It was the FMCE (Flood Mitigation Council of Eastwick) members' dedication and commitment to meet with different entities to tell our story and to apply for funding to help assist with the Eastwick flooding.

As members of the FMCE and Eastwick United, we have been working alongside the EPA, the Office of Sustainability, Drexel University, the Army Corps of Engineers, and the John Heinz National Wildlife Refuge to bring hope back to the neighborhood.

As we look forward to Eastwick's future and continue to work side-by-side with The Nature Conservancy team, we are excited for the next generation to live in a greener area, where children can play in the playground, have a picnic in the park, ride their bicycles, or walk the trails. We believe in one neighborhood and one team to help achieve our goals and accomplish what we started six years ago.

Denise Statham and Michelle White
Eastwick Residents

1999
HURRICANE FLOYD

2004
TROPICAL STORM CHARLEY

2011
TROPICAL STORM LEE

2020
HURRICANE ISAIAS

2021
TROPICAL STORM IDA

Foundational Achievements

Previous studies including *Increasing Resilience in the Lower Darby Creek Area* laid out the technical foundation for resilience planning in the Lower Darby Creek Watershed. Specifically, *Increasing Resilience in the Lower Darby Creek Area* examined climate-informed hydrologic and hydraulic analyses, evaluated key drivers in Eastwick, and assessed the condition and restoration potential of the freshwater tidal marsh at Tinicum.

This work identified major drainage constraints, mapped climate and landscape stressors, and developed early concepts for floodplain reconnection, increased tidal exchange, and nature-based solutions. The work also helped support community engagement by translating complex technical findings into accessible information for residents.



Protecting People and Infrastructure from Flood Risk

The Lower Darby Creek watershed has long faced challenges from industrial pollution, landfills, and damaged natural landscapes. More than 35,000 people live in this area, and the communities experience significant flood risk.

The natural drainage systems that once supported a rich and diverse ecosystem have been heavily altered over time. Instead of broad, connected wetlands, the area is now limited to narrow, confined channels that are more vulnerable to flooding and ecological decline. Today, shifting weather patterns and environmental conditions add even more pressure. More intense storms, rising temperatures, and wetter conditions are expected to increase flooding risks and further stress both the environment and nearby neighborhoods.

The residents of Eastwick and Tinicum have lived with long standing challenges, yet are powerful examples of resilience as they continue to organize, advocate, and envision a healthier future for their communities. Their determination to restore the landscape, mitigate flood risks, and create safer, more sustainable conditions for generations to come is unending.

This project, therefore, seeks to translate this guiding principal into conceptual nature-based solutions to be evaluated for their ability to mitigate flood risk, beautify neighborhoods, improve water quality, and enhance wildlife habitat.



Photos from various events including Eastwick Community Day and FMCE Project Prioritization meeting, 2025.

Weather Events at the John Heinz National Wildlife Refuge



Flooding Event - August 2018



Hurricane Isaias - August 2020



Tidal and Rain Event - January 2024

Philadelphia County

Delaware County

West Philadelphia

Cobbs Creek

Darby Creek

Philadelphia

Eastwick

John Heinz Impoundment

Darby

Philadelphia International Airport

Tinicum Township

Delaware River

Open Park Space

Nature-Based Solutions

Nature-based solutions are holistic approaches used to reduce flood risk. Compared to traditional gray infrastructure that rely on hard materials such as concrete or steel to divert or contain water, nature-based solutions rely on the integration and the design of naturally occurring processes to manage flood waters, and protect ecosystems. These approaches deliver social and ecological co-benefits that conventional infrastructure typically does not provide.

Nature-based solutions love teamwork! Rather than relying on a single intervention, they work best when implemented collectively as a harmonized system of measures to reduce flood risk while also increasing community and habitat resilience. By remaining adaptive, flexible and typically more cost effective than traditional gray infrastructure, these strategies provide longer term benefits for people and for the environment.

This project applies these guiding principals into conceptual nature-based solutions to be evaluated for their ability to mitigate flood risk, beautify neighborhoods, improve water quality, and enhance wildlife habitat.

Double the Benefits!
When floodplains are reconnected, it often creates opportunity to create wetland complexes on the newly lowered land—giving us a two-for-one restoration benefit.

Floodplain Reconnection

Floodplain reconnection restores the natural link between a river and its historic floodplain, often by lowering existing grade, removing levees, or other barriers that have cut off lateral water movement. When reconnected, floodwaters can spread across a wider area, reducing upstream water surface elevations that can lead to flooding in surrounding neighborhoods, recharging groundwater, and supporting streambank habitats.

Flood Conveyance

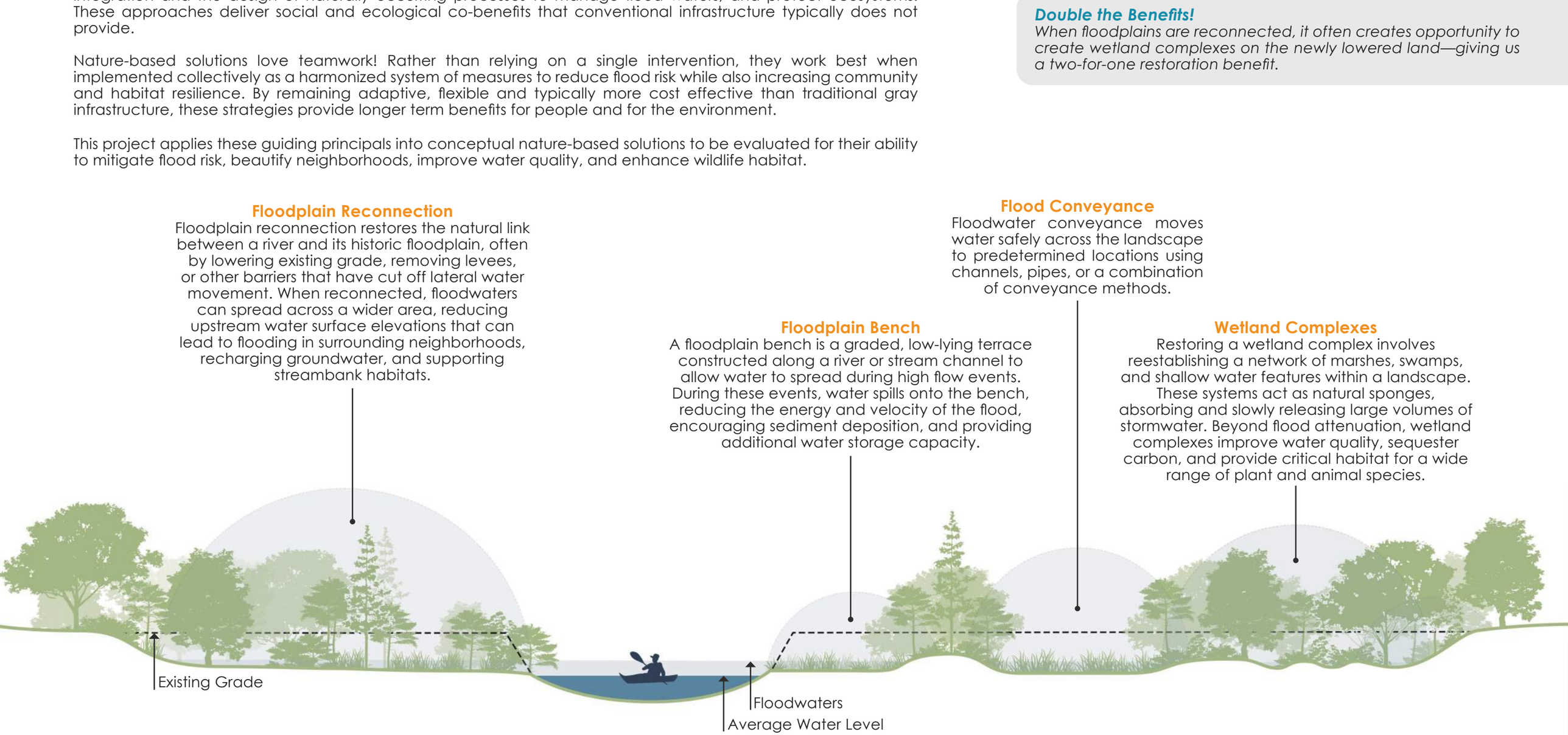
Floodwater conveyance moves water safely across the landscape to predetermined locations using channels, pipes, or a combination of conveyance methods.

Floodplain Bench

A floodplain bench is a graded, low-lying terrace constructed along a river or stream channel to allow water to spread during high flow events. During these events, water spills onto the bench, reducing the energy and velocity of the flood, encouraging sediment deposition, and providing additional water storage capacity.

Wetland Complexes

Restoring a wetland complex involves reestablishing a network of marshes, swamps, and shallow water features within a landscape. These systems act as natural sponges, absorbing and slowly releasing large volumes of stormwater. Beyond flood attenuation, wetland complexes improve water quality, sequester carbon, and provide critical habitat for a wide range of plant and animal species.



Difference between floodplain bench and floodplain reconnection?
The floodplain bench is a constructed "shelf" built into the side of an incised river channel, running parallel to the channel creating extra space for water to flow during flood events. A floodplain reconnection is a larger scale restoration process that aims to restore historical connectivity between a river and its surrounding valley by removing fill, allowing the river to spread out into a larger area during high flow events.

Nature-Based Solutions

OUR JOURNEY TO THIS POINT

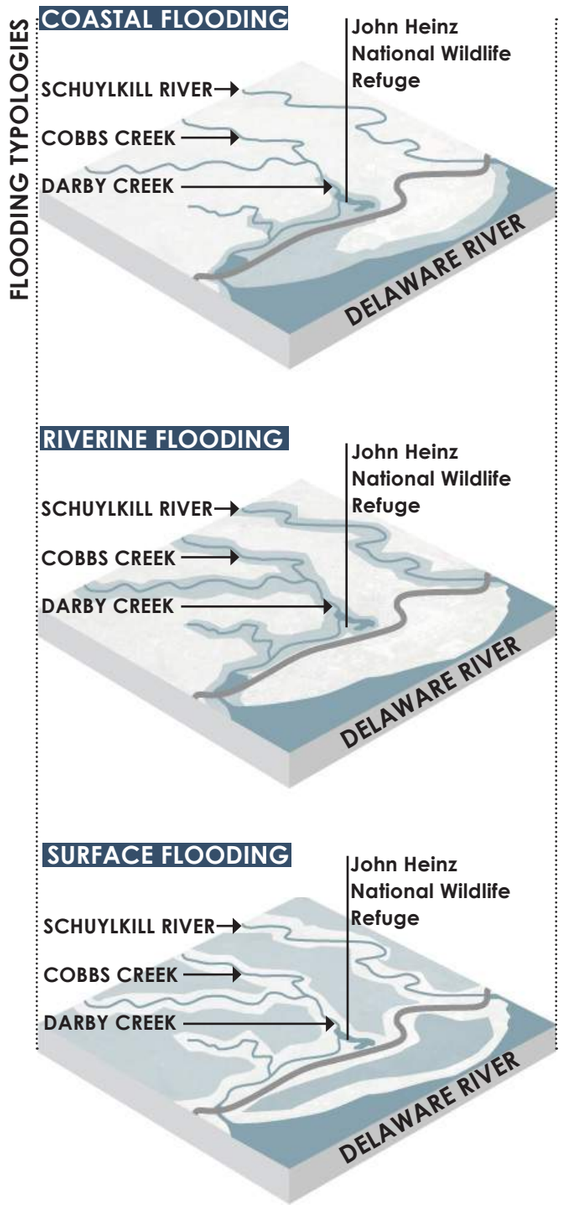
Historical Landscape

Eastwick and Tinicum were shaped by the meeting of two natural regions: the piedmont uplands and the inner coastal plain. Water once flowed through a huge network of tidal freshwater wetlands in this region. Over time, however, these rich estuary systems were dramatically altered by urban development and land use changes disrupted the natural water pathways, breaking apart the connected ecosystem that once supported abundant plant and animal life.

Today, Eastwick and Tinicum face multiple flood hazards, including coastal, riverine, and surface flooding. Combined, these flooding sources create a compounded flood risk and increase the chances of inundation and flood-related events.

Modern Conditions that Impact Flooding

- The 77-square mile Darby-Cobbs Watershed is approximately 67% urbanized. Urban development covers much of the land surface with impervious surfaces like concrete, which absorbs water much more slowly than the natural ground cover.
- Channelization, filling of adjacent floodplains, and infrastructure including airports and roadways reduce overall water storage.
- Daily tidal fluctuations in water surface elevation extend nearly five miles up Darby Creek, compounding the negative effects of urbanization and floodplain filling on flooding conditions.



Site Selection

In collaboration with community members and stakeholders, i.e. FMCE, 15 sites were selected based on potential locations for nature-based solutions with the aim to reduce flood risk and restore habitat for the benefit of the surrounding community and environment. These sites were developed and vetted with the stakeholders and the community during several outreach events.

Data Compilation

Topography data was gathered from several sources. Each dataset was combined into an elevation map using the latest,highest quality data.

Included data source for elevation models:

- Delaware Valley LiDAR (2015), obtained from the USGS 3D Elevation Program (3DEP).

- City of Philadelphia LiDAR (2022), obtained from the NOAA Office for Coastal Management, Digital Coast Data Access Viewer.
- U.S. Army Corp of Engineers Terrain Model (2024), obtained directly from the Army Corp and developed as part of their Eastwick Flood Risk Management Study.
- Impoundment Terrain Model (2025), obtained from Ducks Unlimited and the U.S. Fish and Wildlife Service and developed as part of their study of the impoundment area.
- 2023 land cover mapping data was obtained from the Multi-Resolution Land Characteristics (MRLC) consortium's National Land Cover Database (NLCD).
- The EPAs' OU1 Clearview Landfill "As-Builts" - construction drawings obtained from Tetra Tech.

Field Data Collection

Each site was evaluated using current and historic aerial imagery to understand the existing site conditions. This evaluation helped determine vegetative types, potential access, and what changes have occurred to the river and floodplain boundaries. Field investigations included the collection of soil profiles data using hand augers, vegetative type and coverage, and surveying elevations of critical stream and floodplain features.

Several sites could not be accessed due to permission constraints, however those that were accessed were evaluated during field investigation visits. These visits included visual observation of the existing conditions, soil sample collection, and GPS mapped locations to identify key river and floodplain features.



Photos from data collection event, October 2025.

Hydrologic & Hydraulic Modeling

To determine the possible flood risk benefit provided by the proposed nature-based solution, a hydraulic model was developed. The Army Corps of Engineer's River Analysis System "HEC-RAS" was used to model the Lower Darby Creek and Cobbs Creek. HEC-RAS calculates water surface elevation and changes in flow along a study area.

For this project, Princeton Hydro reviewed an existing HEC-RAS model for the Lower Darby Creek & Cobbs Creek. This model extends from the confluence of the Lower Darby Creek and the Delaware River on the downstream end through the confluence of Cobbs Creek and Darby Creek. The model continues upstream on Cobbs Creek to the Cobbs Creek Recreation Center and upstream on Darby Creek to Hoffman Park.

For each project proposed in this roadmap, Princeton Hydro manipulated the elevations in the model to include the proposed grading for the nature-based solution. For example, for the Cobbs Creek project, the floodplain was lowered to reflect the proposed floodplain reconnection to the creek. Additionally, land cover conditions were revised to reflect the new nature-based design. The model was then run with the new elevations to determine how the proposed project would affect water surface elevations and discharges in our study area.

Model Refinement

The purpose of the HEC-RAS modeling is to evaluate these projects for flood risk reduction in two flood prone communities adjacent to the Darby Creek and Cobbs Creek. Most of the projects focus in the Eastwick neighborhood, with the Township of Tinicum also considered for certain projects near the downstream end of the study area.

To assess how effectively each project could reduce flooding in Eastwick, a study location called the **"Eastwick Overtopping Point"**, was established where floodwater overtops the banks of Cobbs Creek during riverine flooding events, and enters the Eastwick neighborhood.

Water surface elevations at this overtopping point during the 2-year and 5-year storm events were compared under current conditions and with each proposed project in the model. This step was essential in evaluating the potential project locations and the effectiveness of their proposed nature-based solutions.

2050 Conditions

Sea level rise and future increased precipitation values from 2050 were used to develop input parameters for the analysis of select projects. Downstream tidal elevations and upstream flows were increased in the existing conditions analysis as well as in select nature-based solution analyses to understand future flood conditions and flood risk reduction potential.

PROJECT EVALUATION

Combining multiple nature-based solutions projects can maximize flood risk reduction by creating complementary benefits across a watershed. When implemented together, measures such as wetland restoration, floodplain reconnection, and green infrastructure can more effectively capture, store, and slow stormwater, reducing downstream flood impacts while delivering ecological and community benefits at a lower overall cost.

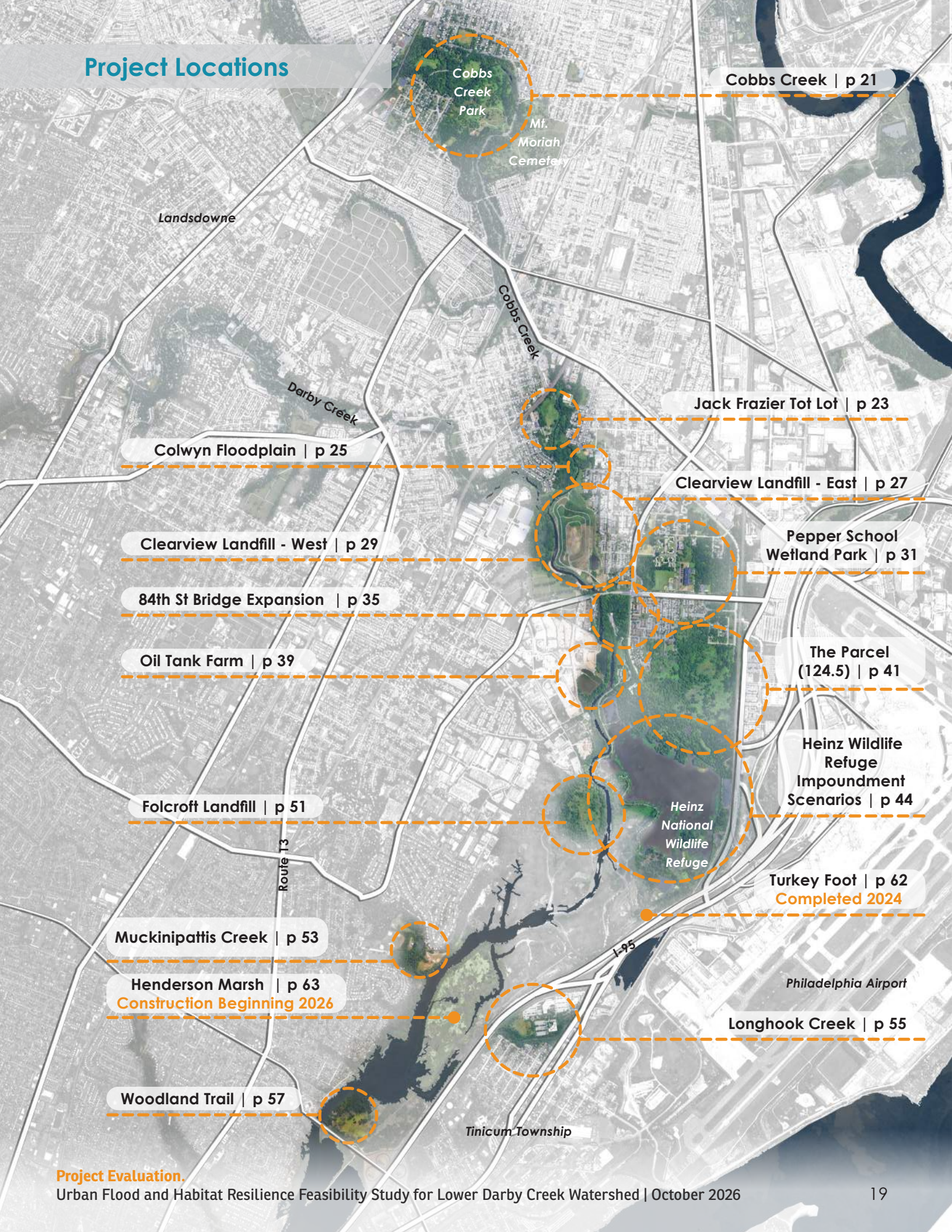
Categories were chosen and weighted with flood risk reduction and ecological benefit given the highest priority. Community support was considered next and holds significant weight in this decision-making process. The remaining criteria are broken into two categories – likelihood for the project completion and long-term considerations. Factors that impact project completion include construction cost, feasibility of construction, likelihood of obtaining permits, and property owners. Long term project considerations include maintenance, adaptability to future climate conditions, and future public use. While these evaluations are subjective and based on the individual proposed project, it is important to recognize that combining multiple nature-based solutions projects may maximize flood risk reduction. When implemented together, measures such as floodplain reconnection, floodplain benching, wetland complex creation and flood conveyance can more effectively capture, store, and slow stormwater, reducing downstream flood impacts.

A Concept Evaluation Matrix was developed to compare the success of each project. Each project is scored on a scale of 1 to 5, 1 representing a very poor performance score and 5 representing an excellent performance score for each category. A more detailed evaluation breakdown is presented on pages 59 and 61.





Project Locations



Cobbs Creek

Floodplain Reconnection

The Cobbs Creek project is located within Cobbs Creek Park on the border of Philadelphia and Delaware County. The proposed project includes:

- Increasing floodplain connection to Cobbs Creek by lowering the ground elevation on both sides of Cobbs Creek by two to six feet.
- Regrading & re-vegetating this area as a wetland complex that supports the natural flow of water.
- Creating/restoring a trail to return community access to the proposed project area after development.

Potential Flood Risk Reduction Benefits

The Cobbs project would reduce flood elevations upstream of the project location. Modeling results indicate no flood risk reduction benefit in our areas of interest at Eastwick or Tinicum, which are downstream of the project location.

Challenges

There are limited challenges associated with this project. However, as a public park, it will be important to work with community groups to ensure this forward-facing project is acceptable to the community.

Additional Benefits

- ✚ New native plants
- ✚ New trails
- ✚ Improved park space
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~17 acres
Material Removed:
~71,000 cubic yards
Approximate Cost of Implementation:
$1,900,000



Cobb's Creek

Jack A. Frazier Tot Lot

Floodable Park & Wetland Creation

The Jack A. Frazier Tot Lot project has two design components, both of which involve lowering the floodplain along the west side of Cobbs Creek.

- Most of the site will be designed to support a "floodable park." This floodable park area will be lowered to an elevation where it can remain a recreational space during normal conditions, but can safely flood during storm events.
- The northeast corner of the project site will be converted to a wetland complex, providing habitat for wildlife.

Potential Flood Risk Reduction Benefits

Modeling results show that flood risk reduction benefits are focused upstream of the project site. While Tinicum and Eastwick, located downstream, are not predicted to experience significant flood risk reductions from this project alone, integrating the project with additional flood mitigation initiatives could increase the potential for meaningful flood risk reduction benefits in these communities.

Challenges

Colwyn Borough has recently started redevelopment of this park, including the installation of a cell tower in the northeast area of the park, making it an unsuitable location for the creation of a wetland.

Additional Benefits

- ✚ New native plants
- ✚ New trails
- ✚ Improved park space
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~10 acres
Material Removed:
~104,000 cubic yards
Approximate Cost of Implementation:
$2,200,000



Jack A. Frazier Tot Lot

Colwyn Wetland

Wetland Complex and Floodplain Reconnection

The Colwyn Wetland project would enhance an existing wooded wetland site just upstream of the Cobbs Creek-Darby Creek confluence. The proposed project includes:

- Increasing floodplain connection with Cobbs Creek by lowering the overall ground elevation three to six feet.
- Creating a healthier wetland complex that supports the natural flow of water.

Since the site is bordered on its northwest side by townhomes/apartments and roads, the project does not include public site access or recreational features.

Potential Flood Risk Reduction Benefits

Modeling results demonstrate that this project would provide very limited flood risk reduction benefits, both on-site and in downstream areas. This may be due to the physical constriction between the Colwyn residential neighborhood and the landfill. This constriction causes a reduction in available flow area that backs water upstream, reducing the effectiveness of floodplain reconnection projects.

Challenges

Challenges may arise in construction due to reduced access and existing slopes, making it difficult to move and store equipment, and remove excavated soil.

Additional Benefits

- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~11 acres
Material Removed:
~70,000 cubic yards
Approximate Cost of Implementation:
$1,600,000



Colwyn Wetland

Clearview Landfill - East

Floodplain Benching

The Clearview Landfill represents a large quantity of fill in the historic floodplain. This project involves adding a 50' floodplain bench to the east side of Darby Creek. To do so, it would be necessary to remove a substantial amount of the existing landfill. This bench would be replanted with native vegetation.

Potential Flood Risk Reduction Benefits

There are minor flood risk reduction benefits associated with this project.

Challenges

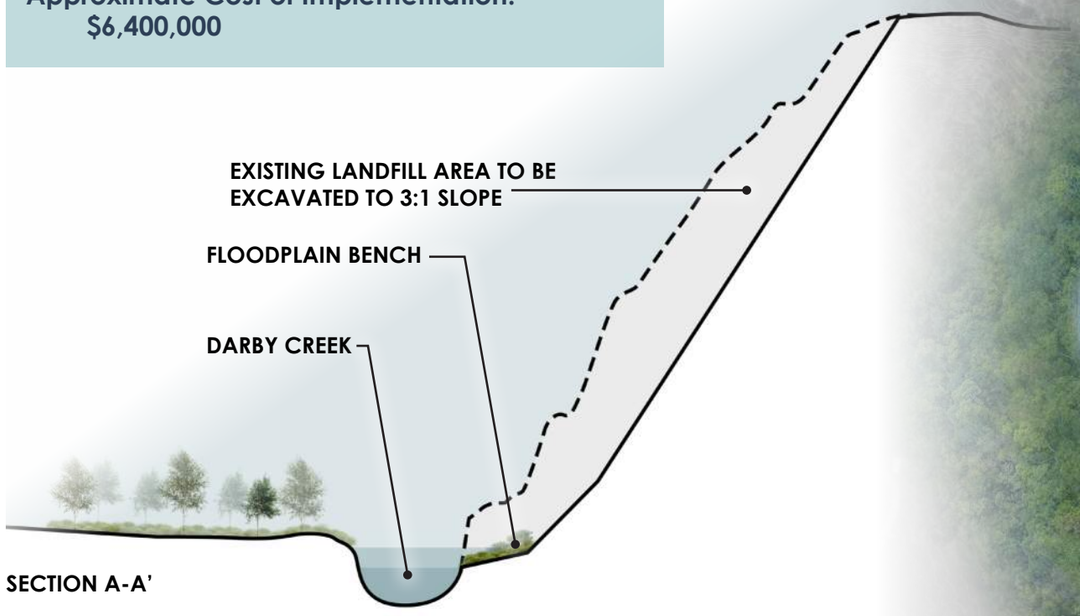
The landfill is a recently remediated superfund site and therefore would present environmental challenges if it were to be disturbed. The flood risk reduction benefits do not outweigh the challenges of disturbing an existing superfund site. This is not recommended for future advancement. In addition, the area recommended for stream benching has recently been planted with trees to encourage remediation efforts.

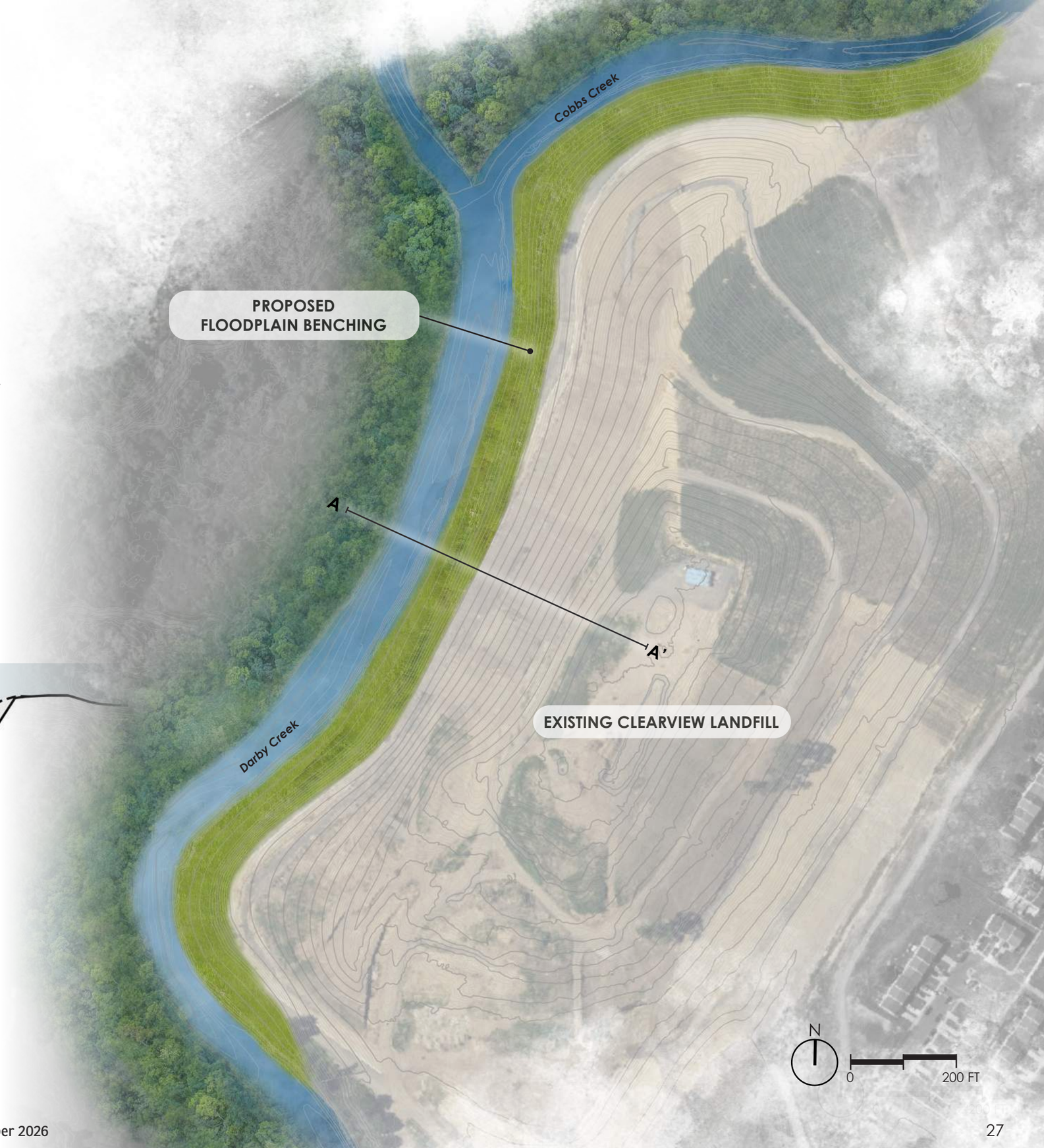
Additional Benefits

- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~17 acres
Material Removed:
~232,000 cubic yards
Approximate Cost of Implementation:
$6,400,000





Clearview Landfill - East

Clearview Landfill - West

Floodplain Restoration

On the west side of the Darby Creek, opposite the Clearview Landfill, a portion of land north of Mount Lawn Cemetery within the Borough of Sharon Hill provides an opportunity for floodplain reconnection. Currently, this site is comprised of wooded vegetation. The proposed project would include:

- Lowering the floodplain on the west side of Darby Creek by two to five feet.
- Converting this site to a healthy wetland complex.

This site would have access from the cemetery and could be a good opportunity to include additional recreational features.

Potential Flood Risk Reduction Benefits

Modeling show that there is flood risk reduction upstream of the project site and in the surrounding Eastwick community.

Challenges

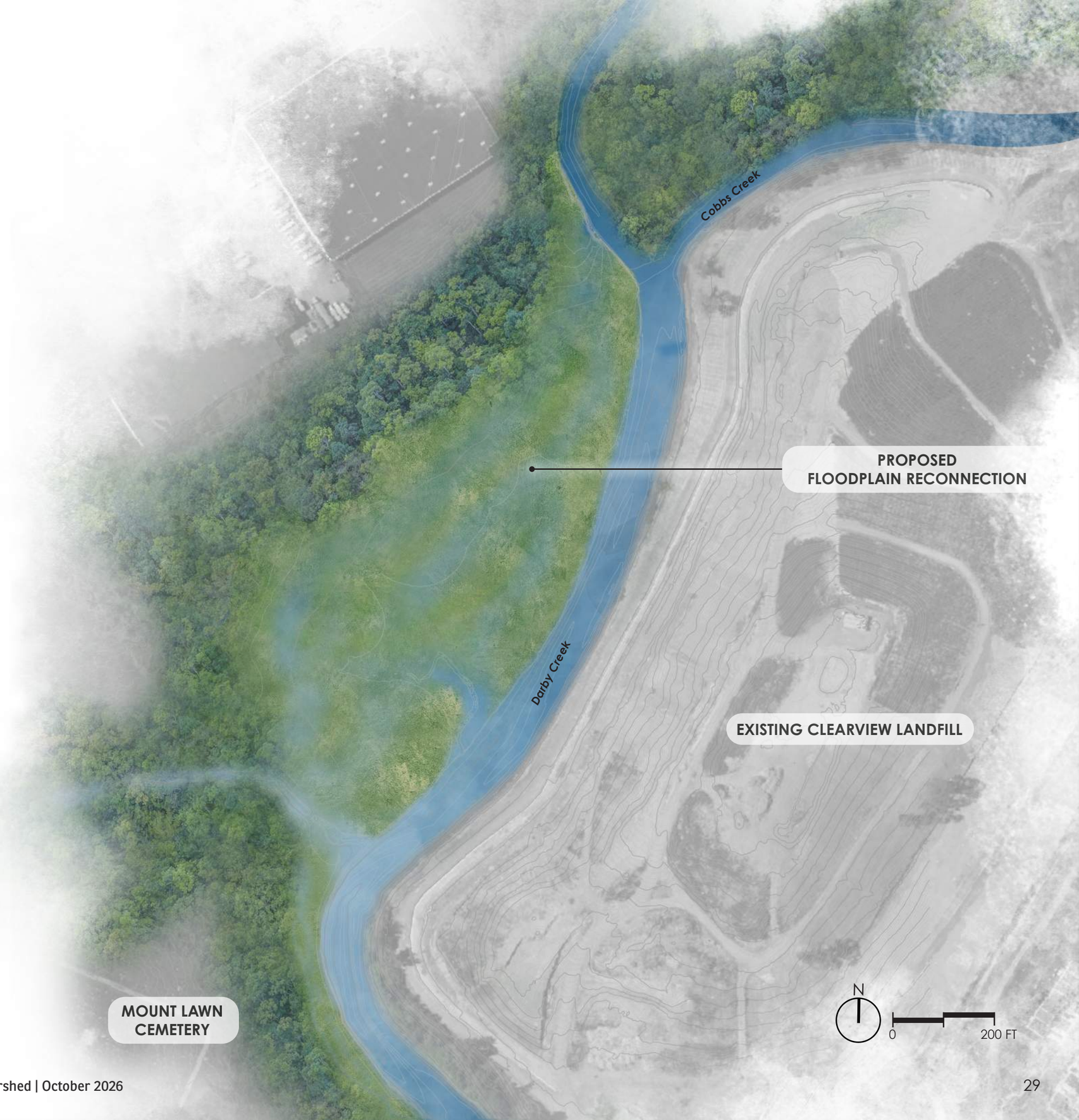
The most critical challenge is that this land is privately owned. As it is in a FEMA floodplain and likely contains existing wetlands on site, this site may not be a candidate for commercial development. Therefore, acquisition by a local municipality or a non-profit organization may be possible for conversion into a nature-based project.

Additional Benefits

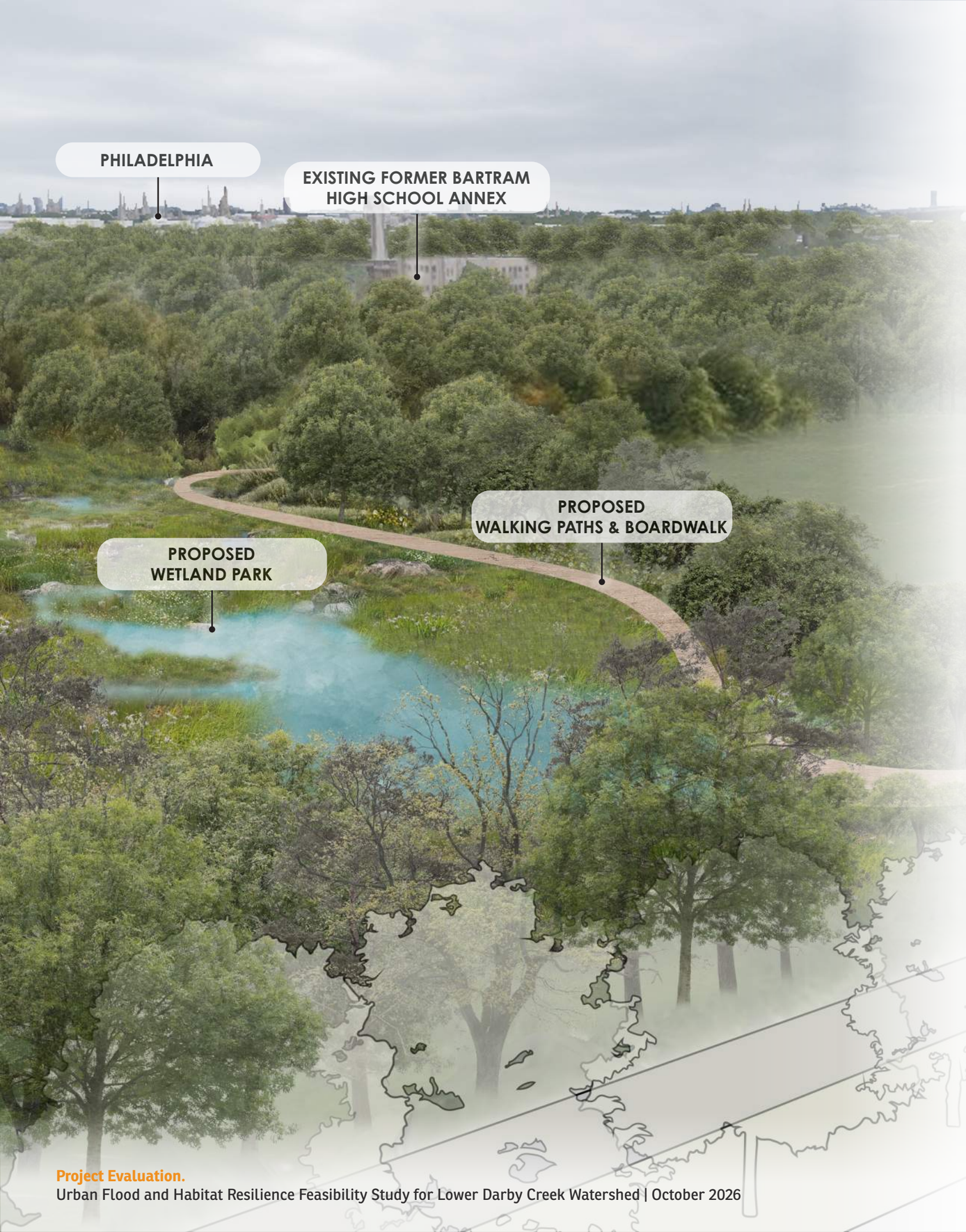
- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~14 acres
Material Removed:
~82,000 cubic yards
Approximate Cost of Implementation:
$2,000,000



Clearview Landfill - West



Pepper School Wetland Park

Wetland Park

The Pepper School Wetland Park project would establish a wetland park at the site of the currently abandoned Pepper Middle School. The proposed project would include the following major components:

- Constructing a culvert and berm to divert water from Cobbs Creek near Eastwick Regional Playground. A berm running parallel to the creek would guide flow into the culvert.
    1. A levee is proposed in this area by others, this levee could be used in lieu of the proposed berm.
    2. A 20' wide by 3' tall culvert would run between the Clearview Landfill and the Eastwick Neighborhood then run under 82nd Street before discharging into the wetland complex located northwest of the Pepper School property.
- Excavating and replanting the Pepper School property in order to establish a healthy and safe wetland complex.
- Creating a hydraulic connection from the Pepper School Property to the John Heinz National Wildlife Refuge to convey flow out of the wetland complex.

*Note that this scenario illustrates only one possible water-routing approach and does not consider other potential routing alternatives.

Potential Flood Risk Reduction Benefits

A berm tall enough for 2-year and 5-year storms would prevent flooding at the overtopping point, reducing flooding in the Eastwick neighborhood. About 10–13% of the flow from these storm events would be diverted from Cobbs Creek into the new wetland through the culvert.

Challenges

Installing a box culvert as currently envisioned will present a significant constructability challenge including:

- Potential conflicts with underground utilities.
- Very low elevation change between the inlet and outlet of the culvert, resulting in low culvert height and flat culvert slope, limiting the amount of water that can be conveyed in the culvert.
- Difficulty achieving adequate cover for stable roadway above box culvert on 82nd Street.
- Longterm maintenance concerns.

Additional Benefits

- ✚ New native plants
- ✚ New Trails
- ✚ Improved park space
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

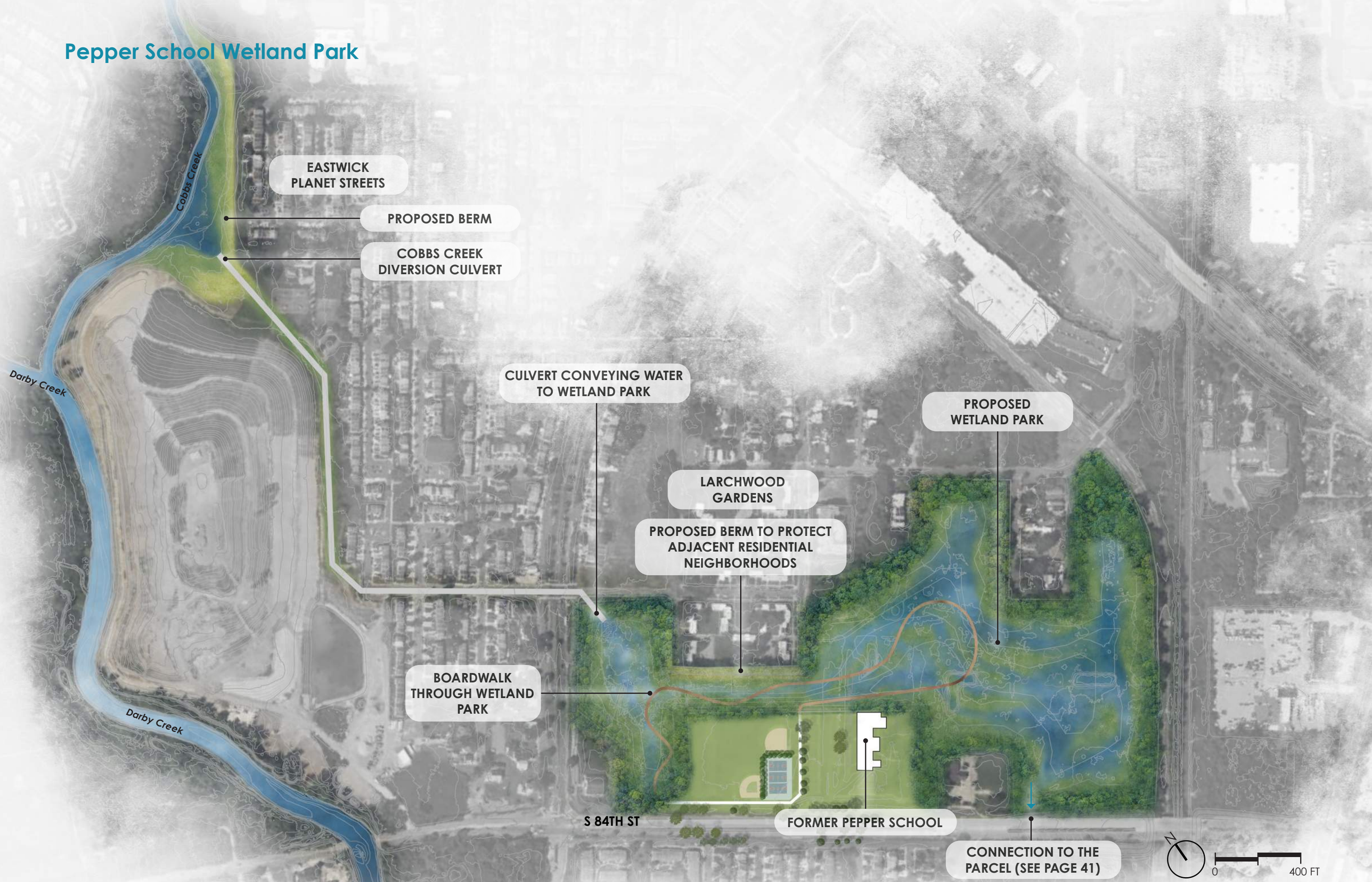
Sharing the Numbers!*

Project Footprint:
~52 acres
Material Removed:
~155,000 cubic yards
Approximate Cost of Implementation:
$8,700,000

*Does not include demolition of the Pepper School or installation of the culvert

Pepper School Wetland Park

Pepper School Wetland Park



84th Street Bridge

Bridge Expansion, Floodplain Benching, and Floodplain Reconnection

The 84th Street Bridge Project would aim to replace the existing bridge with a larger bridge that improves flow and eliminates constriction points. This project would include:

- Widening the bridge and creating a floodplain bench under the eastern portion of the new bridge that extends the bench upstream and downstream along the Darby Creek.
- Expanding floodplain capacity by lowering the overall floodplain downstream of the bridge by about six to ten feet.
- Establishing a healthy wetland complex in the lowered floodplain downstream of the bridge.

Potential Flood Risk Reduction Benefits

Modeling results show that there is some flood risk reduction benefit. Constrictions located upstream near the landfill can limit the positive benefits of the bridge expansion.

Challenges

Expanding the bridge would be complex and expensive. The project would require significant coordination among agencies including the City of Philadelphia and PennDOT. Expanding the bridge is not recommended for further advancement due to high cost and low flood risk reduction benefit.

Additional Benefits

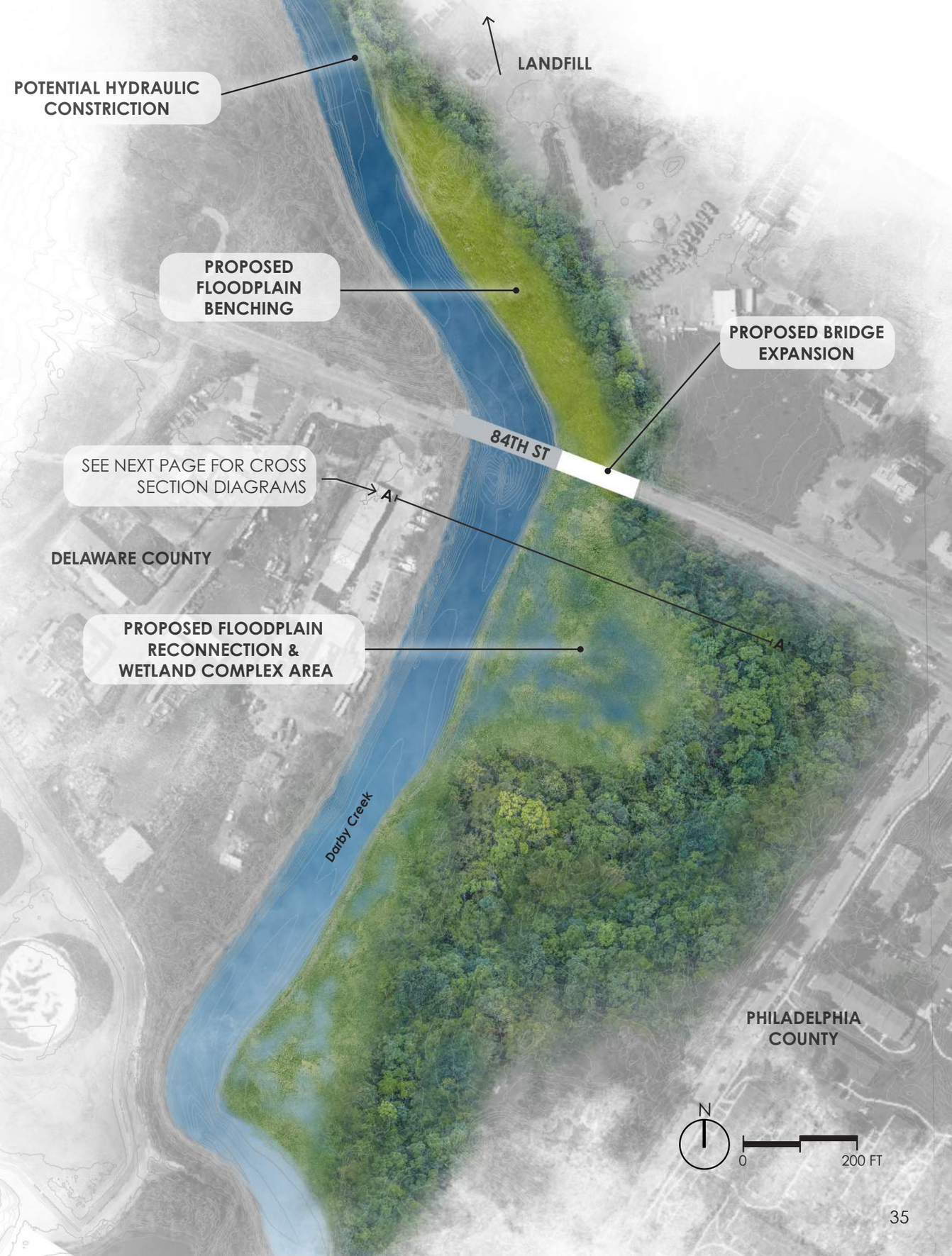
- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Invasive plant management
- ✚ Improved water quality

Alternate Design Scenario

The floodplain reconnection and wetland complex portion of this project is entirely on land owned by the John Heinz National Wildlife Refuge. Given the complexities of the bridge expansion and the positive ecological and recreational benefits of the wetland complex, one alternate design is for this project to move forward without the replacement of the 84th St. Bridge.

Sharing the Numbers!

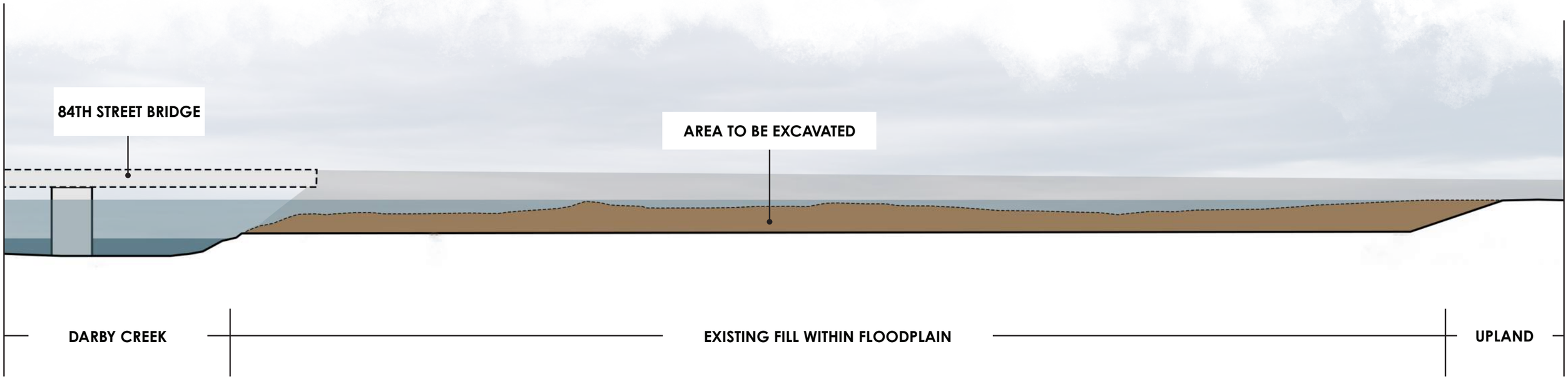
Project Footprint:
~9 acres
Material Removed:
~102,000 cubic yards
Approximate Cost of Implementation:
$14,500,000



84th Street Bridge

84th Street Bridge

Existing Section A-A'



Conceptual Section A-A'



Oil Tank Farm

Wetland Creation & Floodplain Reconnection

The Oil Tank Farm project would convert a complex of wet ponds, which are filled to various elevations, into wetlands and establish hydrologic connectivity to the Darby Creek and approximately 18 acres of floodplain. The proposed project would include several major components:

- Removing an approximately 10' tall berm that separates the existing ponds from Darby Creek.
- Removing existing wet ponds and converting this area to a wetland complex.
- Reconnecting the floodplain by removing the berm and lowering the overall floodplain by approximately two to five feet.

Potential Flood Risk Reduction Benefits

Moderate flood risk reduction benefits are seen as a result of this project. Modeling results show 0.24 feet, or 3 inches of flood reduction during a 2-year storm at the Eastwick overtopping location.

Challenges

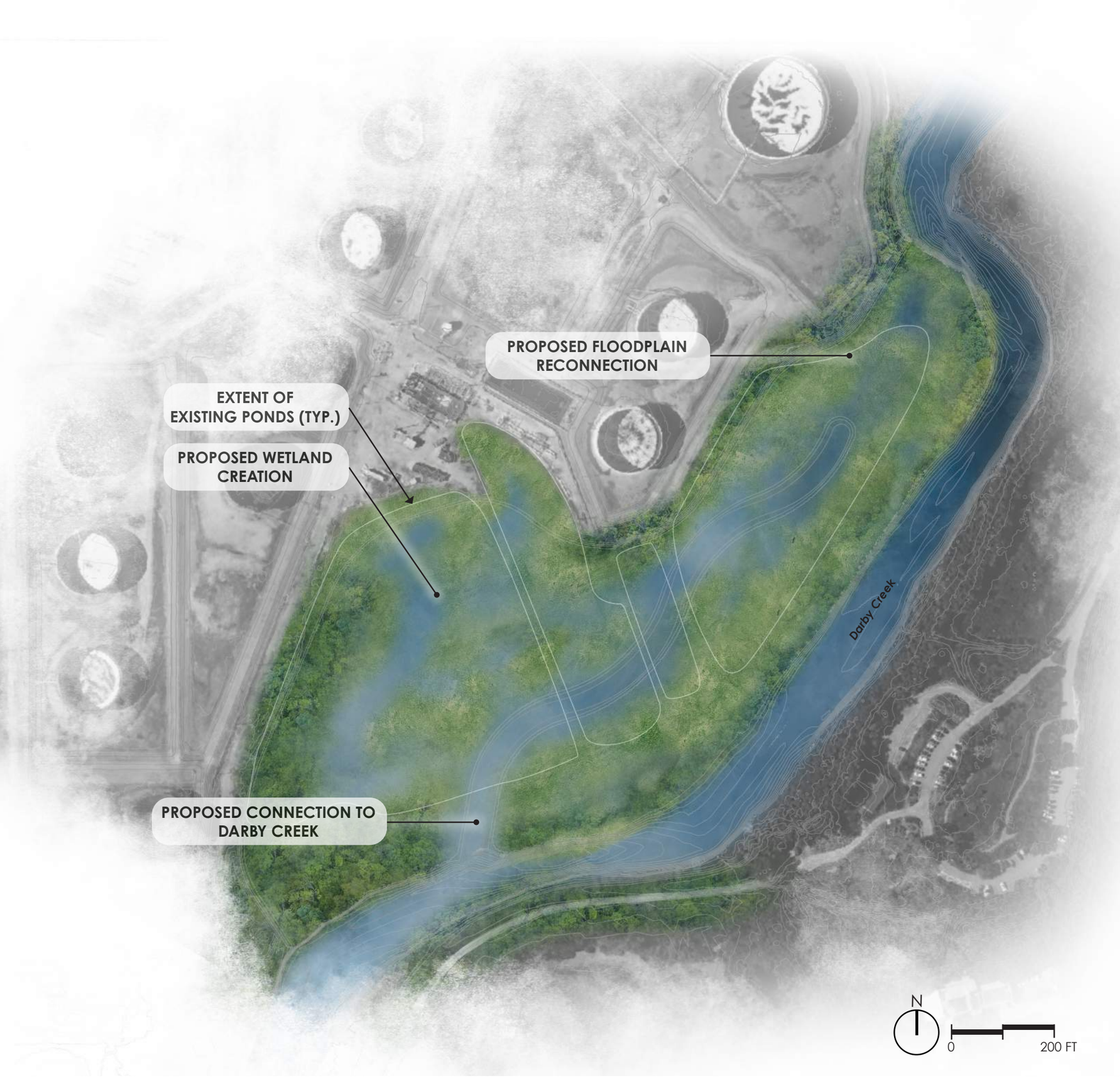
Significant challenges arise from potential contaminants and private landownership. Engagement with the existing property owners would need to occur prior to pursuing this strategy.

Additional Benefits

- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~18 acres
Material Removed:
~117,000 cubic yards
Approximate Cost of Implementation:
$3,900,000



Oil Tank Farm

The Parcel (124.5 acres)

Flood Storage

The Parcel project would establish a wetland on an undeveloped Parcel to the north east of the John Heinz National Wildlife Refuge. The proposed project would impact the following major components:

- Constructing a culvert diverting flow from Darby Creek just upstream of the visitor center parking lot.
    1. A 110 linear foot 20' wide by 4' tall bypass culvert is proposed. A cost benefit analysis of the bypass size should be performed.
- Excavating and replanting the Parcel property to establish a healthy wetland complex.
- Creating a hydraulic connection from the Parcel to the John Heinz National Wildlife Refuge to convey flow out of the wetland complex.

*Note that this scenario illustrates only one possible water-routing approach and does not consider other potential routing alternatives.

Potential Flood Risk Reduction Benefits

Modeling results do not show flood elevation reduction at the Eastwick overtopping point; however, diverting and storing water could have overall flood risk reduction benefits when combined with other projects. This will be assessed during future phases of design. Approximately 10% of the discharge during the 2-year and 5-year storm events can be diverted from Darby Creek into the Parcel Wetland Complex via the proposed culvert.

Challenges

Costs associated with the culvert, excavation and property acquisition are the primary challenges.

Additional Benefits

- ✚ New native plants
- ✚ New Trails
- ✚ Improved park space
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality
- ✚ Invasive plant management

Sharing the Numbers!

Project Footprint:
~63 acres
Material Removed:
~1,038,000 cubic yards
Approximate Cost of Implementation:
$18,100,000



The Parcel (124.5)

The Parcel Conceptual Perspective





EXISTING OPEN WATER CONDITIONS

John Heinz National Wildlife Refuge Wetland Loop Trail Tidal Marsh Restoration

The project team explored several concepts for reconnecting Darby Creek with the John Heinz National Wildlife Refuge impoundment. Concepts considered both **full** and **partial** reconnections to the existing impoundment. All concepts aim to restore the natural relationship between the creek and its floodplain by creating strategically placed openings in the existing embankment, shaping naturalized, sinuous channels, and re-establishing wetland habitats in areas that are currently impounded. These openings will also allow tidal reconnection to the existing impoundment.

Three concepts were advanced for further evaluation. The concepts differ in the number and location of embankment openings, as well as in the extent to which impounded areas are restored to natural wetland conditions.

FULL IMPOUNDMENT TIDAL RECONNECTION
Under this scenario, the entire impounded waterbody would be reconnected with the Darby Creek (reconnecting the hydrology). The impoundment berm would be breached in three locations, represented to the right by blue arrows indicating the direction of flow.



SOUTH IMPOUNDMENT TIDAL RECONNECTION ALTERNATIVE A
Under this scenario, the impoundment would be breached in three locations. An earthen berm would be installed across the impoundment to preserve open water conditions in the northern portion of the impoundment. In this alternative, one of the proposed breaches would flow into the open water area with a designed spillway to allow water passage during high flow events.



SOUTH IMPOUNDMENT TIDAL RECONNECTION ALTERNATIVE B
Under this scenario, the impoundment would be breached in three locations. An earthen berm would be installed across the impoundment to preserve open water conditions in the northern portion of the impoundment.



Full Impoundment Tidal Reconnection

Tidal Reconnection

This concept explores a full impoundment reconnection. Modeling results suggest that full impoundment reconnection would achieve flood risk reduction benefits. This concept does not consider maintaining any areas of open water.

Challenges

The proposed changes would impact the entire impounded waterbody, which currently supports recreation, wildlife habitat, and visual appeal, some of which could be reduced or changed by the proposed scenarios. The existing impoundment covers approximately 176 acres. Challenges related to land-use, permitting, construction, and long-term management are likely. Working closely with stakeholders will be important to balance these interests and reduce trade-offs where possible.

Additional Benefits

- ✚ New native plants
- ✚ New trails
- ✚ Improved park space
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality
- ✚ Invasive plant management

Sharing the Numbers!*

Project Footprint:
~176 acres
Approximate Cost of Implementation:
$4,500,000

*Excludes fine grading within the wetland area.



Full Impoundment
Tidal Reconnection

South Impoundment Tidal Reconnection

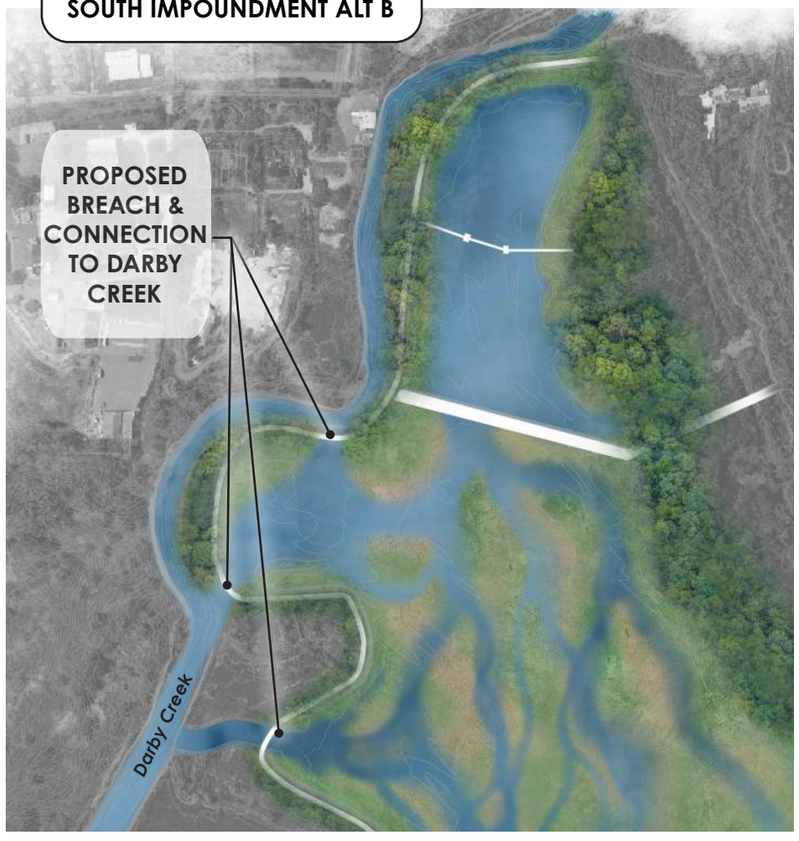
Tidal Reconnection

These concepts explores a partial impoundment reconnection. Modeling results suggest that partial reconnection would achieve flood risk reduction benefits.

Challenges

Similar challenges regarding land-use are expected. These concepts would also require close collaboration with stakeholders to balance these interests and reduce trade-offs where possible.

SOUTH IMPOUNDMENT ALT B



Sharing the Numbers!*

Project Footprint:
~176 acres
Approximate Cost of Implementation:
$4,200,000

*Excludes grading within the wetland area.

SOUTH IMPOUNDMENT ALT A



South Impoundment Tidal Reconnection

Folcroft Landfill

Tidal Reconnection

The Folcroft Landfill is a retired landfill on the west side of Darby Creek within the John Heinz National Wildlife Refuge. The landfill last operated in the late 1970s and is currently listed as an superfund site by the EPA. This project would entirely remove the landfill and replace it with a wetland complex.

Potential Flood Risk Reduction Benefits

Modeling indicates that removal of the landfill would not provide measurable flood-reduction benefits within the areas of interest. However, it would restore the site's natural functions.

Challenges

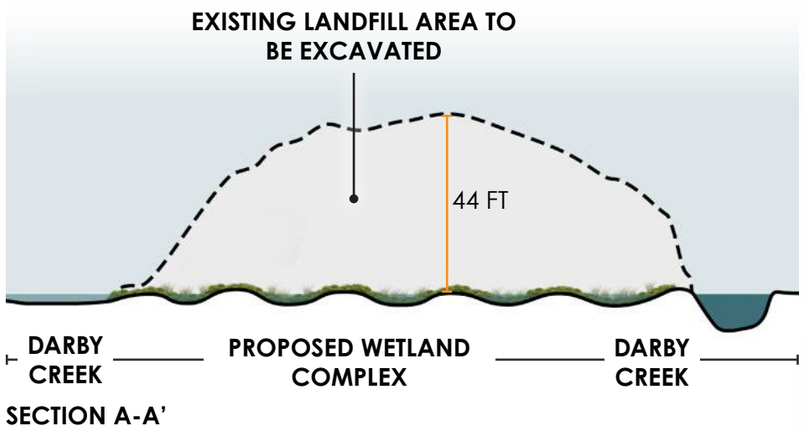
The landfill is an identified superfund site that is currently under investigation by the EPA to evaluate potential risks. The site is considered contaminated meaning that the removal would be much more costly than removing clean material.

Additional Benefits

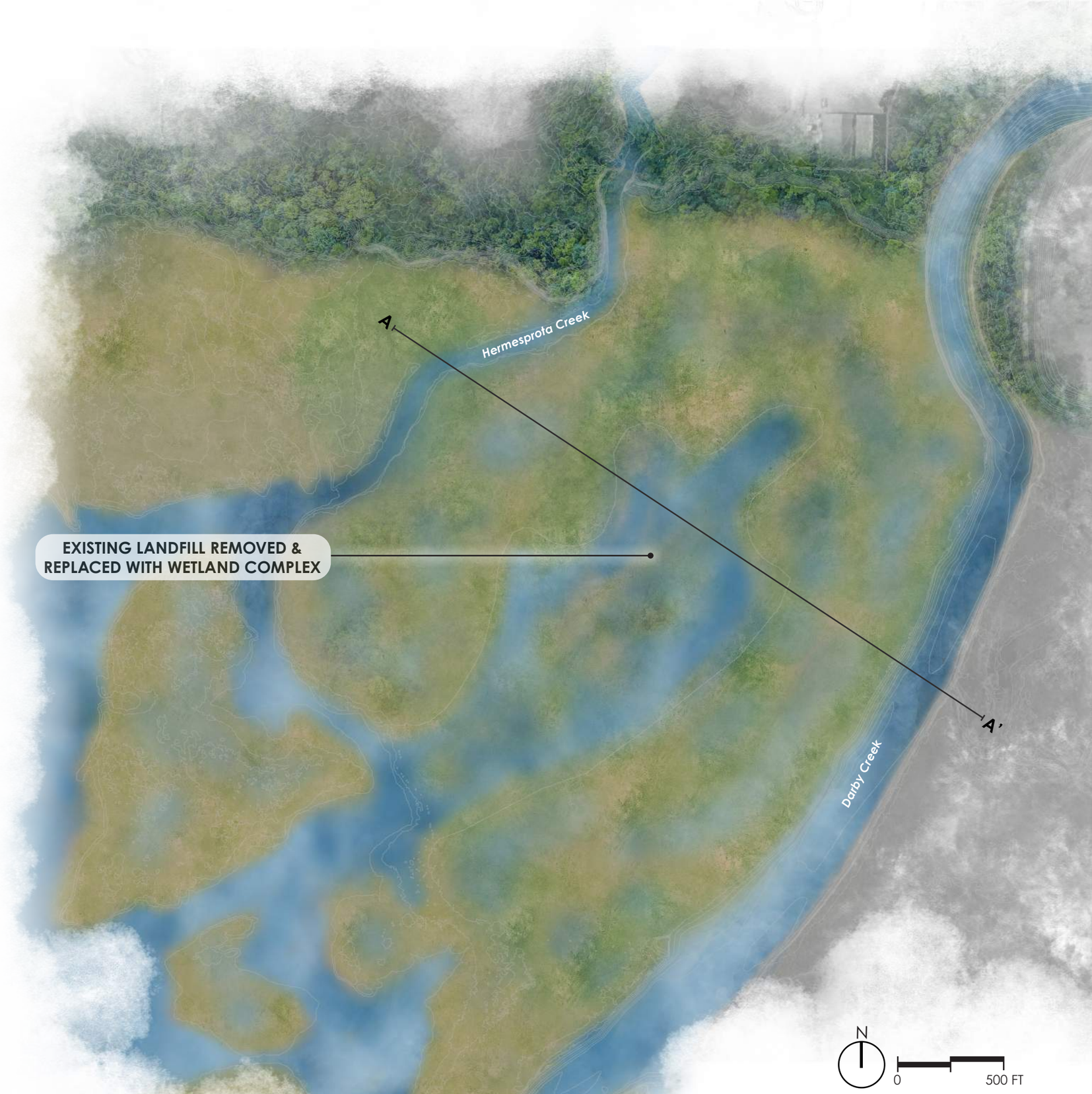
- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~43 acres
Material Removed:
~1,385,000 cubic yards
Approximate Cost of Implementation:
$32,800,000



SECTION A-A'



Folcroft Landfill

Muckinipattis Creek

Floodable Park

The Muckinipattis Creek park project would convert this existing park into a "floodable park" at the confluence of Muckinipattis Creek and Darby Creek. This floodable park area would be lowered via excavation to an elevation high enough that it would remain usable as a public recreation amenity during base flow conditions, but would be allowed to flood during storm events.

Potential Flood Risk Reduction Benefits

This project is too small to have a tangible flood risk reduction benefit, however, when combined with other proposed nature-based solution projects, there is a higher potential for flood risk reduction.

Challenges

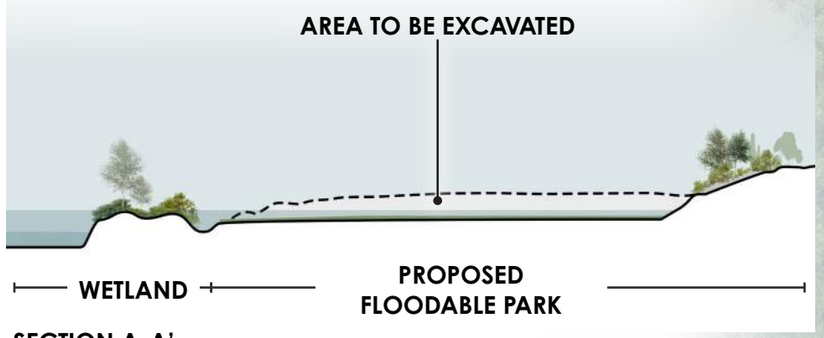
No major challenges are identified; however, as this project would involve excavation in a public park, community buy-in would be important.

Additional Benefits

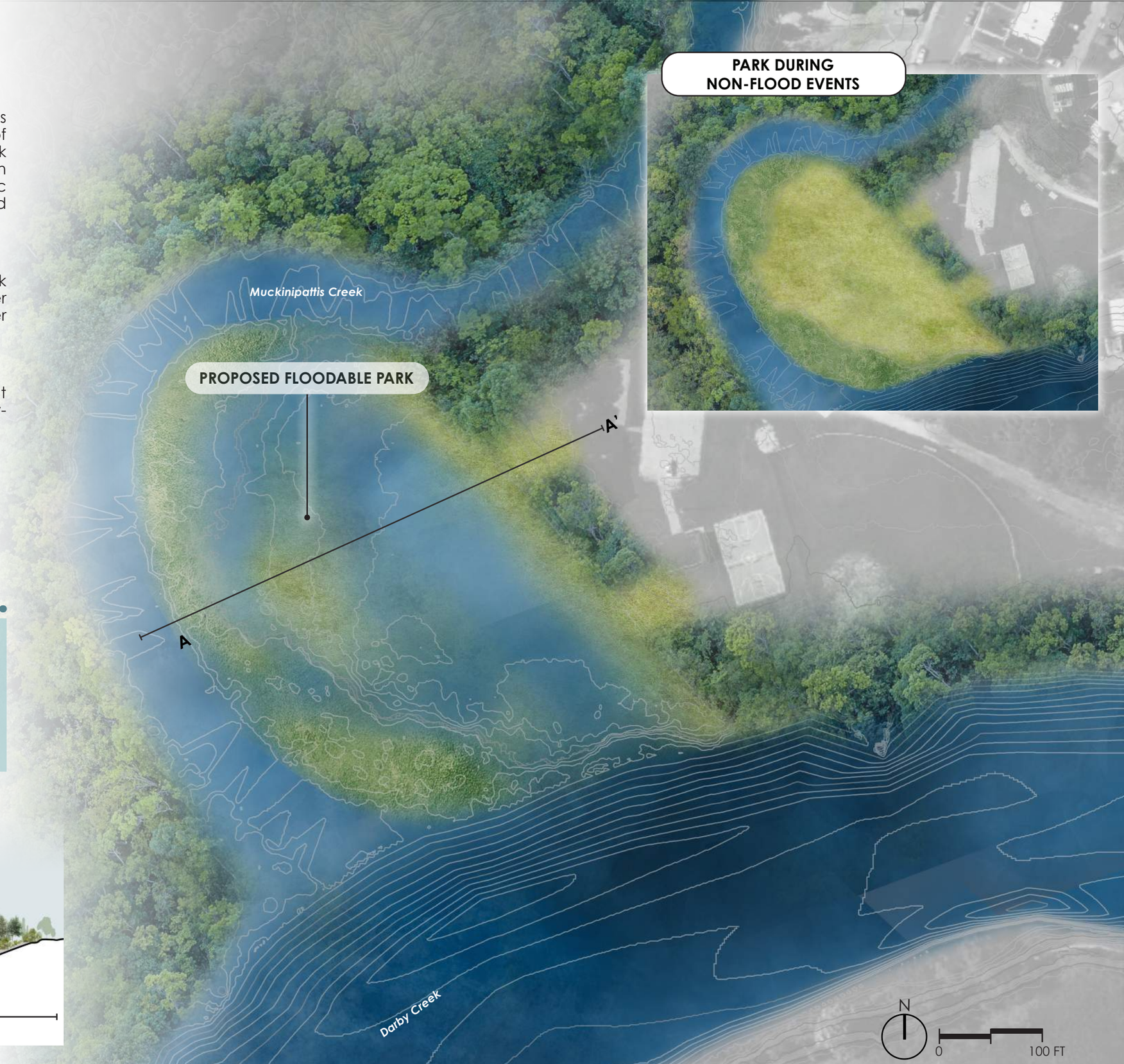
- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality

Sharing the Numbers!

Project Footprint:
~3 acres
Material Removed:
~8,900 cubic yards
Approximate Cost of Implementation:
$300,000



SECTION A-A'



Muckinipattis Creek

Longhook Creek

Flood Storage

Longhook Creek is a tributary to Darby Creek that runs through the Tinicum community south of Interstate 95. FEMA flood records indicate that an existing tide gate prevents tidal flow in Darby Creek from crossing under Interstate 95 into Longhook Creek. This project would include relocating existing levees to create additional areas for flood storage in Longhook Creek, allowing small storm events to be temporarily stored and released during low tide.

Potential Flood Risk Reduction Benefits

For this analysis, a new drainage area was delineated for the watershed to the project area. A new run off volume was calculated for this area and compared to both existing and proposed grading. The increased storage area lowered water surface elevations by as much as 1' in the project area.

Challenges

Existing levees would need to be relocated to accommodate supplemental flood storage.

Additional Benefits

- ✚ New native plants
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality



Sharing the Numbers!

Project Footprint:
~13 acres
Material Removed:
~70,000 cubic yards
Approximate Cost of Implementation:
$2,000,000

Longhook Creek

Woodland Trail & Tidal Marsh Restoration

Tidal Reconnection

The Woodland Trail & Tidal Marsh Restoration Project would establish a tidal marsh just upstream of the Wannamaker Avenue Bridge. This area is an existing wooded wetland complex that receives minimal tidal flow. This effort would involve:

- Increasing the areas ability to store water by creating openings in the existing berm currently surrounding the site and lowering the overall floodplain by three to five feet.
- Establishing a healthy tidal marsh complex and supporting its function and development by allowing both tidal and storm flows to enter and recede from the project area.
- Creating a gentle, winding channel to guide water through the site.

The results of this project would also enhance the existing trail, improving public access, and providing new opportunities for visitors to enjoy the restored landscape.

Potential Flood Risk Reduction Benefits

The constriction caused by the Wannamaker Bridge directly downstream from this project site is the main driver of floodwater elevations. The project site is primarily located in a low velocity backwater area where changes to the topography have limited impact to floodwater elevations. Although this restoration effort alone would not improve flooding in Eastwick or Tinicum, if the bridge-opening modifications are combined with other nature-based solution projects, it could potentially increase flood risk reduction.

Challenges

No major challenges identified, however due to the bridge constriction, flood risk reduction benefits are low.

Additional Benefits

- ✚ New native plants
- ✚ New trails
- ✚ Improved park space
- ✚ Enhanced wildlife habitat
- ✚ Improved water quality
- ✚ Invasive plant management

Sharing the Numbers!

Project Footprint:
~27 acres
Material Removed:
~123,000 cubic yards
Approximate Cost of Implementation:
$3,000,000



Woodland Trail &
Tidal Marsh Restoration

Evaluation Matrix Rubric

To support a transparent and collaborative decision-making process, the project team worked closely with community members to develop an evaluation matrix for assessing potential nature-based solutions. Community members and the project team created a range of criteria that reflected both technical feasibility and community priorities, including flood risk reduction, ecological benefit, community support, aesthetic and recreational value, constructability, longevity and resilience, permitability, property ownership considerations, maintenance requirements, and construction cost.

Each criterion was assigned a relative weight based on its perceived importance to project goals and community values. The weighted criteria were then used to evaluate and score each nature-based solution alternative. Individual criterion scores were combined to calculate a composite score for each alternative, allowing the project team and stakeholders to compare options using a consistent and objective framework. This process helped identify solutions that best balanced environmental benefits, community needs, implementation feasibility, and long-term sustainability.

RELATIVE WEIGHTING

Criteria	Description	Weight
Flood Risk Reduction	How well the concept mitigates flooding and improves hydrological resilience.	20%
Ecological Benefit	Enhancement of biodiversity, habitat creation, and ecosystem services.	20%
Community Support	Alignment with community values, needs, and level of public support.	15%
Aesthetic & Recreational Value	Contribution to public space, beauty, and recreational use.	10%
Constructability	Feasibility of construction given site conditions (including existing utilities), materials, access, and logistics.	8%
Longevity & Resilience	Durability and adaptability to future climate conditions.	7%
Permitability	Likelihood of obtaining necessary permits and regulatory approvals.	5%
Property Ownership	Assesses the ownership status of the land or waterway where the concept is proposed, and ownership willingness to allow project implementation.	5%
Maintenance Requirements	Long-term upkeep needs.	5%
Construction Cost	Estimated capital cost for construction.	5%
	Total	**100%**

CATEGORY EVALUATION

Score	Definition	Flood Mitigation	Ecological Benefit	Community Support	Cost	Constructability	Longevity & Resilience	Permitability	Property Ownership	Maintenance Requirements	Aesthetic & Recreational Value
5	Excellent – exceeds expectations, highly favorable.	Significantly reduces flood risk; proven hydrological performance.	Major ecological improvements; habitat creation.	Strong community enthusiasm and engagement.	Very low cost; high return on investment.	Easily constructible with minimal disruption.	Highly resilient; long-term sustainability.	Fully compliant; permits likely with minimal effort.	Entirely on public land with clear jurisdiction and support.	Minimal maintenance; easily managed.	Beautiful and highly usable public space.
4	Good – meets expectations with minor limitations.	Strong flood mitigation; minor limitations in scope or scale.	Good ecological value; supports native species.	Generally supported; minor concerns.	Reasonable cost; within budget expectations.	Constructible with manageable challenges.	Good resilience; minor vulnerabilities.	Mostly compliant; minor regulatory hurdles.	Mostly public land, minor private parcels with cooperative owners.	Moderate maintenance; manageable with existing resources.	Attractive and offers recreational value.
3	Fair – acceptable but with notable limitations.	Moderate impact; may require complementary measures.	Some ecological benefit; limited scope.	Mixed opinions; needs more outreach.	Moderate cost; may require phased implementation.	Requires moderate engineering or site preparation.	Moderate lifespan; may need upgrades.	Requires negotiation or mitigation measures.	Mixed ownership, some uncertainty or negotiation needed.	Requires regular upkeep; may need external support.	Neutral aesthetics; limited public use.
2	Poor – significant concerns or challenges.	Limited effectiveness; uncertain performance.	Minimal ecological impact.	Significant opposition or skepticism.	High cost; may strain budget or require external funding.	Significant construction challenges.	Limited resilience; vulnerable to future conditions.	Major permitting challenges.	Mostly private land, significant legal or logistical challenges.	High maintenance burden.	Unattractive or inaccessible.
1	Very Poor – unacceptable or infeasible.	Ineffective or unproven concept.	Potentially harmful to local ecosystems.	Strong community resistance.	Prohibitively expensive or financially infeasible.	Technically infeasible or unsafe to construct.	Short-lived or unsustainable.	Unlikely to be permitted under current regulations.	Entirely private land with known opposition or legal barriers.	Unsustainable maintenance needs.	Detracts from public space or community character.

Evaluation Matrix Rubric

Evaluation Matrix

Concept Name	Composite Score	Flood Mitigation	Ecological Benefit	Community Support	Cost	Constructability	Longevity & Resilience	Permitability	Property Ownership	Maintenance Requirements	Aesthetic & Recreational Value
The Parcel (124.5)	4.1	3	5	5	3	3	5	4	4	4	5
Pepper School Wetland Park	4.1	4	5	5	2	2	5	3	5	3	5
Full Impoundment Tidal Reconnection	3.8	3	5	5	2	3	3	3	5	4	4
Clearview Landfill - West	3.8	3	4	5	4	4	5	3	2	3	3
Woodland Trail & Tidal Marsh Restoration	3.6	1	5	4	4	4	3	4	5	4	5
Oil Tank Farm	3.5	3	5	4	4	2	4	2	2	3	3
South Impoundment Tidal Reconnection A	3.5	2	5	4	2	3	3	3	5	4	5
South Impoundment Tidal Reconnection B	3.5	2	5	4	2	3	3	3	5	4	5
Cobb's Creek	3.5	1	4	3	4	4	5	5	5	4	5
Colwyn Wetland	3.2	1	4	3	4	3	5	3	5	4	3
Longhook Creek	3.1	3	3	4	3	3	3	3	2	3	2
Muckinipattis Creek	3.0	1	2	3	5	5	3	5	5	3	4
84th Street Bridge Expansion	3.0	1	4	5	1	2	4	2	5	4	3
Jack A. Frazier Tot Lot	3.0	2	3	1	4	5	5	5	1	3	4
Folcroft Landfill	2.5	1	5	3	1	1	3	1	2	4	3
Clearview Landfill - East	2.1	2	3	1	1	1	5	1	1	4	2

Evaluation Matrix

WHERE WE'RE HEADED

Current Projects

Several projects within the watershed have been completed or are currently under construction. In addition, a number of projects have secured funding and are moving toward implementation, while other project proposals are under consideration. A detailed summary of these efforts is provided on Page 65.

Turkey Foot Ecological Restoration - Completed

Location: John Heinz National Wildlife Refuge

Project Sponsor: Friends of Heinz Refuge

Historic changes to land and water flow have degraded the ecosystem benefits provided by the 7.5-acre Turkey Foot project area, reducing the Refuge's ability to support wildlife and provide climate and community benefits. The Turkey Foot project shows how ecological restoration can improve ecological function and increase human well-being in one of Philadelphia's largest open spaces.

The project reshaped the land to restore the intertidal wetland, allowing water to flow more naturally, reduce stagnant pools, process nutrients, and attenuate flood flows. Additionally, the restoration established marsh habitat for the black rail, a tiny, highly secretive marsh bird.

By restoring natural features, the The Turkey Foot project strengthens the Refuge's capacity in providing wildlife habitat, improving water quality, supporting climate adaptation, and offering benefits to the surrounding residents. Through adaptive management and monitoring, the site will continue to grow into a resilient, self-sustaining ecosystem that benefits both people and nature.



Aerial before and after photos of the Turkey Foot Restoration project (Left: 2022, Right 2025).



Photo of current construction at Henderson Tidal Marsh.

Henderson Tidal Marsh Ecological Restoration - In Construction

Location: John Heinz National Wildlife Refuge

Project Sponsor: Friends of Heinz Refuge

The Tinicum tidal marsh is composed of several interconnected marsh areas, including the approximately 150-acre Henderson Tidal Marsh. This important restoration project will enhance tidal flow by widening existing channels and constructing new channels throughout the marsh complex. These improvements are designed to increase the marsh's resilience, reduce flood risk for nearby communities and the Refuge, and support the long-term health of the ecosystem.

In addition to providing flood mitigation benefits, the project will improve the quality and extent of tidal marsh habitat for fish, birds, and other wildlife that rely on these wetlands. The restoration will also enhance recreational opportunities by improving access and navigation for kayakers exploring the marsh. Construction began in September 2026 and is anticipated to be completed by May 2027.

Future Implementation

Future implementation of these large scale nature-based solution projects will need to be guided not only by flood-risk reduction potential, increased ecological function, and community support, but regulatory compliance and outside funding opportunities as well.

As these nature-based solution projects continue evolving and ultimately seek implementation, it is important to understand both the regulatory and financial considerations that may influence project selection and prioritization. This section identifies potential permits, and approvals, that may be required and funding pathways based on project type, location, and scale. Understanding permitting needs alongside funding opportunities early in the process helps guide design, reducing risk of inefficiencies. It also positions projects for smoother implementation and long-term success.

Permitting and Regulatory Considerations

Implementation of large-scale nature-based solution strategies will require coordination among local, state, and federal permitting agencies. Engaging with regulators early in the design process will streamline approvals and reduce potential project delays. Permitting considerations may include:

Federal

1. **Federal Planning Requirements**
    - Any federal action (e.g., funding, permitting, designing) requires the federal government to assess the potential impacts to the human environment of the action, in accordance with the National Environmental Policy Act (NEPA). Review under the NEPA varies on the type of project, with smaller projects reviewed under a Categorical Exclusion (CATEX), while larger projects may require a Environmental Assessment and Finding of No Significant Impact (EA/FONSI) or Environmental Impact Statement (EIS).

2. **Federal Permits and Approvals**
    - U.S. Army Corps of Engineers is responsible for reviewing and issuing permits for projects that disturb navigable waters under Section 10 of the Rivers and Harbors Act and waters of the US, including wetlands under Section 404 of the Clean Water Act.

    - Section 7 of the Endangered Species Act requires all federal agencies to ensure that any actions they fund, authorize, or carry out do not jeopardize the continued existence of plant and animal species listed as threatened or endangered, and do not destroy or adversely affect designated critical habitats for listed species. To comply with this requirement, federal agencies must consult with the US Fish and Wildlife Service and the National Marine Fisheries Service before proceeding with any actions. If a proposed activity has the potential to "take" (i.e., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect) a listed species, then the agency must follow avoidance and minimization measures. Avoidance measures would include moving the project out of critical habitat or where species are present or may include time-of-year restrictions on specific activities. Minimization would include creating buffers or other habitat modifications, additional timing and phasing changes to reduce disturbance, using technology (e.g. sound barriers) and finally implementing mitigation measures such habitat restoration. Similarly, the Magnuson-Stevens Act requires that agencies consult on potential impacts to Essential Fish Habitat. Similarly, the Magnuson-Stevens Act requires that agencies consult on potential impacts to Essential Fish Habitat.

Nature-Based Solutions Grant Inventory

Nature-Based Solutions Related - Grant Inventory (7-22-2026 Update)						
Grant/Funding Source	**Grant Name**	**Project Name**	**Entities Involved**	**Funding**	**Key Objectives / Outcomes**	**Started or Completed**
Projects Underway or Complete						
NRDAR funding (Dept of Interior) and USFWS Base Funding	Damage Assessment Funds	Turkey Foot Tidal Restoration (Construction)	US Fish and Wildlife Service (USFWS - John Heinz NWR), Friends of Heinz Refuge, Princeton Hydro	$350,500	Restore tidal flow into the Turkey Foot tidal marsh, improving fish passage, increasing flood storage, and reducing flood risk	Completed
NFWF (NOAA funds)	National Coastal Resilience Fund	Developing a Flood and Habitat Resilience Feasibility Study for Lower Darby Creek Watershed	USFWS, the Nature Conservancy, Princeton Hydro	$866,691	NBS Feasibility Study: Identify and evaluate nature-based strategies for flood risk reduction and ecological restoration within the Refuge and upstream portions of Darby and Cobbs Creeks.	Started
NRDAR funding (Dept of Interior)	Damage Assessment Funds	Henderson tidal marsh restoration	USFWS, Ducks Unlimited (DU)	$2,300,000	Restore tidal flow into the Henderson tidal marsh, improving fish passage, increasing flood storage, and reducing flood risk	Started
Bipartisan Infrastructure Law	National Fish Passage Program	Henderson tidal marsh restoration		$900,000		
NOAA	Transformational Funding	Henderson tidal marsh Restoration - Building Ecological and Community Resilience Through the Floodplain Restoration of Lower Darby Creek at John Heinz National Wildlife Refuge		$9,500,000		
NFWF	Delaware Watershed Conservation Fund	Impoundment - Tidal Marsh Restoration	USFWS, Princeton Hydro, EA Engineering	$750,000	Develop several restoration design options for the refuge impoundment, following the evaluation of site conditions and modeling.	Started
Project Funding Secured						
National Fish and Wildlife Foundation (NFWF) - NOAA Funds	National Coastal Resilience Fund	Designing Floodplain Restoration to Reduce Flood Risk and Enhance Habitat in Lower Darby Creek Watershed	The Nature Conservancy, USFWS, and Princton Hydro	$428,185	Design of two floodplain hydrologic reconnection project sites (84th Street Bridge and Woodland Loop Trail) from the list of nature-based solutions developed during the feasibilty study.	
Project Proposals Submitted						
National Fish and Wildlife Foundation (NFWF)	Delaware Watershed Conservation Fund	Pepper Wetland Park: A Flood Resilience Project in Eastwick (PA)	Office of Sustainability, Eastwick organizations, the Nature Conservancy, PWD, USFWS	$300,000	Planning and conceptual design of a wetland park at the Pepper Middle School property, including wetland restoration, maintaining active recreation space, and enhancing stormwater conveyance to the site. Community design workshops are included in the scope of work.	
US Housing and Urban Development (HUD)	CDBG-DR			$300,000		

Nature-Based Solutions Grant Inventory

Federal Permits and Approvals (continued)

- Section 106 of the National Historic Preservation Act requires federal agencies to review the potential effects of their actions on historic properties and to consult with stakeholders before approving, funding, or permitting said actions. The historic properties include but are not limited to historic districts, properties, buildings, sites with or that may contain archaeological artifacts and formal tribal lands. Federal agencies must consult with the State Historic Preservation Office (SHPO) and federally recognized Tribal Historic Preservation Officers (THPOs) for all projects. Additional stakeholders may include the Advisory Council on Historic Preservation, the National Park Service, local governments, local historic commissions, and the general public. If there is a determination of "an adverse effect," then the federal agency must take steps to mitigate the effects (e.g., avoidance and minimization plans) and will often have to enter into a Memorandum of Agreement with the SHPO and other affected parties.

- The Comprehensive Environmental Response, Compensation and Liability Act (aka Superfund) is a federal law enacted to address the remediation of sites with uncontrolled or abandoned hazardous wastes. The law authorized the EPA to clean up these sites; it provides a funding source for the clean up and requires the EPA to maintain a list, the National Priorities List, of sites that are the most hazardous and require long-term clean up operations. Activities that aim to redevelop these sites are subject to review and approval of the plans for remediation by the EPA and state equivalent authorities. The approved plans can often require capping, treating or removing affected soils and groundwater over the course of several years. Additionally, soil and groundwater monitoring and adaptive management plans are often required following the completion of the approved clean-up plan.

State Permits (Pennsylvania Department of Environmental Protection – PADEP)

1. **State Permits and Approvals**
   - Activities that disturb waters of the commonwealth, including wetlands are subject to review and approval by the PADEP under the Pennsylvania Code Chapter 105. Similarly, projects that disturb the 100-year floodway and floodplain are subject to review and approval by the PADEP under the Pennsylvania Code Chapter 106.

   - Projects that disturb greater than 5,000 square feet are subject to review and approval either by PADEP or a designated local county conservation district under the Pennsylvania Code Chapter 102.

   - Projects that disturb greater than one-acre of soil are subject to review and approval either by PADEP or a designated local county conservation district under the Pennsylvania Code Chapter 102 for a NPDES General Permit for Discharges of Stormwater Associated with Constructing Activities (e.g., PAG-02). permits for stormwater discharges associated with construction activities.

   - Chapter 102 and Chapter 105 permits for erosion and sediment control, stream encroachments, floodways, or wetland impacts.

Funding Opportunities

A diversified funding strategy from multiple sources will be essential to advance these large-scale nature-based solutions. Future projects should utilize a combination of local, state, and federal funding sources to maximize investment impact. Often, grant programs require matching funds from non-federal and sometimes federal sources. A diverse funding approach can help meet the match requirements.

As appropriate and as funding allows, the bundling of projects based on type, potential benefits, or location could be an efficient implementation strategy. Incorporating multiple stakeholders and entities as project partners also helps strengthen grant applications by not only emphasizing the broader positive implications of the projects, but also showing the projects have far-reaching buy-in and support.

Funding opportunities and their associated details and requirements may change year to year, so the funding options listed below include those available as of Spring 2026. These opportunities include:

Federal Programs

- **FEMA's Building Resilient Infrastructure and Communities (BRIC) program**

Pennsylvania's Emergency Management Agency (PEMA) administers the BRIC application for flood mitigation and resilience projects within Pennsylvania. The current funding focuses on implementable projects, modern building codes, and long term, measurable reductions in disaster risk. Eligible entities include:

1. Local governments, authorities, or other FEMA eligible subrecipients
2. Have projects that:
   - Align with approved County and State Hazard Mitigation Plans
   - Meet federal and state environmental and historic preservation (EHP) rules
   - Are cost effective and reduce risk from natural hazards

A letter of intent is required prior to submitting a full application. Based on the PEMA 2026 BRIC Application Guidance, there are cost-share requirements based on the following criteria:

1. Standard cost share:
   - 75% Federal / 25% Non Federal
2. Small and Impoverished Communities (SIC):
   - 90% Federal / 10% Non Federal
   - Defined as ≤3,000 people and ≤80% of national per capita income

The highest priority of the program is infrastructure and construction projects. These projects could include protection of public buildings, utilities, transportation, water, wastewater, and natural systems; projects addressing hazards such as flooding, wildfire, drought, earthquakes, and severe weather; and projects with a conceptual design. Note that phased projects are not eligible.

- **EPA Clean Water State Revolving Fund (CWSRF)**

This program, administered in Pennsylvania through PennVEST, provides low-cost financing to communities for water quality infrastructure projects such as municipal wastewater facilities, nonpoint source pollution control, decentralized wastewater treatment systems, stormwater runoff mitigation, green infrastructure, estuary protection, and water reuse.

Eligible entities include communities, private entities, nonprofit organizations, and citizen groups.

State and Regional Funding

- **Pennsylvania Infrastructure Investment Authority (PennVEST)**

Through a variety of sub-programs, PennVEST offers low-interest loans and grants, including those for stormwater, green infrastructure, and estuary revitalization projects. The program is funded through a variety of sources including the Clean Water State Revolving Fund, Drinking Water State Revolving Fund, Bipartisan Infrastructure Law, or other state funding sources.

The Traditional Construction Funding Program offers funding through loans for all phases of a project, from feasibility studies through construction, dependent on the type of project.

- **Pennsylvania Growing Greener Plus**

As part of PADEP's grant and loan program, Growing Greener Plus offers grants to organizations of the follow categories:

1. Incorporated watershed association.
2. County, including county planning commission, or municipality.
3. County conservation district.
4. Council of governments.
5. Other authorized organization that is one of the following:
    - Educational institution.
    - Municipal authority.
    - 501(c)(3) tax-exempt entity

The program opens yearly and awards up to $500,000 per grant request. Priorities for the program include watershed restoration and protection (design, permitting, and/or construction); technical assistance; planning; growing greener watershed renaissance initiative; and operation and maintenance repair/replacement.

- **Pennsylvania Community Development Block Grant**

The US Department of Housing and Urban Development provides annual grants on a formula basis to states, cities, and counties to develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low- and moderate-income persons.

The program administers funds to the eligible municipalities for infrastructure or revitalization projects, including those related to stormwater. The minimum request for projects is $100,000, with no ceiling limit.

- **PA Department for Conservation of Natural Resources (DCNR) Community Conservation Partnership Program**

This program through DCNR typically awards approximately $50 million for projects annually, with individual awards ranging from $50K - $500K.

Eligible applicants include county and municipal governments; municipal agencies; 501(c)(3) non-profits organizations; and for-profit businesses (limited to particular options). There are several sub-programs under this larger program. Potential relevant sub-programs include the Community Recreation and Conservation Planning program and Park Rehabilitation and Development program.

- **National Fish & Wildlife Foundation – Delaware Watershed Conservation Fund**

This National Fish & Wildlife Foundation has created this annual funding opportunity to conserve, restore, and protect habitats on public and private land, across rural, urban, and Tribal areas, that contribute to the overall health of the Delaware River watershed—as well as benefit the quality of life and economic vitality of the communities in the Delaware River watershed.

There are four grant categories: Implementation; Planning; Capacity Building; and Research, Monitoring, and Evaluation. Projects in each category should support the Delaware River Basin Restoration Program Framework and link to the Delaware River Watershed Business Plan.

The most recent funding round encouraged a 1:1 match, but it was not required. Grant awards ranged from $75,000 up to $1,500,000, depending on the grant category.

- **National Fish & Wildlife Foundation – Five Star Grant Program**

The Five Star grant program seeks to develop community capacity to sustain local

natural resources for future generations by providing modest financial assistance to local partnerships focused on improving water quality, watersheds and the species and habitats they support. Projects include a variety of ecological improvements along with community outreach, education, and stewardship. Ecological improvements may include one or more of the following: community tree canopy enhancement; community gardens; wildlife habitat restoration and conservation, including wetland, riparian, forest and coastal habitat.

Program priorities include on-the-ground restoration; environmental outreach, education, and training; and community partnerships. The program is anticipated to have one round open annually and award projects ranging from $30,000 to $150,000 with 30-40 grants awarded each year.

The program has specific geographic focus areas; in 2026, Philadelphia was included as a priority area within Pennsylvania.

- **National Fish & Wildlife Foundation – Coastal Resilience Fund**

The NCRF is a national program focused on reducing risks to coastal communities. Projects must be located within the coastal areas of U.S. coastal states, including the Great Lakes states, and U.S. territories and Tribal lands. For the purpose of this funding opportunity, the eligible project area is defined as all coastal Hydrologic Unit Code (HUC) 8 watersheds that drain to the sea and any adjacent HUC 8 watersheds that are particularly low-lying or tidally influenced ("coastal areas"). Philadelphia is within the eligible project area.

Program priorities include nature-based solutions; community risk reduction benefits; fish and wildlife benefit; community impact and engagement; and transfer and sustainability.

Awards for projects involving Community Capacity Building and Planning, Site Assessment and Preliminary Design, and Final Design and Permitting are expected to be in the range of $100,000 to $1,500,000. For Restoration Implementation projects, NFWF expects the average NCRF awards to be in the range of $1,000,000 to $7,000,000. Non-federal match is not required, but encouraged.

- **National Estuary Program Watersheds Grant Program**

The program provides funding for projects within the 28 National Estuary Program watersheds. While the priorities change annually for each funding round, projects addressing the following issues are a focus:

1. Loss of key habitats resulting in significant impacts on fisheries and water quality such as seagrass, mangroves, tidal and freshwater wetlands, forested wetlands, kelp beds, shellfish beds, and coral reefs;
2. Coastal resilience and extreme weather events including flooding and coastal erosion related to sea level rise, changing precipitation, warmer waters, or salt marsh, seagrass, or wetland degradation or loss and accelerated land loss;
3. Impacts of nonpoint source pollution, excess nutrients and warmer water temperatures on aquatic life and ecosystems, including low dissolved oxygen conditions in estuarine waters;
4. Stormwater runoff which not only can erode stream banks but can carry nutrients, sediment, and trash into rivers and streams that flow into estuaries;
5. Recurring harmful algal blooms;
6. Unusual or unexplained marine mammal mortalities; and
7. Proliferation of invasive species that limit recreational uses, threaten wastewater systems, or cause other ecosystem damage.

Local and Innovative Financing

- **City of Philadelphia Stormwater Grants**

These annual grants fund the design and construction of stormwater retrofit projects on

one or multiple non-residential properties within the City of Philadelphia.

Eligible applicants include property owners, tenants, community groups, non-profits, businesses, and stormwater management vendors. The application is typically due in March of each year.

Grant applications are evaluated for several criteria: greening, cost effectiveness, additional project funding, community impacts, maximizing drainage area capture, and strong property owner involvement.

- **William Penn Foundation**

The William Penn Foundation's Environment and Public Space program provides funding for projects within categories such as green stormwater infrastructure; investment in parks; climate resilience plans; community greening plans; improvement of public spaces; and reducing sewage overflows.

The Foundation's grant process involves completing an application either in response to an RFP or through an open application.

Powered by Partnership

The roadmap sets a clear direction for sustainable, inclusive, and measurable progress. Its success, however, depends not only on a strong vision but on disciplined implementation and shared ownership moving forward. As the Roadmap transitions from planning to action, future efforts must remain flexible, data-informed, and responsive to community needs, ensuring initiatives evolve alongside changing conditions and priorities.

Together, the past, present, and future efforts of the nature-based solutions work reflect a deliberate progression and eagerness to go from vision to action. Early work established shared goals, identified and sought consensus on priority area, all grounded in community and stakeholder input.

This Roadmap is both a blueprint and a call to action.

Current efforts continue refining concepts, strengthening partnerships, and advancing projects. Through strategic implementation, continued stakeholder and community collaboration and engagement it offers a pathway to meaningful, community-driven change—one that is resilient, inclusive, and built to endure.



Group photo of various community and team members.

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The Nature Conservancy
Protecting nature. Preserving life.




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