

02

BACKGROUND & METHODS

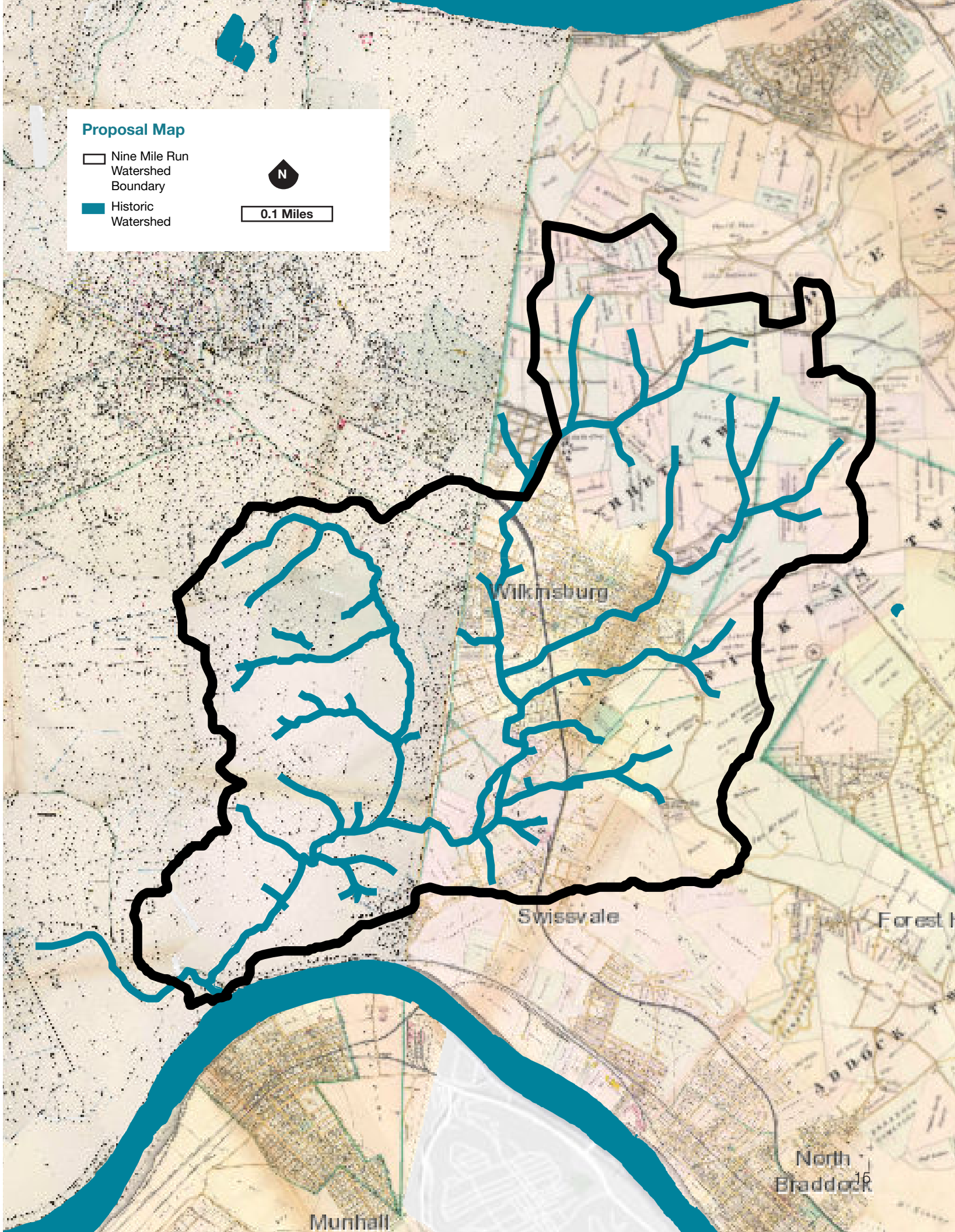
The RIPPLE plan rebuilds our community’s relationship with water by starting upstream, where it matters most.

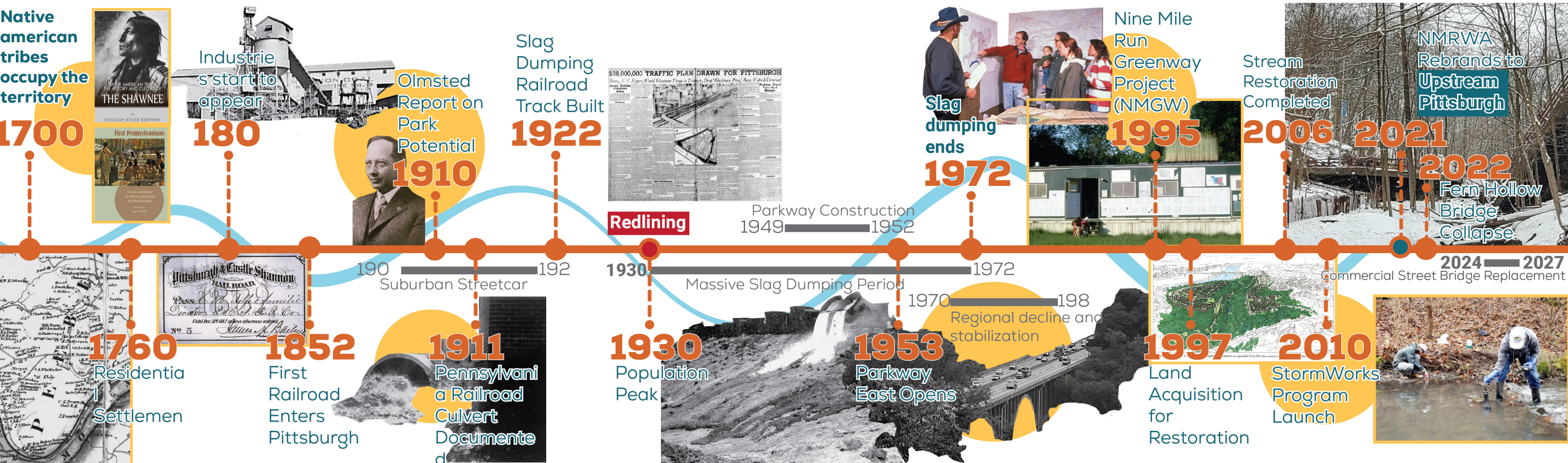
UpstreamPgh has worked since 2001 to protect and restore the Nine Mile Run Watershed, growing out of the Nine Mile Run Greenway Project and early efforts to heal one of Pittsburgh’s most impacted urban streams. From the beginning, UpstreamPgh has recognized that caring for water requires long-term commitment and collaboration across disciplines and communities. Over more than two decades, the organization has brought together residents, planners, artists, engineers, designers, students, and local governments to shape projects that improve environmental conditions while strengthening community stewardship. This work treats relationships and shared responsibility as essential infrastructure, building the capacity needed to care for complex systems over time.

This plan builds directly on that history, carrying forward earlier watershed visions while responding to today’s challenges, and is intended to guide UpstreamPgh’s work over the next 25 years. The sections that follow outline the conditions, priorities, and strategies that shape this watershed-wide approach to renewal and resilience.



RIGHT Crescent Early Childhood Center rain garden construction (UpstreamPgh)





ABOVE Graphic timeline of settlement, development, and infrastructure milestone in Nine Mile Run

A HISTORY OF TRANSFORMATION

The Nine Mile Run Watershed has been shaped over time by successive patterns of settlement, industry, and infrastructure. For thousands of years, Indigenous peoples stewarded a landscape defined by a vast network of streams, wetlands, and forested land. European settlement began in the early 1700s, initially driven by trade, and expanded significantly in the nineteenth century as industrial activity intensified. By the 1800s, quarries and coal operations dotted the northern and eastern portions of the watershed, reflecting the rapid pace of industrial-era urbanization.

Despite early advocacy to preserve open space along the southern portions of Nine Mile Run—as early as 1910—and residential zoning protections adopted in 1923 to limit industrial

uses and protect water quality and habitat, industrial activity ultimately dominated the valley. For more than five decades, Duquesne Slag Company used the area as a dumping ground, burying the stream under industrial waste and causing severe environmental degradation.

In the mid-1990s, a multidisciplinary group of artists, researchers, urban planners, environmentalists, and activists launched the Nine Mile Run Greenway Project. This effort led United States Army Corps of Engineers to undertake what was then the largest urban stream restoration project of its kind in the country, reversing more than a century of ecological damage. Today, the Nine Mile Run Watershed is widely recognized as a model for urban ecological recovery. At the same time,

climate change, increased rainfall, frequent flooding, and aging infrastructure continue to challenge the watershed’s long-term resilience.

Across Pittsburgh and Allegheny County, vulnerability to these challenges is shaped by long-standing environmental injustices. Black and low-income communities have been disproportionately affected by inadequate infrastructure, historic disinvestment, and the ongoing impacts of climate change. These vulnerabilities are especially evident in neighborhoods within the Nine Mile Run Watershed, where outdated stormwater management systems struggle to accommodate intensified rainfall and extreme weather, resulting in chronic flooding, basement backups, soil erosion, and water infiltration.

Redlining practices introduced in the 1930s reinforced these inequities by grading neighborhoods from “A” (best) to “D” (hazardous) based on discriminatory criteria such as race and income, effectively denying investment to Black and immigrant communities and leaving a lasting legacy embedded in today’s infrastructure systems.

Lower-income, Black, and immigrant communities were often limited to more affordable, flood-prone areas, where housing was less desirable and infrastructure was insufficient.

COMMUNITY CONTEXT

Today, historically redlined neighborhoods like Homewood and East Hills, continue to experience challenges such as inadequate stormwater infrastructure and persisting air quality concerns. Many people in the northeastern section of the watershed would be considered the working poor, where an individual spends a significant amount of time in the labor force but is still below the poverty level due to low and stagnant wages.

For example, **East Hills** has a median household income of just \$16,626 far below Pittsburgh’s median, with over half of its renters classified as cost-burdened. Such economic instability leaves limited resources for residents to adapt to water infrastructure failures, such as damp basements or sewer backups.

Homewood’s median household income of \$41,400, combined with its high percentage of elderly residents and single-parent households, exacerbates the community’s inability to manage the costs associated with water infrastructure repair.

Meanwhile, **Wilkinsburg’s** median household income was \$46,553, slightly below Pittsburgh’s median income. In contrast, neighboring Churchill’s median household income was more than 2.5 times that of Wilkinsburg, highlighting the economic disparities between the borough and its surrounding communities.

Swissvale and **Edgewood**, while slightly more economically stable, have also experienced population and economic declines, with increases in poverty rates in Swissvale signaling growing vulnerabilities.

These economic stressors, coupled with aging infrastructure, a physical stressor, put these communities at higher risk for property damage or personal injury during a rain event. There have also been measurable increases in the number and intensity of major rain events across the county, prompting real estate developers and insurance agencies to discount these communities further. Without intentional investment in these areas, the devastation of community flooding and landslides become more of an inevitability. Effective solutions will require targeted investments in green infrastructure, equitable development strategies, and community-led initiatives to address both the physical and socio-economic dimensions of water equity.

Addressing water equity in communities with the greatest need would improve stormwater infrastructure, enhance climate resilience, and restore environmental and human health.

UpstreamPgh’s work involves mitigating the physical impacts of flooding and runoff as well as rectifying the structural inequities that have left these communities more susceptible to diminished quality of life and harm.

Limited economic resources in areas like East Hills, Homewood, and Wilkinsburg make it difficult for residents to address infrastructure issues, while outdated systems exacerbate the risk of water contamination. Homewood’s

outdated housing stock, high impervious surface coverage, and chronic flooding challenges further strain an already economically fragile community. According to the City of Pittsburgh’s Health and High Water report, heavy rainfall and energy inefficiencies can lead to mold growth, increased rates of asthma, and other water-related health hazards. Additionally, East Hills’ high proportion of cost-burdened renters and Wilkinsburg’s economic disparities leave residents vulnerable to displacement and unable to invest in critical repairs. Overall, these systemic challenges create a cycle of environmental degradation and economic instability, disproportionately affecting low-income and predominantly Black communities.

Wilkinsburg, as the largest contributor to the Nine Mile Run watershed, faces its own set of challenges. it’s aging sewer systems and large amounts of impervious surfaces exacerbate stormwater runoff issues which pollute local

waterways and contribute to increased risk of flooding further degrading water quality and public health. The Nine Mile Run Aquatic Ecosystem Restoration Project made significant improvements to stream stability and water quality within Frick Park, but the urbanized areas that drain into Nine Mile Run still contribute large volumes of uncontrolled runoff causing intense peak storm flows, exacerbating struggles with trash management, illegal dumping and erosion.

Systemic disinvestment, demographic shifts, and limited access to resources create economic conditions that hinder their ability to respond to water infrastructure challenges. The lack of sufficient funding for maintenance or upgrades, coupled with aging systems and environmental injustices like discriminatory housing policies, burdens not only the physical infrastructure but also the sustainability of these communities.



	NINE MILE RUN WATERSHED	WILKINSBURG	SWISSVALE	EDGEWOOD	CITY OF PITTSBURGH				ALLEGHENY COUNTY	PENNSYLVANIA
					East Hills	Homewood	Point Breeze	Squirrel Hills		
Population Change % (2000-2025)	-18.99%	-28.29%	-10.97%	-8.18%	-30.05%	-45.30%	-12.90%	2.79%	-2.65%	6.46%
Population Change % (2010-2025)	-7.43%	-12.74%	-7.36%	-0.22%	-10.70%	-18.60%	-7.84%	-0.24%	1.98%	2.93%
Population Change % (2020-2025)	-3.07%	-3.54%	-5.09%	-1.08%	-2.14%	-8.95%	-4.44%	-3.02%	-0.24%	0.55%
2020 Median Age	39.5	39.9	39.0	40.6	32.5	32.3	38.7	38.4	40.2	41.0
2023 Median Household Income	\$61,778	\$46,553	\$64,966	\$102,907	\$16,626	\$41,400	\$103,277	\$109,972	\$76,393	\$76,081
2020 Single Parent Household	8.00%	8.66%	6.09%	3.25%	24.27%	22.89%	3.24%	2.80%	2.52%	2.46%
2023 Renter Households	25.32%	40.14%	25.67%	16.87%	20.05%	20.42%	20.31%	17.85%	15.45%	12.36%
2023 Households in Poverty (%)	17.07%	21.33%	9.00%	2.04%	50.13%	19.26%	4.30%	11.13%	11.89%	12.00%
2023 Cost Burden (Owner)	2.66%	1.64%	3.73%	6.22%	0.08%	1.03%	1.14%	3.16%	3.22%	3.84%
2023 Cost Burden (Renter)	10.70%	17.59%	8.34%	5.08%	12.66%	9.74%	5.49%	6.95%	6.47%	5.45%
2025 Use Asthma Prescription (%)	5.58%	4.98%	4.26%	4.37%	4.42%	4.62%	4.23%	4.13%	5.26%	5.27%
2020 Minority Populations	43.84%	69.32%	34.47%	19.05%	97.61%	96.61%	35.89%	21.10%	19.07%	19.06%

ABOVE The demographic values shown in this chart are aggregate data based on partial census tracts using data apportionment, which distributes data (like population) based on the percentage of settlement points or weighted centroids (blocks) falling within the custom target area. The Municipal and City of Pittsburgh data here reflect the portion of the political boundary within the Nine Mile Run sewershed.

THE ORIGIN AND IMPACT OF UPSTREAMPGH



ABOVE The Re-evaluating Stormwater Plan (1998) redesigned the Nine Mile Run outflow to dissipate the water's energy as it exited the culvert and to provide safe access to the stream for park visitors.

In 1996, artists with Carnegie Mellon University’s STUDIO For Creative Inquiry Bob Bingham, Tim Collins, and Reiko Goto envisioned something extraordinary: turning an industrial waste site near Pittsburgh’s Frick Park into a thriving public green space. The Nine Mile Run Greenway Project brought together a diverse coalition—community members, scientists, artists, government agencies, corporations, educators, and private funders—for a groundbreaking four-year effort that would shape the future of Pittsburgh’s urban ecosystems. This visionary work led to the formation of the Nine Mile Run Watershed Association (now UpstreamPgh) in 2001.

Their impact was profound. The Nine Mile Run Aquatic Ecosystem Restoration Project, completed in 2006, protected and saved a 2-mile stretch of Nine Mile Run

from being enclosed in a culvert during the development of the Summerset at Frick Park housing development. Further, the Nine Mile Run Greenway extended Frick Park to the Monongahela River and became a model for urban stream restoration, celebrated to this day as one of the U.S. Army Corps of Engineers’ most successful and well researched urban stream restorations.

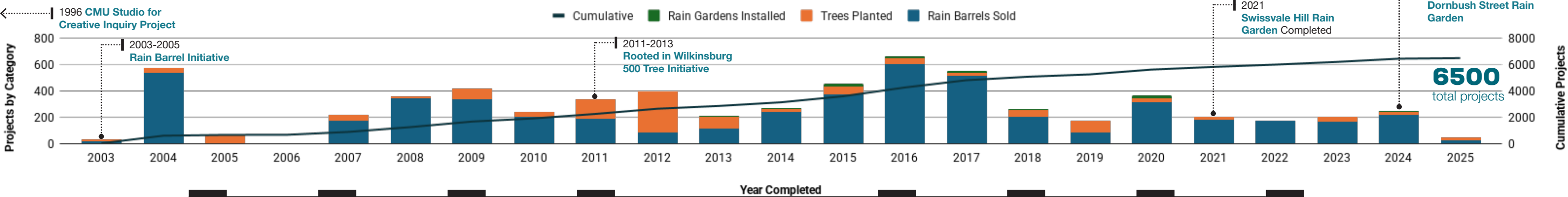
Since then, UpstreamPgh has expanded its focus while staying true to its roots. They have monitored and maintained Nine Mile Run’s restoration area, installed large-scale green infrastructure in the upper watershed, and tackled water challenges across the region, from sewage overflows to contaminated drinking water. In 2020, the organization rebranded as UpstreamPgh to reflect their broader mission.

Today, UpstreamPgh strives to be the region’s leading water resource nonprofit through a three-tiered approach:

- Hyper locally, by deepening our work in the East End’s neighborhoods.
- County-wide, by uniting ecological activism and environmental justice movements.
- Regionally, by advocating for federal investment in the Ohio River basin and headwaters.

At the heart of UpstreamPgh’s work is the belief in connection—between individuals, nature, and communities. Through these time-tested strategies that started it all, UpstreamPgh is using its 25 years of expertise to create healthier ecosystems and communities for future generations.

UpstreamPgh's Completed Projects (2003-2025)



1998	2014-2025	2018	2019	2020	2021	2024	2026
Nine Mile Run River Conservation Plan A foundational document that proposed the ecological restoration of the heavily degraded Pittsburgh stream, advocating for naturalized flood control and watershed health improvements.	RRRP Study A community-based green infrastructure project in the Nine Mile Run watershed focused on installing green infrastructure and control measures to reduce and slow the volume of stormwater runoff contributing to local flooding and sewer overflows.	Nine Mile Run Watershed Forest Master Plan Established a strategic framework to leverage the watershed's existing urban forest as a critical piece of green infrastructure for managing stormwater runoff, improving stream health, and fostering municipal coordination across the communities.	Nine Mile Run Hydrology Report Created an essential GIS-based modeling tool to accurately map stormwater runoff and calculate peak flow estimates across the entire watershed, to strategically identify and prioritize sites for implementing Green Stormwater Infrastructure.	Nine Mile Run Environmental Equity Study Combined data on social vulnerability, public health, and environmental quality to strategically prioritize locations for green infrastructure projects where they would have the greatest social and environmental impact in under-served communities.	Negley Run Environmental Equity Study A Green Stormwater Infrastructure Suitability Index made up of public health, social vulnerability, and flood risk data, to ensuring that future environmental investments are prioritized in the most historically under-served neighborhoods.	Fern Hollow Vision Plan Since the Bridge collapsed in 2022 UpstreamPgh has worked with Neighborhood Allies Social Impact Design team on a community-led vision plan that incorporates placemaking, ecological restoration and accessibility into two project locations within the Fern Hollow Valley.	Fern Hollow Creek Comprehensive Water Resources Master Plan Building off of the Fern Hollow Vision Plan, and in partnership with the U.S. Army Corp of Engineers, City of Pittsburgh and Ethos Collaborative, this project aims to restore flow and function to Fern Hollow Creek and guide future restoration projects.

A LEGACY OF TRANSFORMATION

UPSTREAMPGH'S PAST PROJECTS

\$15,023,381

in state and local grants raised

105

green infrastructure projects built

1,269

trees planted

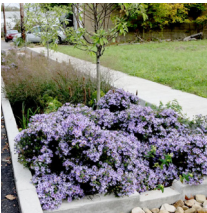
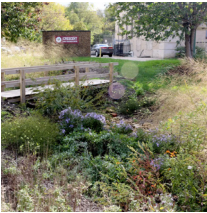
5,126

rain barrels installed

7,095,000

gallons of water managed

RIGHT PAGE Past projects completed by UpstreamPgh (interactive map can be found here: <https://evolveea.maps.arcgis.com/home/item.html?id=9d7159b8df74455baeebf9d1326299e>)



Dornbush | The Dornbush Green Stormwater Infrastructure Project was completed in the Spring of 2024. This project intercepts an estimated 1.7 million gallons of runoff, 0.11 pounds of Nitrogen, 0.25 pounds of Phosphorous and 0.0351 tons of sediment annually from Dornbush Street, the 2nd steepest street in Pittsburgh. This project was made possible through funding from the Pennsylvania Department of Environmental Protection Growing Greener grant program, the Heinz Endowments and the Urban Redevelopment Authority of Pittsburgh.

Crescent School | The Crescent Early Childhood Center Rain Garden was built as part of the Rosedale Runoff Reduction Project. Completed in 2017, the \$117,815 design and construction project was funded by PA Department of Environmental Protection, Richard King Mellon Foundation, and The Heinz Endowments.

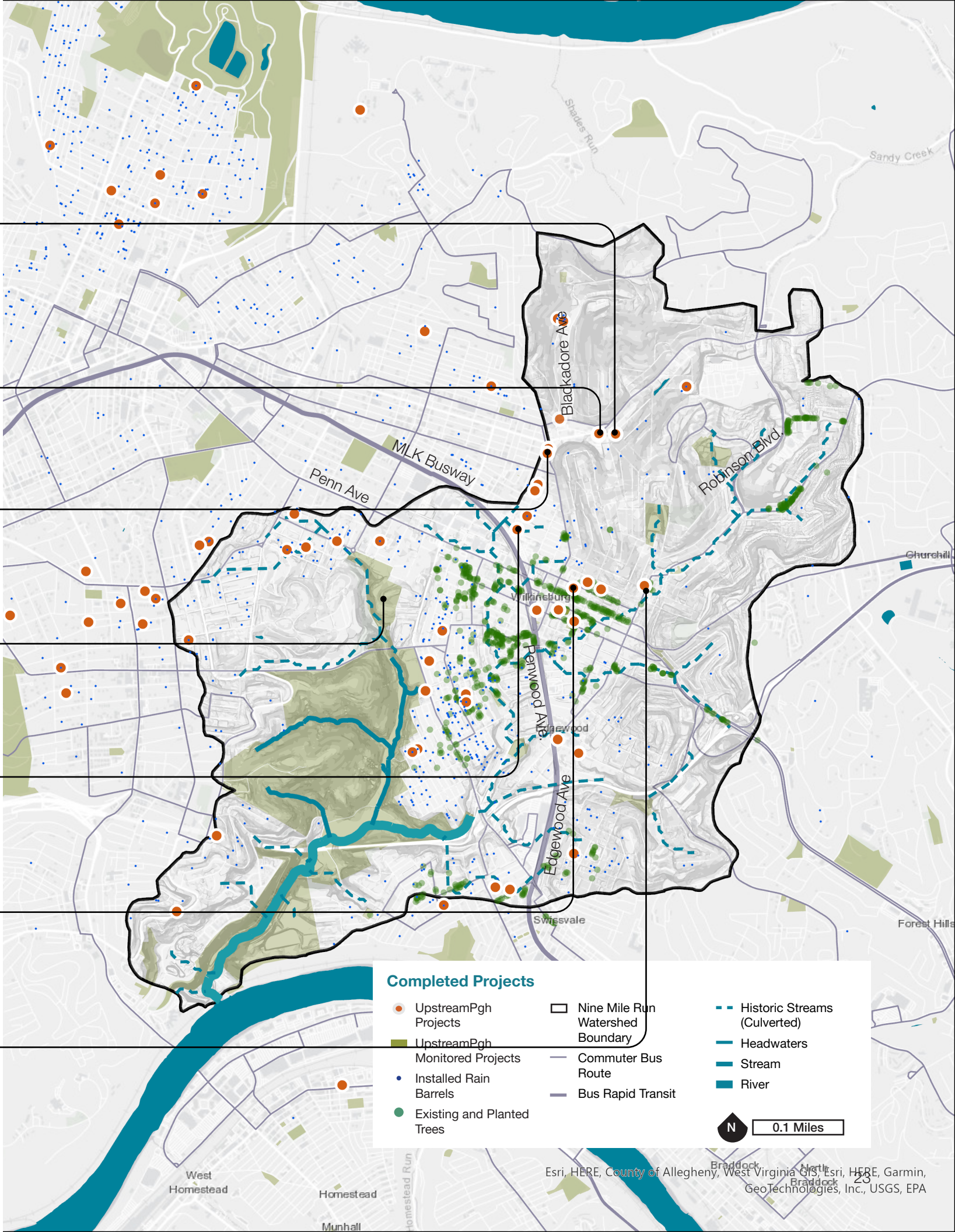
Oakwood-Batavia | This project was completed in 2016 as part of the Rosedale Runoff Reduction Project. This project was funded by the Commonwealth Financing Authority, Richard King Mellon Foundation, and The Heinz Endowments.

Fern Hollow Restoration | Building off of the Fern Hollow Vision Plan, and in partnership with the U.S. Army Corp of Engineers, City of Pittsburgh and Ethos Collaborative, this project aims to restore flow and function to Fern Hollow Creek. This actionable and comprehensive plan will guide future restoration projects in Fern Hollow.

Rosedale Hill | The Rosedale Hill Gardens were completed in the Fall of 2021 but began in 2017. Two once vacant lots were transformed into a community space with funding from Operation Better Block Neighborhood Partnership Program sub-grant, URA Neighborhood Improvement Fund grant, and Love Your Block grant.

Wilkinsburg Stormwater Resilience Project | In an effort to reduce stormwater runoff in the Wilkinsburg Business District, two large publicly owned municipal parking lots have been retrofitted with rain gardens and bioswales in place of concrete medians. Phase I – South Avenue was completed in 2023, and Phase II – Wallace Avenue in 2024. Combined, these project manage 1.7 million gallons of stormwater, 2.8 pounds of Nitrogen, 3.4 pounds of Phosphorous and 8.8 tons of sediment annually.

Swissvale Hill | Completed in September of 2021 this project is located on 3 vacant lots owned by the Borough of Wilkinsburg. The total cost of this project was \$125,000, including design and construction, which was only possible through generous funding from the Richard King Mellon Foundation and the Heinz Endowments.



BY THE NUMBERS

Numbers calculated below are an aggregate of data collected for each project site.

Water Capture Opportunities

- 183 vacant lots¹
- 3.8 million sf impervious area²
- 99,066 ft streetscape²
- 10 parks & open spaces¹
- 6 parking lots¹
- 81 parcels in public ownership¹

Environmental Justice Considerations

- 43.4% employment³
- 68.4% renters⁴
- \$37,400 median income⁵
- 4,471 impacted residents²
- 60% area historically redlined⁶
- 22.3% cost burdened households²

[1] Allegheny County Real Estate Assessment, 2025
[2] Consultant Team, 2025
[3] American Community Survey, Civ. Pop Employed 16+, 2023
[4] American Community Survey, Renter Households, 2023
[5] American Community Survey, Median HH Income, 2023
[6] University of Richmond's Digital Scholarship Lab

A FUTURE OF REGENERATION
UPSTREAMPGH'S RIPPLE PLAN

Water Capture Districts

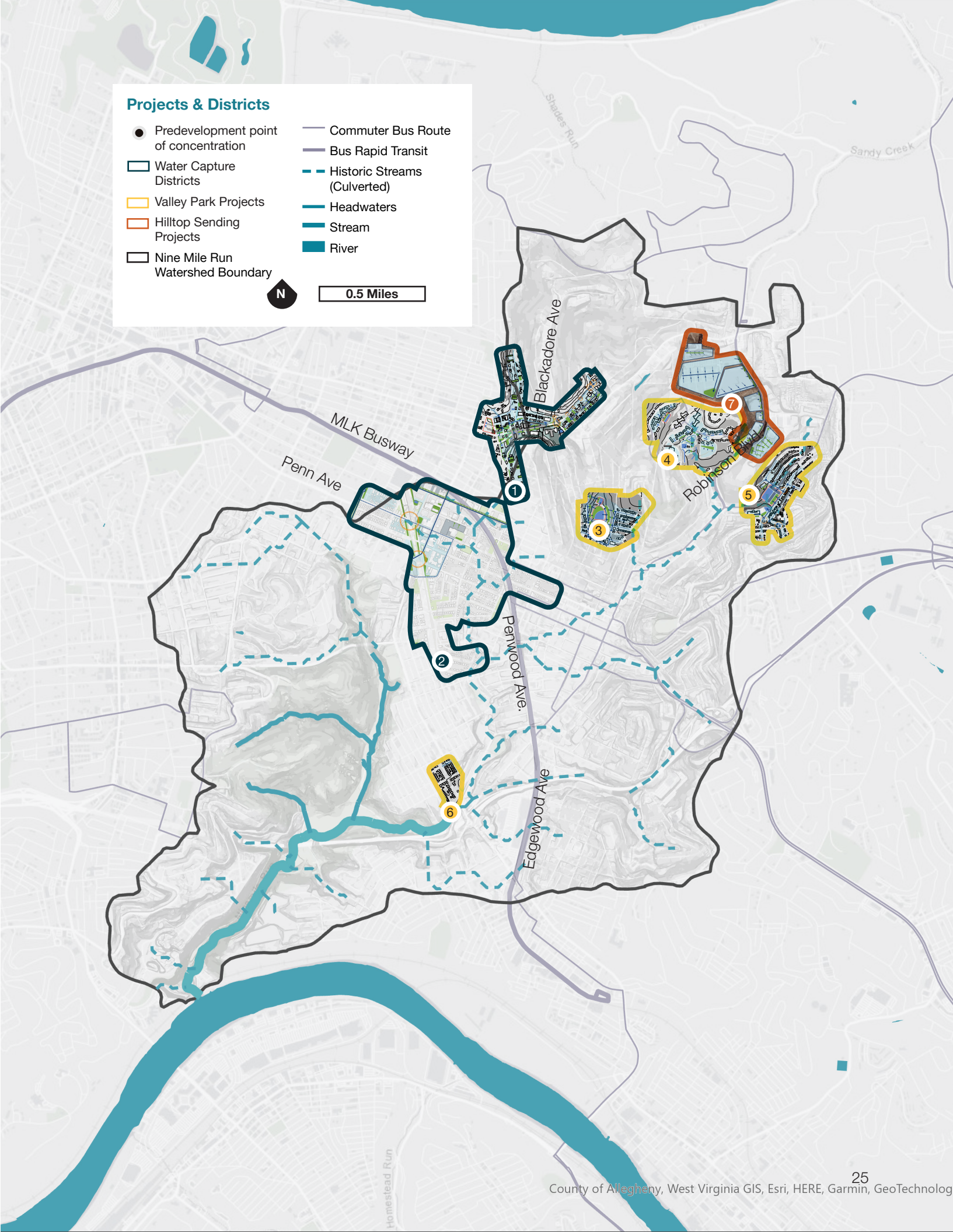
- 1 Frankstown-Bennett Water District
Frankstown-Bennett is a busy corridor where roads, businesses, and buried streams concentrate stormwater, contributing to flooding and sewer backups. Improvements along streets, parking areas, and nearby open spaces can extend UpstreamPgh's existing efforts to manage stormwater and can make a safer, more walkable district.
- 2 Rockwell Park to Wilkinsburg Water District
Rockwell Park to Wilkinsburg is a relatively flat area with light industrial and main street commercial uses and is the largest impervious area in the shed. Increased investment and redevelopment can be directed to support new open spaces, street improvements, and private property upgrades to create a connected network of green stormwater infrastructure.

Valley Park Projects

- 3 Hunter Park
Hunter Park is a neighborhood park where rainwater naturally flows, making it an ideal place to manage stormwater in ways people can see and enjoy. The park is slated for investment, where the community can engage in the design of play areas and fields that capture on site stormwater as well as water from the adjacent properties and right-of-ways.
- 4 East Hills Park & Park Hill Drive
East Hills Park and Park Hill Drive include a school campus, park space, and surrounding homes where rainwater moves quickly downhill, contributing to erosion and flooding. The community is engaged in planning improvements to school grounds, park areas, and streets. This project can capture stormwater on site and from nearby roads and properties.
- 5 Turner Intermediate School
Improvements to the schoolyard, fields, parking areas, can store on-site rain as well as capture runoff from nearby roads. The community has identified a need for field upgrades, making this an ideal opportunity for visible learning and environmental benefits for students and the surrounding neighborhood.
- 6 Nine Mile Run Outflow
The Nine Mile Run Outflow is where stormwater from across the watershed exits the culvert and becomes an open channel stream within Frick Park. Improvements at and upstream of this location can reduce concentrated discharges that contribute to infrastructure damage while creating a more welcoming and visible entry to the park and celebrate the restored Nine Mile Run.

Hilltop Sending Properties

- 7 Hilltop "Sending" Properties are private properties at the highest points of the watershed that generate significant stormwater runoff, including large parking lots, vacant parcels, and vehicle storage areas. Private investment in green infrastructure reduces runoff at its source and helps relieve pressure on sewers and flooding downstream.



HOW WE CHOSE OUR PROJECTS

The POSSIBLE-PROBABLE-PREFERRED framework guided project selection by exploring opportunities, assessing likelihood, and identifying priorities for implementation.

POSSIBLE



All POSSIBLE projects were mapped to find a wide range of future opportunities informed by physical, social, and economic trends.

Possible scenarios were studied through computational suitability analysis, GIS-based environmental justice analysis, landscape structure and patterns, and most importantly, the community's experience of water-related issues.

PROBABLE



Next, infrastructure, performance and policy trends were analyzed to identify PROBABLE projects — ones that were likely to occur or most urgently needed.

The probable phase identified projects that have momentum, including those with committed stewards, available or emerging funding, institutional support, or strong community advocacy that make them most likely to move forward. Projects without momentum but of great importance, are also elevated.

PREFERRED

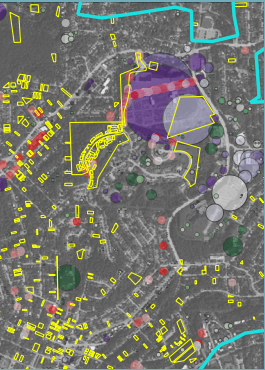


Photo Credit: John Moyer

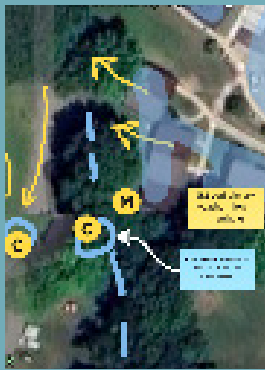
Lastly, the technical analysis, community values, and environmental goals were synthesized to select PREFERRED projects.

The preferred projects matched UpstreamPgh's and its partners' capacity to implement and maintain the infrastructure and addressed community needs. The project team identified the policies, partnerships, and resources needed for long-term success.

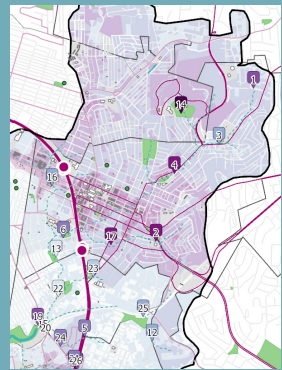
Computational analyses identified opportunities



The GROUND Method examined landscape structure and patterns



Environmental justice analyses mapped social issues



The POSSIBLE phase identified shed-wide Green Stormwater Infrastructure typologies and community criteria.

Community & Partner Engagement

- Community watershed survey
- Community focus groups
- Opportunities mapping survey

Shortlisted projects



Policy review



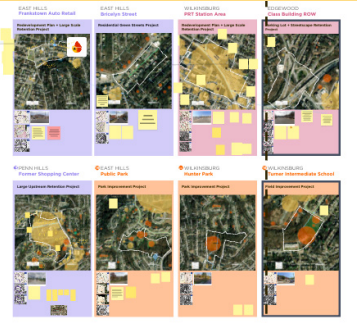
Community input



The PROBABLE analysis refined these opportunities into a short list of projects.

Community & Partner Engagement

- Municipal focus groups
- Target neighborhood interviews
- Community watershed survey (continued)
- Opportunities mapping survey (continued)



PROJECT EVALUATION CRITERIA

- Improve downstream water issues
- Solve adverse upstream water-related issues.
- Improve human and ecological health.
- Increase economic opportunity.
- Create culturally restorative places.

The PREFERRED phase prioritized project areas where coordinated action could begin.

Community & Partner Engagement

- Public open houses
- Site walks and sidewalk chats
- Community watershed survey (continued)
- Opportunities mapping survey (continued)

Computational Analysis

The Computational Analysis identifies high runoff areas and sites that could receive stormwater.

Opportunity Factors

- Impervious surfaces
- Flow accumulation patterns
- Flat or gently sloped areas
- Soils with moderate to high infiltration potential
- High sun exposure (solar aspect)
- Vegetated areas
- On-site paved areas (parking lots, plazas etc.)
- Right of way paved areas (streets, alleys, sidewalks etc.)

Exclusion Factors

- Dense tree canopy
- Existing buildings
- Cemeteries
- Wetlands
- Railroads

Integrating geospatial analysis and satellite imagery builds a foundation for computational analysis to identify physically suitable GSI areas, and their degree of feasibility. The consultant team have defined “opportunity factors” and “exclusion factors”, which are combined to calculate a ranked, aggregate score for the buildable area. Opportunity factors are infrastructural or environmental features that have the physical capabilities to host GSI and those that experience varying environmental degradation. Exclusion factors define areas that do not have the infrastructural or environmental capabilities to host GSI.

The buildable area is defined as the multiplicative product of six binary exclusion factors. An area must pass all six tests to be considered buildable.

1. Not Buildings- Excludes existing building footprints
2. Not Roads- Excludes road rights-of-way (for non-streetscape types)
3. Not Cemetery- Excludes cemetery parcels
4. Not Wetlands- Excludes mapped wetlands
5. Tree Canopy- Excludes areas with dense canopy (see below)
6. Not Railroad- Excludes railroad corridors

The result is binary where 1 indicates buildable land and 0 indicates excluded land. All subsequent suitability composites are multiplied by this mask, ensuring that excluded areas receive a score of zero regardless of other factors.

Opportunity Factors in the computation are statistically normalized and reclassified to a 0-to-1 scale.

Calculated Project Opportunities

There are three typologies of Green Stormwater Infrastructure that are identified using this analysis:

Depaving and Retrofits.

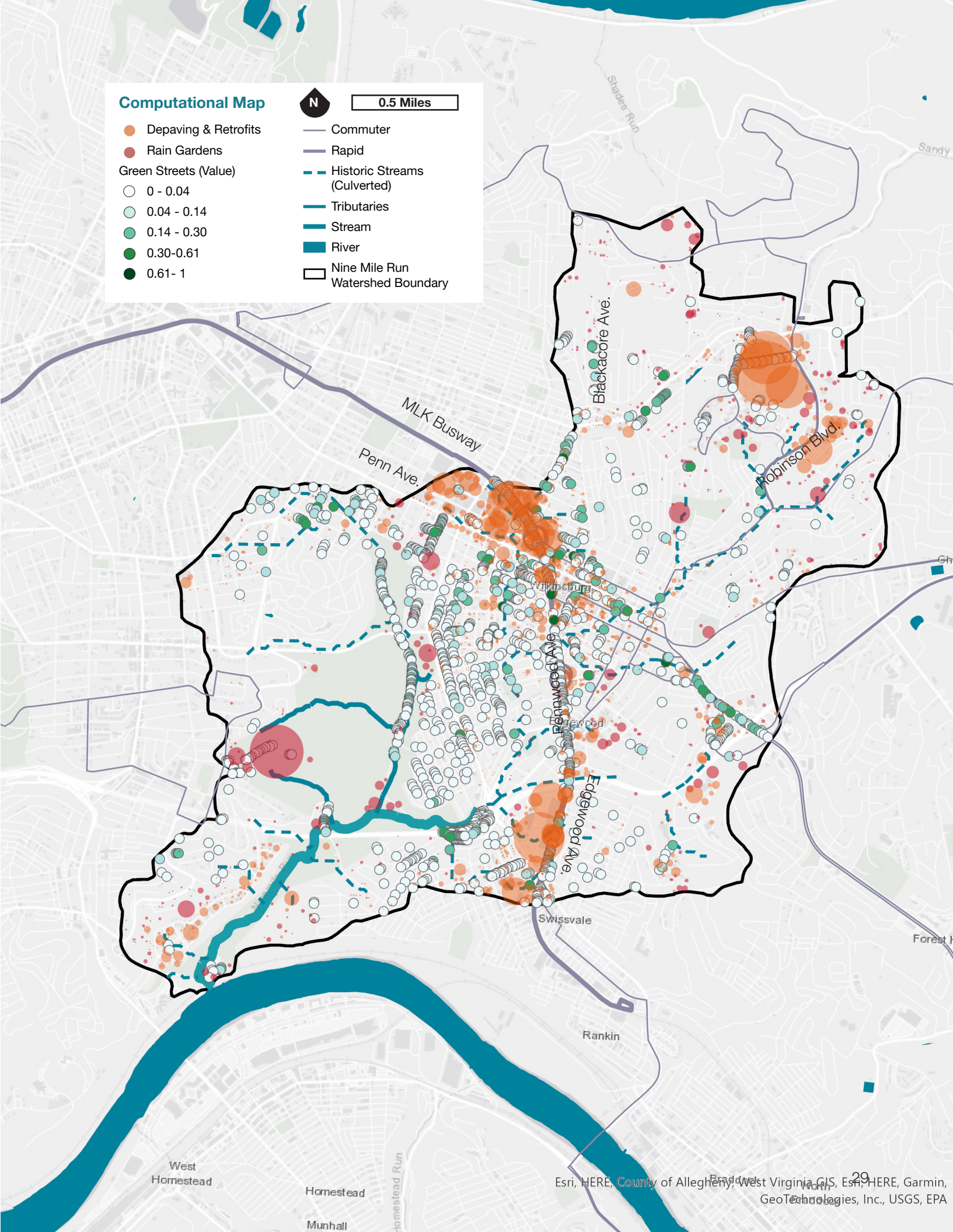
Depaving opportunities target existing paved surfaces (excluding roads and buildings) within the buildable area. These points identify areas with impervious percentage at or above 70% that are neither roads nor buildings. Slope is included to favor sites where grading and drainage modifications are practical.

Rain Gardens.

Rain gardens and bioretention facilities require open, vegetated land with adequate solar exposure, moderate-to-gentle slopes, and soils capable of supporting infiltration. These points identify buildable area and the flow accumulation layer at the given scale. The weighting prioritizes slope as the dominant physical constraint, with solar exposure and soil permeability as secondary factors.

Green Streets.

Green street interventions target existing road corridors. Because these projects occur within the road right-of-way, the buildable area (which excludes roads) is not applied. These points identify road segments where stormwater flow accumulates and slopes permit curb-cut or bioswale installation.



GROUND Method Analysis

The GROUND Method identifies spatial trends that gauges water performance in data-scarce areas.

Evaluation Factors

- Topography
- Hydrology
- Slope, soils, and vegetation
- Imperviousness
- Density and land use
- Parcel ownership
- Zoning and regulations
- Investment & development activity
- Infrastructure
- Governance and administration

The GROUND Method—short for Go Review On-site Urban + Natural Dynamics—examines the physical structure of a watershed to understand how it functions. By analyzing historic and existing topography, hydrology, and development patterns, it reveals how water moves and interacts with the built environment, including dynamics that are not always visible at the surface.

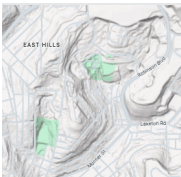
The method identifies hydrological typologies—areas with similar landforms and infrastructure that behave alike during rain events—helping explain patterns of flooding, sewer backups, and erosion across

the watershed. These typologies also inform design, maintenance, and management strategies by showing where similar solutions are likely to be effective.

In this plan, the GROUND analysis identified four stormwater management areas with distinct green infrastructure strategies. Combined with environmental justice analysis and the prioritization tool, the method helped focus investment on practices and locations most likely to succeed while defining the structure of the watershed as a connected system rather than a collection of isolated sites.

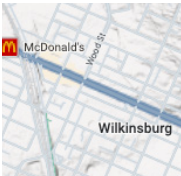
Hydrological Typologies

There are four hydrological typologies that describe the structure of this watershed:



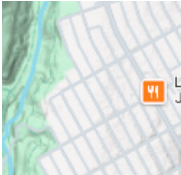
Upper shed valley networks.

Narrow valleys and steep hillsides in the upper watershed with larger subshed areas. Stormwater moves quickly through these areas, often causing localized flooding and sewer backups. Individual parcels are typically poorly suited for on-site retention, making networked systems necessary to capture and manage runoff effectively.



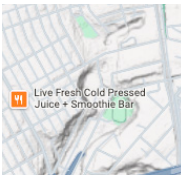
Low slope commercial district.

Relatively flat, privately owned commercial areas with high impervious surface coverage. Flooding and backups are typically localized but may be less acute than in steeper areas. On-site stormwater and right-of-way retention is technically possible but often economically challenging, requiring supportive policies, incentives, or cost-sharing programs to reduce upfront costs.



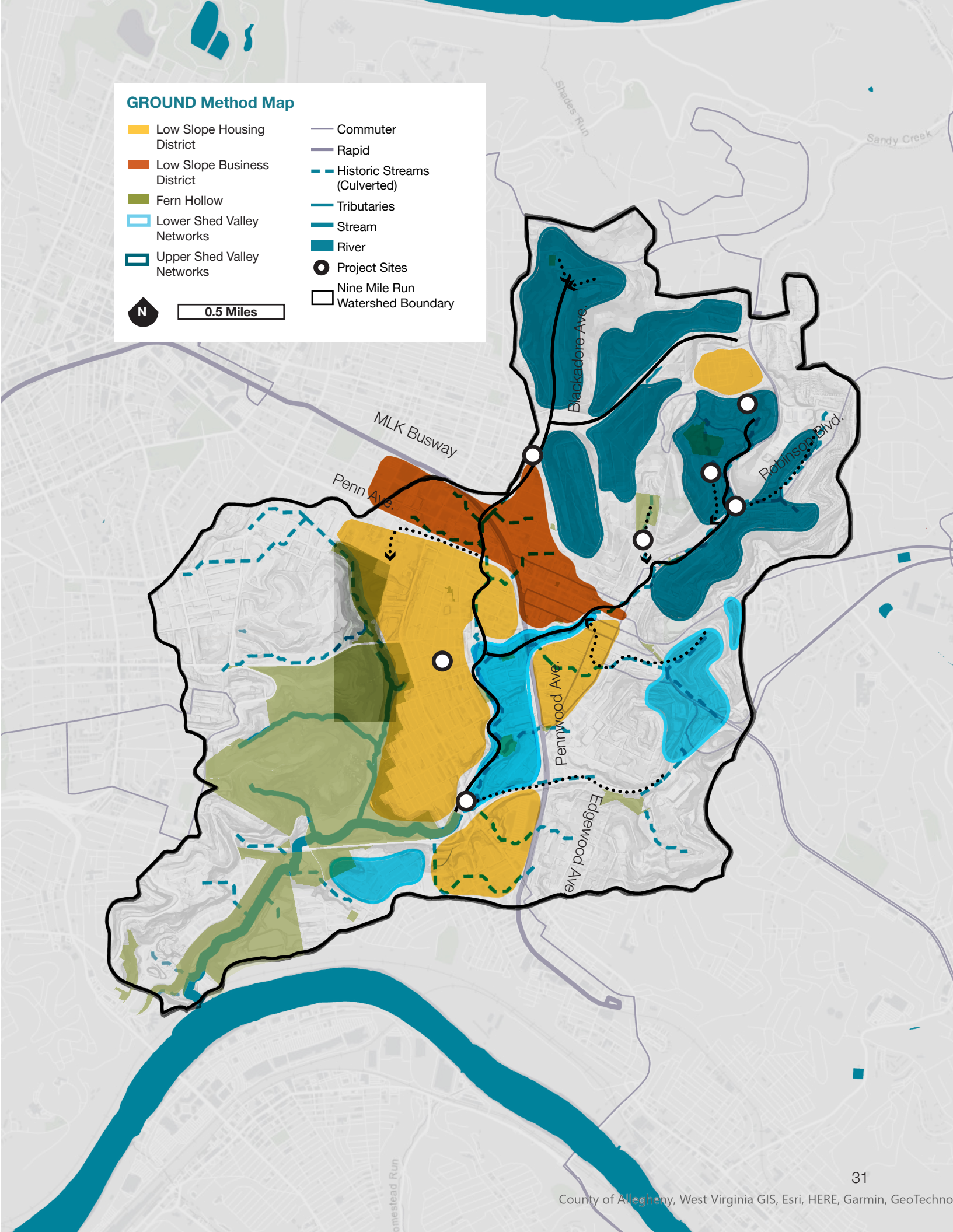
Low slope residential district.

Relatively flat, primarily privately owned residential areas with yards and low lot coverage. Flooding and sewer backups tend to be localized. On-site and right-of-way stormwater retention is feasible, and investment in green stormwater infrastructure is more likely where property values are higher. Networked systems are generally less viable due to limited slope and lower availability of public open space to receive the water.



Lower shed valley network.

Small valley systems in the lower watershed with relatively limited subshed areas. These areas experience flooding and sewer backups as runoff concentrates. Adjacent parcels may retain some stormwater, but coordinated, networked systems are more effective for capture and storage. In some locations, proximity to the open stream creates opportunities for redirection and restoration.



Environmental Justice Analysis

The Environmental Justice analysis shows where water-related impacts fall hardest on people and communities.

Ecological Vulnerability Factors

- Proximity to industry
- Within a floodplane
- Basement back ups
- Areas prone to landslides

Economic Vulnerability Factors

- High unemployment rate
- Low median income
- High percentage of renters
- Cost burdened homeowners
- Cost burdened renters
- Redlined communities

While UpstreamPgh is known as a an advocate for stormwater management best practices, what sets the organization apart is its commitment to facilitate a positive relationship between people and water. In addition to addressing the geographic factors that contribute to flood prone areas, it is important to understand the personal impacts of flooding that put a strain on this relationship.

This analysis quantifies the ecological and economic household factors, where living near an abundance of water will leave them vulnerable to negative impacts. Vulnerability refers to the degree to which individuals and communities are exposed to environmental stressors and lack the capacity to anticipate, cope with, and recover from their impacts—particularly those related to water systems.

Throughout Allegheny County, vulnerability is deeply rooted

in systemic environmental injustices; Black and marginalized communities are disproportionately affected by aging infrastructure, historical disinvestment, and the compounding effects of climate change.

Within the Nine Mile Run watershed the hillside areas that have long experienced flooding and erosion are also the areas found to have the greatest number of compounding Environmental Justice factors. These areas would gain the most from strategic interventions that reduces flood risk, enhances public spaces, and, most importantly, creates resilient systems that address long-standing infrastructure challenges.

Long-term success will depend on strong relationships with residents, community organizations, and municipal partners, and aligning site-based solutions with funding opportunities to maximize impact across the watershed.

Environmental Justice Themes

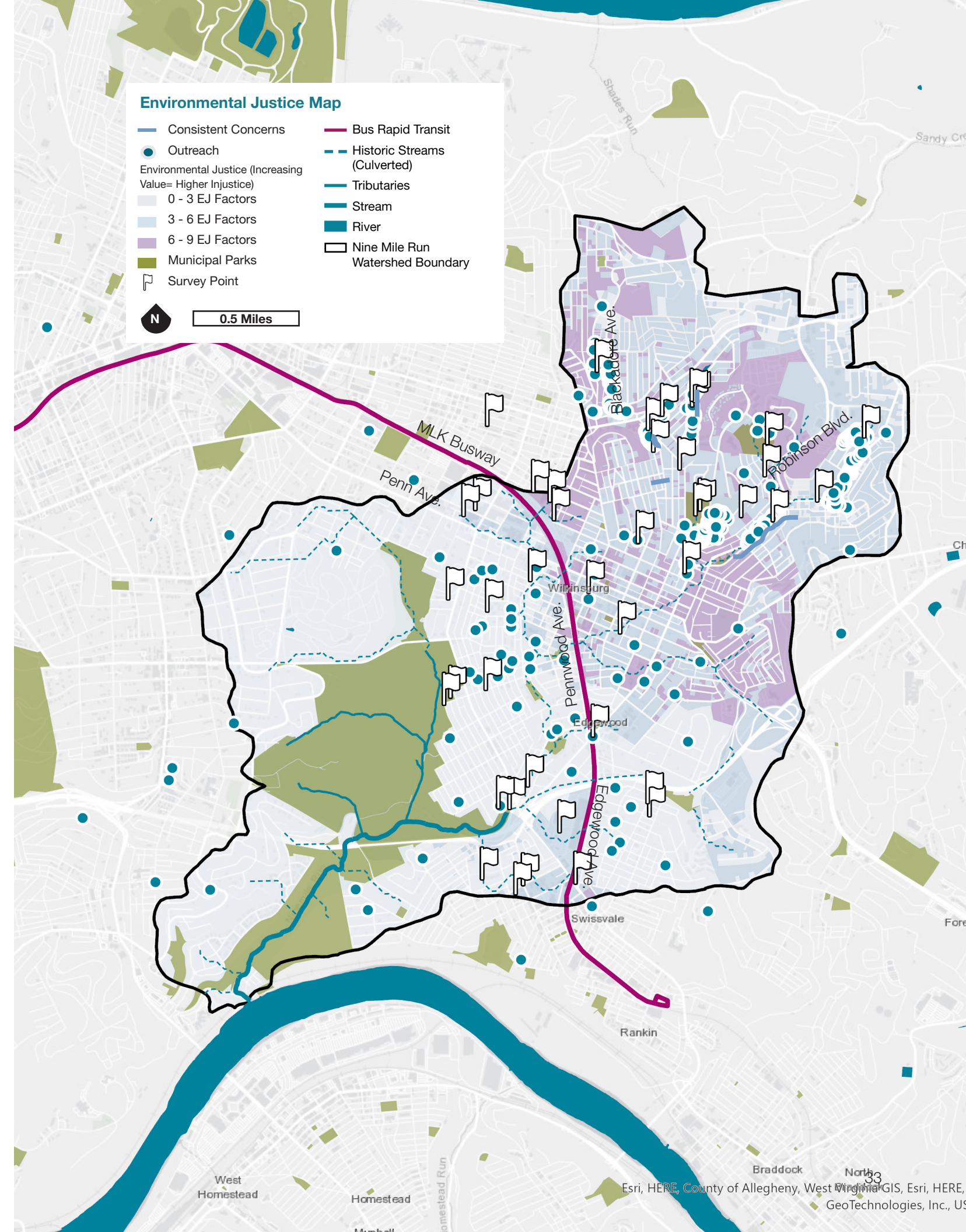
Based of data gathered from the site analyses, community surveys, and intentional outreach indicate, here are some recommendations:

Continue engaging residents who have already participated in this process
Especially those that are directly impacted and best positioned to offer critical insights as projects evolve. Their lived experience brings forward additional solutions and ensures that proposed strategies respond to real, ongoing challenges.

Prioritize projects that directly serve communities facing the greatest need
Particularly those that have endured chronic flooding, decades of delayed investment and having to abandon their homes as a result. These communities should no longer be asked to wait while climate risks intensify and infrastructure continues to fail.

Communities should not be financially burdened
Consider the long-term maintenance and upkeep of future projects; every investment must include a dedicated budget and sustainability plan to ensure solutions remain effective, affordable, equitable and be held accountable over time.

Advance solutions that protect water quality across the watershed
Ensuring the safety of rivers and the drinking water systems that the region relies on daily.



Community Feedback

As of December 2025

Over the summer, UpstreamPgh went to over 200 homes to hear about the water places and water priorities that are most meaningful to the people who live there.

This map displays public survey data points from the two surveys distributed as part of the public input process. The issue based Watershed Survey is marked by the blue dots, where UpstreamPgh canvassed and received responses about how residents perceived their watershed issues. The place-based Opportunities Survey is marked by white flags, and are tagged to locations that were residents saw potential opportunities or challenges for stormwater management.

The team's efforts were concentrated around the environmental justice areas in the north-eastern section of the watershed. While the survey was open to anyone who would like to participate, the project team focused a door-to-door effort on the residents who live within walking distance of shortlisted project opportunities. It was important to not only select high impact project sites, but to hear first hand accounts for those who are most impacted.

Engagement events include:

- 4

Interested partner meetings
- 01

Public open house
- 22

Community pop up meetings
- 04

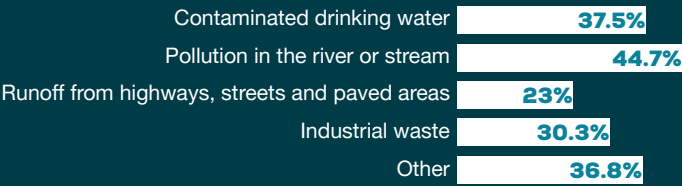
Municipal focus groups
- 230

Doors knocked
- 63

Survey respondents from canvassing

Community Watershed Survey Highlights

What specific environmental issues most concern you regarding water quality in the watershed?

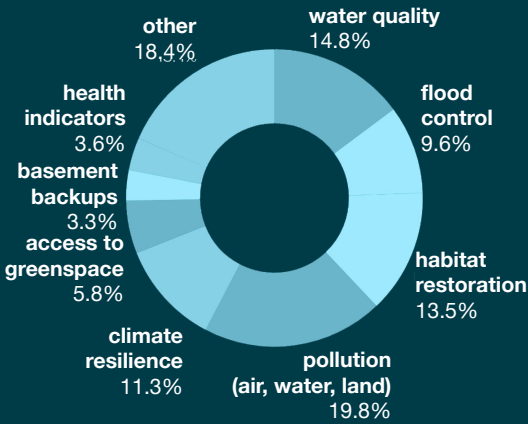


What type of solutions or actions do you think would be the most effective in addressing comments or concerns about environmental justice in your watershed?

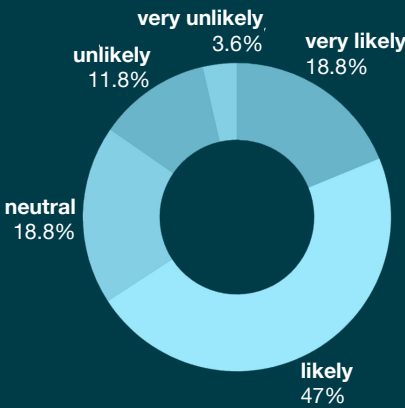


What types of environmental issues do you think should be addressed first in your area?

Residents who selected "Other" noted abandoned homes, loose trash and pest infestations (eg. raccoons an rats) as their most concerning environmental issue.



In your opinion, how likely is it that your neighborhood will experience flooding in the next year?



Community Feedback Map

- Consistent Concerns

Watershed Survey Participant Locations

Watershed Opportunity Map Locations

Municipal Parks

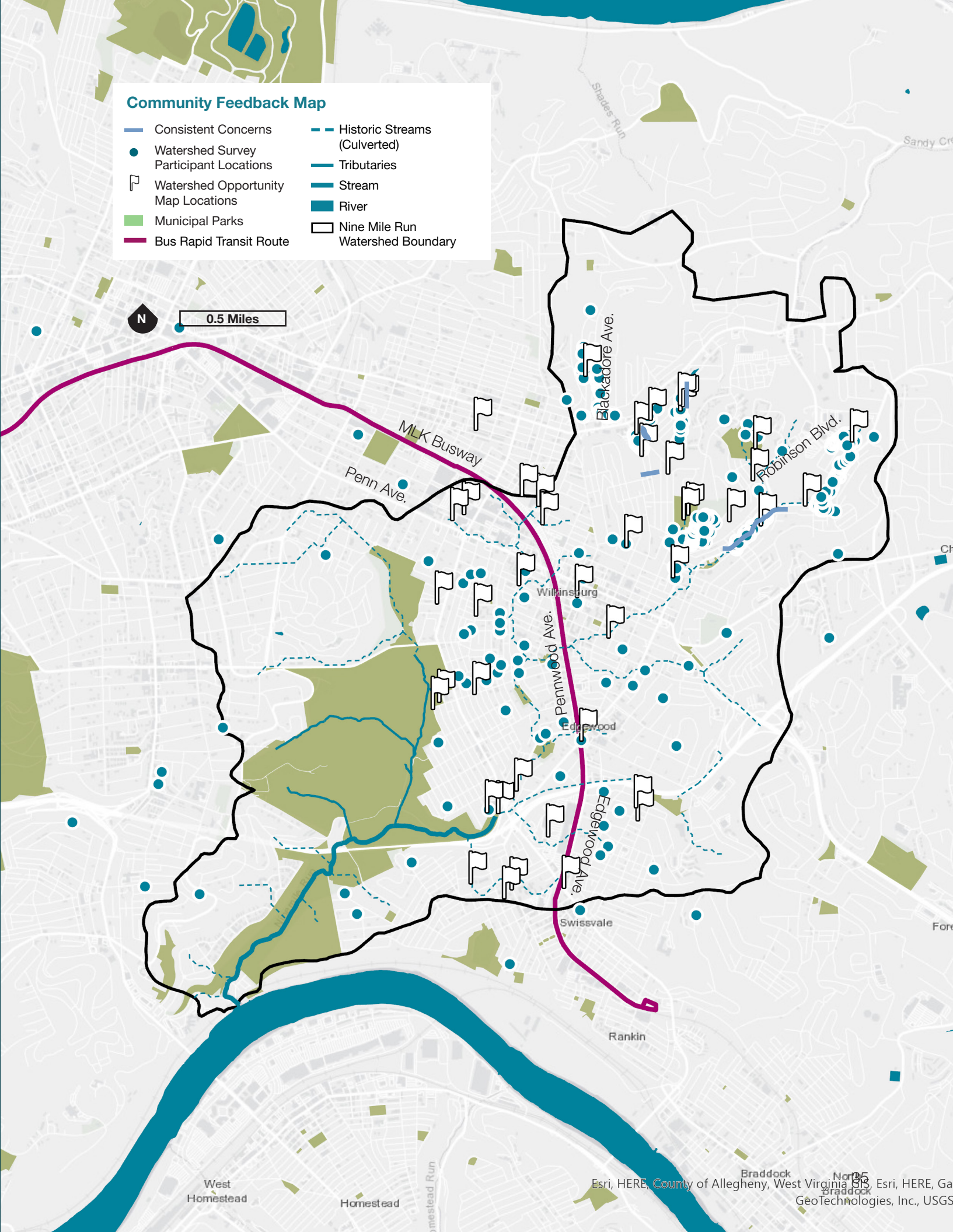
Bus Rapid Transit Route
- Historic Streams (Culverted)

Tributaries

Stream

River

Nine Mile Run Watershed Boundary



WHAT IS A GREEN STORMWATER INFRASTRUCTURE NETWORK?

Structuring A GSI Shedwide System

Many individual properties or sites have limited ability to store or infiltrate significant volumes of stormwater, due to steep slopes, constrained spaces, and soil limitations. As such, networked GSI that chains together numerous small GSI projects, presents an impactful and compelling alternative with regards to site selection. Networked GSI facilities distribute storage over a larger geographic area, while simultaneously providing managed conveyance links for overflow / flood mitigation during large storms and reduced volume / improved treatment trains during smaller ones. In essence, networked GSI functions as a microshed, with the size determined by the capture area, the availability and capacity of the receiving site, and natural hydrological patterns such as overland drainage patterns, small channels, street gutters, and similar, that define the drainage network that can connect to it.

Ecological and urban systems can be complex, preventing municipalities and agencies from ultimately reaching a meaningful scale for neighborhood and regional stormwater management.



ABOVE Wightman Park in Squirrel Hill (Ethos Collaborative, Pashek)

Managing shedwide GSI installations as a system can help standardize design practices, construction details, and long-term maintenance needs.

Networked and Non-Networked GSI

The UpstreamPgh projects distinguish between networked and non-networked green stormwater infrastructure (GSI) to clarify how individual interventions contribute to watershed-scale outcomes.

Non-networked systems such as individual, isolated rain gardens, green roofs, and parking lot retrofits, manage runoff at the site level, reducing localized flooding and improving infiltration. These installations are often implemented during redevelopment or as small public projects, providing visible environmental benefits but limited cumulative impact given their isolated nature.

Non-networked projects often serve as demonstration sites that build local support, while networked systems require coordination across properties, agencies, and funding sources.

In contrast, **networked systems** connect multiple GSI elements through rights-of-way, open spaces, or coordinated sub-watershed planning. By managing water as a linked system rather than as a series of discrete fixes, networked GSI can store and convey runoff more efficiently, relieve pressure on sewers, and restore hydrological continuity. These systems also open opportunities for multi-benefit design—integrating mobility, habitat, and public space improvements.

Wightman Park in Squirrel Hill is an example of a networked system. Right of way conveyance and green infrastructure was paired with GSI improvements in the Park that allowed storm water runoff from 1.25 acres to be captured and treated in the park before it could enter the sewer system. These improvements reduced basement backups and localized street flooding in the area and improved a beloved neighborhood park.

Networked GSI can also be instrumental in addressing projected climate impacts by allowing designers to effectively maximize / optimize performance of new facilities, which in turn can reduce storm-related burdens and extend the lifespan of existing storm sewer infrastructure.

In cities like Pittsburgh, much of the constructed below-grade storm infrastructure was constructed between 1900 and 1920, predating modern design codes and best practices. As a result, areas throughout the city where sewer and flood infrastructure is chronically undersized, experience patterns of frequent flooding, basement backups and sewer capacity issues, even without future climate considerations.

In addition, even infrastructure that was designed to relatively recent design standards, set between 1970 and present, can be problematic with regards to projected climate-influenced precipitation patterns. These design standards are typically based on historic data, and do not take into consideration the impacts of future climate projections with regards to flooding, landslides, erosion, and urban heat island effects.

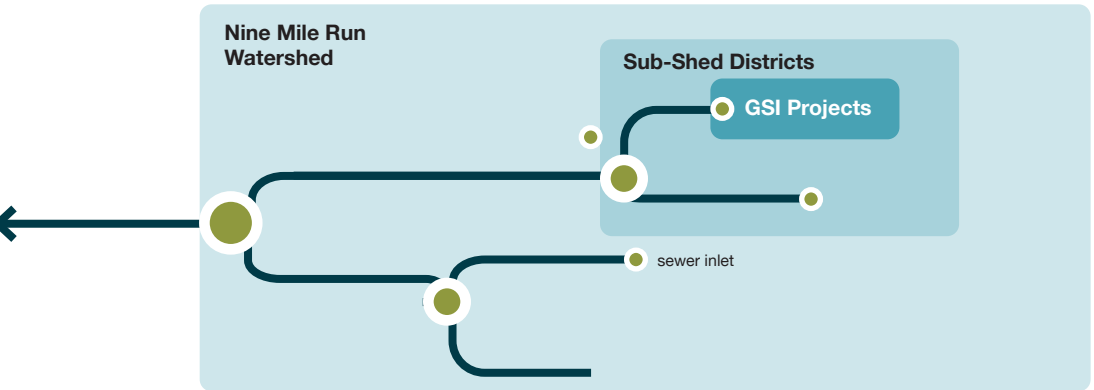
Networked and non-networked GSI form the foundation of a distributed, shedwide infrastructure strategy—one that scales individual actions into measurable watershed resilience. However, implementing GSI at this scale is not just a technical challenge. The greatest limitations are often scale and stewardship: how systems are organized, maintained, and supported over time.

This raises three guiding questions for implementation:

- What is the optimal scale for managing stormwater as a system?
- How can maintenance and operations be coordinated and sustained?
- Who is best positioned to implement and steward these systems over the long term?

Municipalities exhibit varying levels of stringency in their stormwater codes, with some demonstrating more progressive approaches than others. Most notable is the institution of a stormwater fee, which collects a fee based on the number of gallons sent into the sewer system, and is exclusively used to repair and replace aging catch basins. Advocating that a portion of this fee be directed toward Green Stormwater Infrastructure (GSI) development significantly influences municipal GSI implementation and positions UpstreamPgh to serve in a supportive and advisory capacity rather than as the primary developer.

Network scale and stewardship strategies shape how UpstreamPgh and its partners shift from individual projects to managing a watershed system.



Green Stormwater Infrastructure (GSI) Technologies

Green stormwater infrastructure can be managed within a property's boundaries or within the public right-of-way. Here are some typical infrastructure types.

ON-LOT INFRASTRUCTURE



Rain Barrels. A rain barrel is a water tank used to collect and maintain rainwater runoff, usually from the rooftops through the rain gutters. The collected water can be used for several non-potable water uses, such as: garden irrigation, flushing toilets and car washing.

Pros: Simple and relatively low-cost to install, conserves water for irrigation, reduces runoff from rooftops, and increases public awareness of water stewardship at the household level.
Cons: Overflow during large storms, requires regular maintenance (cleaning, winterizing, mosquito prevention); improper installation can lead to leaks, foundation issues, or stagnant water problems.



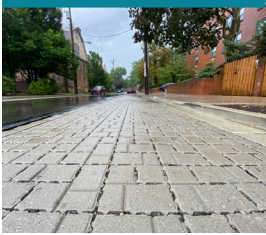
Bioswale. A linear vegetated channel that slows, filters, and conveys stormwater, often located along streets, parking lots, or other paved corridors. Bioswales use engineered soils, vegetation, and gentle slopes to promote infiltration, remove pollutants, and reduce runoff volumes.

Pros: Visibly manages runoff, improves water quality, and enhances streetscape ecology with native plants.
Cons: Requires adequate space, proper grading, and consistent maintenance; volunteer care can vary in quality, while professional management demands multiple installations with standardized planting for efficiency.



Street Trees Sidewalk Improvements. Tree trenches and permeable sidewalk systems that capture runoff while supporting urban canopy growth. These systems require engineered soil volumes, root paths, and subsurface drainage to balance tree health with stormwater performance and structural stability.

Pros: Provides shade, air quality benefits, and visible green infrastructure.
Cons: Root-infrastructure conflicts and ongoing care costs can be challenging; performance depends on proper design, soil conditions, and long-term maintenance.



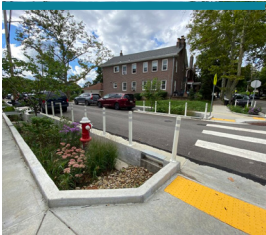
Porous Paving. Permeable asphalt, concrete, or modular pavers that allow water to pass through to underlying soils or below-grade conveyance systems. These surfaces are designed with structural layers that store and slowly infiltrate runoff, reducing peak flows and improving water quality.

Pros: Reduces surface runoff and supports groundwater recharge while maintaining usable pavement; can improve existing drainage and surface conditions.
Cons: Susceptible to clogging without regular maintenance; performance can decline in freeze-thaw climates; porous street paving requires a specialized cold-weather maintenance regimen.



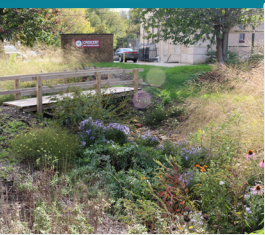
Below Grade Conveyance. Pipes or engineered channels that redirect stormwater underground to manage flow or connect multiple GSI sites. These systems must be designed to maintain adequate slope, capacity, and access points for inspection and maintenance while preventing sediment buildup and hydraulic bottlenecks.

Pros: Efficiently moves water away from flood-prone areas; adaptable to existing networks.
Cons: Hidden and expensive to maintain; offers no visible community benefit; disruptive and costly; ownership is unclear.



Street Curline Conveyance. Curblines channels or “street creeks” direct runoff toward inlets, storage areas, or green infrastructure systems. These systems must be hydraulically engineered so that water flow is within traffic safety limits during minor storms, while still conveying to inlets or downstream BMPs.

Pros: Cost-effective and visible system that simplifies maintenance and reduces underground infrastructure; allows controlled surface flow to green infrastructure.
Cons: Requires precise grading and frequent cleaning; limited capacity for large storms and potential safety or icing issues if not properly designed.



Rain Gardens. Small, bowl-shaped planting areas that collect and infiltrate runoff from roofs, driveways, or other impervious surfaces. These systems rely on engineered soils and native vegetation to filter pollutants and promote groundwater recharge while providing localized flood reduction.

Pros: Cost-effective, visually appealing, and supports pollinator habitat; can be integrated into residential and community-scale landscapes.
Cons: Limited storage capacity; performance depends on soil conditions and proper grading; maintenance often falls to volunteers, and professional management requires many installations with standardized plantings to ensure efficiency.



Below-Grade Storage. Underground chambers, tanks, or modular systems that temporarily hold stormwater before infiltration, treatment, or controlled release. These systems are typically used where surface space is limited and can be integrated with other infrastructure such as parking lots or streets.

Pros: Maximizes storage capacity in dense urban areas; hidden from view, preserving usable surface space; helps meet regulatory storage and release requirements.
Cons: Expensive to install and maintain; provides little ecological or aesthetic benefit; requires regular inspection to prevent sediment buildup and ensure functionality.



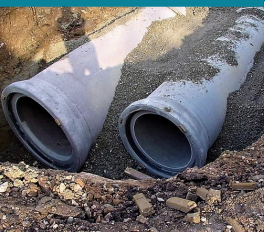
Street Bump-outs Curb extensions. These systems are designed with curb cuts, engineered soils, and underdrains to collect, treat, and slowly release runoff while also calming traffic and improving pedestrian visibility.

Pros: Improves pedestrian safety and adds visible green infrastructure.
Cons: Can reduce on-street parking and complicate snow removal or traffic flow; requires careful grading and coordination with utilities to function effectively.



Green Alleys. Retrofits of alleyways using permeable paving, drainage channels, or vegetation to absorb and filter runoff. These systems typically require subgrade reconstruction and coordination with existing utilities to ensure adequate infiltration, load-bearing capacity, and long-term performance.

Pros: Utilizes underused spaces for stormwater management; can enhance neighborhood aesthetics and reduce localized flooding.
Cons: Access constraints and buried utilities can limit feasibility; construction can be disruptive and costly, and maintenance responsibilities may be unclear.



Separated Storm System. Infrastructure that separates stormwater from sanitary sewage, reducing combined sewer overflows. These systems require dedicated stormwater pipes, inlets, and outfalls, and must be carefully coordinated with existing utilities to ensure proper flow routing, slope, and maintenance access.

Pros: Greatly improves water quality and system reliability.
Cons: Costly and disruptive to install; limited opportunities for ecological enhancement, cannot re-enter the combined system to be effective (possible when low in the watershed or near an open channel).



Water Integrated Public Art. Design features that merge artistic expression with functional stormwater capture, conveyance, or display—such as sculptural basins, interactive fountains, or visible drainage channels. These installations integrate into plazas, parks, or building frontages within the urban environment.

Pros: Enhances public spaces while performing stormwater functions; raises awareness of water systems and sustainability goals.
Cons: Requires close coordination among artists, engineers, and maintenance staff; can involve higher upfront costs and specialized upkeep.

PUBLIC RIGHT-OF-WAY INFRASTRUCTURE