

Swan Creek Restoration and Resilience

JUNCTION NEIGHBORHOOD

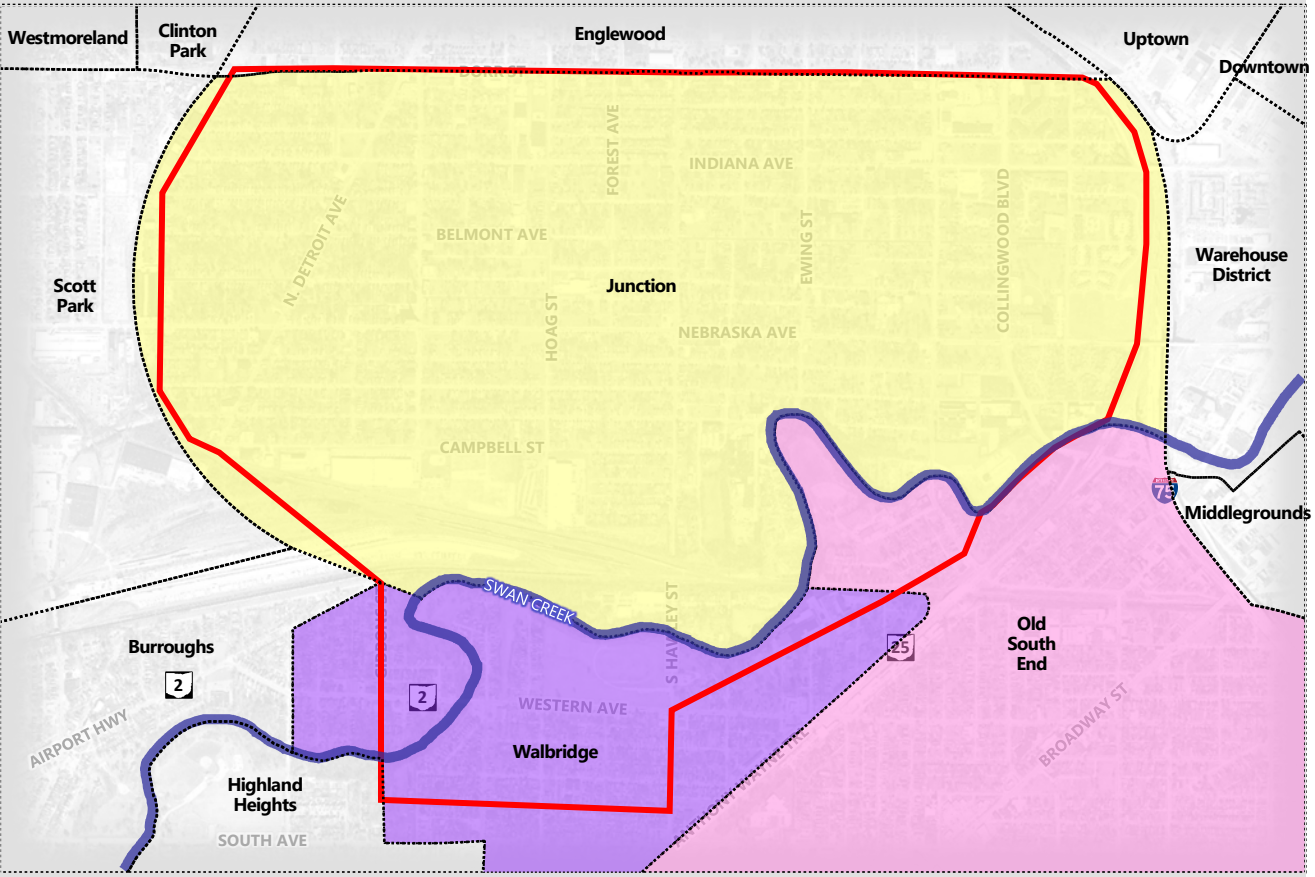
Planning Project

Action Plan

April 2026

NATIONAL FISH AND WILDLIFE FOUNDATION

Project Area



- Junction
- Old South End
- Walbridge
- Swan Creek
- NFWF Boundary | Area of Interest

The Junction Neighborhood (Junction) is a historic, predominantly residential and small-business neighborhood in Toledo with deep cultural assets. Home to more than 7,000 residents across approximately 4,700 residential parcels, with somewhere between 1,300 and 1,700 parcels or 27-37% considered vacant.

The NFWF project area includes the Junction neighborhood, as well as a portion of the Old South End and Walbridge neighborhoods. The project area is located south of Dorr St. and encircled by the Norfolk Southern Detroit Line to the west and I-75 to the east. The Southern boundary encompasses Swan Creek and follows the general trajectories of Curtis Street, South Hawley Street, Colton Street, and Gibbons Street.

Funding Acknowledgement

Project was funded through the National Fish and Wildlife Foundation (NFWF) National Coastal Resilience Fund 2023 which awarded a $607,944.97 grant with matching contributions of $27,840.00. (Easy Grants ID: 80496)

The plan also outlines how further funding support under the NFWF grant program or other federal, state, or local programs, will be sought.

Table of Contents

Project Area | Funding Acknowledgement 1

Overview 3

Project Partners & Stakeholders 4

Project Team & Consultants 5

Executive Summary 6

Planning Process 10

Existing & Future Conditions 17

Hydrologic Analysis 27

Site Selection & Prioritization 41

Conceptual Designs and Recommended Action 45

Next Steps 56

Nature-Based Solutions "Toolkit" 63

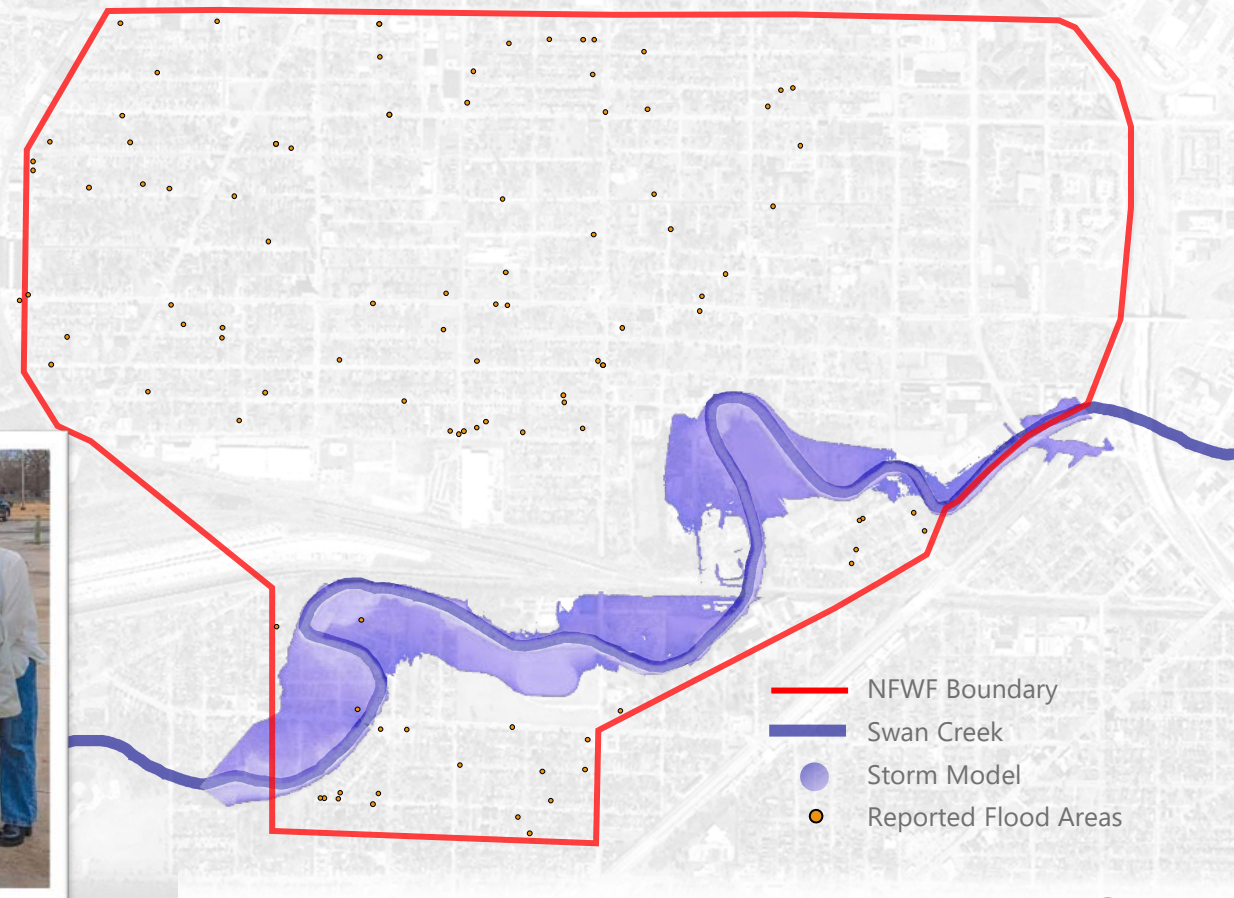
Overview

A Nature-Based and Community-Informed Strategy for Resilience and Revitalization, prepared by The Mannik & Smith Group, Inc. (MSG) in partnership with EDGE, the Junction Coalition, Toledo Design Collective and local stakeholders. Tasked with assessing the Junction Neighborhood's vulnerability to climate hazards associated with heat and flooding, MSG used hydrologic modeling, existing data, and extensive engagement with the community to identify 10 nature-based, actionable projects to strengthen resilience.









Project Partners & Stakeholders

LUCAS SOIL & WATER CONSERVATION DISTRICT

TRUST FOR PUBLIC LAND™

Ohio Environmental Protection Agency

TMACOG

Anthropocene Alliance

NATIONAL WILDLIFE FEDERATION™

TOL City of Toledo

- Economic Development
- Parks and Youth Services
- Plan Commission
- Public Utilities | Division of Environmental Services

Partners for Clean Streams

METROPARKS TOLEDO

Junction Neighborhood Ambassadors

LUCAS COUNTY Land Bank

Project Team & Consultants

THORNTON BUCKEYE GROUP
EXPERIENCE. INTEGRITY. RESULTS.

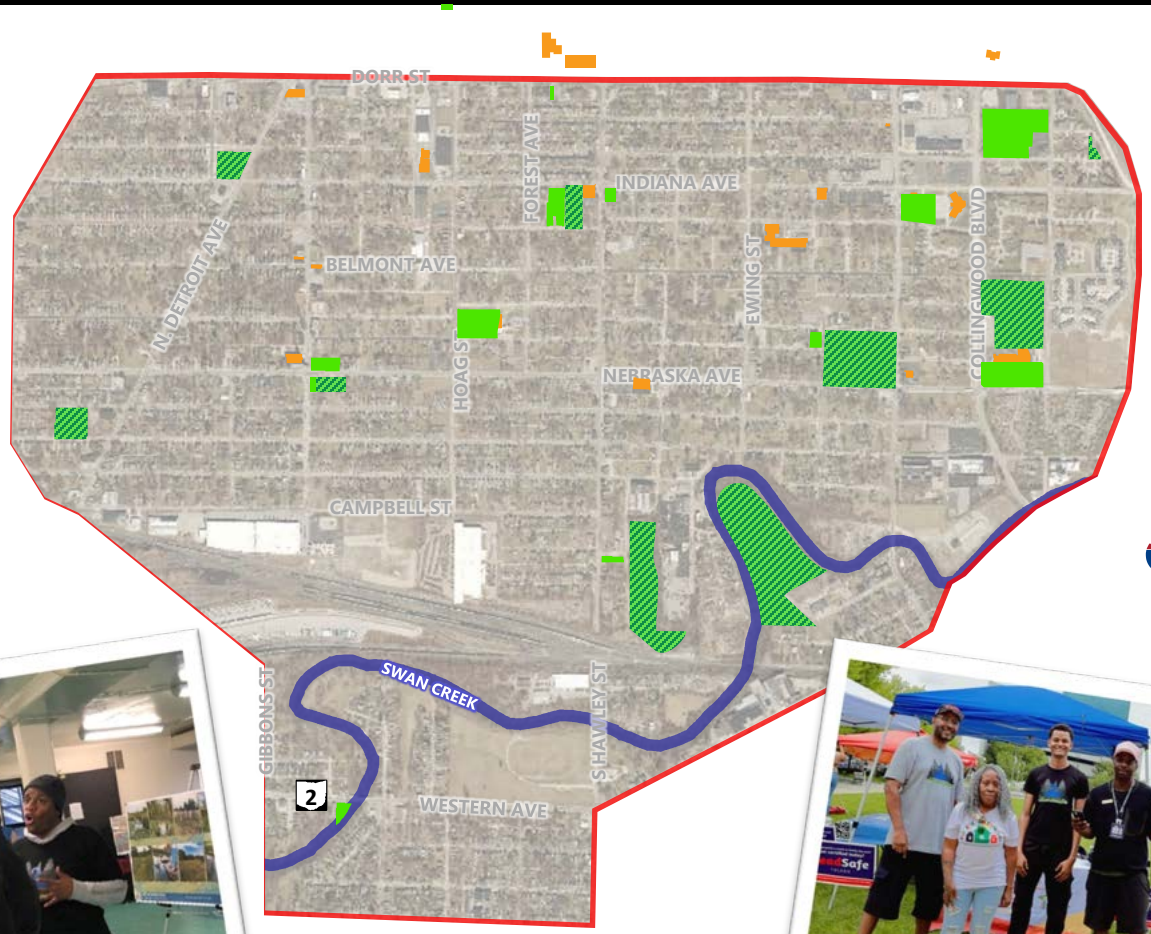
ORANGE ROCK CONSULTING

Mannik Smith GROUP

Toledo Design Collective
URBAN PLANNING & DESIGN

EDGE

Executive Summary



- NFWF Boundary
- Swan Creek
- Extents (2.1 Square Miles)
- Parks
- Greenspace
- Community Anchors



Swan Creek, which is actually a river, is a vital part of the Junction Neighborhood, forming its southern boundary. While the river is currently polluted and prone to flooding, its restoration and the identified complementary projects could offer significant benefits to the neighborhoods. They could reduce flood risks, improve water quality, and create green space. The projects outlined in this plan would enhance resilience by better managing stormwater and mitigating climate impacts, while also providing an educational resource on environmental stewardship for schools and community centers.

The Junction Neighborhood is a historic residential and commercial district in Toledo, made up of a tight-knit, engaged populace with significant interest in maintaining their community identity through redevelopment opportunities. The strength of the community is evident in its public and private gathering spaces, including its parks, churches, community centers, and other crucial community anchors. This Junction Resilience Action Plan responds to chronic infrastructure, natural, and social vulnerability by identifying ten natural and nature-based solutions to reduce stormwater impacts, cool neighborhoods, and stabilize commercial and residential areas. The strategic program emphasizes community co-benefits, green jobs, recreation, and improved neighborhood amenities, and lays out a phased prioritization, potential solution locations, and data-driven areas of concern recommended to be addressed in coordination with project partners.

Community Planning

Junction has been the subject of more planning efforts than any other Toledo neighborhood. As such, this effort was built on foundations laid by the hard work of many dedicated and informed individuals. The intention of this plan is therefore to reflect the community feedback and conclusions found in previous efforts and provide specific, actionable solutions to the hurdles that stand in the way of this community's resilient future. Among others the following plans have been considered:

2015 Junction Greening Plan



The Junction Neighborhood's southern boundary is defined by Swan Creek and over 90 acres of active and abandoned industrial land. The land in the western end of the industrial corridor is home to active businesses due to the accessibility of the rail line and major truck routes. However, industrial parcels east of Hawley consist primarily of abandoned businesses and scrap yards. The majority of these parcels between Hawley and Ewing are in private ownership and offer little opportunity for greening or redevelopment. However, a 7.5-acre area east of Ewing and along Swan Creek consists of contiguous vacant industrial and residential parcels that are publically owned. The entire area has become a dumping ground for construction materials, tires, and other unknown wastes. The abandoned industrial parcels nearest the river contain sediments contaminated by industrial activity. Due to the costs of demolition and cleanup of contaminants, these properties will likely never redevelop and will continue to be a drain on the community. The location of these parcels within Swan Creek's floodplain also makes redevelopment unlikely.

Swan Creek Access

Flexible, low-cost greening designs that will stabilize the site, prevent further blight, and make the site appealing to future small-scale investment.

Innovative stormwater management integrated with redevelopment plans

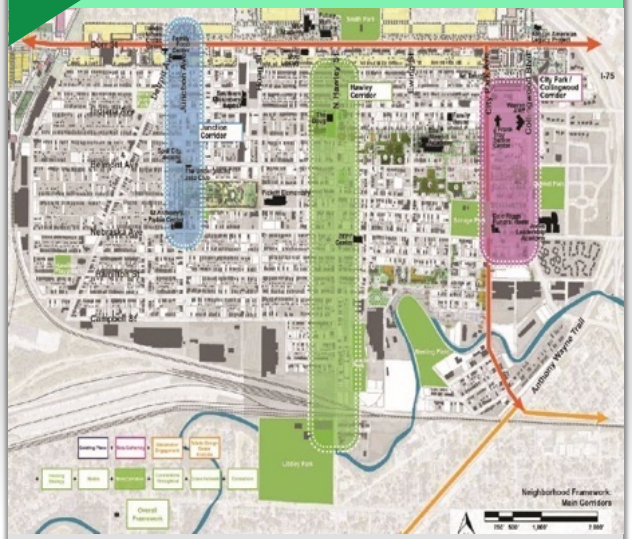
Identify long-term use during redevelopmentplanning process

COMMUNITY VISION - Although this area was identified as the most challenging location in the neighborhood, it is also the most in need of rehabilitative work. Analysis of vacant parcels identified these parcels as highly suitable for natural area restoration, which could include a combination of floodplain restoration, reforestation, and native species plantings. The Junction Coalition views the area along Swan Creek as an opportunity for reconnecting the community and the greater Toledo Area with its waterways while also restoring a portion of Swan Creek's natural hydrology. Remediation of the creek's industrial legacy would allow for recreational use and connectivity for future water trails. Like many of the region's Metroparks, it could offer outdoor recreational activities such as canoeing, bird watching, and fishing. Educational opportunities are numerous and include a living laboratory for the four neighborhood schools, stewardship programs, and a first-hand look at the city's industrial history.

In 2015 Swan Creek was identified as an opportunity to reconnect the neighborhood with its waterways while restoring the creek's natural habitat. Cleaning up its industrial past would allow for outdoor activities and water trails. Like other Metroparks, it could provide recreation for all ages and learning opportunities.

Credit: TMACOG / US EPA

2018 Junction Master Plan



The 2018 Neighborhood Plan highlighted three key corridors connecting the community to important locations and services, actively being used by the neighborhood: Junction, Hawley, and City Park/Collingwood. These corridors, each with a different focus, extend from Dorr Street in the north to Swan Creek in the south.

Credit: TDC

2018 Junction Master Plan



The main corridor, Hawley Street, that transects the center of the neighborhood, connects Swan Creek and terminates at four underused green spaces: Sterling Field, Landers' Park, and Libbey Park. By using Swan Creek, these spaces can be connected, encouraging outdoor activity, improving community well-being.

Credit: TDC

The Forward Toledo Plan is a community-driven land-use guide for Toledo's next 10-20 years. It highlights the Junction Neighborhood tree-planting project and federal funding for 10,000 trees. Trees can play a role in the reuse of vacant or undeveloped land, promoting vacant land reuse, like for the Swan Creek Corridor.



Credit: City of Toledo

Improve Tree Canopy — SUSTAIN 6

Urban forests and wooded areas provide the greatest positive impacts on wellbeing. However, a single tree planted can provide many benefits. A maple tree with a 24" caliper has the potential to remove 4,335 lbs. of CO2 from the atmosphere, absorb 25,391 gallons of rainwater, filter 28.9 lbs. of air pollution, and save 1,355 KWHs of electricity over the course of twenty years.[3] However, many of these benefits are not realized until the tree has matured. City policies and guidelines for plantings and urban greening should be reviewed with this consideration in mind.

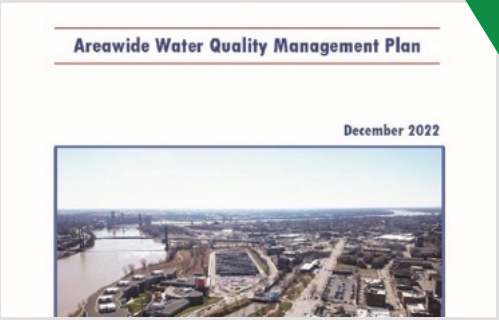
Communities across the United States, including Toledo, have started to take additional action to strengthen this natural resource. Trees Atlanta and the Greening of Detroit are two examples to highlight. However, more could be done to protect existing trees with an emphasis on trees in the public right-of-way or preserving trees on sites that are ready for commercial development. Cities like Ann Arbor, MI and Columbus, OH have policies in place that either protect existing trees or require replacement if trees are removed for development.

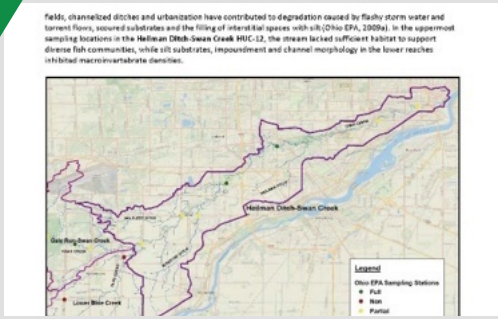
Trees also play a role in the reuse of vacant or undeveloped land. This is especially important because residential and vacant land account for nearly 75% of a city's tree canopy (see **Promote Recreational Opportunities** or **Improve Park Access** for more detail).[4] As of 2023, The City of Toledo has made a commitment to plant more than 2,000 trees in streetscapes and partnered with Metroparks on an urban reforesting project that will plant 15,000 trees using a combination a federal funding resources.[5] The City also received $6.1 million in federal funds to plant 10,000 trees in low-income neighborhoods and enhance the urban tree canopy.[6] This is in addition to local efforts like the Junction Neighborhood planting project.

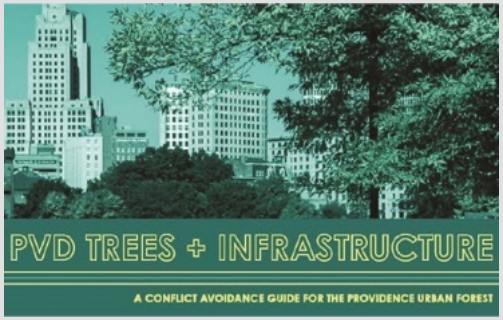


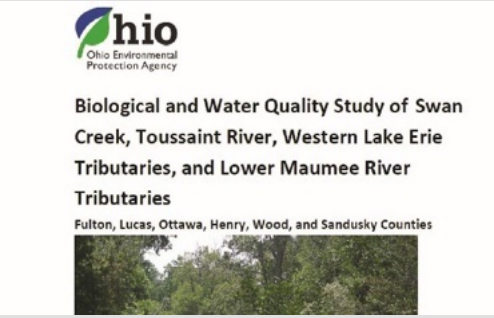
Best Practices

Many resources and references were reviewed in order to gain a broad understanding of previous planning efforts specific to the City of Toledo and Junction Neighborhood. Additionally, regional and general guidance documents were also reviewed to understand best practices for climate resilience and adaptation strategies. Some of these resources include:













- A National Scan of Pre-Approved Building Programs and Their Potential Application in Ohio, Greater Ohio Policy Center, 2023
- An Open Space Action Plan for the Junction Neighborhood in Toledo, Ohio, 2016
- Forward Toledo, Comprehensive Land Use Plan, 2024
- Junction Neighborhood Master Plan, 2018
- Limited Environmental Review and Finding of No Significant Impact: Toledo Swan Creek North Sewer Separation, 2017
- LTCP Project S-1B Swan Creek North Sewer Separation Project, 2016
- Nine-Element Nonpoint Source Implementation Strategic Plan, Lower Swan Creek: Heilman Ditch-Swan Creek HUC-12, 2016
- PVD TREES + Infrastructure: A Conflict Avoidance Guide for the Providence Urban Forest, 2023
- The Junction Neighborhood Greening Plan (TMACOG), 2015
- The Toledo Metropolitan Area Council of Governments Areawide Water Quality Management Plan, 2016
- Toledo Climate Change Vulnerability Assessment for Stormwater, 2018
- Toledo Waterways Initiative, Long-Term Control Plan Report - Addendum, 2016

Planning Process

Community Engagement









Workshops & Visioning Sessions

Over the past year, the Junction Coalition, Neighborhood Ambassadors, and the project team and its partners have been listening to and learning from residents.

A total of 15 engagement events were held, a combination of special events dedicated to the resiliency planning project and other community events that included specific engagement on Swan Creek or the resiliency planning effort. These events aimed to educate residents and allow information sharing, to raise awareness of climate issues and adaptation strategies, and to experience activities centered around Swan Creek. These events included:

- Youth Engagement Swan Creek Design Charette (July 2024)
- Junction Coalition Community Meetings (Oct 2024, Nov 2024, July 2025, Sept 2025)
- Swan Creek Resiliency Planning Webinar (Dec 2024)
- Swan Creek Visioning (March 2025)
- Earth Day Event (April 2025)
- Lead Walk (June 2025)
- Building Blocks for Sustainable Communities Event (July 2025)
- Fish Fest (July 2025)
- Great Lakes (August 2025)
- R&B Park Jam (August 2025)
- Parking Day (September 2025)
- Partner for Change Stakeholder Meeting
- Talkin' Trash (September 2025)

Community Engagement



Online & In-Person Surveys / Activities







During various engagement events, the project team and ambassadors listened to residents' concerns and ideas. The community identified key challenges and themes that served as a guide for project development and prioritization. This input led the project team to identify ten project types that could be implemented to improve climate resiliency. While several of these projects were nature-based solutions, the planning team took a holistic approach, including programmatic solutions as well as structural solutions (storm shelter and resilient housing retrofits) in the list of potential projects.

15	Activities
3	Surveys
544	In-Person Interactions
32,894	Online Interactions

Solution Analysis

Challenges

- Flooding
- Storm Drains
- Lack of Trees

Project Ideas

- More Trees
- Wetlands
- Heat & Shade Structures
- Cooling Ponds, Mist/Splash Pad
- Pollinator Garden
- Programs for Homeowners
- Basement Flood-Proofing
- Cultural Design
- Reclaim Land
- More Green Space
- Log Jam Removal & Cleanup
- Underground Retention & Dike
- Ecological Healing & Wildlife
- Solar & Smart Sprinklers
- Orchard
- Extend Existing Parks
- Cool Roofs & Insulation
- Efficient Windows
- Green Building Codes
- Permeable Pavement

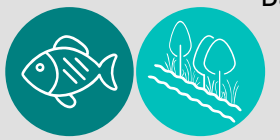
Feedback Summary & Priorities

Themes

- Outdoor Activity
- Accessibility
- Safety
- Gather & Rest
- Multigenerational
- Programming
- Connectivity
- Food Access
- Health Outcomes
- Inspiration
- Maintenance
- Jobs

Proposed Approach

Based on community input and best practices, the following projects are being proposed:



Swan Creek Habitat Restoration & Bank Stabilization
Forested Riparian Buffer Installation

Wildlife.
Pollinator garden.



Community Green Space
Pipes to Parks (Daylighting)
Enhanced Park Space
Floodable Landscapes

Turn into more land, add trees to get rid of cement.



Green Stormwater Infrastructure (GSI) (Trees)
Treebox Filters
RE-TREE Street Tree Planting

Trees, deciduous and orchard.



Pre-Approved Building Plans

Green building codes. Light-colored roofs.



GSI (Retention and Infiltration)
Underground Storage / Detention Systems
Roadside Bioswales & Rain Gardens

Basement flooding – check curbs after large rain event



Storm Shelter & Community Center

Gathering and educational space indoors

Revitalization, not gentrification on vacant lots



Blighted and Vacant Property Redevelopment

Energy efficient windows, insulation, streetlights



Climate-Resilient Housing Strategy



Flood Resiliency Redundant Multimodal
Pedestrian Bridge

Trail leading to park with a bridge and sidewalk.

Storm drains are full. Cooling stations. Safety.



Programmatic Projects (Toolkit)
GSI Incentive Programs

Community Engagement

Rock the Vote!







At the Swan Creek Visioning event and several subsequent events, community members were asked to vote (via online surveys and a "rock the vote" hands-on activity) for the types of projects that they would like to see implemented in Junction and along Swan Creek in their neighborhoods. This direct input helped the project team to identify the top five project types that resonate with the residents and community members. These top five project types were further explored to pinpoint potential project locations for implementation, focusing on the vulnerable areas identified through the hydrologic analysis and review of the heat index data.



Community Engagement



The Technical Advisory Committee met throughout the project (in June 2024, October 2024, February 2025, May 2025, and September 2025) to hear updates from the project team and provide feedback and critical input regarding projects and programs that intersect or overlap with the Resiliency Planning project.

The project has also been shared among a wider audience, beyond the residents who live within the project area, at various regional events and conferences throughout the last year, including:

- Junction Coalition and Ohio Environmental Council Restoration Tour (August 2025)
- Ohio Statewide Planning Conference (September 2025)
- Alliance for the Great Lakes Healing Our Waters Conference (September 2025)

Existing & Future Conditions

The Need for Resilience

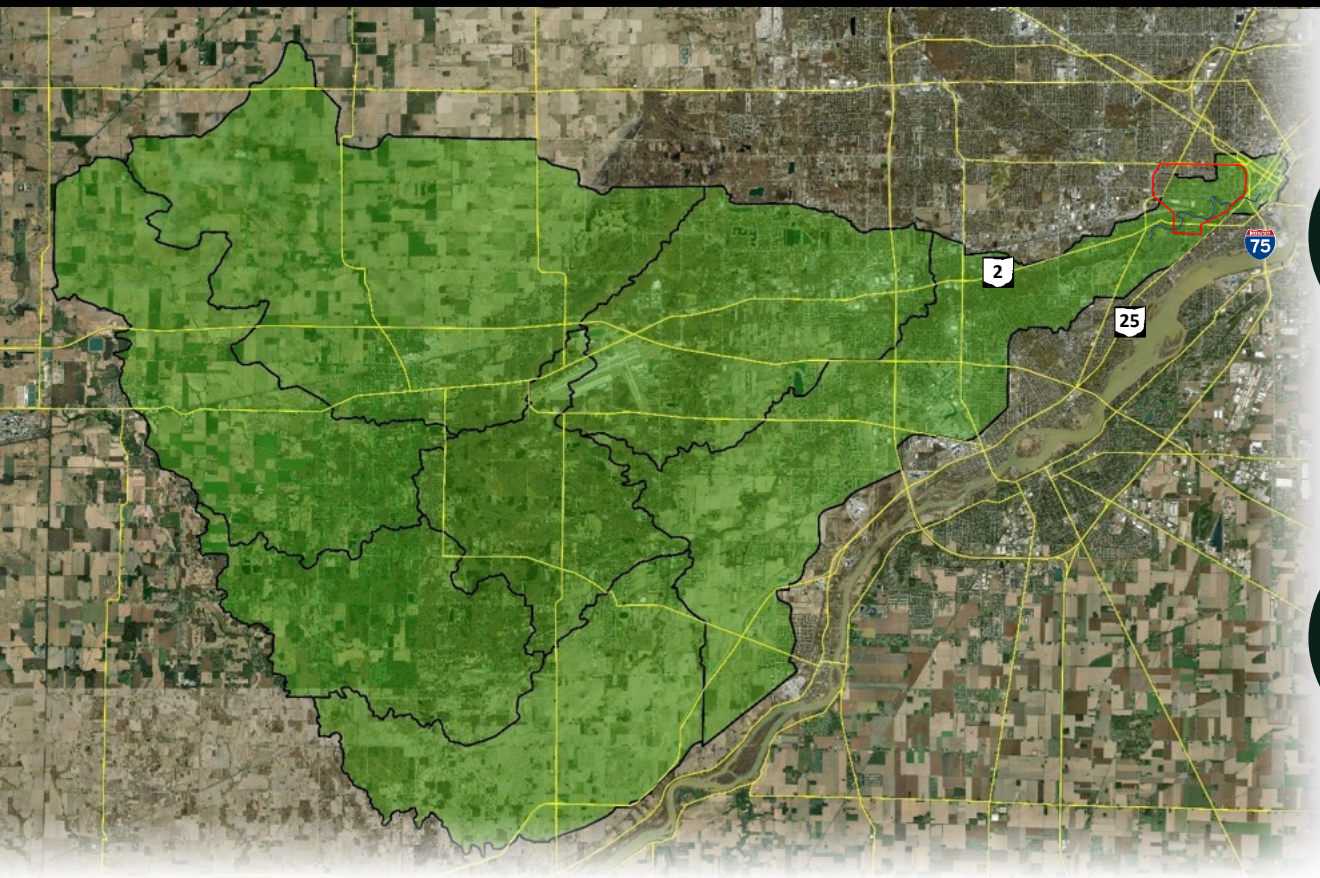


The NFWF project area includes the Junction neighborhood, as well as a portion of the Old South End and Walbridge neighborhoods. These neighborhoods that make up the project area are economically disadvantaged, with the northwest portion of the project area identified as one of the most socio-economically vulnerable census tracts in the City (GLISA 2021)[1]. Socio-economic factors, and particularly the percentage of the population living in poverty, have been shown to be important predictors of an individual's ability to recover from disasters (LADCP 2015)[2]. With future climate changes expected to result in increased large rain events and flash flooding as well as increased temperatures, planning for climate resiliency becomes a critical community need.

[1]*Great Lakes Integrated Science + Assessments. Climate Change Vulnerability Assessment for Stormwater: City of Toledo. 2021. Ann Arbor, MI.*

[2]*Los Angeles Department of City Planning. Plan for a Healthy Los Angeles. 2015. Los Angeles, CA.*

Watershed Challenges



Pluvial flooding is flooding that occurs when intense rainfall creates runoff that exceeds the capacity of local drainage systems. In urban areas, pluvial flooding causes street ponding and basement water backups (especially where runoff drains to a combined sewer system).

Fluvial flooding is river flooding that occurs when water levels in rivers or streams rise and overtop their banks. Coastal Lake Erie water levels influence the Maumee River and Swan Creek and significant rises in lake water levels can cause water to "backup" into Swan Creek or inhibit drainage away from the project area.

The NFWF project area encompasses 2.1 square miles (1338 acres) of urban land and 2.5 miles of Swan Creek and is situated at the downstream end within the Heilman Ditch subwatershed, one of seven major subwatersheds in the 204 square mile drainage area.

The flow characteristics and water quality of Swan Creek in Junction are influenced by nearly 130,000 acres in three different counties, as Swan Creek is fed by over 200 miles of tributary creeks and ditches. Swan Creek, which is over 40 miles long, flows through the project area, on its way to empty into the Maumee River just 1.2 miles further downstream.

This portion of the Maumee River, approximately 5.2 river miles upstream of Maumee Bay, is also influenced by Lake Erie water levels. With both Lake Erie water levels and regional rainfall patterns expected to change in the near future due to climate change, this study aims to investigate and quantify future coastal and riverine flooding concerns in the NFWF project area.

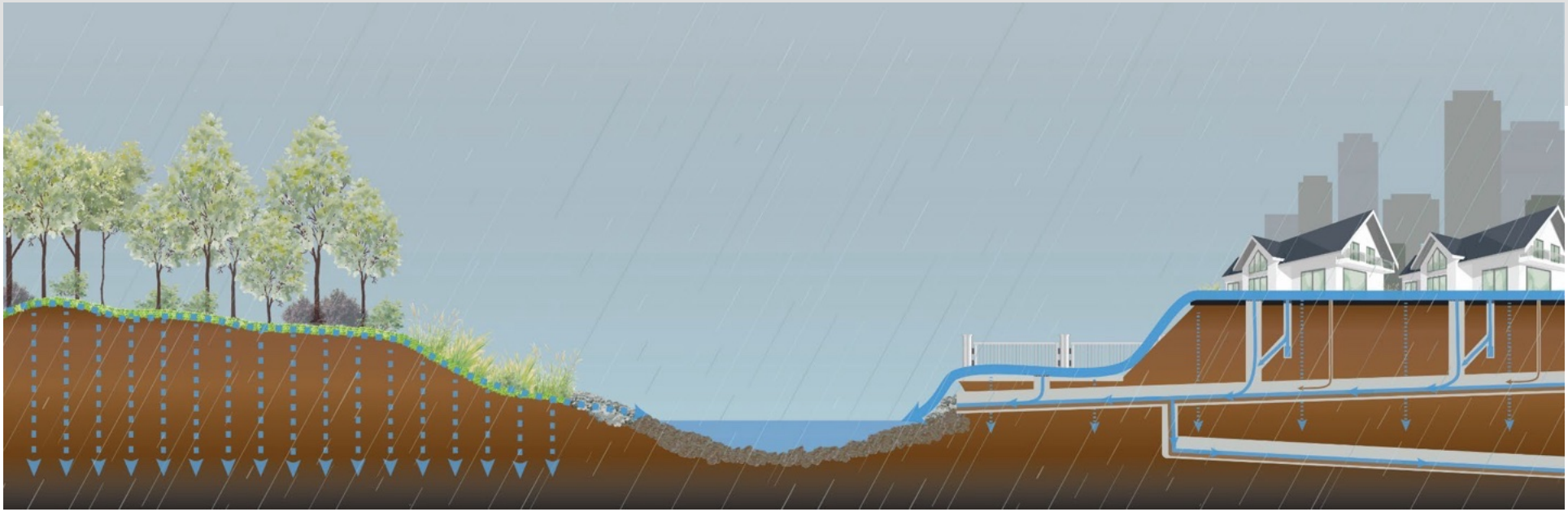
The project area is affected by both pluvial (rain-driven) and fluvial (river-driven) flooding, with coastal influences.

Urban Runoff

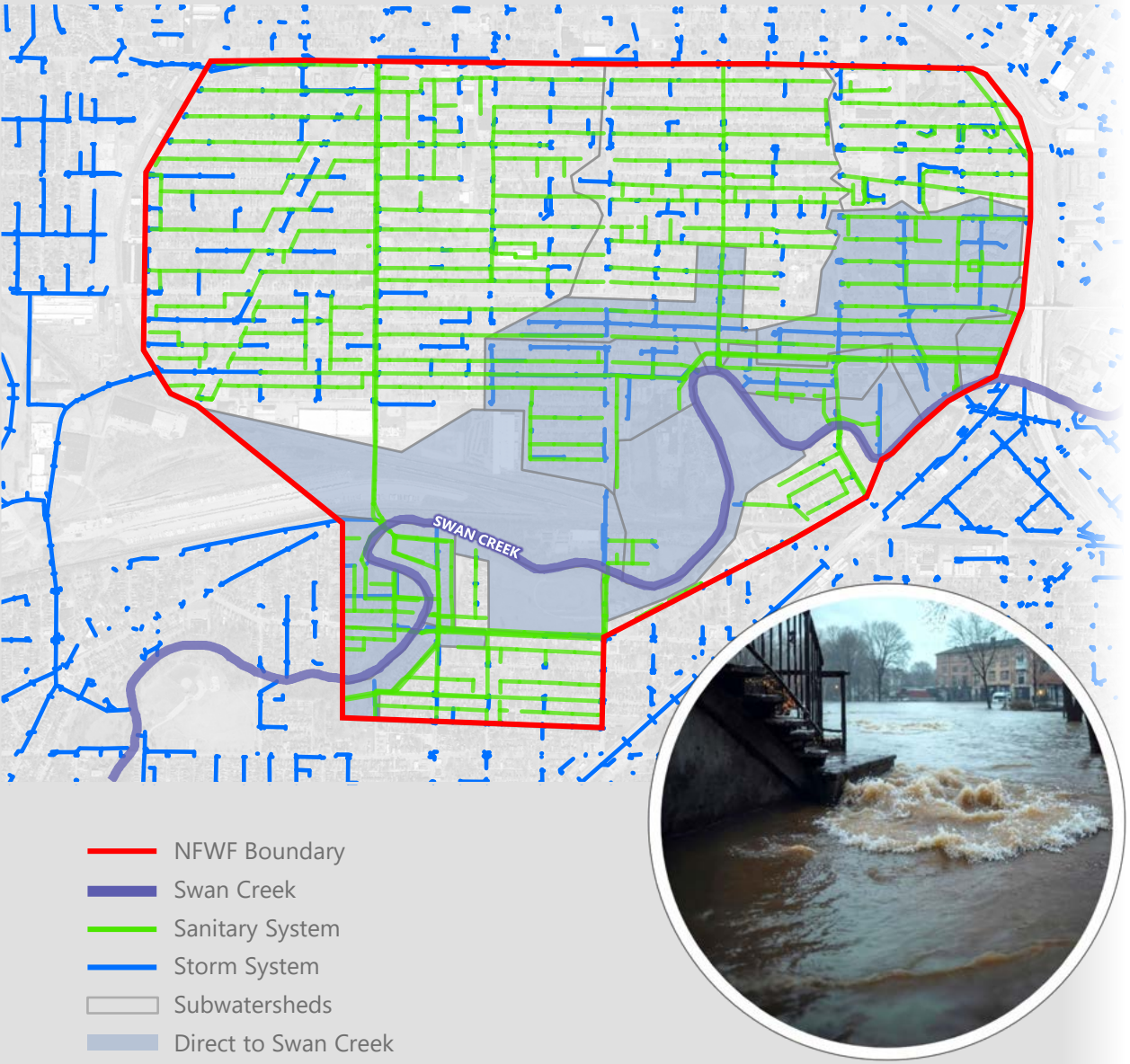
Runoff flows faster over smooth impervious areas than it does over vegetated areas (like grass or forests), so runoff also reaches streams quicker in urban areas than in more pervious rural or undeveloped areas. The combination of the amount of runoff (volume) and speed at which it reaches streams (velocity) together contribute to higher peak flow rates in urban streams, which cause more frequent flooding when water levels overtop streambanks. This "flashiness" characteristic in urban streams can lead to other problems such as streambank erosion and channel instability, as well as increases in water temperature and pollution (like oils and heavy metals washed from road surfaces) that can negatively affect aquatic organisms.

In urban areas with built "grey infrastructure," stormwater runoff flows along streets into catch basins, where it drops into buried pipes that dump into either:

- stormwater pipes that outlet to streams and rivers, or
- a combined sanitary and stormwater system that flows to a water reclamation facility for treatment.



Urban Drainage System and Flood Risk



In the project area, like much of the City of Toledo, the stormwater infrastructure was originally built as a combined system with emergency outlets to relieve pressure during very large storm events and prevent sewage backups into buildings. When the emergency outlets are activated, during a combined sewer overflow (CSO) event, untreated (or sometimes disinfected) sewage flows into Swan Creek. In fact, within the project area there are two large underground CSO storage tunnels and five permitted combined sewer outlets to Swan Creek. In 2024, 14.6 million gallons (MG) of untreated sewage was discharged to Swan Creek through CSOs within the project area (City of Toledo 2024)[3].

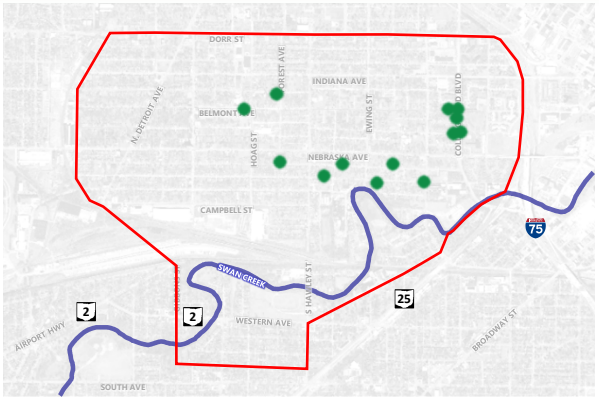
As part of the Toledo Waterways Initiative, an effort to reduce combined sewage overflow events, the City of Toledo has completed partial sewer separation projects, including several within the project area. In the NFWF project area, approximately 37% of the area drains either directly to Swan Creek or to Swan Creek via separated stormwater pipes, while the remaining 63% of the area drains to the combined sewer system.

[3]*City of Toledo Division of Water Reclamation. Annual Combined Sewer Overflow (CSO) Report. 2024. Toledo, OH.*

Green Infrastructure



The City of Toledo has begun to identify vulnerable components of its stormwater system, with pipes, maintenance issues, and flood-prone areas being the most sensitive and least adaptive to the influences of climate change (GLISA 2021). Green infrastructure and nature-based solutions are more adaptive than traditional "grey infrastructure" and are prioritized as implementation strategies to become more resilient.



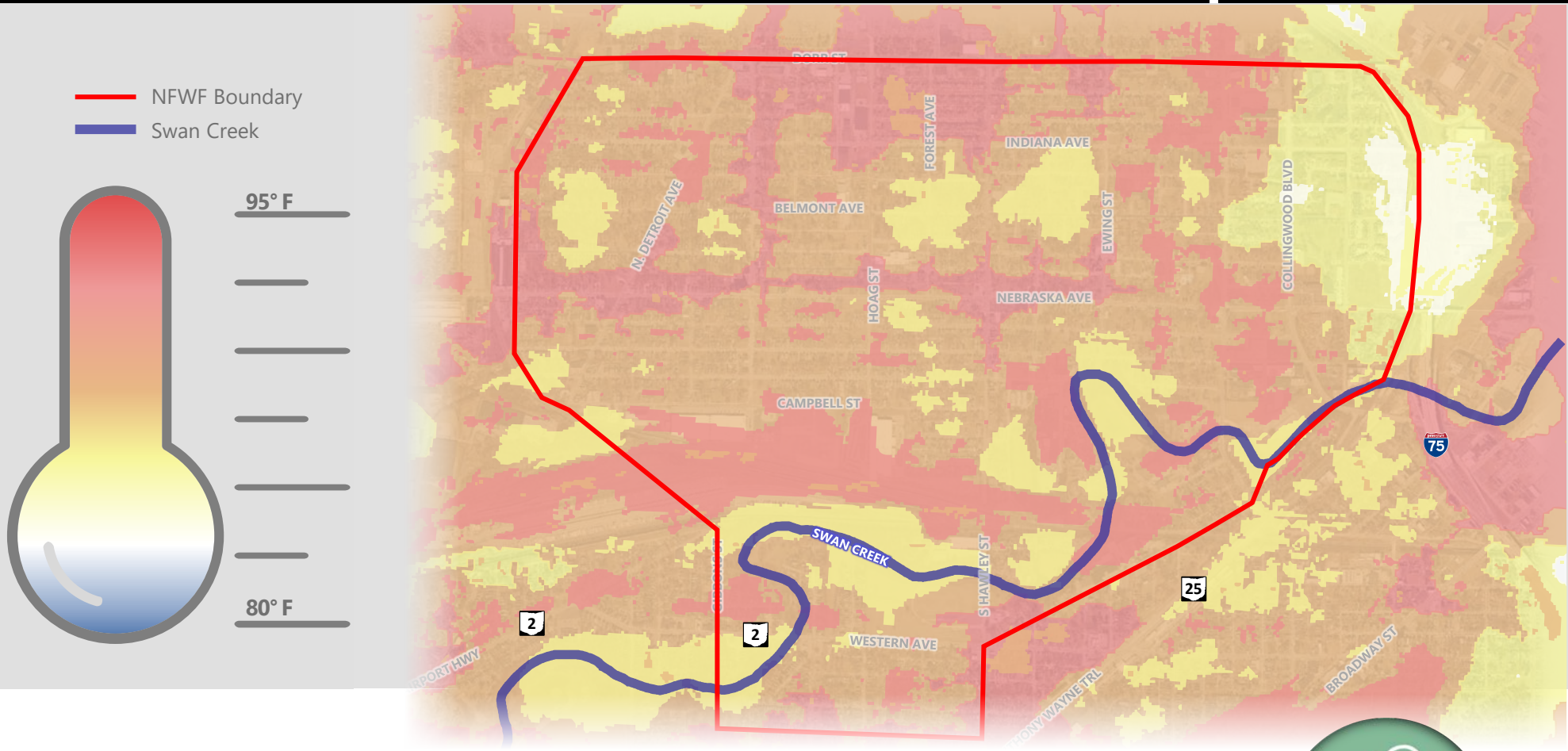


Adding green infrastructure projects into the urban landscape has already proven to be successful in the Junction Neighborhood. The sewer separation project incorporated several "green infrastructure" polishing units, where stormwater flows into bioswales or bioretention areas to be naturally filtered, prior to entering Swan Creek.

The bioswales (for example, along Collingwood Blvd) capture stormwater runoff from adjacent streets and lots before it enters catch basins and the piping system, slowing and cleaning the water by filtering it through plants and layers of soil and stone. In some cases, a larger stormwater pipe draining several blocks is daylighted into a bioretention basin (like those along Tecumseh St and City Park), allowing the water to spread out over the basin, where it can temporarily pond, infiltrate and even evaporate after a storm event has ended.

Adding these types of green stormwater assets distributed throughout the neighborhood helps to reduce localized street flooding and also reduces runoff volumes and peak flows entering Swan Creek from the adjacent drainage areas.

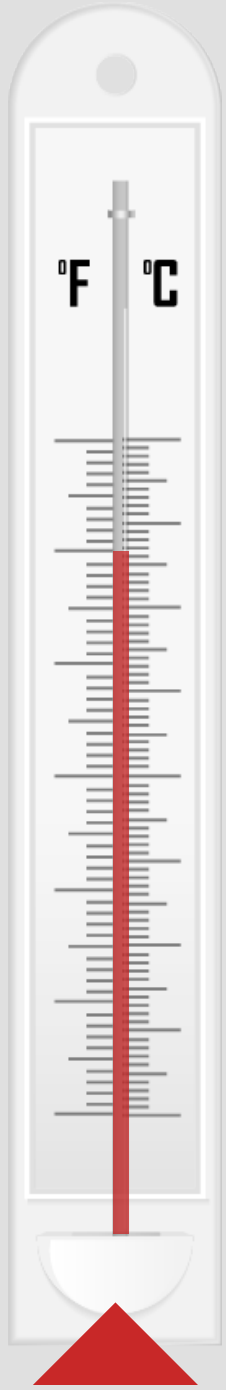
Vulnerable Areas | Heat Risk

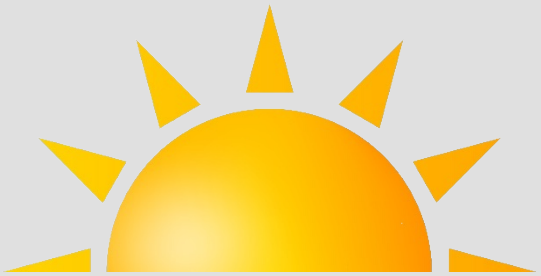


The City of Toledo conducted a community heat-mapping study in July 2021 to evaluate the impact of heat on the most vulnerable communities. In urban areas, the high concentration of buildings and pavement absorb and retain heat, contributing to the "Heat Island Effect." Green infrastructure, including trees and dense gardens, reflects more solar radiation than hard surfaces, and cool the air through evapotranspiration from photosynthesis, helping to counteract the heat island effect.

The City of Toledo has begun a "RE-TREE" campaign (Restoring and Enhancing Tree Canopy for Resilience, Equity, and Engagement) with over $6 Million in secured funding from the Urban and Community Forestry Program to increase the tree canopy throughout the City.

Future Forecast





Maximum Average Temperature in Summer

- Increase 5° F by mid-century
- Increase 10° F by end of century



Maximum Average Temperature in Winter

- Increase 3.5° F by mid-century
- Increase 10° F by end of century

In Toledo, Ohio there has been slight shift in climate conditions over the last seventy-five years. Already, the area has experienced a 3.2°F increase in annual temperatures between 1951 and 2012, with 29 fewer days below the freezing point 32°F (UMCC 2016)[4].

Based on future climate modeling from the Climate Risk and Resiliency portal (CLIM-RR), the average summer high temperature of 79.8°F is projected to increase by 5.1°F to 84.9°F by mid-century and by 10.3°F to 90.1°F by the end of the century. The average summer low temperature of 65.0°F is likewise projected to increase by 4.9F to 69.9°F by 2050 and by 10.6°F to 75.6°F by 2100 (CLIM-RR 2024)[5].

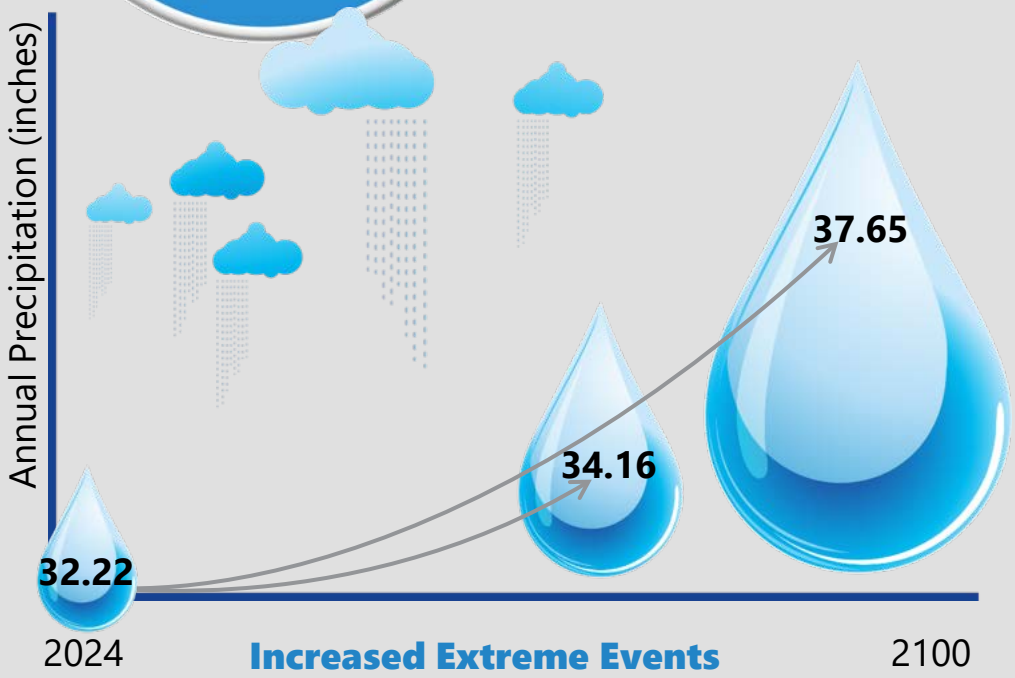
[4]*Univeristy of Michigan Climate Center. City Fact Sheet: Toledo, OH. 2016. Ann Arbor, MI.*

[5]*Climate Risk and Resiliency Portal, Argonne National Laboratory. ClimRR Climate Projection Report: Custom Area – Junction Neighborhood. 2024.* https://climrr.anl.gov/

Future Forecast

According to the 2021 Lucas County Land Bank Survey, approximately 30% - 35% of occupied structures in the Junction Neighborhood need roof assistance (repair)

Projected average annual precipitation increase by 3.5% by 2035 in Toledo, Ohio *Climate Risk and Resilience Portal (ClimRR)*



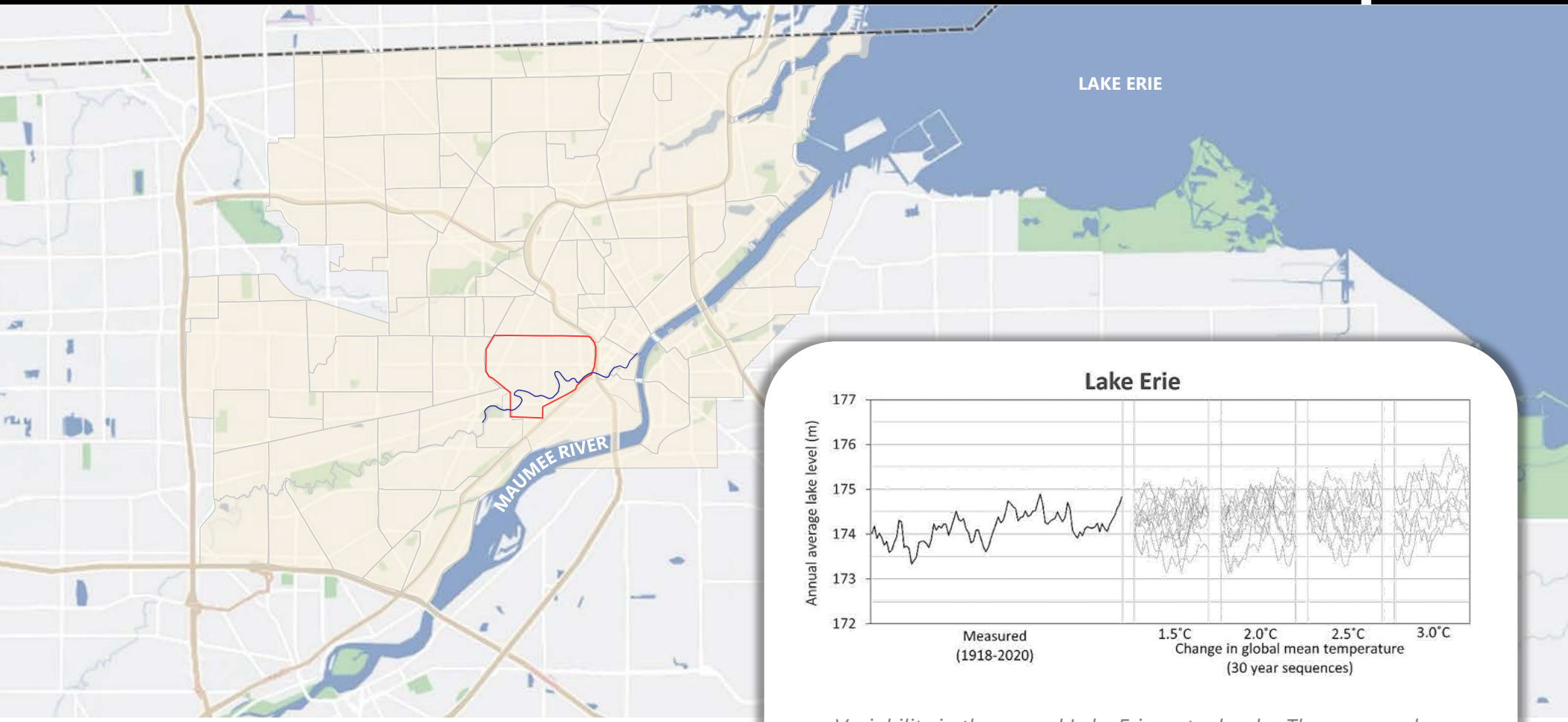
Total annual rainfall is projected to increase in the project area from 32.2 inches to 37.6 inches by 2050 and to 38.7 inches by 2100. The number of days with precipitation are not projected to change significantly, so most of this additional precipitation will come in the form of more intense events.

Extreme rain events have already increased in size and frequency. Between 1951 and 2012, there has been a 41.1% increase in the heaviest 1% of precipitation events (UMCC 2016). The precipitation volume for the top 1% of extreme events is projected to increase further by 16% (compared to 1991-2020) in climate scenarios with a global mean temperature rise of 2°C (3.6°F) and increase by 30% in climate scenarios with a global mean temperature rise of 3°C (5.4°F) (USGCRP 2023)[6]. For the project area, this means that the historic 100-year (24-hour) rainfall event, which has a 1% chance of occurring in a given year, would increase from 5.42 inches of rain to 6.29 inches and 7.10 inches respectively under the two climate scenarios, making it comparable to the historic 500-year event, which is 7.04 inches (NOAA 2025)[7].

[6]*US Global Change Research Program. Fifth National Climate Assessment. 2023. Washington DC.*

[7]*National Oceanic and Atmospheric Administration, National Weather Service. Point Precipitation Frequency Estimates: Toledo, OH. 2025. NOAA Atlas 14, Vol 2, Version 3. Silver Spring, MD.*

Coastal Impacts



Variability in the annual Lake Erie water levels. The measured water levels are shown as a thick black line, while individual model projections under 1.5°C, 2°C, 2.5°C and 3°C changes in global mean temperature are shown as thin grey lines. Water levels are referenced to IGLD85. (Seglenieks and Temgoua, 2022)

Lake Erie water levels are predicted to fluctuate more in a future warmer climate, with overall trends in water level models showing higher water levels of up to 0.7 m (2.3 ft) for a 2°C temperature rise or 1.2 m (3.9 ft) for a 3°C temperature rise (Seglenieks and Temgoua, 2022)[8]. Changing lake water levels may influence Swan Creek because Swan Creek flows into the Maumee River in an area that is influenced by Lake Erie water levels.

[8]*Seglenieks F. and A. Temgoua, 2022. Future water levels of the Great Lakes under 1.5°C to 3°C warmer climates. Journal of Great Lakes Research v48: 4, p865-875. https://doi.org/10.1016/j.jglr.2022.05.012*

Hydrologic Analysis

Hydrologic Modeling

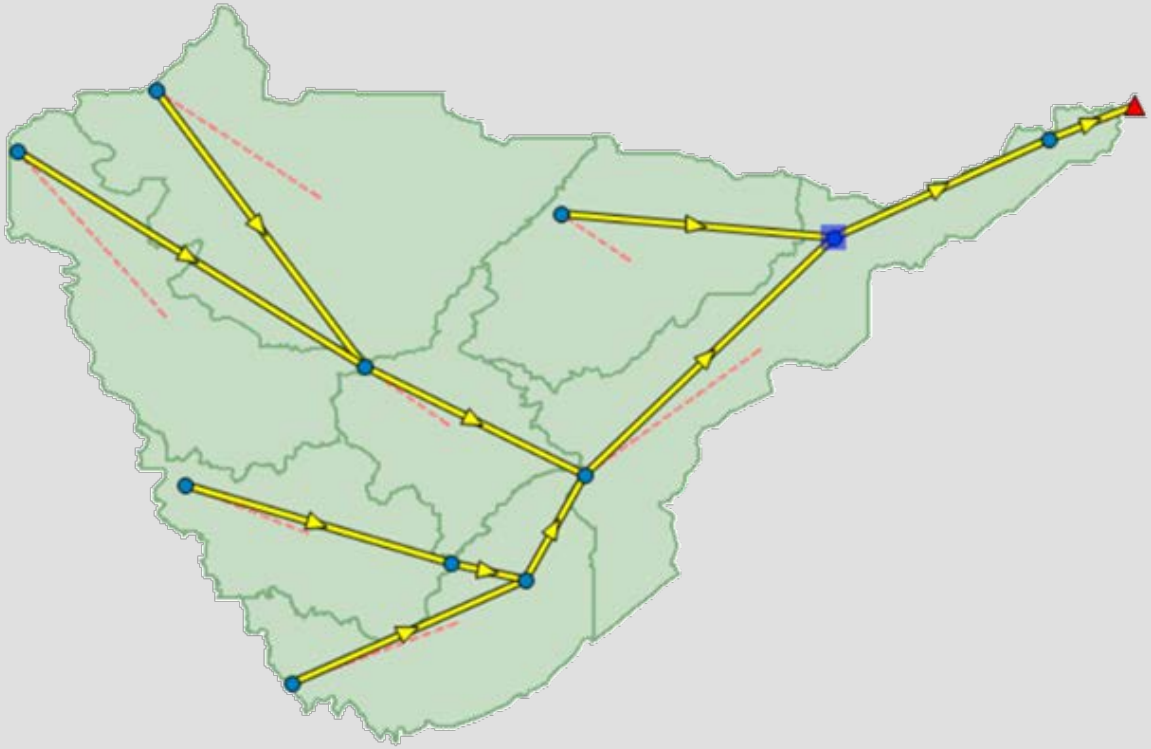
MSG analyzed the project area and Swan Creek, within the project area, as well as portions of the existing stormwater drainage system using the CHI PCSWMM software, which integrates two-dimensional modeling of surface flooding with the EPA Stormwater Management Model (SWMM) for conveyance of flow through subsurface structures. MSG determined hydrologic properties from available topographic, land use, soils, and hydrography data. The model used the Modified Green-Ampt Method to calculate rainfall infiltration, using soil data from the National Cooperative Soil Survey – Web Soil Survey to assign infiltration parameters. Land use data were obtained from the US Geological Survey National Land Cover Database.

MSG opted to input a digital elevation model with a 30-meter grid into the mode to create the two-dimensional modeling grid and polygons. We used the existing HEC-RAS (*Hydrologic Engineering Center's River Analysis System*) flood model developed by the Federal Emergency Management Agency (FEMA) as an input to build the PCSWMM model. Details of the existing drainage system were added using pipe lengths and slopes available in the City of Toledo GIS layers for catch basins, stormwater pipes, and combined sewer pipes. Elevations for pipe outfalls were interpolated from the digital elevation model.

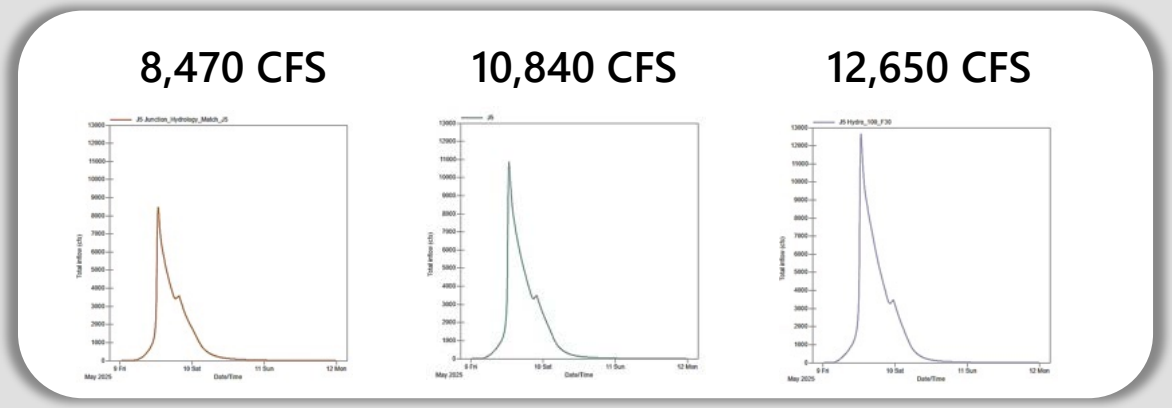
We completed the analyses for the current and future climate conditions for the 50% (2-year), 10% (10-year), and 1% (100-year) annual chance storm events. Current climate conditions were based on the NOAA Atlas 14 Precipitation Data using a NOAA Type A rainfall distribution. Future climate conditions are based on a 2°C temperature rise scenario (16% increase in rain volume) and a 3°C temperature rise scenario (30% increase in rain volume). Future climate scenarios also incorporate a rise in the downstream boundary condition for Swan Creek to simulate a higher Lake Erie water level. Storm event rainfall volumes are shown in the table below:

Storm Event	Rain (in)	Flow from FEMA (cfs)	Flow from PCSWMM Model (cfs)	Flow from StreamStats
2 YR	2.41		3660	2830
10 YR	3.51	5900	5540	4500
25 YR	4.22		6770	5340
50 YR	4.81	8000	7610	5970
100 YR	5.42	9000	8470	6600
500 YR	7.04	11000	11510	8060
Fut 100 YR (+2C)	6.29		10840	
Fut 100 YR (+3C)	7.1		12650	

Fluvial (Riverine) Flooding Results



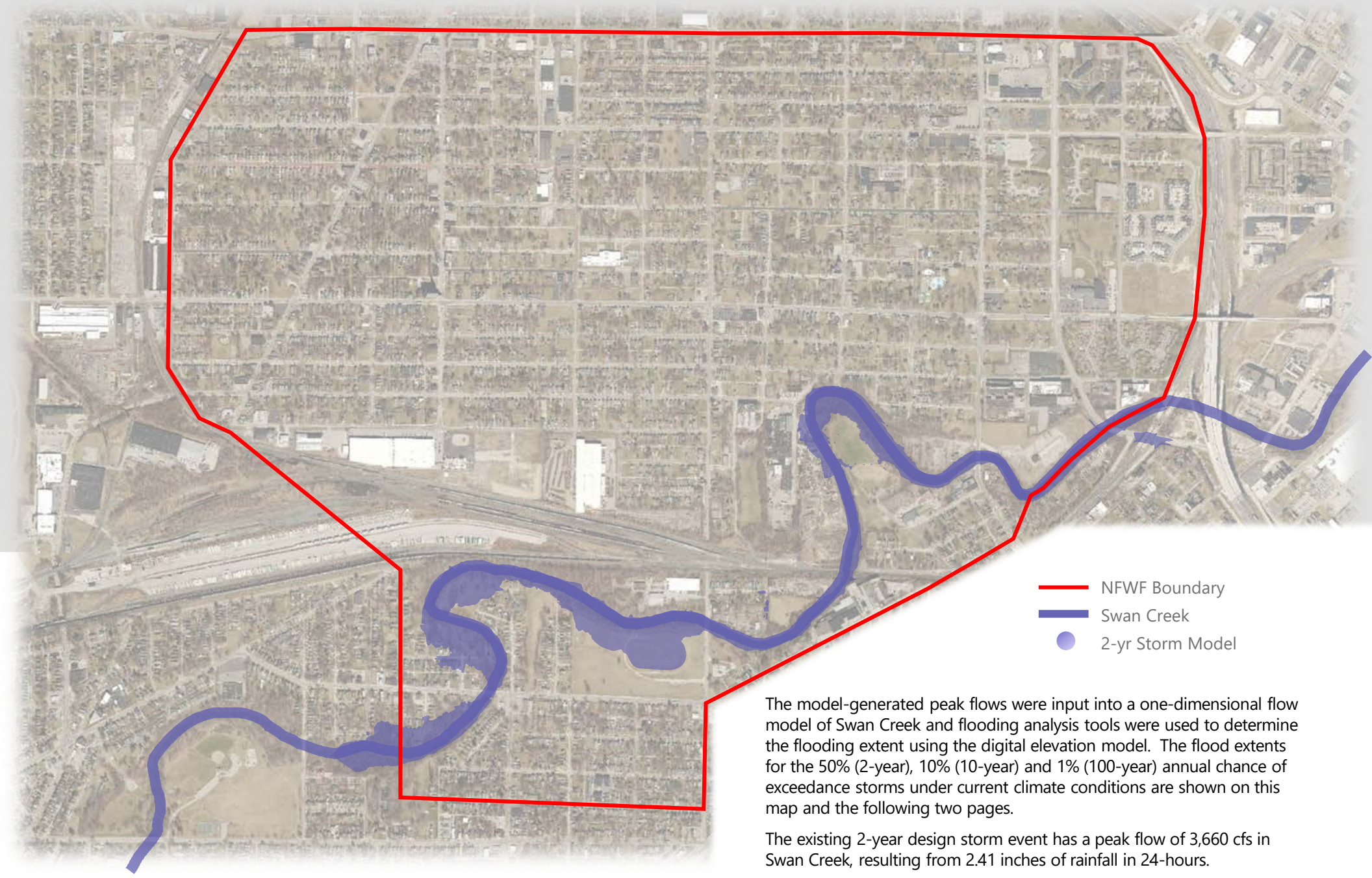
Model setup of major subwatersheds and stream segments that was used to generate hydrographs for current and future modeling scenarios



MSG developed a simplified runoff model of the entire Swan Creek watershed to simulate design storm rain events and generate flow hydrographs for Swan Creek (at the project area) that roughly match the FEMA Flood Insurance Study (FIS) peak flows with proportionate runoff from the major subwatersheds (based on estimates from USGS StreamStats). We used this model to estimate future climate scenario peak flows for Swan Creek. It is important to note that the FEMA study's peak flows are quite a bit higher than StreamStats estimates (which are based on regional regression equations) due to adjustments made by FEMA during their analysis. The flows developed here may be conservative since they are based on modeling that more closely matches the higher FEMA peak flows.

In the future climate scenarios, the modeled peak flows in Swan Creek increase by 20 to 40%, to 10,840 cfs for the 2°C temperature rise scenario and 12,650 cfs for the 3°C temperature rise scenario.

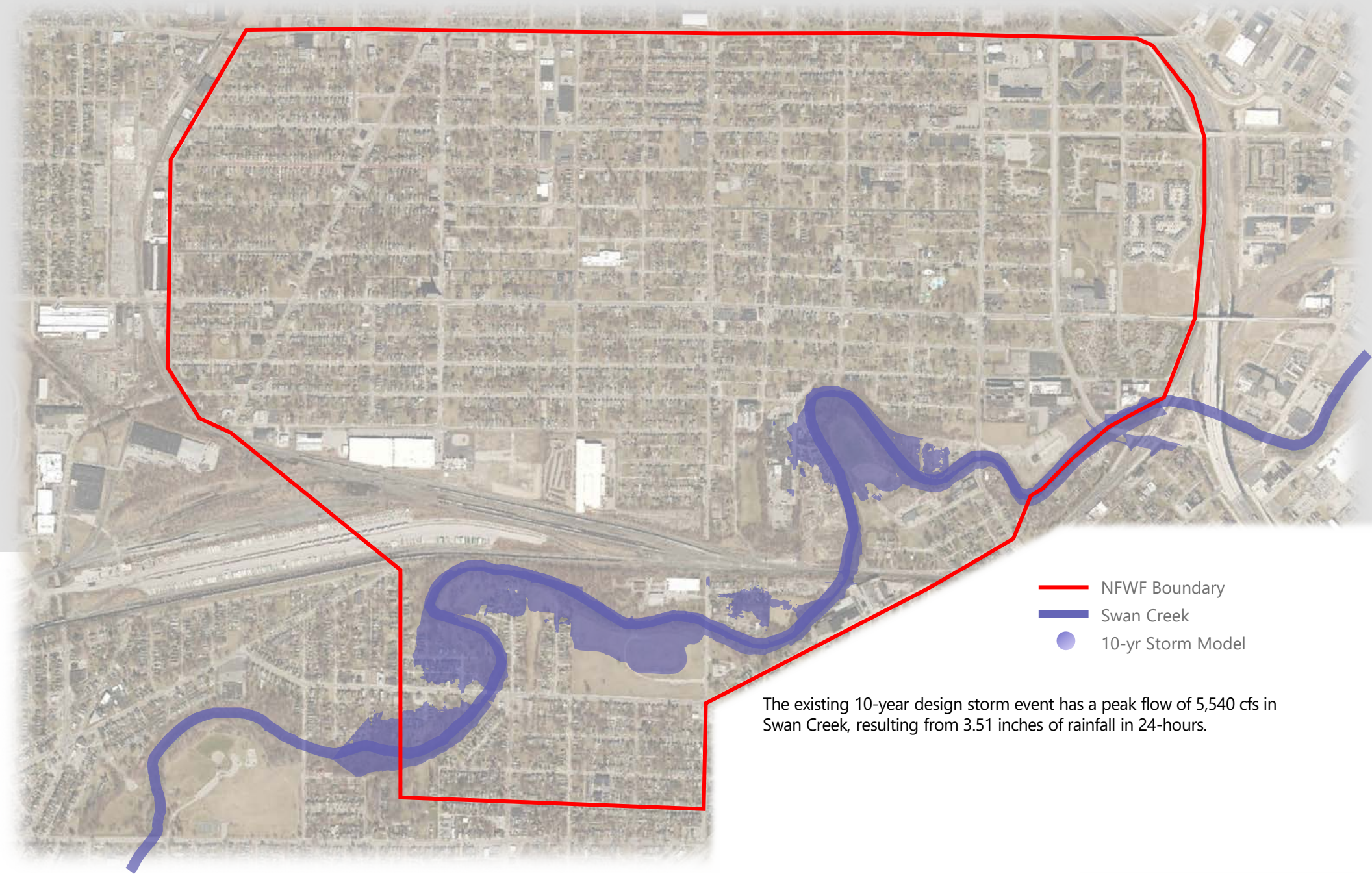
2-Year Storm



The model-generated peak flows were input into a one-dimensional flow model of Swan Creek and flooding analysis tools were used to determine the flooding extent using the digital elevation model. The flood extents for the 50% (2-year), 10% (10-year) and 1% (100-year) annual chance of exceedance storms under current climate conditions are shown on this map and the following two pages.

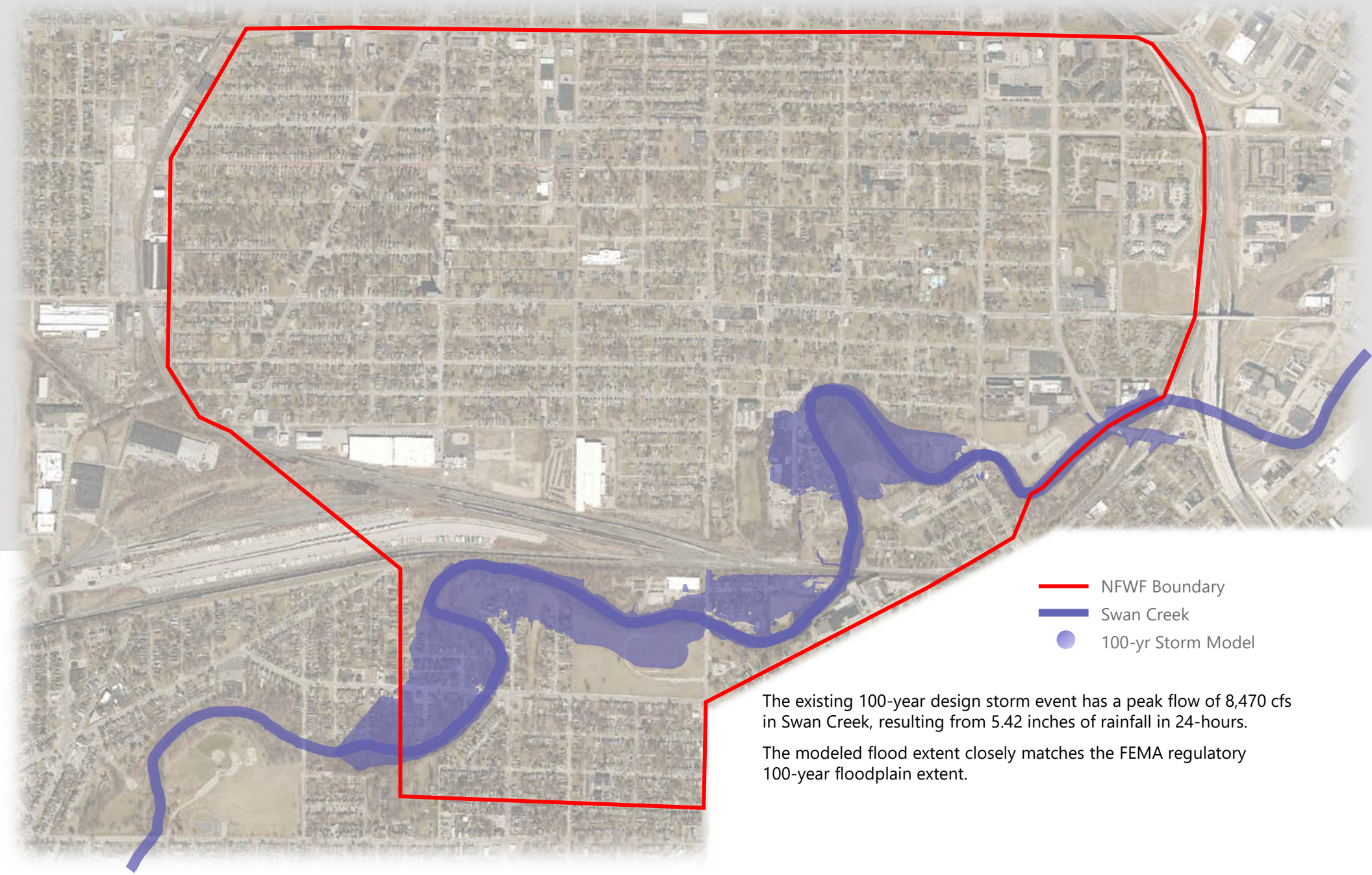
The existing 2-year design storm event has a peak flow of 3,660 cfs in Swan Creek, resulting from 2.41 inches of rainfall in 24-hours.

10-Year Storm



The existing 10-year design storm event has a peak flow of 5,540 cfs in Swan Creek, resulting from 3.51 inches of rainfall in 24-hours.

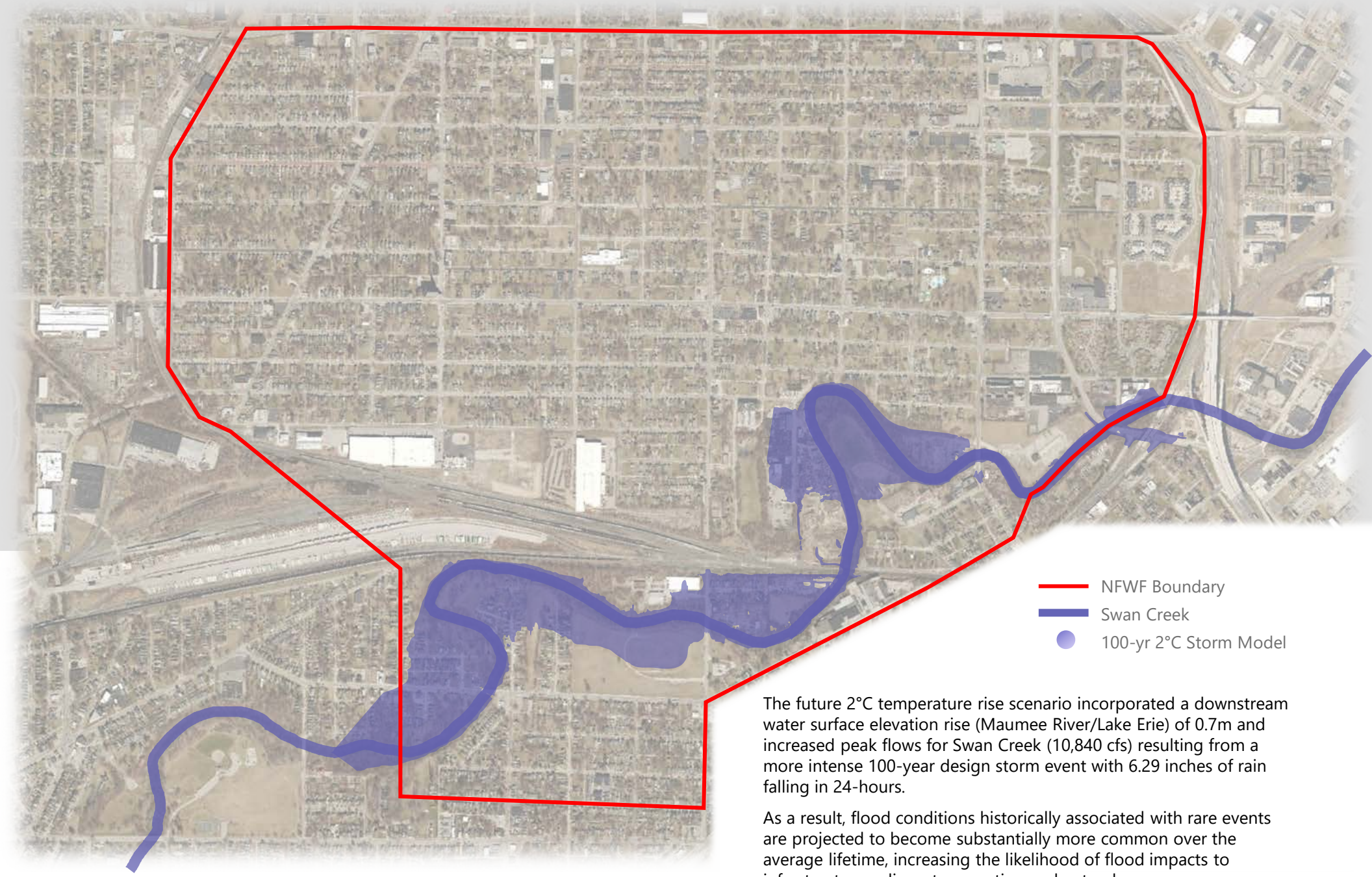
100-Year Storm



The existing 100-year design storm event has a peak flow of 8,470 cfs in Swan Creek, resulting from 5.42 inches of rainfall in 24-hours.

The modeled flood extent closely matches the FEMA regulatory 100-year floodplain extent.

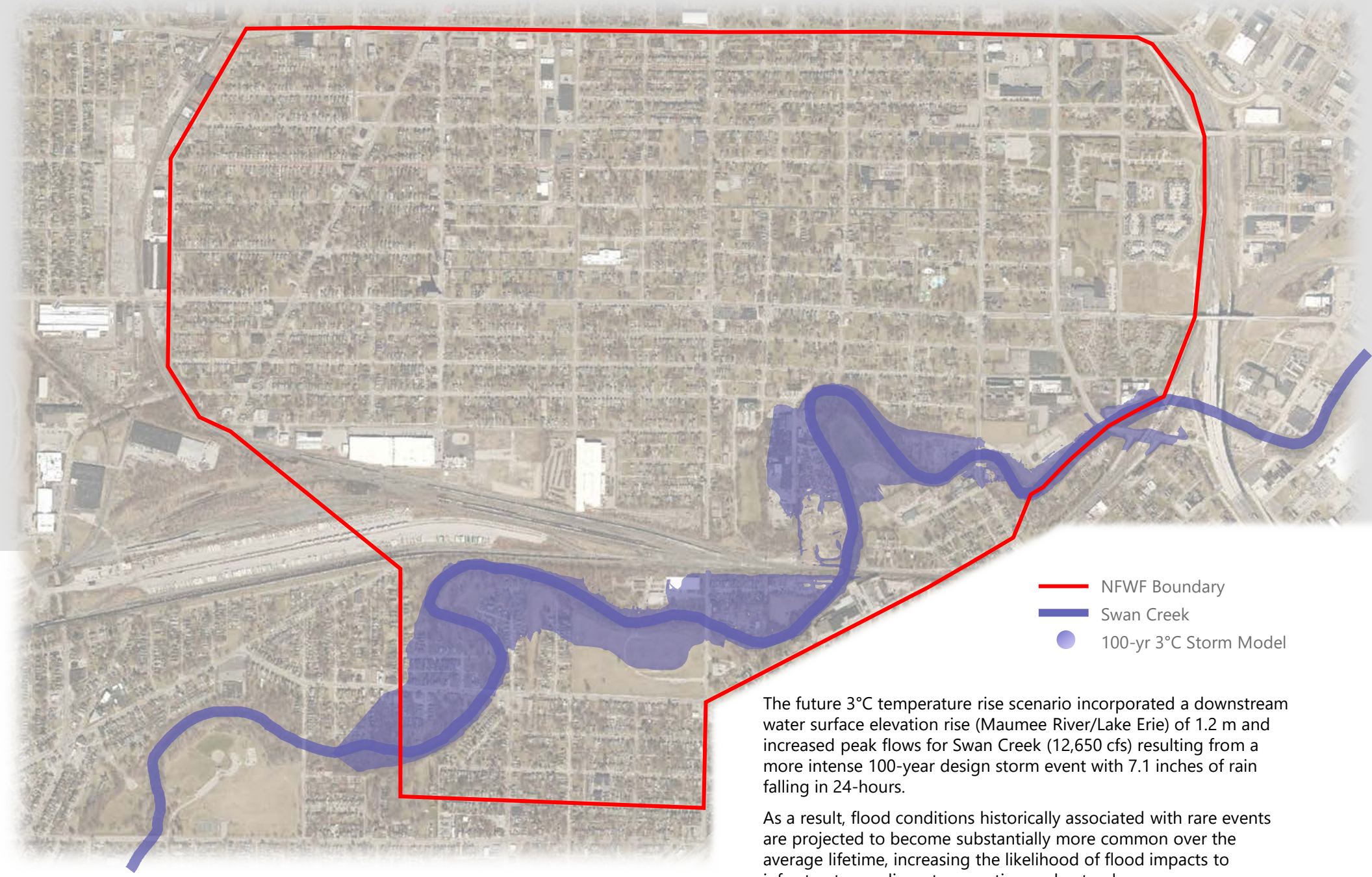
100-Year Storm | Future 2°C



The future 2°C temperature rise scenario incorporated a downstream water surface elevation rise (Maumee River/Lake Erie) of 0.7m and increased peak flows for Swan Creek (10,840 cfs) resulting from a more intense 100-year design storm event with 6.29 inches of rain falling in 24-hours.

As a result, flood conditions historically associated with rare events are projected to become substantially more common over the average lifetime, increasing the likelihood of flood impacts to infrastructure, adjacent properties, and natural resources.

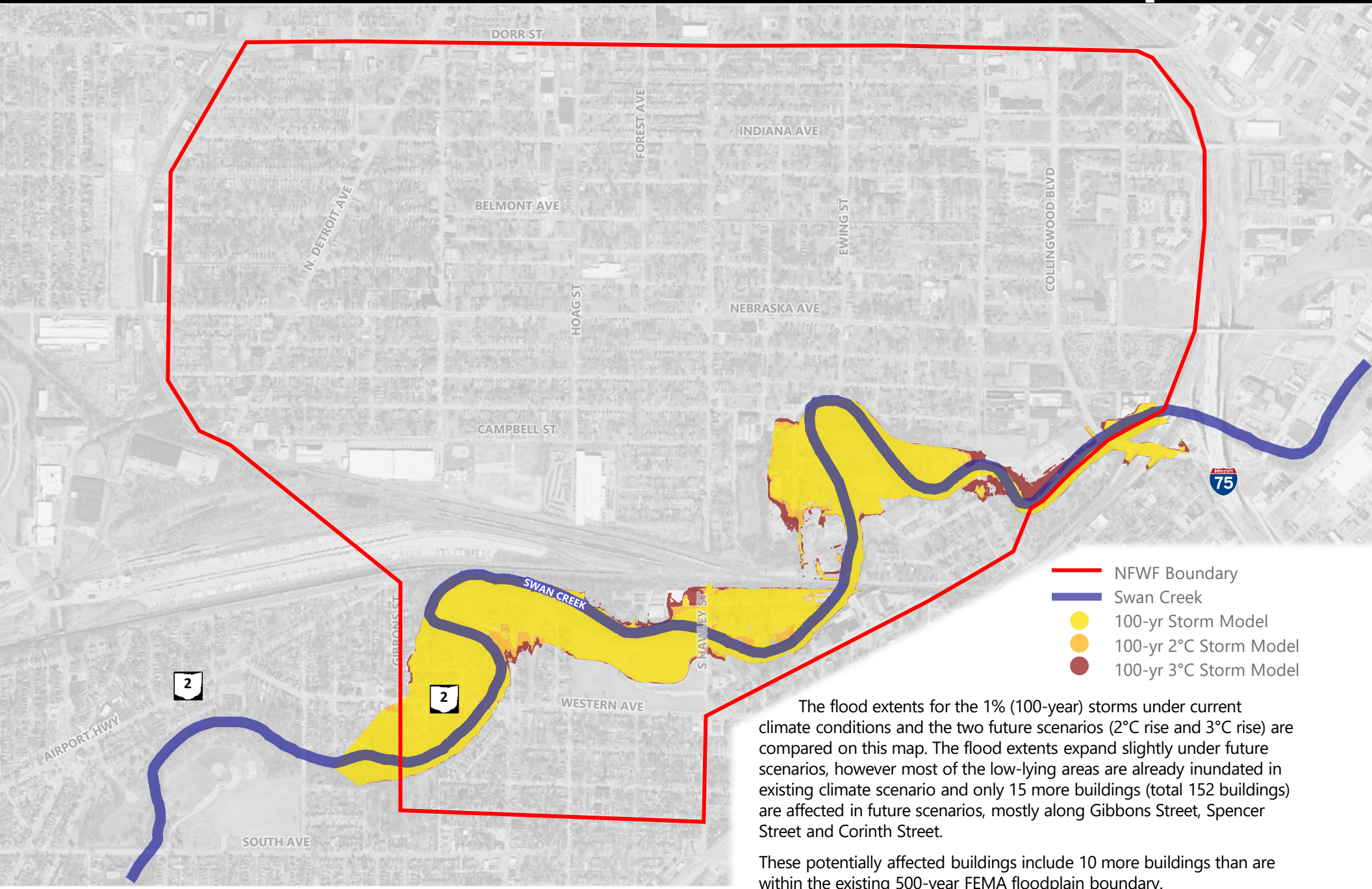
100-Year Storm | Future 3°C



The future 3°C temperature rise scenario incorporated a downstream water surface elevation rise (Maumee River/Lake Erie) of 1.2 m and increased peak flows for Swan Creek (12,650 cfs) resulting from a more intense 100-year design storm event with 7.1 inches of rain falling in 24-hours.

As a result, flood conditions historically associated with rare events are projected to become substantially more common over the average lifetime, increasing the likelihood of flood impacts to infrastructure, adjacent properties, and natural resources.

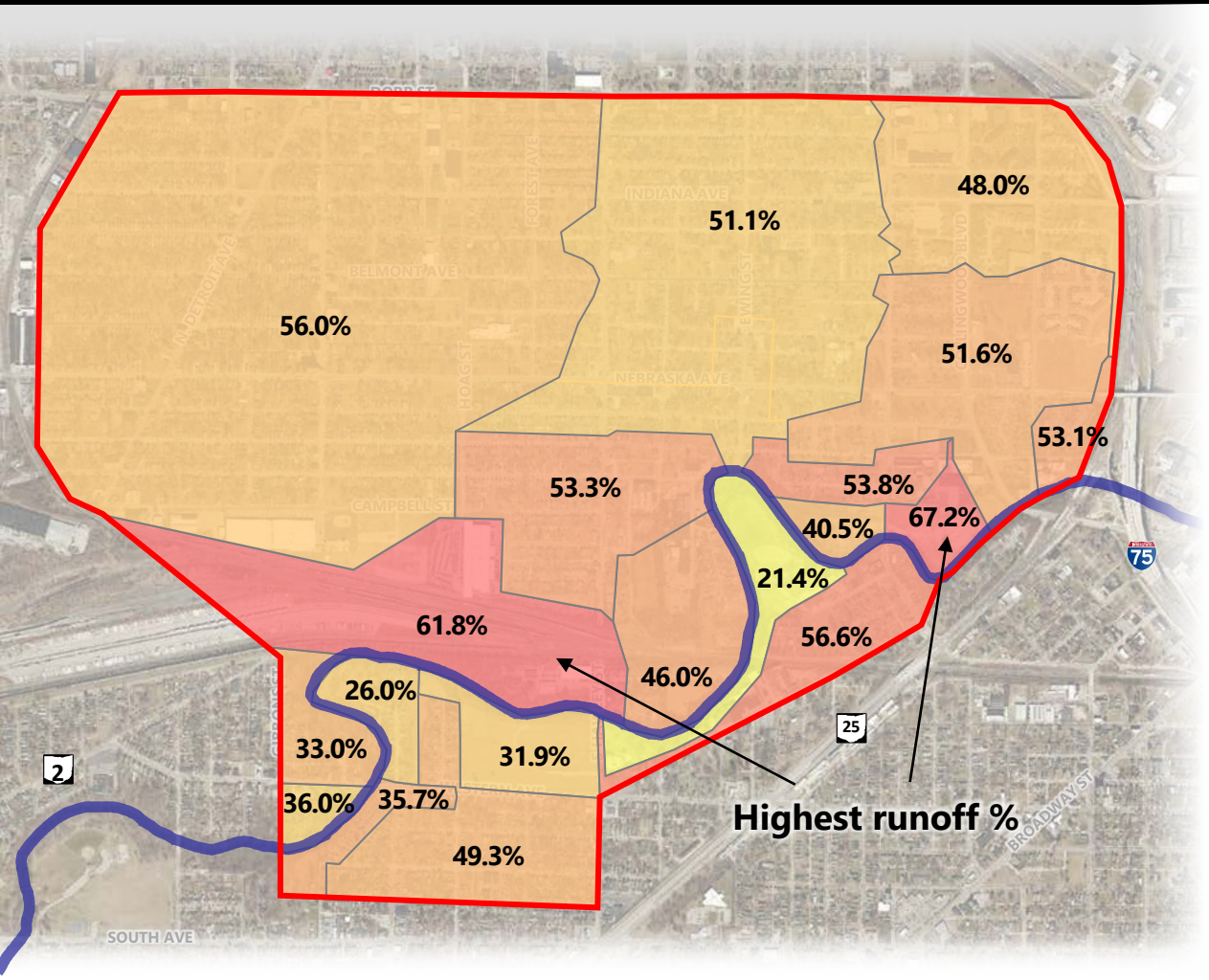
Storm Comparison



The flood extents for the 1% (100-year) storms under current climate conditions and the two future scenarios (2°C rise and 3°C rise) are compared on this map. The flood extents expand slightly under future scenarios, however most of the low-lying areas are already inundated in existing climate scenario and only 15 more buildings (total 152 buildings) are affected in future scenarios, mostly along Gibbons Street, Spencer Street and Corinth Street.

These potentially affected buildings include 10 more buildings than are within the existing 500-year FEMA floodplain boundary.

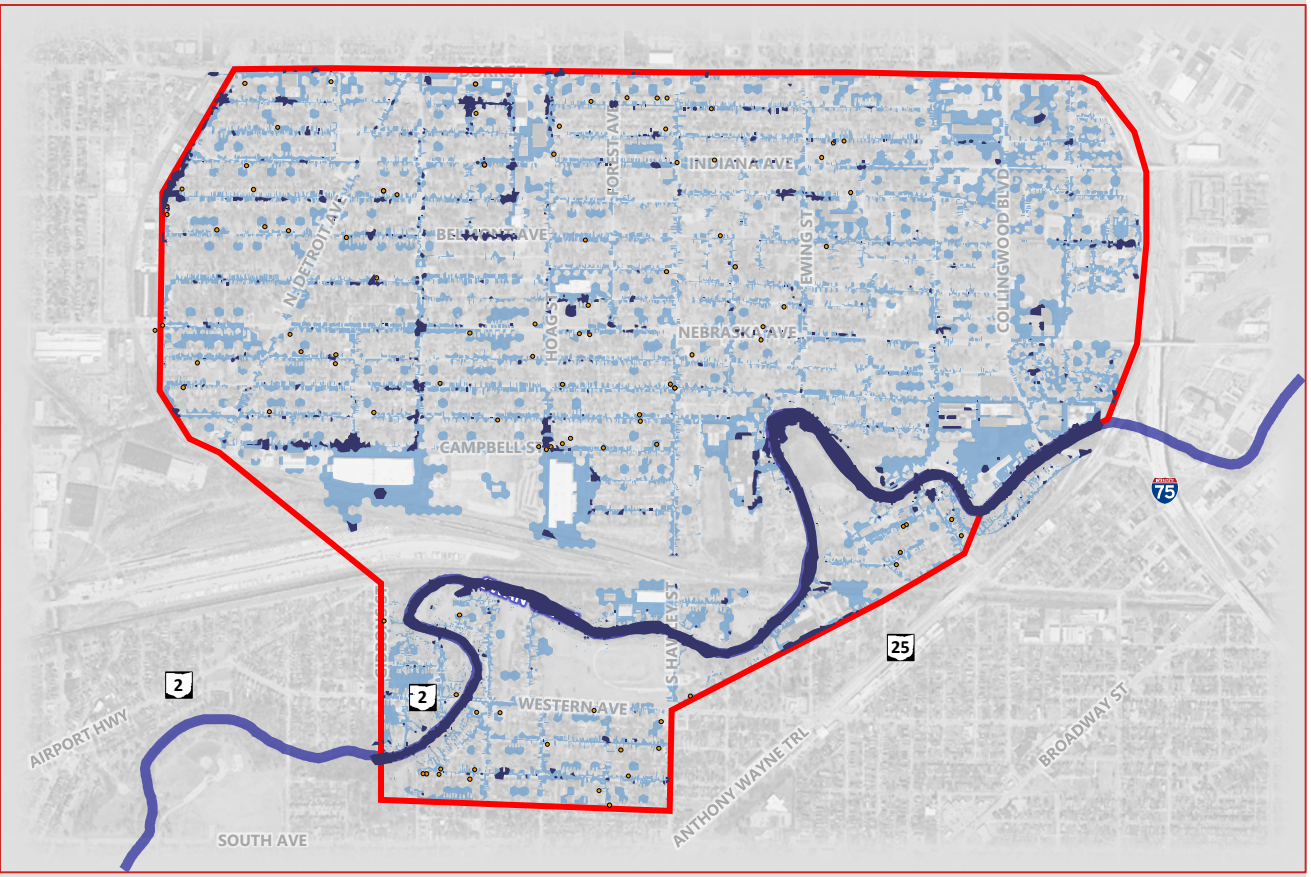
Impervious Areas



Based on analysis of impervious data from the US Geologic Survey National Land Cover Database (2011), the NFWF project area is 51.7% impervious, meaning over half of the land in this area is hardened or "built" and does not allow water to infiltrate, or soak into the ground. Buildings and pavement, such as roads, sidewalks, driveways and parking lots are all types of impervious surfaces. As the amount of impervious area increases, so does the proportion of rainfall that is converted into runoff.

A simple runoff model of the major subwatersheds within NFWF project area was developed to understand relative runoff, taking into account the soil infiltration properties and impervious surface percentage. The map is color –shaded to represent the resulting runoff coefficient, which is the proportion of the rainfall volume that is converted to runoff.

PCSWMM Model Max Depth 100 Ex



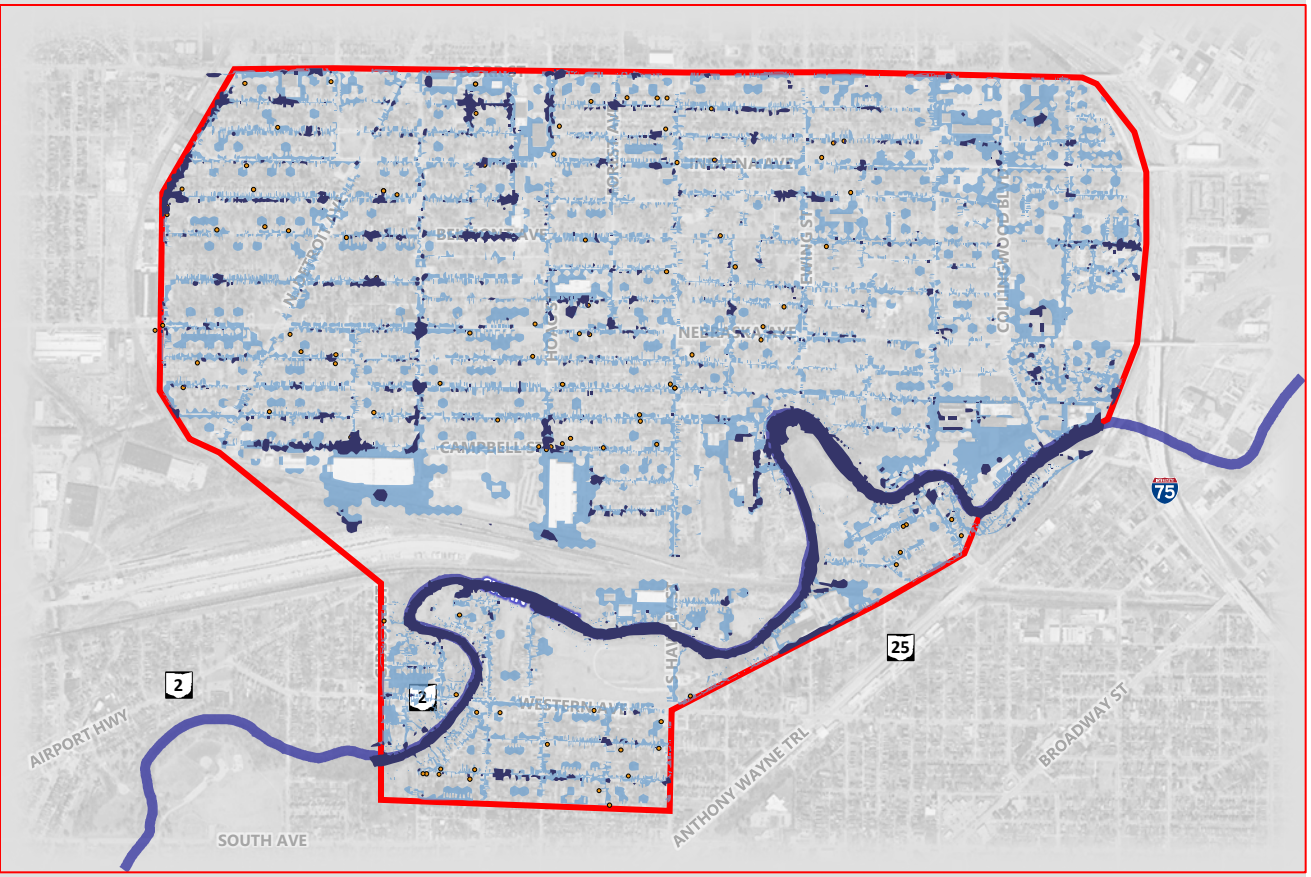
- Swan Creek
- NFWF Boundary | Area of Interest
- 100-year Storm Model
- Max Depth > 3 inches
- Reported Flood Areas

The project area was also modeled in PCSWMM using a two-dimensional rain-on-grid analysis to simulate overland flow paths along streets and water flow into the drainage systems within the neighborhoods. This analysis was used to help identify areas where street flooding occurs and where the drainage system has inadequate capacity.

The model results for the 100-year event (under current climate conditions) was overlain with the addresses compiled from flooding complaint data submitted by residents, police or City employees through the Engage Toledo reporting system. The flooding data, including street and basement flooding, were provided by the City of Toledo.

This overlay shows a strong visual correlation between the modeled water depths (especially for depths > 3 inches) and flooding complaints, which helps to validate the model results.

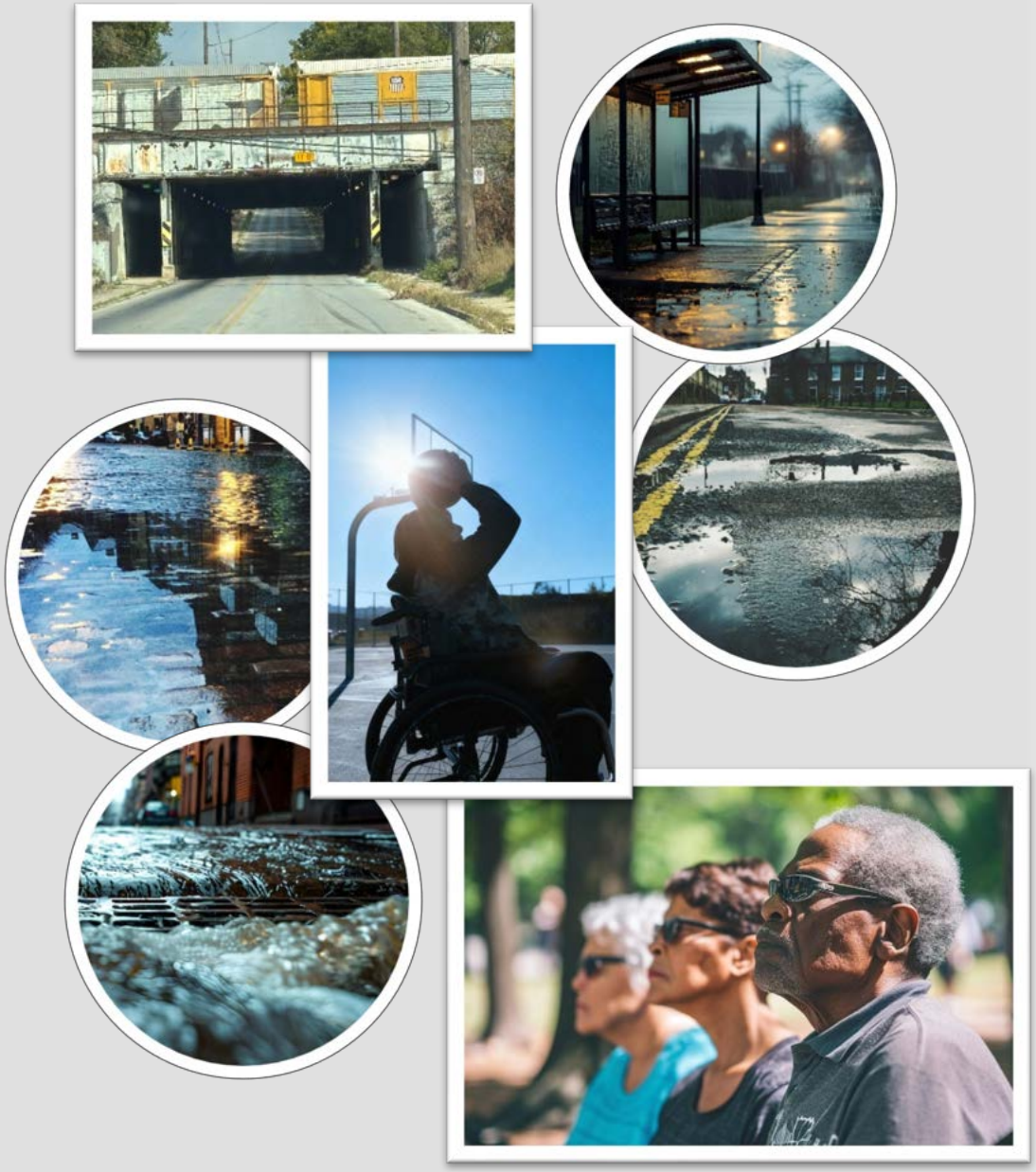
PCSWMM Model Max Depth 100 Ex & Future 3°C



- Swan Creek
- NFWF Boundary | Area of Interest
- 100-year Future 3°C Storm Model
- Max Depth > 3 inches
- Reported Flood Areas

The 100-year water depths for future climate scenarios reveals additional vulnerable areas where projects to increase stormwater system capacity (through the addition of retention projects or conversion of impervious areas) may be most beneficial.

Vulnerable Areas



MSG used the hydrologic analysis results, in combination with the City's heat study data, to identify vulnerable areas and areas of high risk for climate-related impacts. Additional data layers that were used to help identify risks included roads, bus routes, public open spaces and parks, schools, safe routes to schools, senior facilities and housing. The identified areas include:

- Neighborhoods adjacent to Swan Creek
- Blocks with aging infrastructure or poor drainage (brick streets had frequent flooding complaints)
- Highly impervious areas, including large industrial/commercial buildings
- Hawley Street Tunnel under CSX Railroad
- Collingwood Ave (southeast of the Swan Creek bridge)
- Pedestrian / bus routes with high heat index
  - Dorr Street
  - Indiana Ave
  - Nebraska Ave
  - Western Ave
  - N. Detroit Ave
  - Junction Ave
  - City Park
  - Division Street

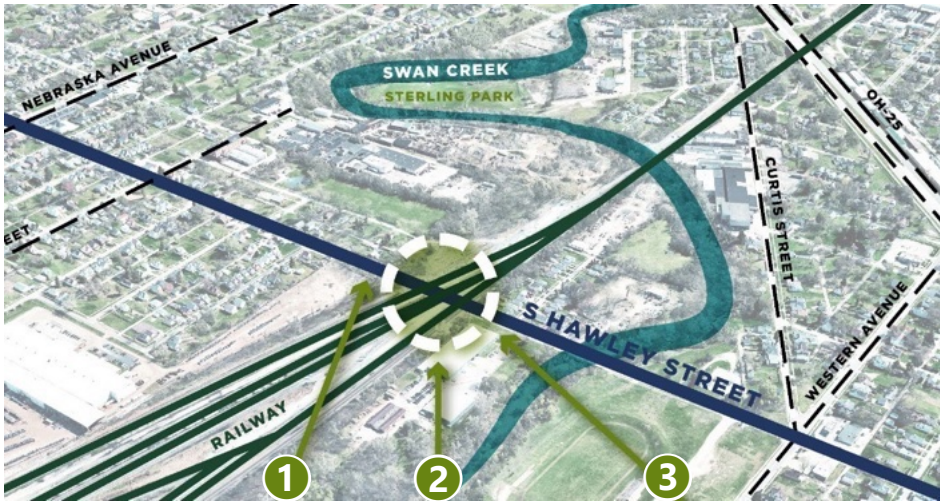
Hawley Tunnel

The Hawley Tunnel, a railroad bridge over N. Hawley Street, has been identified as a vulnerable area subject to frequent flooding both by residents and from the hydrologic analysis results. Although the modeled flood elevations show that Swan Creek does not overtop the Hawley Street bridge structure for the 100-year event, the surrounding banks and roadway north of the bridge have lower elevations that allow Hawley Street to become inundated during extreme rainfall and flooding events. Ponding on the roadway in and near the tunnel may also come from street drainage and overland flow down the steep slope on the north side of the tunnel. The stormwater pipes that discharge into Swan Creek on the west side of Hawley Street are surcharged during high flows, which inhibits drainage away from the tunnel area via the stormwater piping system. Given the topographic challenges of this location, with water potentially coming from both sides of the tunnel and from the railroad above, the solution to minimize flooding here is not immediately apparent. A pumping system may be required to mitigate flooding here, although a more detailed analysis of surface elevation data along with catch basins and piping connections is needed to fully understand the potential effectiveness of various solutions.

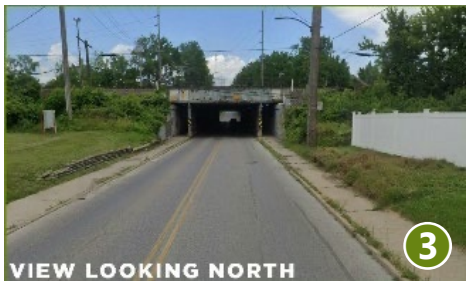
Beyond the flooding and stormwater drainage concerns, the tunnel presents a safety hazard for pedestrians as it is a secluded area and dimly lit. The structural steel beams appear to have visible deteriorations and rust. Previous planning documents, including the Junction Master Plan, have identified concerns with the Hawley Tunnel and have proposed, at a minimum, aesthetic improvements such as upgraded lighting and painting murals through the tunnel.

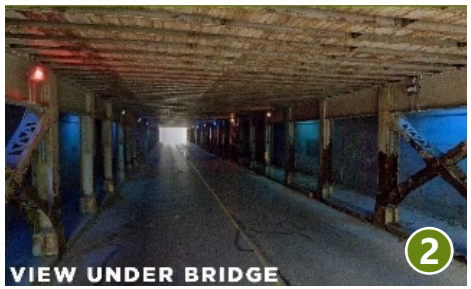
In the summer of 2023, the Lucas Metropolitan Housing Authority obtained clearance from Norfolk Southern Railway to beautify the tunnel with murals and programmable LED lighting, however the lighting was the only work completed and has since been partially replaced with standard bulbs as damage and vandalism have occurred.

The tunnel bridge structure is owned by Norfolk Southern Railway, with the City of Toledo maintaining the street and its associated stormwater infrastructure under the bridge. Any maintenance or design will need to be coordinated with both jurisdictional entities.









Site Selection & Prioritization

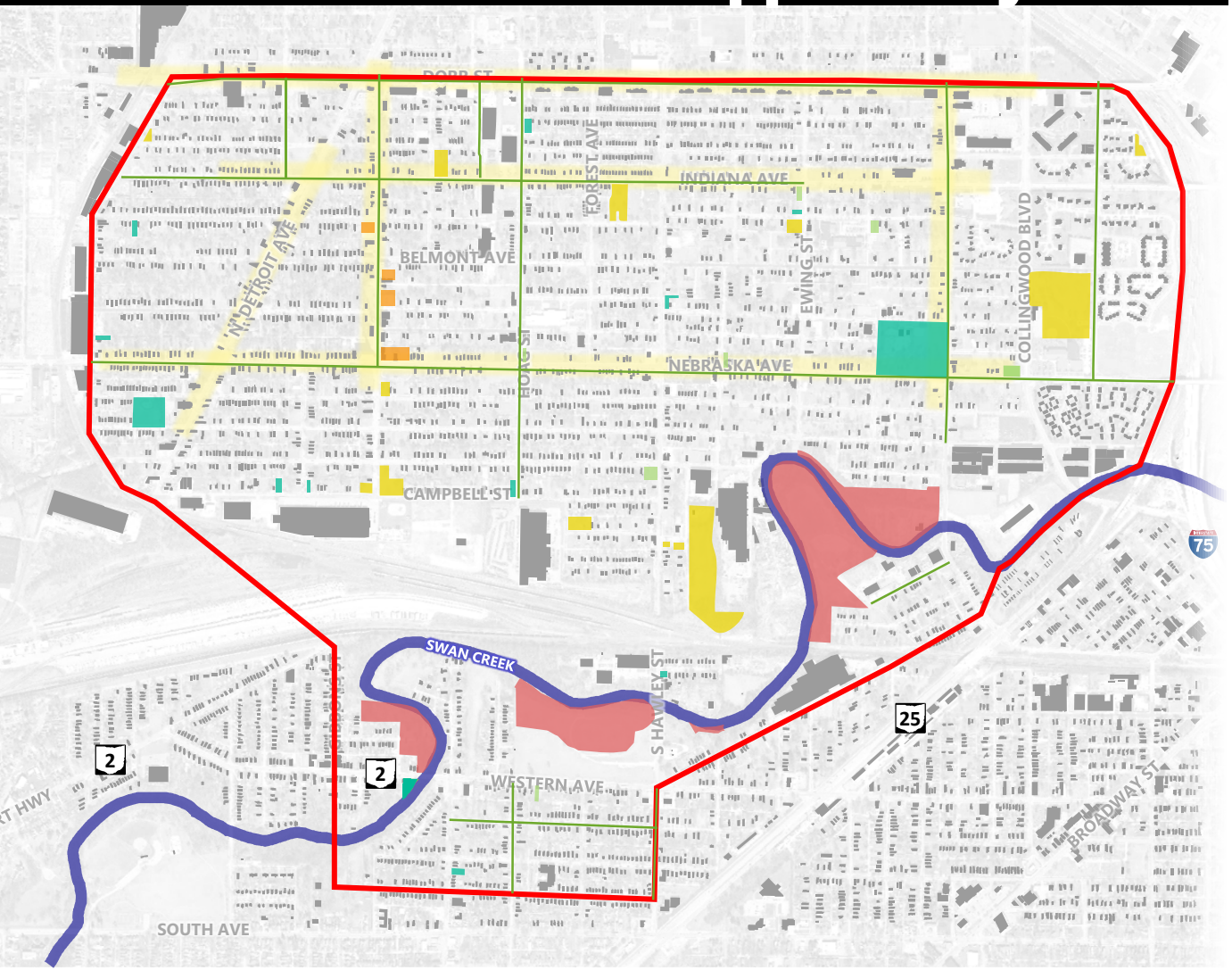
Site Selection

The project team identified potential sites for project implementation based on the flooding and heat risk areas identified coupled with existing conditions and site constraints, including factors such as location, topography, existing stormwater infrastructure, roadway and sidewalk width, ownership, and previous planning priorities.

The site selection focused on reviewing three general categories of spaces within the project area:

- Parks and Community Spaces - A variety of nature-based projects can be implemented into existing parks and community spaces to improve the park spaces and benefit the surrounding areas by capturing stormwater or providing shade. Park improvements make the spaces more useful for residents to recreate or gather.
- Vacant Parcels owned by the City of Toledo or Lucas County Land Bank - These areas and sites can be used to implement a variety of project types, including stormwater-focused bioretention areas, heat-reducing tree plantings, as well as property redevelopment for residential infill or re-imagining into public spaces. Parcels adjacent to Swan Creek are prioritized for riparian habitat restoration and flood capacity improvements.
- Corridors – Urban transportation corridors (including pedestrian and bus routes) sidewalks, streets and adjacent right-of-way areas, where linear green infrastructure projects like roadside bioswales or street tree plantings could be implemented. In some of these corridors, streets could be narrowed to achieve additional traffic-calming benefits and provide more space for green infrastructure elements or for upgraded sidewalks with street trees.

Opportunity Areas | Recommendations

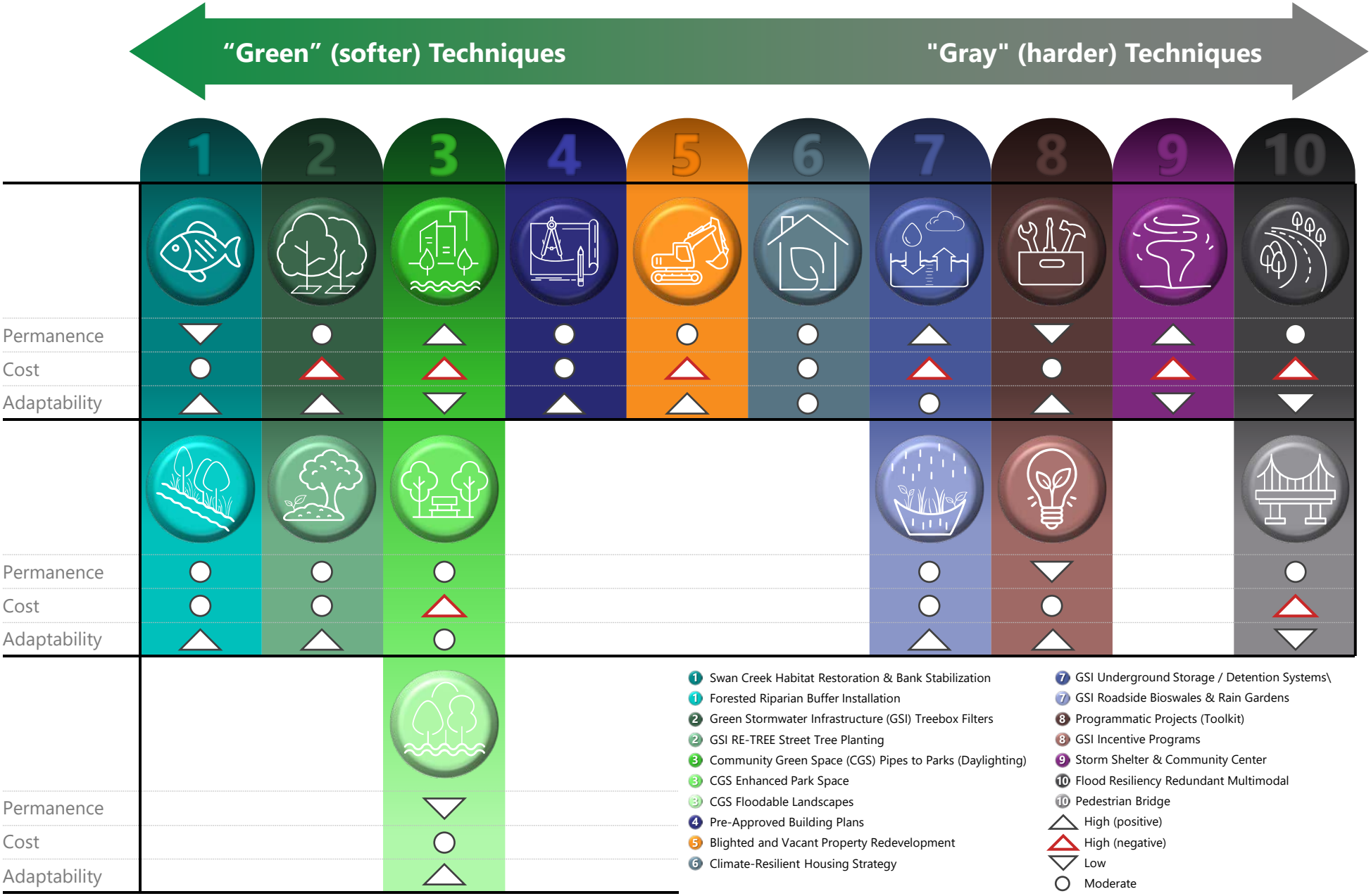


This map shows recommended project locations grouped by the prioritized project type for each location, however in many cases multiple practices could be integrated on a single site. Further investigation into specific site constraints will need to occur as detailed designs are developed for each site.

This map is not meant to exclude other parcels or project sites that may be equally beneficial but rather to serve as a starting point to pinpoint opportunities for further design development.

- Swan Creek
- NFWF Boundary | Area of Interest
- Habitat Restoration
- Community Green Space
- Green Infrastructure | Stormwater Focus
- Green Infrastructure | Tree Focus
- Property Redevelopment
- Corridors

Techniques | Cost-Benefit Analysis



Conceptual Designs and Recommended Action

Conceptual Designs



The following conceptual designs and renderings, as examples of the community-selected Top 5 project types, are included in the Resilience Action Plan to illustrate how these projects could be implemented within the NFWF Project Area. These illustrations are intended to spark ideas and encourage creativity in re-thinking community spaces by integrating resilient features into our landscape at all scales, from streets and sidewalks, to vacant lots and community parks.

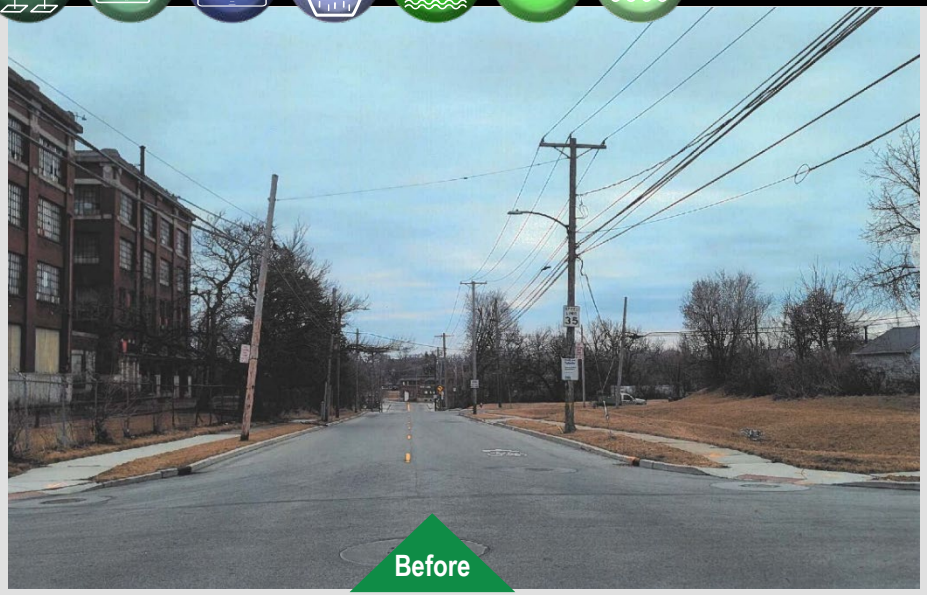
This conceptual design integrates many of the ten project types, reimagining the vacant lots and brownfield site (currently undergoing remediation) on the northern bank of Swan Creek, west of City Park Ave as a public park space connected to Sterling Park via a pedestrian bridge that spans Swan Creek. The expanded green space includes a large wetland restoration area within the floodplain, and intentional, safe recreational access points for fishing or kayaking in Swan Creek. The surrounding neighborhoods are connected in multiple locations to the river by trails and walking paths that allow residents to explore the riparian corridor.

Swan Creek Habitat Restoration



- Green Stormwater Infrastructure (Retention and Infiltration)
- Storm Shelter & Community Center
- Blighted and Vacant Property Redevelopment
- Green Stormwater Infrastructure (Retention and Infiltration)
- Green Stormwater Infrastructure (Trees)
- Community Green Space
- Programmatic Projects (Toolkit)
- Habitat Restoration & Bank Stabilization
- Flood Resiliency Redundant Multimodal
- Community Green Space
- Green Stormwater Infrastructure (Retention and Infiltration)
- Habitat Restoration & Bank Stabilization

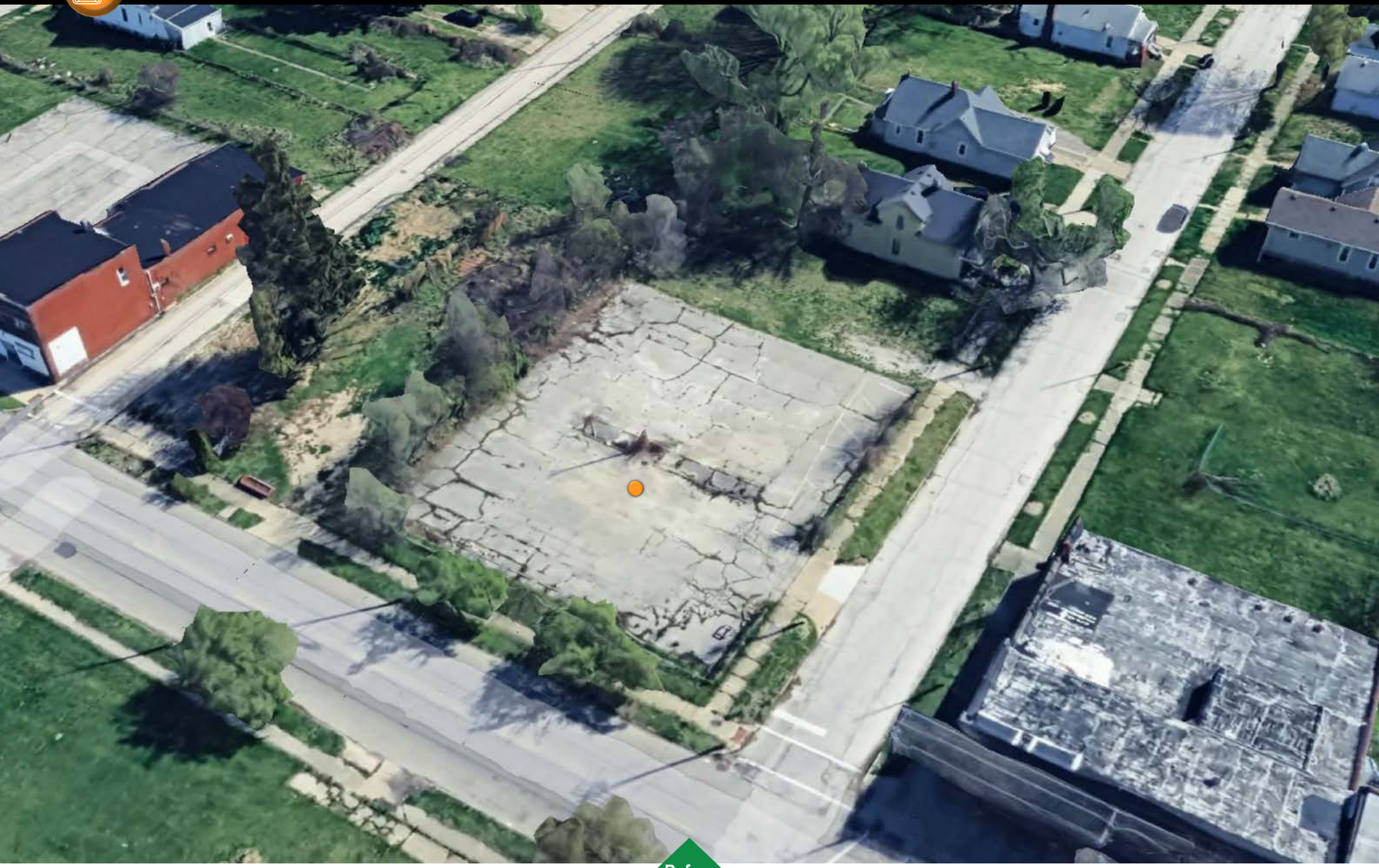
Green Stormwater Infrastructure





These conceptual renderings show examples of green infrastructure being incorporated into the existing urban "grey" streetscapes, with the addition of bioswales and street trees. Although these renderings show two specific locations along City Park Ave, similar concepts could be implemented throughout the project area, on almost any street depending on specific site constraints

Blighted and Vacant Property Redevelopment | Existing Condition



Before

Proposed Concept



This concept illustrates property redevelopment of a City-owned parking lot into a multi-use community gathering space, suitable for pop-up markets or community events. The concept design integrates nature-based solutions to shade as well as cool the pavement and treat stormwater onsite, reducing runoff from the impervious surface.

Conceptual Entrance



Conceptual Event Space

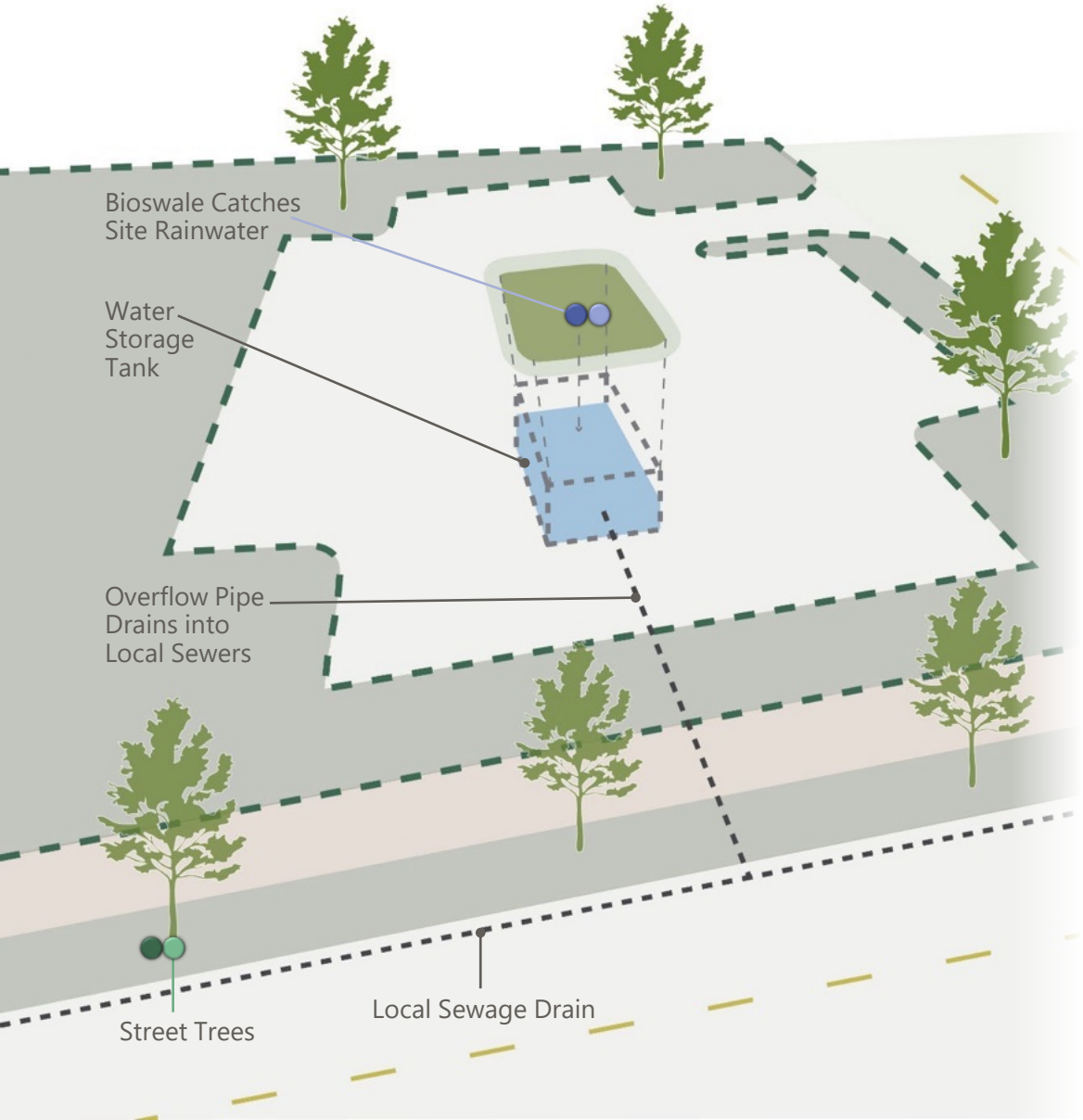


Conceptual Bioswale



After

Bioswale



In addition to the fresh pavement, a project of this nature presents opportunities to layer on numerous other improvements for the area.

- Underground stormwater retention designed to allow natural absorption in regular conditions and hold water onsite during large rain events
- Shade Trees require adequate root space and thoughtful integration into a site; the construction or redevelopment process can facilitate a higher chance of tree survival and lower chance of infrastructure impacts down the line
- Accessibility can be addressed with greater intention when a site is redeveloped, compared to what may have been there historically
- Enhanced lighting plans can be implemented in the course of transforming a space
- Community-driven utilities, such as municipally-controlled electric and water, could be made available to help lower the barrier to entry for vendors who might not have or might not be able to run generators for power or bring their own water supply

Pre-approved Building Plans



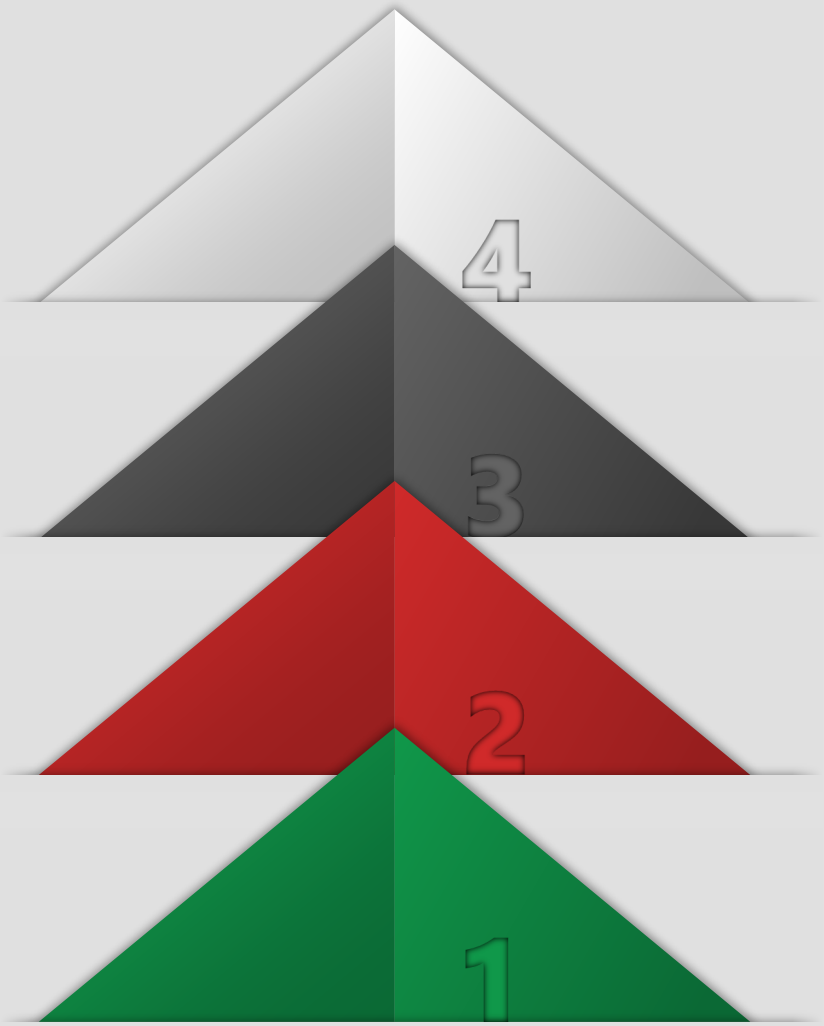
In March of 2025, the Ohio REALTORS® and the Greater Ohio Policy Center launched "Housing Ohio, Tools for Development."

This pattern book includes building plans, zoning reforms, and a guide to help jurisdictions explore pre-approving building permits with these plans.

This document urges the communities within the NFWF Project Area to embrace this facilitation of resident-led redevelopment and to take it one step further. The existing program represents a major step in helping make housing more affordable through infill development. We challenge you to embrace an additional level of resilient architecture through the integration of eco-friendly and practical sustainable solutions.

This conceptual schematic of an "Eco House" incorporates sustainable site design elements and housing construction materials and techniques to illustrate what resilient housing could look like in the project area neighborhoods. Pre-approved resilient housing would include building plans and design packages that can lower barriers to redevelopment, streamlining building and zoning approval processes and encourage affordable, durable, and modern housing.

Next Steps



Next Steps

The projects, innovations, and ideas described throughout this plan are the result of data-driven and stakeholder-informed strategic planning built upon the project area's past work and current feedback. The project team compiled 10 actionable projects, assessing their most effective implementation within the boundaries of the Project Area.

While these don't represent every solution, the recommendations presented reflect a careful consideration of the complex characteristics of the Project Area, including environmental pressures and vulnerabilities, updated flood modeling, socioeconomics, and the needs of individuals.

The next steps along this roadmap to a more resilient, sustainable, and stronger community depend on the solutions embraced and those who embrace those solutions. Acknowledging that the future is full of alternatives, this plan will conclude with a focus on the project area's future.

Participation

Each project outlined in this Plan can be implemented for the betterment of the community. How easily this implementation occurs depends on the number of individuals who embrace the projects. The leadership and public will be best served when they collaborate and focus on problem-solving with shared intentions. The project team is optimistic regarding the participation in these projects, given the community's history of organization around these challenges.











Conventional Framework

This project will stabilize the degraded riverbanks, minimizing the siltation downstream. This will result in improvements to water quality and lower the risk of failure under similar conditions in the future.



Sustainable Framework

This project will restore eroding riverbanks and return biodiversity to the area. Through a focus on nature-based solutions, the restoration will return the hydrodynamic and biological functionality to the river.

Both descriptions portray the same project but focus on different components and points of view. When considering how to fund a project, the words used, and the highlighted components are important. Neither is wrong, but both have their place when pursuing funding which can come from diverse sources operating under vastly different frameworks.



Paramount to each project is the investment that brings it to fruition. The project team recommends seeking strategic funding strategies that leverage prior and ongoing efforts as a local match and build momentum. As the funding landscape and priorities shift, each project must be scrutinized for its strengths and weaknesses under the current evaluation matrix.

Adaptive Management

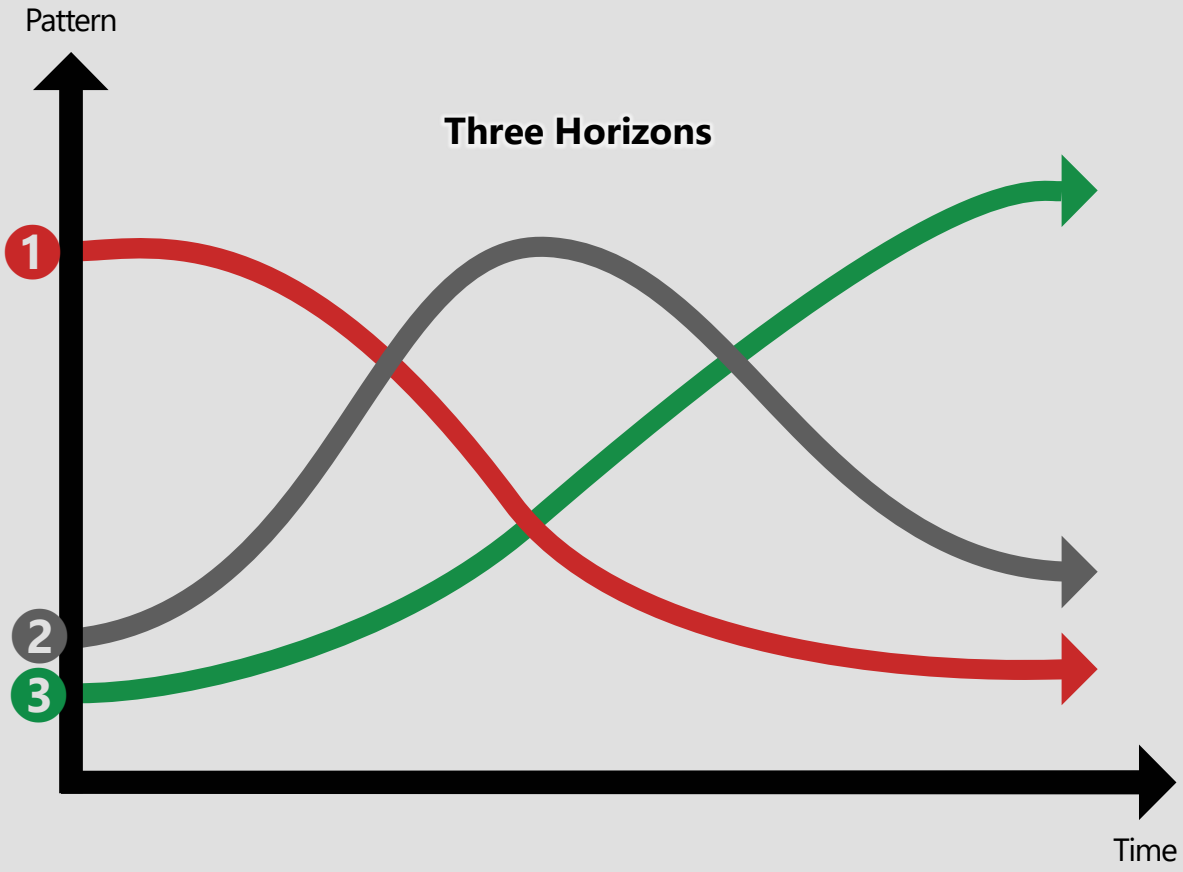


We've all seen a forgotten project, the ribbon cutting was a year or two ago, and now the fresh paint is chipping, the signs are fading, the flowers have died, and the grass has grown across those once freshly-installed sidewalks. Preventing this situation is why adaptive management exists, but it means more than just performing maintenance. Adaptive management is the process of monitoring and changing management practices to keep up with the use and pressures a project faces. It allows for a space or a program to adjust as time passes so that it can remain as impactful on year five as it was on day five.



In a space or building this can look like a maintenance and improvement plan that is reviewed and updated on an annual basis to help meet established benchmarks or goals within five- or ten-year increments. Rather than performing "upkeep" intentional actions are taken to help the asset keep-up with its users' needs. In a program this can look like an integrated and honest evaluation of the program's performance and a willingness to pivot when it appears that changes can be made to better meet the established goals.

Adaptive Management



One of example an adaptive management tool is the "Three Horizon Method".

Horizon 1 – "Business as Usual" – a program or space is imagined and implemented to fulfill a specific vision. This vision is attained and then begins to diminish as external needs and pressures shift or internal capacity lessons as time goes on

Horizon 2 – "Innovation" – a proactive intentionality in place from day one, looking for a way to innovate, grow, and change to best fit the needs and desires of the community

Horizon 3 – "Viable Future" – simply an aspirational preparedness, more of a mindset than a plan until it crosses Horizon 2, at which point it becomes the new vision and goal for the "reborn" program or space.

Conclusion

The vision embraced by this plan for the future of the Project Area is ambitious, but the community members living here have a history of overcoming difficult odds to achieve what at times seems impossible. Advancing a community to be more resilient in the face of uncertainty, land use change, and shifting priorities is a challenge that these neighborhoods have accepted. Progress is possible by working together to learn from both past successes and failures, understanding vulnerabilities, and being invested today for the residents of tomorrow.

Swan Creek Restoration and Resilience
JUNCTION NEIGHBORHOOD
Planning Project





2025



Nature-Based Solution “Toolkit”



Swan Creek Habitat Restoration & Bank Stabilization

About This Approach

Habitat restoration and shoreline stabilization are methods to help reduce the risks posed by flooding and erosion through efforts to reverse impacts on a natural waterway. These risks to communities are generally expected to increase with future development of impermeable surrounding surfaces, degradation of the waterway, and more extreme weather events.

Conceptual Overview

This approach generally implements a mix of traditional armoring (bulkheads, rip-rap) and natural habitat features (bluff vegetation, bank regrading). Waterway dynamics are a key consideration in how this hybridized approach is implemented.

Resiliency Considerations & Design Process

Focus on the most erosion-prone reaches, prioritizing locations that pose the greatest threat to homes, infrastructure, or key community spaces. Designs should strike a balance between bank stability and safe and equitable public access for recreation, such as fishing, trails, or overlook areas. Approaches deemed appropriate at the time of deployment may need to be amended or replaced as natural pressures evolve. Regular monitoring and assessment are critical to successful implementation.

Swan Creek Habitat Restoration & Bank Stabilization



Low-energy environments and areas not prone to ice-flow impacts can be addressed using "natural" approaches such as the Palmiter Method



Mid-energy environments require more-robust "nature-based" approaches such as rip-rap features, or bendway weirs



High-energy environments may call for drilled shaft, crib, or sheet-pile walls which offer stability at the expense of natural materials

"Green" (softer) Techniques ⟷ **"Grey" (harder) Techniques**

Benefits

- Reduces erosion
- Improves habitat
- Enhance water quality
- Reconnection of floodplains
- Increases flood storage capacity

Drawbacks / Limitations:

- Can be costly at scale
- Permitting may be required
- May need repair after floods, freezes, or other event impacts
- Resiliency Considerations & Design Process



Forested Riparian Buffer Installation

About This Approach

An intentional creation of a green buffer around a waterway can have ecological, recreational, and aesthetic benefits. Trees will provide healthy habitats for desirable wildlife, and the canopy will lower the temperature of the water, creating habitat for fish and salamanders, among others. Plantings can serve as community projects that further connect the public to overlooked resources.

Conceptual Overview

This approach can be implemented as both a restorative and an additive methodology. As a restorative approach, forested buffers can be a replacement for existing property uses ill-suited for proximity to a waterway. Forested buffers along a waterway can also be combined with walking trails or park facilities to add additional "sense of place" and layer environmental value to what could be otherwise "wasted space".

Resiliency Considerations & Design Process

This process should be implemented along Swan Creek in areas that allow for additional connectivity to parks and public spaces. Swan Creek can be transformed from a boundary to an aesthetically pleasing feature. Assuming that the space alongside the creek can be made available, Junction would benefit from the addition of healthy natural buffers integrated into a connected community space. Flood events, freezes, or other natural pressures may increase the benefit of having "breathing room" around a waterway.

Forested Riparian Buffer Installation



Benefits

- Improves water quality
- Provides shade and cooling
- Supports wildlife corridors

Drawbacks / Limitations:

- Requires land and setbacks
- Trees take time to mature



Treebox Filters

About This Approach

Small planter boxes with vegetation such as trees, bushes, or even grass, along with non-compacted soil, are integrated into urban and suburban streetscapes to divert and use stormwater.

Conceptual Overview

Treebox filters are well-established features alongside modern urban streetscapes. While their disruption of the sidewalk surface and shade can help to cool the area where they are placed, some of their greatest benefits occur below the street surface. The soil, stone, or mulch materials placed within the treebox create a filter for large pollutants swept in along with the runoff collected from the street and sidewalks during a rain event. The tree and soil further use, clean, and retain the water, allowing it to enter the storm drain system after the peak flows have lessened.

Resiliency Considerations & Design Process

Depending on the specific design or engineered level of impact, these can be installed as independent projects or during street/sidewalk work. When supported by adequate management and utilities coordination, they can be seamlessly integrated into a variety of locations.

Treebox Filters



Benefits

- Provides shade and cooling
- Improve air quality
- Capture stormwater runoff
- Visually enhances streetscape

Drawbacks / Limitations:

- Limited capacity
- Maintenance required
- Needs adequate soil volume and conditions for root growth



RE-TREE
Street Tree Planting

About This Approach

This established and successful program aims to expand Toledo's canopy from 17% to ~40%. Continuing and expanding the tree canopy provides measurable environmental and social benefits. Street trees intercept rainfall, provide shade, cool urban heat islands, and improve air quality. This approach can prioritize areas within the neighborhood with the greatest heat exposure, least vegetation, and greatest need for shade and stormwater management.

Conceptual Overview

This approach focuses on large-scale street tree planting in vulnerable and under-canopied areas within neighborhoods. Bus stops, parks, and areas near elderly or heat-sensitive populations should be emphasized for strategic placement to maximize shade along streets, sidewalks, and public spaces. Trees also support traffic calming and aesthetic improvements, helping redefine the public realm as greener and more comfortable for residents.

Resiliency Considerations & Design Process

Prioritize planting in neighborhoods with low canopy coverage, high pavement density, and documented heat vulnerability. Coordinate with utility providers to ensure proper spacing and avoid conflicts with overhead lines or underground services. Long-term care agreements and community stewardship programs should be built into the planting process to ensure tree survival and equitable canopy distribution across Project communities.

RE-TREE Street Tree Planting





Benefits

- Reduces heat and heat island effect
- Improves air quality
- Intercepts and slows rainwater
- Enhances aesthetics

Drawbacks / Limitations:

- Requires watering and maintenance
- Vulnerable to storms, pests, and vandalism
- Limited rooting space in dense urban corridors



Pipes to Parks
(Daylighting)

About This Approach

Daylighting converts buried storm pipes and culverts into open, naturalized waterways. This approach restores ecological function, increases public access, and provides space for water to safely flow and infiltrate during storms.

Conceptual Overview

Formerly channelized or piped streams are excavated and reshaped into stable, vegetated channels. Native plantings, flood benches, and gentle side slopes provide ecological diversity and hydraulic resilience. When implemented within public corridors, daylighted streams can double as linear parks or greenways that improve connectivity and quality of life.

Resiliency Considerations & Design Process

Prioritize sites with historic or existing culverts that could be feasibly daylighted within public ownership or rights-of-way. Pair with park or trail improvements to maximize public benefit. Adaptive management and monitoring should guide vegetation establishment, erosion control, and additional amenity development over time.

Pipes to Parks (Daylighting)



Benefits

- Improves water quality through natural filtration
- Expands floodplain and storage capacity
- Creates recreational and educational amenities
- Enhances habitat diversity

Drawbacks / Limitations:

- High upfront cost and engineering needs
- May require complex permitting and easements
- Land availability is often limited



Enhanced Park Space

About This Approach

Enhanced parks combine recreational space with resilient design. By integrating green infrastructure, active accessible recreation, and flood management features, these parks become vital community assets that perform multiple functions.

Conceptual Overview

This approach upgrades existing parks while providing inclusive, high-quality recreation. Examples include permeable pathways, native meadows, bioswales, shaded gathering areas, and art or interpretive features that reflect community identity. Enhanced parks promote both environmental performance and social cohesion.

Resiliency Considerations & Design Process

Engage residents and stakeholders early to identify desired amenities and resilience priorities. Ensure universal access and equitable distribution of park improvements. Incorporate stormwater management as a visible design feature to educate the public and demonstrate sustainability in action. The construction of a feature, such as a performing space in a park, can be enhanced through the integration of under- and above-ground green stormwater infrastructure.

Enhanced Park Space





Benefits

- Improves community health and well-being
- Enhances floodplain function
- Increases park usability and beauty
- Builds neighborhood identity

Drawbacks / Limitations:

- Requires new programming and funding
- Ongoing maintenance and staffing needs
- May temporarily limit access during upgrades



Floodable Landscapes

About This Approach

Floodable landscapes are open spaces, such as sports fields, parks, plazas, or playgrounds, designed to hold floodwater temporarily without damage. They protect nearby infrastructure and can be used in a variety of ways during dry periods.

Conceptual Overview

By using contour grading, native vegetation, and resilient surfacing, floodable areas can safely accommodate occasional inundation. Athletic fields, open meadows, or civic greens are dual-purpose, usable most of the time, yet able to store stormwater when needed. Near Swan Creek or other flowing waterbodies that carry floodwaters, additional volume can be created in amenities that, during normal levels, serve as pedestrian access to the water.

Resiliency Considerations & Design Process

Site in low-lying, flood-prone areas or adjacent to waterways. Use durable, fast-recovering plant species and materials that can tolerate periodic inundation. Clear signage and public education can help users understand and value these spaces as active resilience features. Design with layers of use such as a regraded river slope and low-lying grassy lawn with a sloped berm surrounding it. This area can be flooded in storm conditions and provide safe and easy access to the water under normal conditions.

Floodable Landscapes





Benefits

- Reduces flood damage to adjacent areas
- Increases flood storage capacity
- Provides recreation and ecological habitat
- Cost-effective compared to gray infrastructure

Drawbacks / Limitations:

- May require closures after storm events
- Soil compaction can reduce performance
- Public perception of “floodable” areas may require education



Financial burdens unique to minority populations or with origins in economic injustice can be overlooked drivers of household economic instability that, over time, contribute to property abandonment and neighborhood disinvestment. We acknowledge this history and the community's trauma as we put forward this and other approaches in the pursuit of equitable resilience.

Pre-Approved Building Plans

About This Approach

Pre-approved resilient building plans lower the costs and complications of permitting while ensuring new homes meet modern resilience standards. This approach increases the chances that existing or former residents can build back into this community while speeding the approval and construction phases often encountered by residents attempting to rebuild or invest in safer housing.

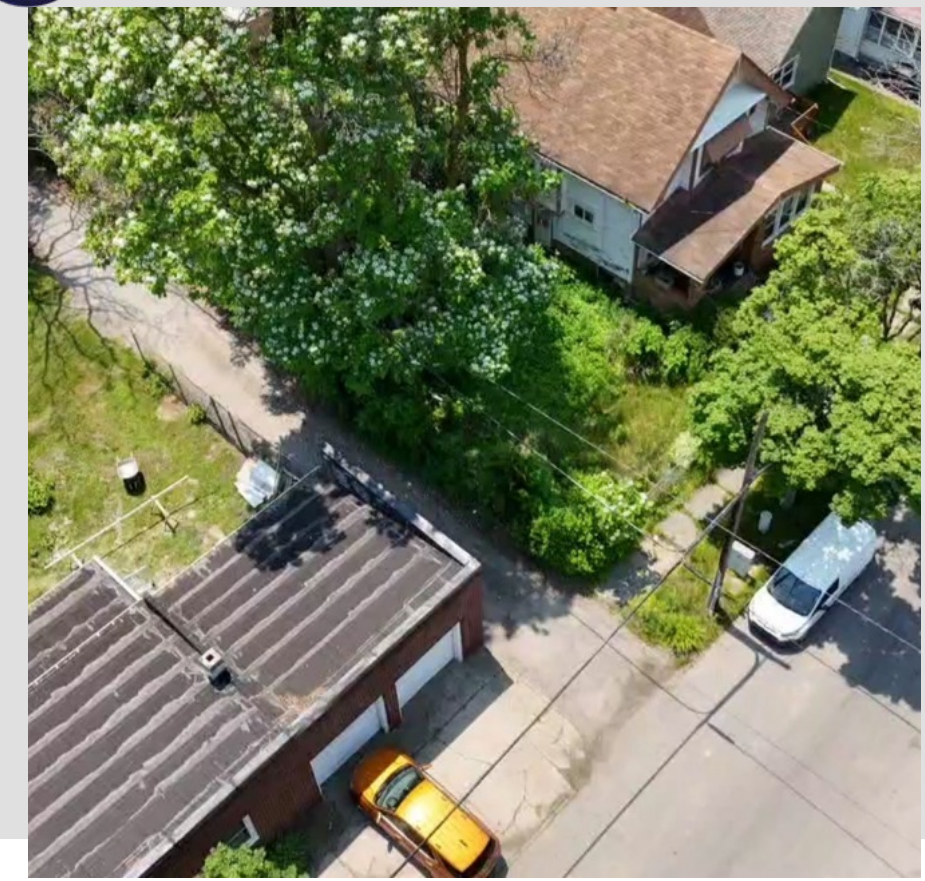
Conceptual Overview

Standardized, code-compliant home designs incorporate energy efficiency, flood protection, and climate-ready materials. By offering a catalog of designs that meet city and state requirements, residents and small developers can confidently build resilient homes with fewer regulatory hurdles and costs.

Resiliency Considerations & Design Process

The Greater Ohio Policy Center and Ohio REALTORS® have developed plans in partnership with architects and builders that have begun being rolled out in cities across Ohio. These existing plans include design variations that fit different lot sizes, elevations, and architectural styles, although they do not yet incorporate resilient approaches explicitly. The pre-approval program focuses on addressing the missing middle, which refers to a lack of medium-density housing options in urban areas. Building upon an existing infill housing model will facilitate resilient innovation with less risk. A successful roll-out will provide clear guidance on siting, elevation, and sustainable materials to maximize long-term safety and performance.

Pre-Approved Building Plans





Benefits

- Faster and cheaper permitting
- Guarantees resilient design elements
- Simplifies the building process for residents

Drawbacks / Limitations:

- May limit architectural variety
- Requires upfront city investment in plan development
- Updates needed as codes evolve



Financial burdens unique to minority populations or with origins in economic injustice can be overlooked drivers of household economic instability that, over time, contribute to property abandonment and neighborhood disinvestment. We acknowledge this history and the community's trauma as we put forward this and other approaches in the pursuit of equitable resilience.

Blighted and Vacant Property Redevelopment

About This Approach

Redeveloping blighted and vacant properties transforms liabilities into community assets. When the community determines that a property's highest and best use is transformation, then these sites can become green spaces, stormwater management areas, or community hubs that improve safety and quality of life.

Conceptual Overview

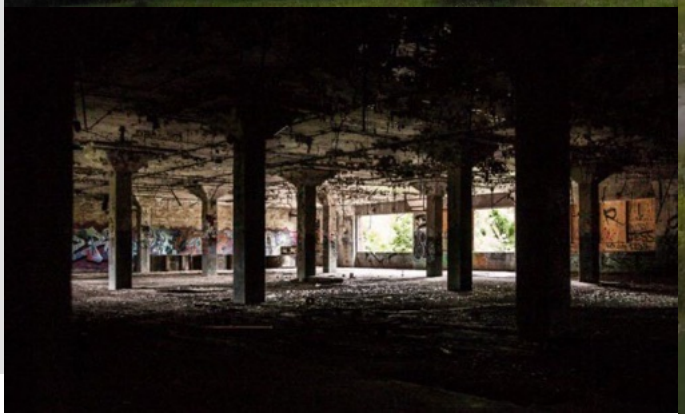
Underutilized or contaminated parcels can be repurposed through strategic partnerships with land banks, nonprofits, and developers. Green reuse, such as pocket parks, bioswales, or urban gardens, can catalyze neighborhood revitalization while addressing chronic flooding or heat issues.

Resiliency Considerations & Design Process

Identify parcels within flood-prone or heat-vulnerable areas for targeted neighborhood improvements through reinvestment. Work with the Land Bank and brownfield programs to secure cleanup and development funding. Engage the community in visioning to ensure redeveloped spaces meet social and environmental goals.

Blighted and Vacant Property Redevelopment







Benefits

- Reduces neighborhood blight and crime
- Increases property values and community pride
- Expands green and open space
- Restores ecological function to degraded sites

Drawbacks / Limitations:

- Cleanup and remediation costs can be significant
- Funding and ownership coordination are complex
- Maintenance responsibilities must be clearly defined



Financial burdens unique to minority populations or with origins in economic injustice can be overlooked drivers of household economic instability that, over time, contribute to property abandonment and neighborhood disinvestment. We acknowledge this history and the community's trauma as we put forward this and other approaches in the pursuit of equitable resilience.

Climate-Resilient Housing Strategy (Resilient Homes)

About This Approach

Retrofitting existing homes enhances community resilience by improving safety, comfort, and efficiency. A climate-resilient housing strategy equips homeowners with the tools and resources to adapt to increasing heat, flooding, and severe weather. Often, it is a difficulty finding local and willing craftsmen, and not a lack of funding on the part of the residents, that is a hurdle in addressing resilient housing construction. This approach should not only consider a program to help the residents, but also to support local contractors, or even help create and educate aspiring local contractors.

Conceptual Overview

Recommended upgrades may include insulation, energy-efficient windows, sump pumps, backflow preventers, rain barrels, and landscaping for stormwater control. These improvements not only protect residents from hazards but also reduce utility costs and improve overall living conditions.

Resiliency Considerations & Design Process

Seek guidance from the residents as to which barriers are the most impactful to their maintenance and improvement of their homes and shape the approach to address the issues identified. The best solution for the residents might be the facilitation of a contractor training corps to help equip service providers or generate local apprenticeships, so that community members have access to a larger workforce. Offer technical guidance and coordinate with weatherization or housing assistance programs. If a financial solution is appropriate, financial incentives or non-predatory, low-interest loans should be made possible to increase participation in reinvesting in the community. This solution must be centered around local residents and vulnerable populations, not outside investment. This solution must be rooted in the resident-identified needs to build community trust and interest.

Climate-Resilient Housing Strategy (Resilient Homes)





Benefits

- Protects families and property
- Lowers long-term energy and maintenance costs
- Reduces community vulnerability during disasters

Drawbacks / Limitations:

- Upfront investment can be a barrier
- Requires homeowner engagement and education
- Some retrofits need professional installation



Underground Storage / Detention Systems

About This Approach

Underground storage systems manage stormwater where surface space is limited. By capturing runoff during storms and releasing it gradually, these systems reduce pressure on existing drainage infrastructure and mitigate localized flooding.

Conceptual Overview

These systems are typically installed beneath parking lots, athletic fields, or parks. They use chambers or vaults to store excess runoff and incorporate flow control devices that regulate discharge into storm sewers or surface basins. When designed with filtration or pre-treatment, they can also improve water quality before release.

Resiliency Considerations & Design Process

This approach is best suited for new development or major redevelopment where excavation is already planned. Designs should account for long-term maintenance access and be sized to accommodate increasing rainfall intensity due to climate change. Coordination with the City's stormwater management team is essential to ensure compatibility with downstream conveyance and storage capacity.

Underground Storage / Detention Systems





Benefits

- Manages large stormwater volumes efficiently
- Conserves surface land for other uses
- Reduces downstream flooding
- Can integrate with redevelopment projects

Drawbacks / Limitations:

- High initial construction cost
- Potential utility and access conflicts
- Requires regular inspection and sediment removal



Roadside Bioswales & Rain Gardens

About This Approach

Bioswales and rain gardens capture, filter, and infiltrate stormwater runoff from roads, sidewalks, and parking areas. These green infrastructure practices provide both functional and aesthetic enhancements to the urban landscape.

Conceptual Overview

Vegetated swales and shallow landscape depressions slow and treat runoff close to where it falls. Native vegetation, mulch, and engineered soil layers promote filtration and infiltration while reducing pollutant loads. Their placement along curbs or within boulevards transforms typical drainage corridors into green corridors.

Resiliency Considerations & Design Process

Use native and drought-tolerant plants to enhance longevity and reduce maintenance. Site bioswales in areas with adequate infiltration and sufficient setback from structures. Integrate with pedestrian routes, signage, or educational features to highlight stormwater function and community value. Regular maintenance is critical to ensure consistent hydraulic performance.

Roadside Bioswales & Rain Gardens



Benefits

- Reduces flooding and peak flow
- Filters pollutants before they reach waterways
- Provides native habitat and pollinator support
- Beautifies streetscapes

Drawbacks / Limitations:

- Maintenance-intensive (weeding, debris removal)
- May hold water temporarily after large storms
- Requires infiltration-friendly soils



Programmatic Projects
(Toolkit, Incentives, Snow Lots)

About This Approach

Programmatic projects support resilience beyond physical construction. Toolkits, incentive programs, and management strategies expand the reach of green infrastructure by empowering residents, businesses, and city departments.

Conceptual Overview

These initiatives can include educational materials, training workshops, green infrastructure rebates, or adaptive management policies (like snow lot conversions for temporary storage). Together, they establish a community-wide framework for sustainable practices and long-term resilience.

Resiliency Considerations & Design Process

Develop a clear toolkit with best practices, maintenance guidance, and visual examples tailored to Junction's needs. Create incentives that are simple, equitable, and accessible to all income levels. Partner with community organizations to extend outreach and measure program outcomes. This approach can be inclusive of innovative approaches for city departments, such as "snow lot conversions". This could be facilitated by implementing curb cuts and robust landscaping in certain green lots, where during the winter, snow can be stored by plow crews. This would allow the snowmelt to largely drain into the soil while preserving the lot's use for recreation during the non-winter months.

Programmatic Projects (Toolkit, Incentives, Snow Lots)





Benefits

- Builds local skills and awareness
- Encourages private-sector and resident participation
- Low-cost compared to major capital projects
- Flexible and scalable over time

Drawbacks / Limitations:

- Requires cross-departmental coordination
- Early adoption may be limited
- Needs consistent funding and staff capacity



GSI Incentive Programs

About This Approach

Green Stormwater Infrastructure (GSI) incentive programs motivate private property owners to install sustainable stormwater solutions like rain gardens, cisterns, or permeable paving. These initiatives multiply public investment by encouraging distributed action.

Conceptual Overview

Through rebates, tax credits, or technical assistance, GSI incentives make it easier for residents and businesses to manage their own runoff. The city could provide educational support and may coordinate with local contractors or nonprofits to streamline implementation and ensure quality control.

Resiliency Considerations & Design Process

Target high-runoff or low-income parcels for greater equity and impact. Simplify application processes and publicize success stories to inspire participation. Coordinate with broader sustainability goals like energy efficiency or beautification grants for maximum synergy.

GSI Incentive Programs





Benefits

- Extends impact beyond public lands
- Builds private investment in resilience
- Reduces stormwater loads on public systems
- Strengthens community partnerships

Drawbacks / Limitations:

- Requires stable, long-term funding
- Monitoring and verification can be resource-intensive
- Participation may be uneven across neighborhoods



Storm Shelter & Community Center

About This Approach

Dual-use community centers provide safe refuge during disasters while serving as year-round gathering spaces. When designed to FEMA safe-room standards, these facilities become vital resilience hubs.

Conceptual Overview

These centers combine daily community functions; like recreation, meetings, and classes, with hardened infrastructure for severe weather. Backup power, reinforced construction, and accessible design ensure usability during crises.

Resiliency Considerations & Design Process

Integrate shelters into existing or planned community spaces to reduce costs and maximize use. Include sustainable energy systems and resilient communication infrastructure. Develop clear management and emergency operation plans in collaboration with local emergency services.





Benefits

- Protects residents during extreme events
- Strengthens community cohesion
- Provides a multipurpose civic asset

Drawbacks / Limitations:

- High capital cost for construction
- Requires ongoing staffing and management
- Must meet strict FEMA and ADA requirements



Flood Resiliency (Redundant Multimodal Transportation Infrastructure)

About This Approach

The consideration of resilient transportation infrastructure is critical to increasing the resiliency of the community. There must be a thorough valuation of low-lying portions of neighborhoods, areas that could be isolated from evacuation routes due to a lack of redundancy, and the assessment of emergency and non-emergency transportation routes across the spectrum of modes (car, bike, on foot, bus). Identifying and addressing critical transportation infrastructure ensures that essential routes remain open during floods, maintaining emergency access and community connectivity.

Conceptual Overview

This approach identifies and addresses the at-risk transportation infrastructure network. The study area is home to residents who rely on public transportation, walking, and biking alongside personal motor vehicles. It is also home to a community built and rebuilt over time in a manner that has failed to prioritize connectivity throughout. The identification of roads or parcels in need of elevation or protective berms along flood-prone corridors is one solution. A general increase of ingress/egress over Swan Creek and between isolated portions of the community would help to weave together the community, which is a benefit under emergency or mundane conditions. Wherever feasible, designs integrate stormwater conveyance and adjacent green infrastructure to reduce flood depth and duration.

Resiliency Considerations & Design Process

Prioritize low-lying critical corridors used by emergency services, schools, and evacuation corridors. Pair elevation improvements with floodplain reconnection or compensatory storage to avoid downstream impacts. Coordinate with state and regional transportation agencies for funding alignment.

Public Infrastructure Flood Resiliency (Raised Roads)





Benefits

- Maintains evacuation and emergency access
- Protects key transportation links
- Reduces infrastructure damage costs

Drawbacks / Limitations:

- High construction and land acquisition costs
- May shift floodwaters elsewhere if poorly designed
- Requires coordination with regional drainage plans



Pedestrian Bridge

About This Approach

Pedestrian bridges provide safe, flood-resilient crossings that maintain community connectivity even during high-water events. They serve both practical and recreational purposes, linking neighborhoods and green spaces.

Conceptual Overview

Elevated footbridges span creeks, floodplains, railroads, or roadways, designed for accessibility and durability. Materials like weathering steel or reinforced concrete ensure longevity, while aesthetic lighting and signage promote community identity. They can be paired with low/no-maintenance vegetation to help encourage small wildlife, insect, and bird habitat connectivity across the same barriers.

Resiliency Considerations & Design Process

Locate crossings strategically to enhance pedestrian safety and flood-resilient connectivity. Integrate bridge design with broader trail networks and stormwater corridors. Use durable materials and elevate above projected flood levels to ensure long-term function and safety.

Pedestrian Bridge





Benefits

- Provides safe evacuation and daily mobility
- Connects parks, trails, and neighborhoods
- Encourages walking and recreation

Drawbacks / Limitations:

- Moderate to high construction cost
- Requires inspection and maintenance
- Must be designed for flood loads and debris impact