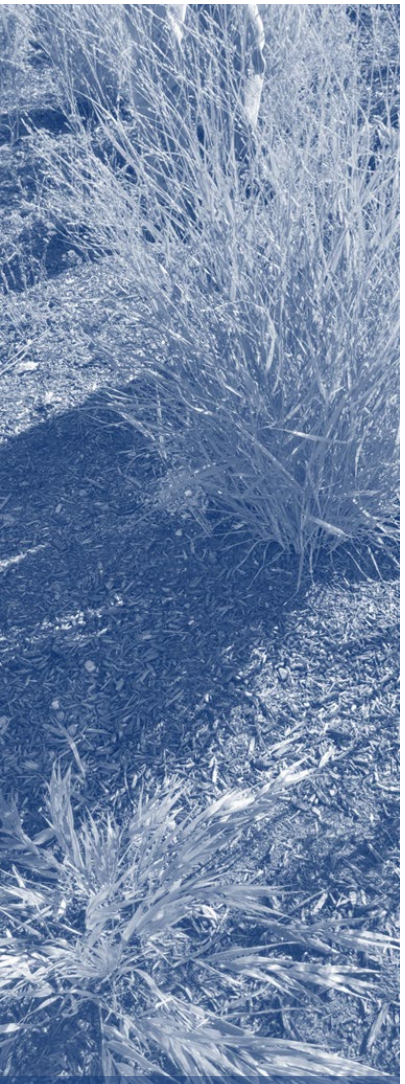
Resilient Worcester Project Presentation: Drainage Master Plan & Integrated Flood Model

Green Worcester Advisory Committee Meeting | June 15, 2026

Worcester, MA Institute Park, photo by Weston & Sampson

Agenda



NBS in Worcester, photo by Weston & Sampson

- **Overview of Drainage System Master Planning**
- **Summary of Previous Work (Phase I, 2022-2025)**
- **Current Phase II Work (2025-2026)**
  - Development of a 2-D Integrated Flood Model
    - Data Collection & Real Time Monitoring
  - Nature-Based Solutions:
    - Small-Scale NBS Concepting
    - Large-Scale NBS Concepting
  - Input: Core Team & Advisory Committees
  - Public Education & Outreach
- **Phase III and Beyond**
- **Conclusions**
- **Q&A**

Goals and Outcomes

Worcester, MA Institute Park, photo by Weston & Sampson

The Drainage System Master planning is intended to:

- **Provide an understanding of existing and future flood risk throughout the City**
- **Support flood mitigation planning,** such as by prioritizing mitigation strategies (e.g. policy or regulatory changes) or infrastructure projects (grey and/or green) based on modeled effectiveness, evaluate impacts of future development
- **Serve as a decision-support tool,** helping guide capital improvement projects, evaluate benefits vs costs, and defend infrastructure investments and policy decisions
- **Support regional collaboration** by understanding how runoff from neighboring communities contributes to flooding, providing a foundation for cooperative stormwater management planning

SUMMARY OF PREVIOUS WORK

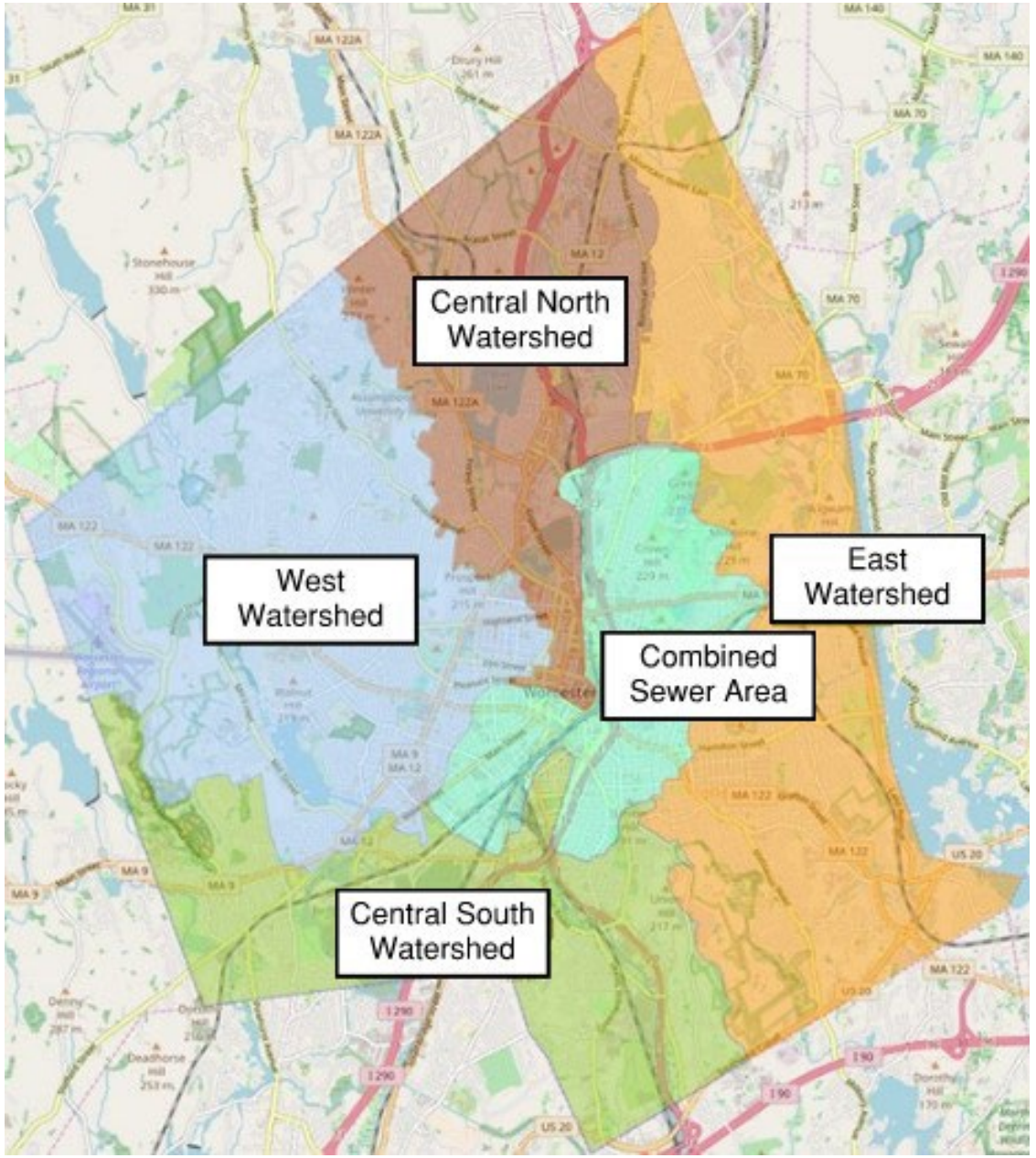
Drainage System Master Plan Phase I

Overview

- Partially funded by EEA MVP Action Grant
- July 2022 – February 2025

Key Tasks

- Field Investigations
- Updates to City's drainage system mapping
- 1-D Hydraulic/Hydrologic Model Development
- Gray Infrastructure Alternatives Screening
- Nature Based Solutions Screening



Area of Study (excluded Combined Sewer Area)

CURRENT PHASE II WORK

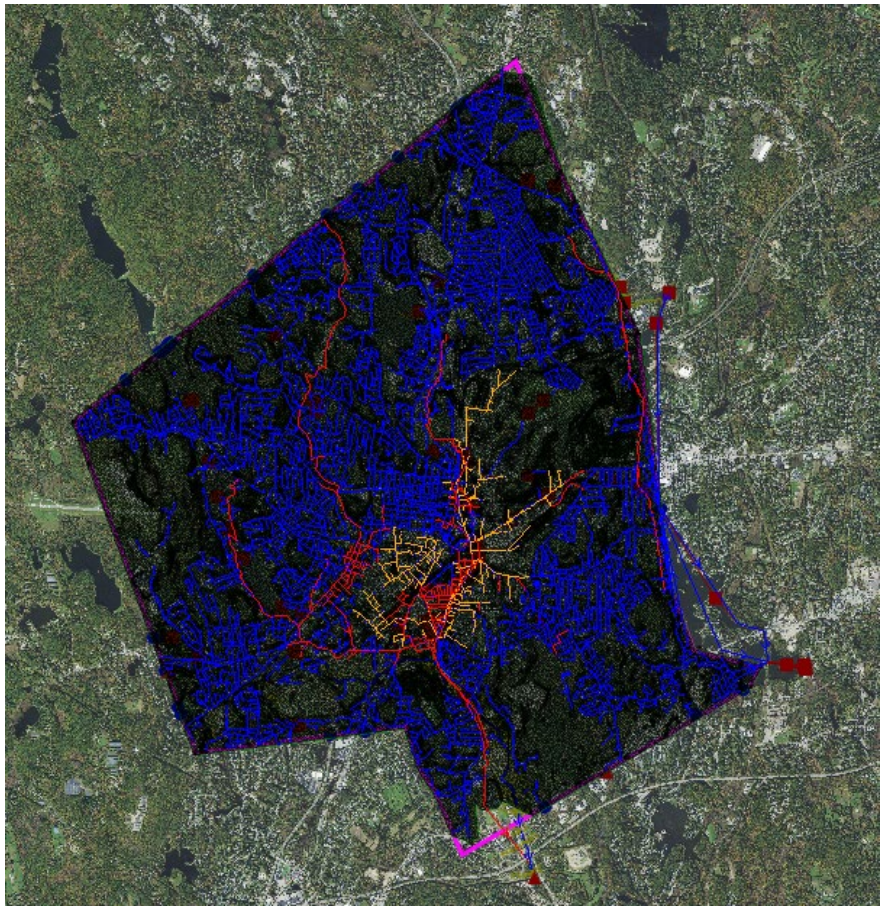
Drainage System Master Plan Phase II (Integrated Flood Model)

Overview

- Partially funded by EEA MVP Action Grant
- October 2025– June 2026

Key Tasks

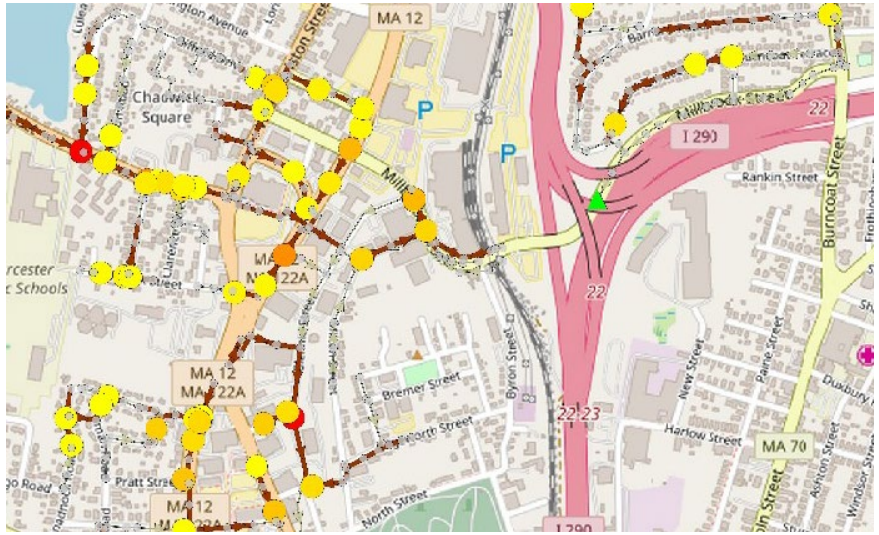
- Development of a 2-D Integrated Flood Model
  - Data Collection & Real Time Monitoring
- Nature-Based Solutions:
  - Small-Scale NBS Concepting
  - Large-Scale NBS Concepting
- Input: Core Team & Advisory Committee formation
- Public Education & Outreach

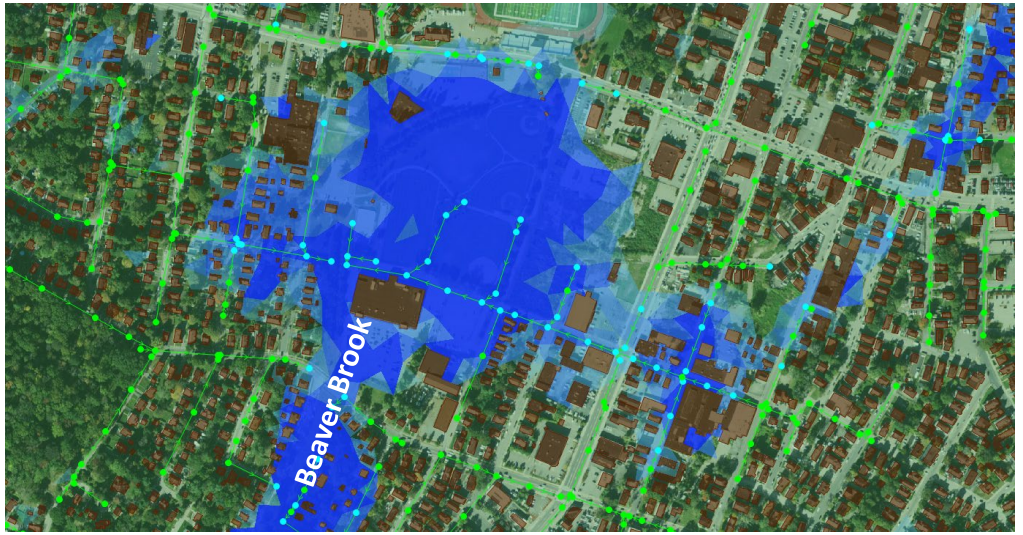


Area of Study

Difference Between 1-D and 2-D H&H Model

Worcester's 1-D Models	Worcester's 2-D Integrated Model
• Shows pipes and manholes • Represents how water moves through these pathways • Generally assumes water moving in one direction • Well-suited to evaluate pipe capacity and flow conveyance projects • Shows flooding now and in the future	• Represents how water moves across land and pipes • Water is allowed to move in multiple directions • Well suited to evaluate pipe network + rivers/stream management, sub-surface storage, green infrastructure • Allows users to see where water accumulates (and why), how it routes, and how fast it moves • Shows flooding now and in the future





CURRENT PHASE II WORK

Development of an Integrated Flood Model

Worcester, MA Coes Knife Reservoir, photo by Weston & Sampson

- Developing model in InfoWorks Integrated Catchment Model (ICM) 2-D

- **Built on Phase I model by adding:**
  - Surface waterbodies
  - Dams
  - Bridges and culverts
  - Combined sewer model
  - Broad Meadow Brook watershed model
  - Catch basins
  - Runoff from upstream communities
  - Runoff from highways and airport
  - Rain-on-grade to show impacts between where the rainfall falls and where it enters a drain or river

CURRENT PHASE II WORK

Development of an Integrated Flood Model

Worcester, MA Coes Knife Reservoir, photo by Weston & Sampson

This model:

- Brings together stormwater and drainage data with surface waterbodies to create a **comprehensive citywide tool for evaluating flooding and identifying effective flood mitigation strategies.**

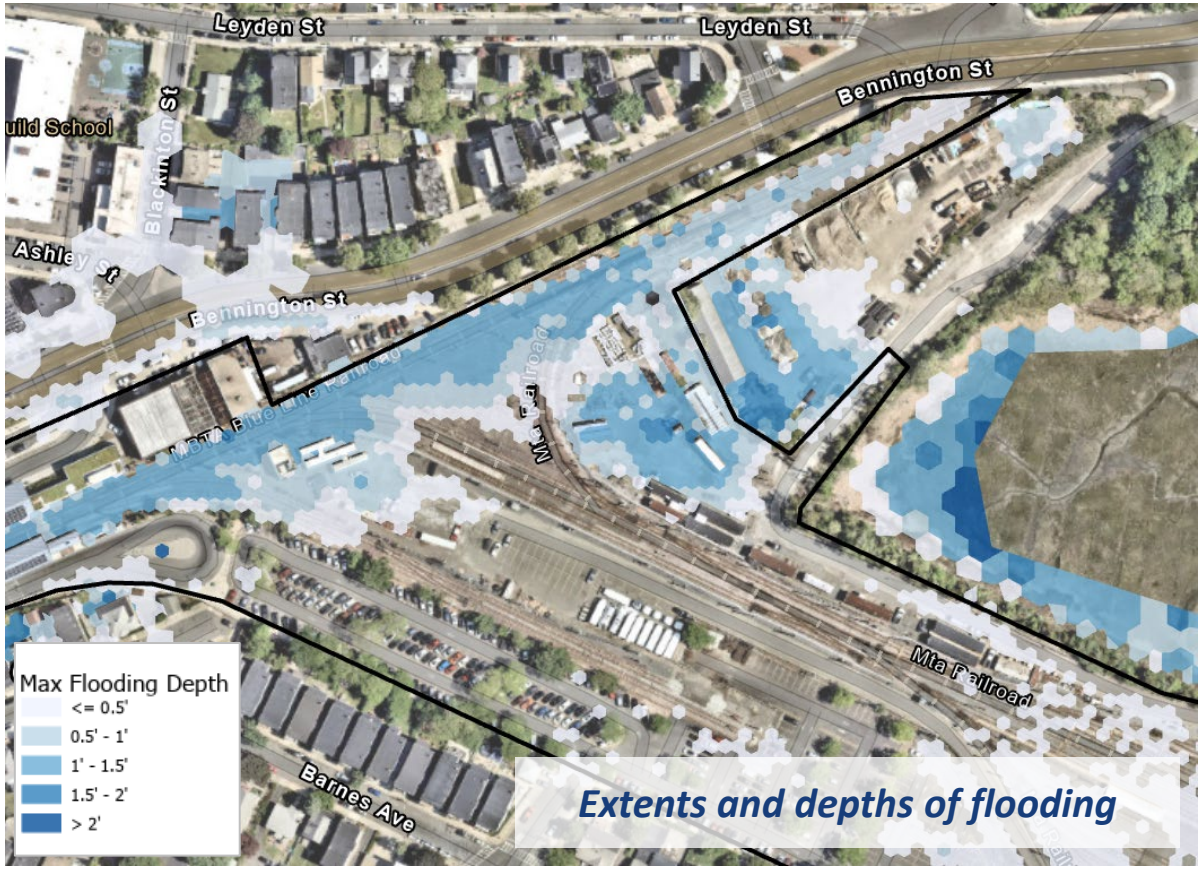
- Provides a more **holistic representation of real-world flooding**
  - Dynamically simulates interactions between stormwater systems, rivers, overland flow, and surface flooding across the landscape
  - Simulates street/nuisance flooding and river/waterbody flooding
  - Shows flood extents, depths, flow paths, and infrastructure impacts during complex storm events

- **Helps understand maintenance issues**

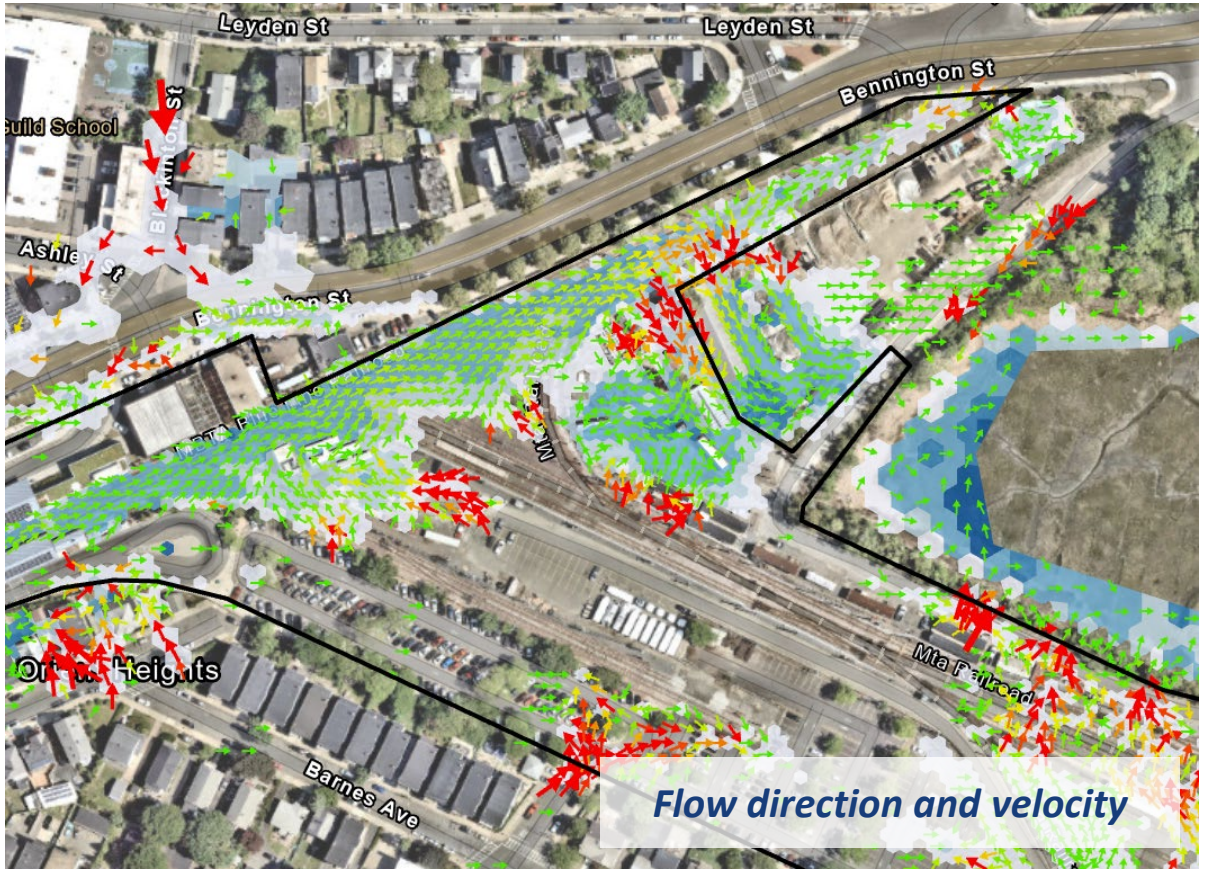
- Shows **flooding conditions** under both **present and future** climate scenarios

Example Flood Model: Boston, MA – MBTA Facility

Present Day 10-year, 24-hour (4.97 in. rain) with present day tides (MHHW)



Extents and depths of flooding



Flow direction and velocity

Two ways to view and understand same event:

- First highlights **extents, depths, and durations** of flooding
- Second highlights **flow directions and velocities, helping to identify sources of flooding**

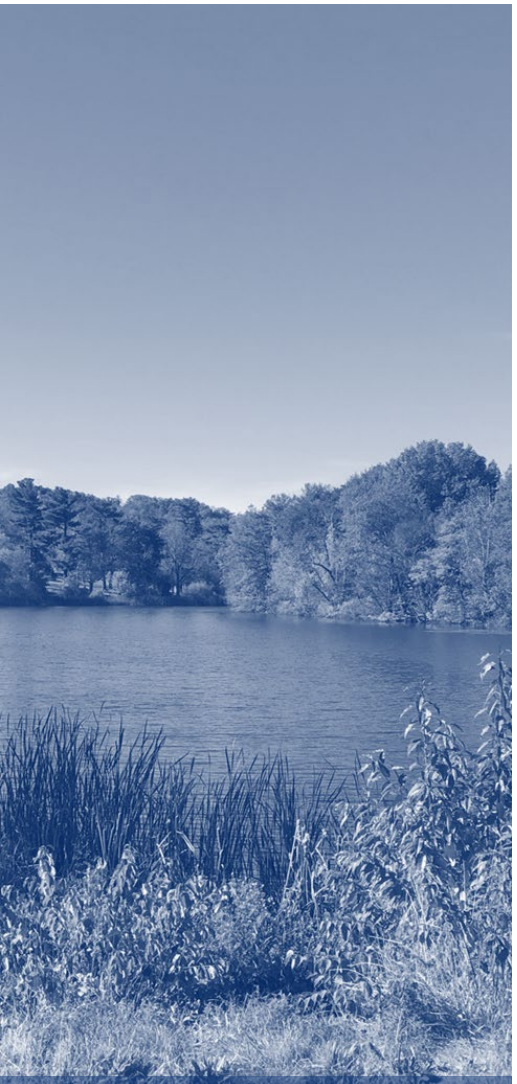
Example Flood Model: Boston, MA – MBTA Facility

Animation **demonstrates how the site retains flooding after a storm passes** due to high tidal water preventing storm drains discharging fully and isolated low spots due to poor onsite drainage

2050 10-Year, 24-hour (6.09 in. rain) with 2050 tides and SLR (MHHW, 7.52 ft. NAVD88)

CURRENT PHASE II WORK

Overview of Real-Time Monitoring



Worcester, MA Institute Park, photo by Weston & Sampson

- Measure real-world water level and flow conditions alongside precipitation, allowing us to **calibrate and validate the flood model**
- **7** Rain Gauges
- **35** In-System (Stormwater Pipes) Monitors
  - 25 are temporary
  - 10 are long-term
- **16** In-Stream Monitors
  - 12 are temporary
  - 4 are long-term

Calibration is where observed storm data are compared to model results. Based on this evaluation, key hydrologic and hydraulic parameters are refined to improve the agreement between simulated and observed conditions.

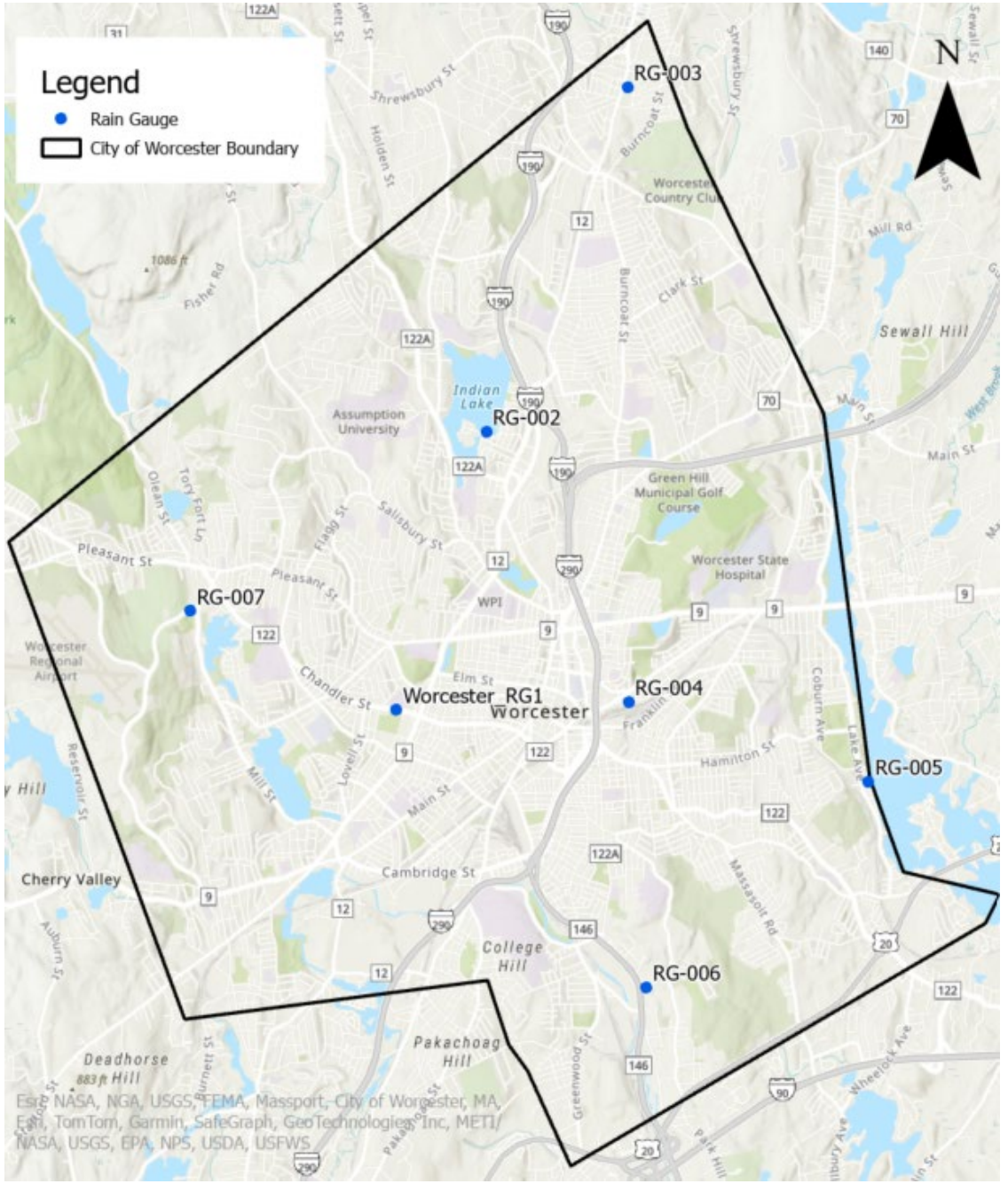
Validation is the process of testing the calibrated model against independent storm events to confirm the model can reliability reproduce real-world conditions.

CURRENT PHASE II WORK

Rainfall Monitoring

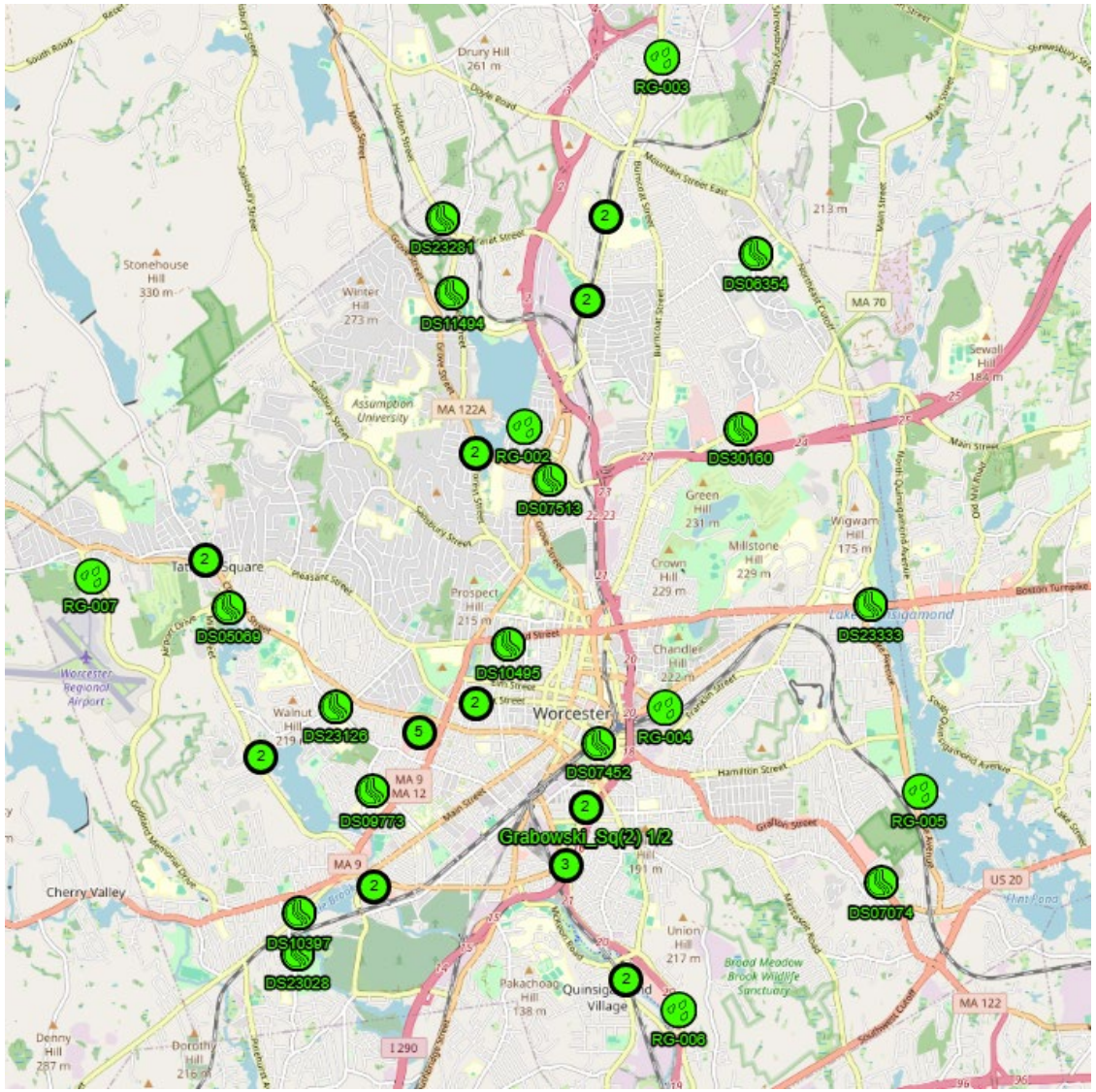
Rain Gauge	Total Rainfall (in.)
RG-002	1.98
RG-003	2.16
RG-004	1.80
RG-005	1.80
RG-006	2.03
RG-007	2.35
Worcester_RG1	1.42

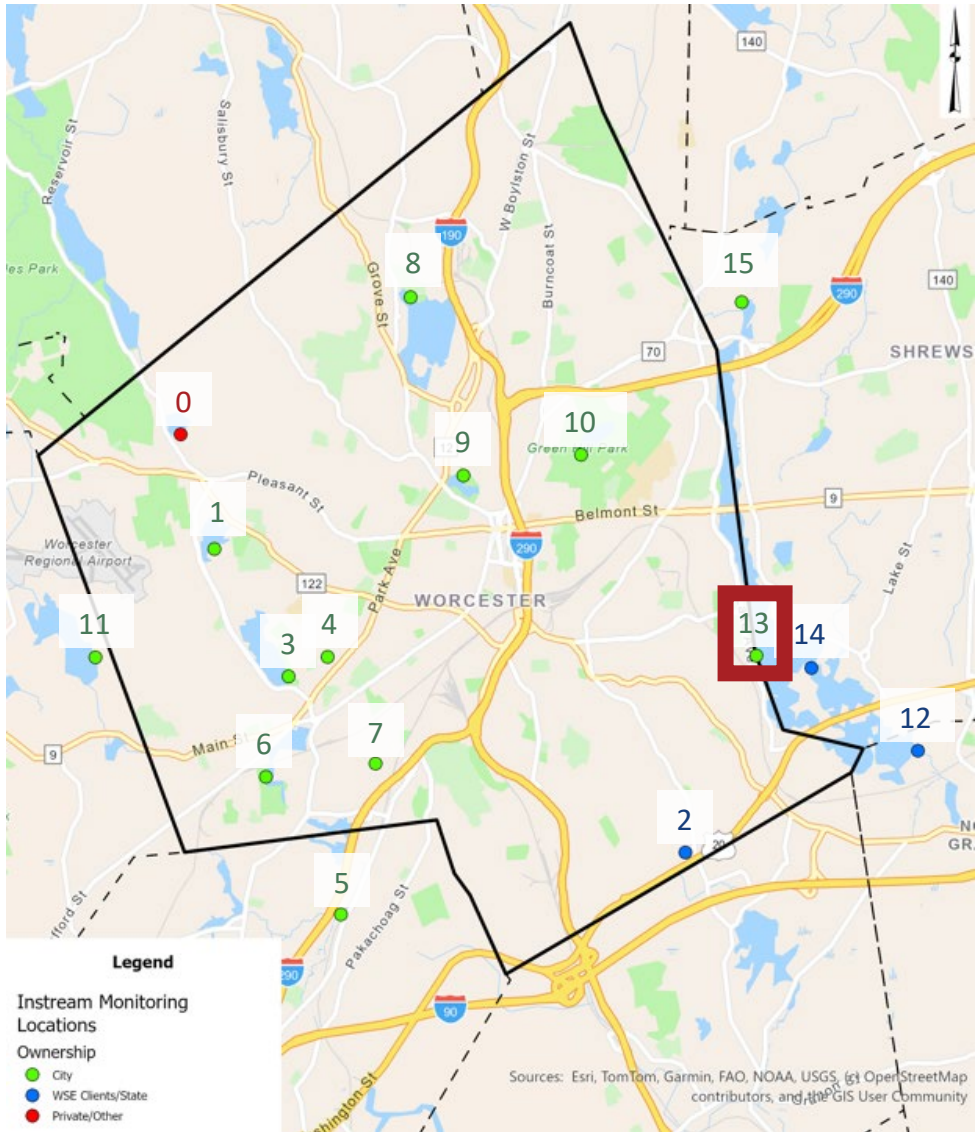
Data collection range used in analysis:
4/15/26 12:00 – 5/11/26 12:00



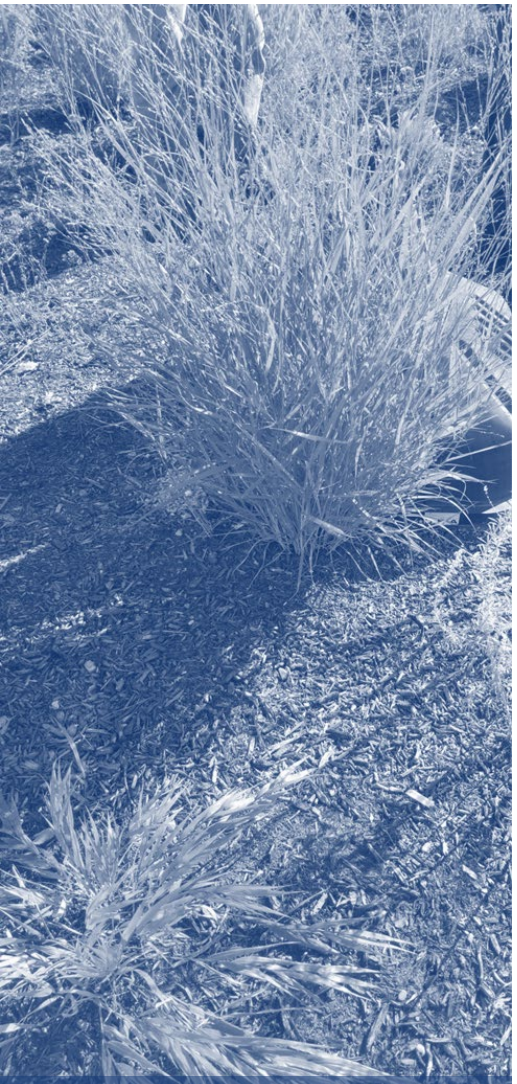
CURRENT PHASE II WORK

In-System (stormwater pipes) & In-Stream Monitoring





Small-Scale NBS: Prioritization & Concept



NBS in Worcester, photo by Weston & Sampson

Prioritization of NBS

- **Refine the top 40 sites** identified in Phase I
- **WPI Students (MQP) advanced work on screening top 40 sites**, considerations for screening included
  - Flood mitigation potential
  - Co-benefits such as heat stress mitigation and equity considerations
  - Feasibility
- **15 sites** were identified for review

Concept Development

- With guidance from Weston & Sampson, WPI students **selected the top 6 sites** from prioritization
- Worked with City to **chose 1 site to develop a preliminary conceptual design plan, estimate flood reduction, and prepare a cost estimate**

Small-Scale NBS: Concept for Burncoat Street Preparatory School

Proposed Design

- **Green and gray infrastructure** for improved stormwater management
- **Parking reconfiguration** and **safe play area** for students
- **HydroCAD was used** for 5 and 25-year storms to **evaluate sizing** for rain garden and subsurface storage
- Total cost estimate: **$1.2 Million**

Image by WPI MQP Team

Large Scale NBS: Scope & Goals

Scope

- **Identify additional nature-based solutions** that are related to restoration of streams, ponds, and other natural features
- Refine the list of additional restoration NBS to a **top 3**
- Prepare **feasibility level concepts**

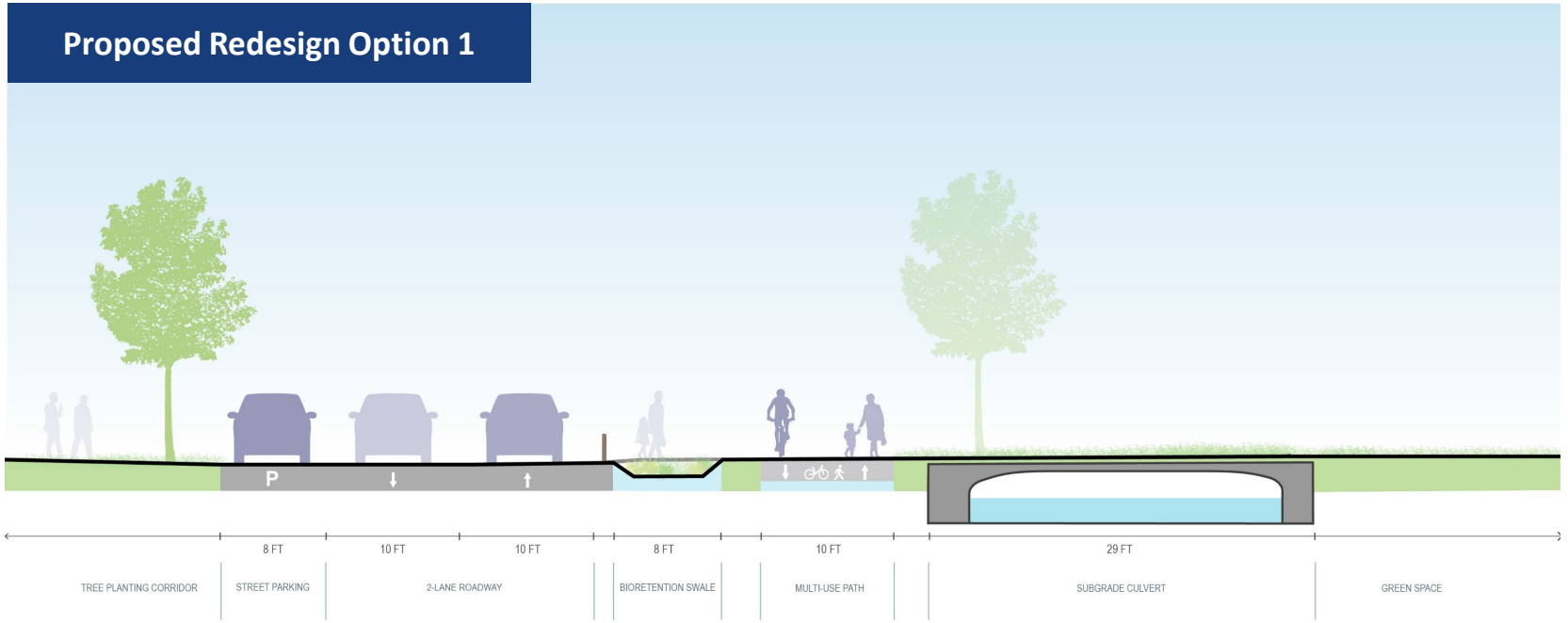
Goals

- **Flood management** within the Beaver Brook Watershed
- **Improve mobility and transportation**, providing safe and accessible corridors for pedestrians
- **Recreation and connectivity** of green spaces within the watershed
- **Increased canopy** and reduction in urban heat island
- **Enhancement of water quality** and management of natural systems for Beaver Brook

CURRENT PHASE II WORK

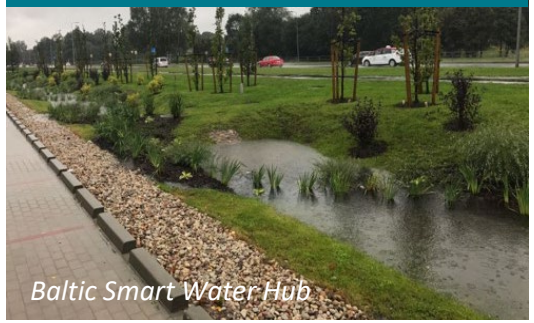
Large Scale NBS: Concepts for Beaver Brook Parkway

Proposed Redesign Option 1

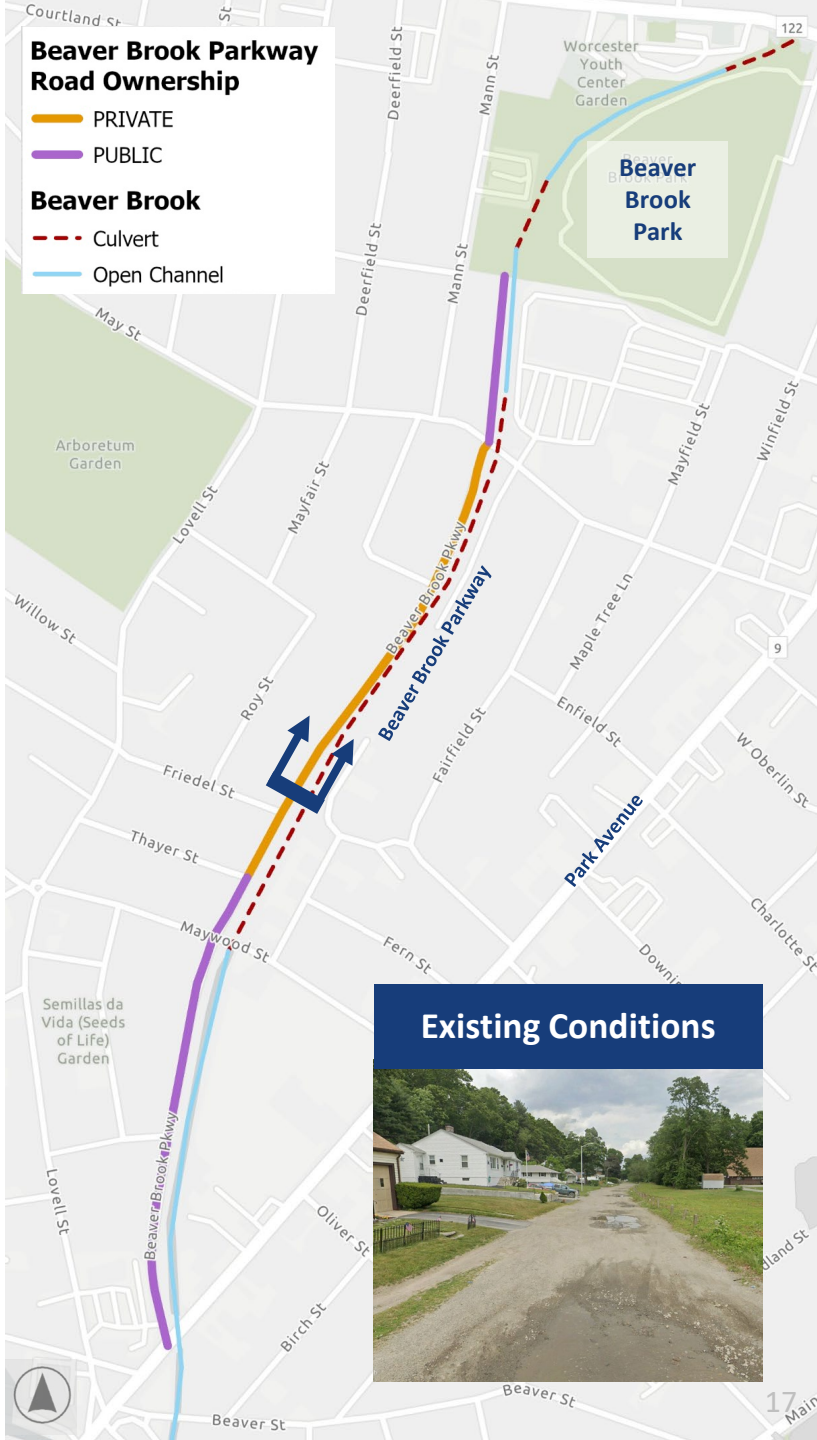


Tree Planting Corridor

Bioretention Swale



Porous Asphalt Multiuse Path

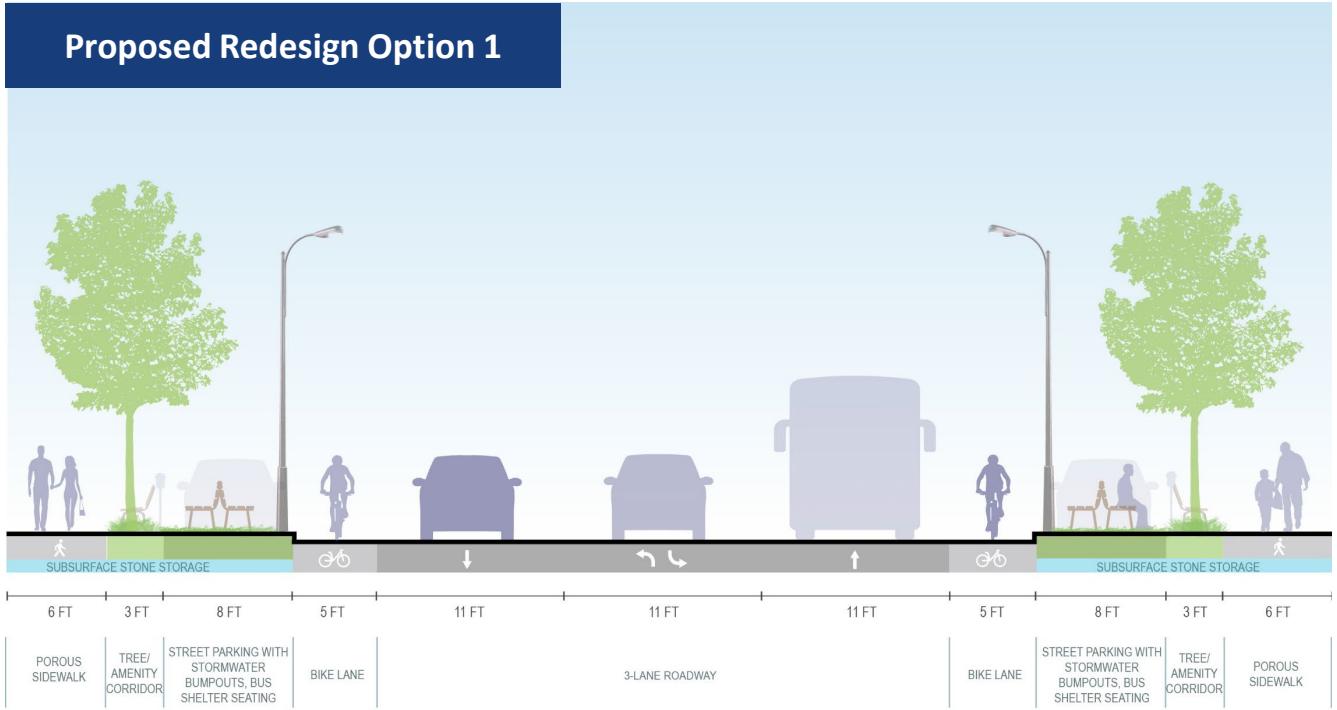


Existing Conditions

CURRENT PHASE II WORK

Large Scale NBS: Concepts for Park Avenue

Proposed Redesign Option 1



Street Trees and Improved Sidewalk

City of Houston

Separated Bike Lanes

Worcester Mobility Action Plan

Street Parking with Stormwater Bumpouts

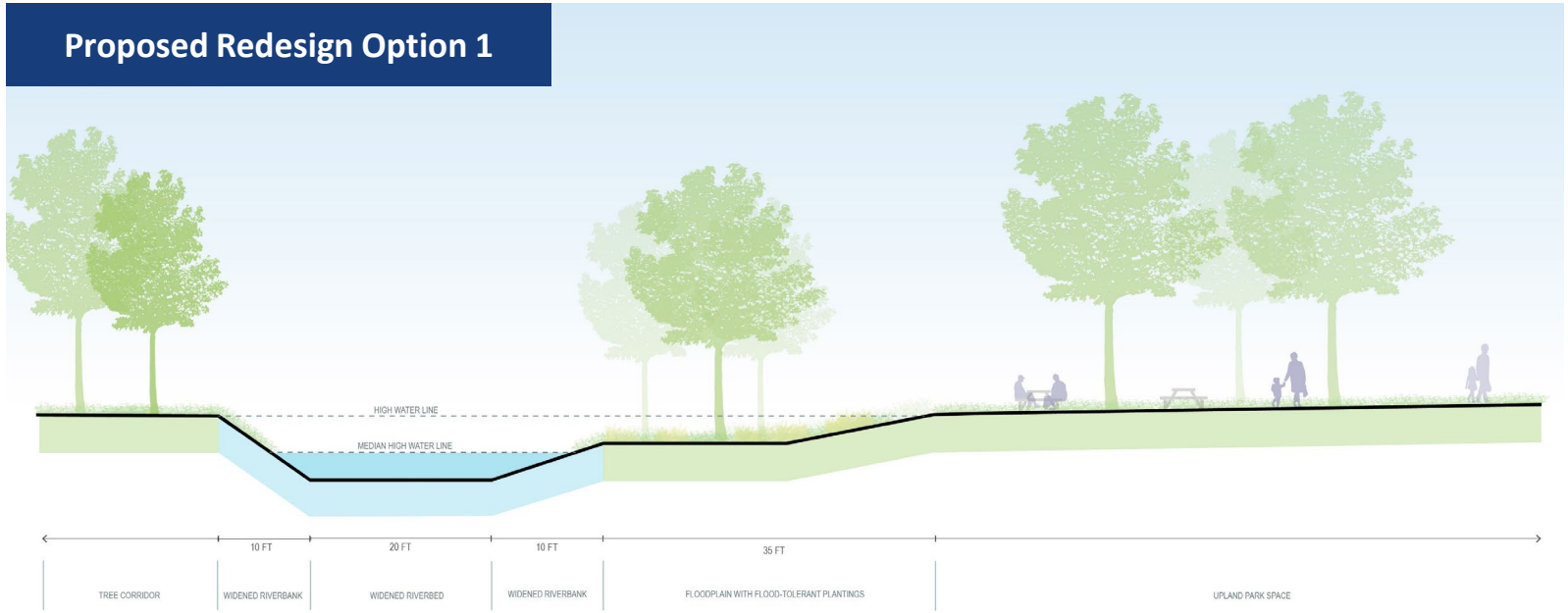
City of Palo Alto

Existing Conditions

CURRENT PHASE II WORK

Large Scale NBS: Concepts at 520 Park Ave

Proposed Redesign Option 1



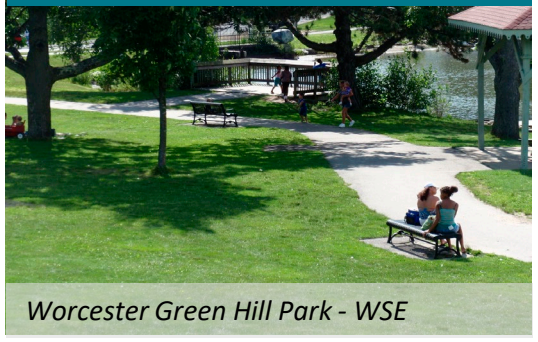
Widen Stream Bed

City of Yonkers

Floodplain with Flood-Tolerant Planting

PWP Landscape Architecture

Public Space Integration



Worcester Green Hill Park - WSE

Existing Conditions

Input from Core Team Members

City of Worcester, Department of Sustainability and Resilience

- John Odell - Chief
- Luba Zhaurova – Project Manager
- Jessica Davis – Assistant Project Manager
- Katie Liming – Lakes & Ponds Coordinator

City of Worcester, Department of Public Works

- Sean Divoll – Assistant Commissioner, Water & Sewer
- Dave Harris – Director of Sewer Operations
- Dylan Ludy – Assistant Director of Sewer Operations

City of Worcester, Planning & Regulatory Services

Michelle Smith – Assistant Chief Development Officer

Massachusetts EEA

- Hillary King – MVP Regional Coordinator

Promoting **collaboration and coordination** within the City of Worcester Departments

Providing ongoing feedback on project work to align with **City goals** and **implementation feasibility** and **State Climate Change guidance**

Input from Advisory Committee Members

- **Robert Connolly**
  City of Worcester, Emergency Communications and Management
- **Eric Flint**
  City of Worcester, Executive Office of Economic Development
- **Stefanie Covino**
  Blackstone Watershed Collaborative
- **Karla Sangrey**
  Upper Blackstone Clean Water
- **Jenn Madison**
  Mass Audubon
- **Stephen McCauley**
  Worcester Polytechnic Institute and Green Worcester Advisory Committee

Connecting work to the broader community, academic, and regional resilience initiatives

Supporting **transparent and inclusive communication** with local partners and stakeholders

Public Education and Outreach

Elementary School Educational Program

- **Educational program** at four Worcester elementary schools led by the Blackstone River Watershed Association (BRWA) in collaboration with Worcester DPW
- Students participated in **interactive activities including**
  - Working with a Watershed Model
  - Observation of a DPW catch basin cleaner
  - ArcGIS watershed map man

Jobs in Urban Forestry and Nature-Based Solutions

- Documentary style educational video(s) to give youth a **firsthand look into careers they might pursue**
  - Candid interviews, field footage, and authentic storytelling
  - Interviewees included 10+ professionals across government, nonprofit, academia, and private practices

Anticipated Phase III Work

Worcester, MA Institute Park, photo by Weston & Sampson

Collaboration and Community Engagement

- **Continued collaboration** with the City, Advisory Committee, and external stakeholders
- **Further educational learning experiences** with local schools, along with a public watch program, and community workshops

Flood Model Improvement and Results

- **Enhancement** and **calibration** of integrated flood model
- **Present and future flood risk evaluation** utilizing the flood model
- **Development of flood viewer**
- **Final report and operation and maintenance plan** of flood model for continued use and benefits

Design of Flood Mitigation Strategies

- **Further design of nature-based solutions**
- **Further design of gray infrastructure strategies**

Beyond Phase III

Worcester, MA Institute Park, photo by Weston & Sampson

Routine Model Updates and Maintenance

- **Continue to update and maintain the model** as published in the Operations & Maintenance plan that will be developed as part of Phase III

Evaluation of Flood Mitigation Projects

Continued Support of Nature-Based Solutions

- **Collaboration and conversations within the city** about **maintenance of existing green infrastructure** and **support of proposed green infrastructure**

Ongoing Community Education & Buy-In

- **Further development of educational programs** initiated as a part of this project
- Advertisement of flood viewer to the public

Conclusions

- Phase I built the core of the Drainage System Master Plan and looked across sections of the city for site-specific NBS
- Phase II is expanding that work to build a more robust flood model and further concepts for small and large-scale NBS
- Additional work will be required in Phase III (funding requested from EEA) to calibrate and validate the model and build a flood viewer
- Ongoing maintenance of these tools will be needed

- **Ultimately, Worcester will have a comprehensive decision-support tool, helping guide capital improvement projects, infrastructure investments, and policy decisions**

Thank You!
Any Questions?

Jennie Moonan, PE, Project Manager: Moonan.Janet@wseinc.com
Frank Occhipinti, PE, Principal: occhipif@wseinc.com

Worcester, MA Coes Knife Reservoir, photo by Weston & Sampson