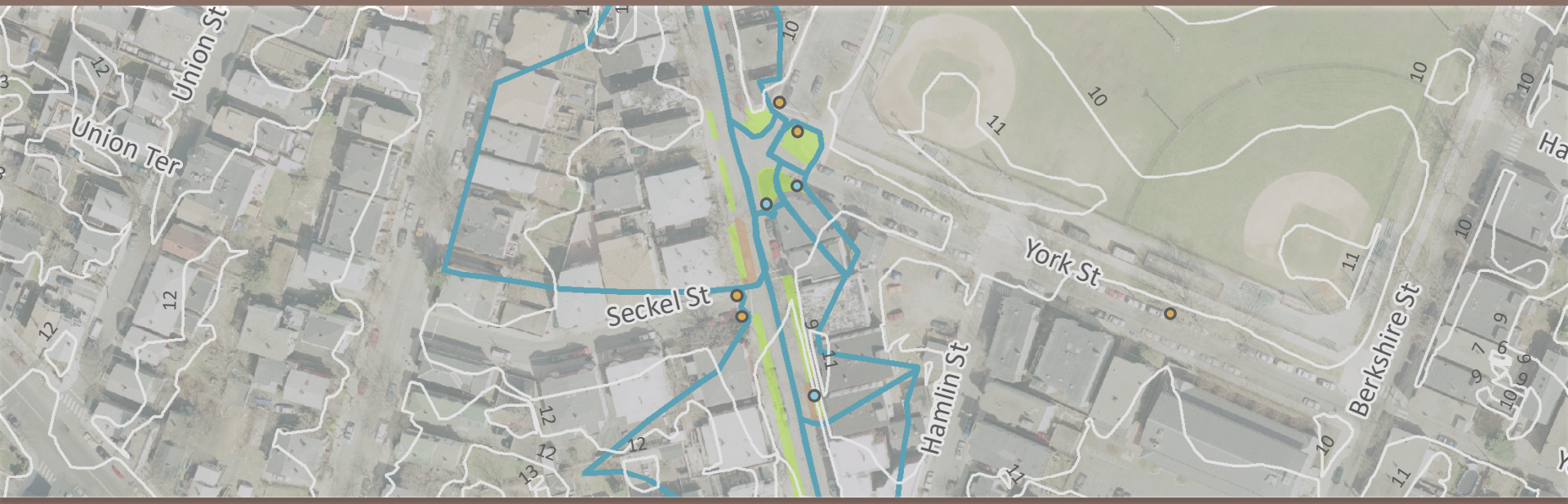


DESIGNING DISPERSED, SMALL-SCALE GREEN INFRASTRUCTURE SYSTEMS

CAMBRIDGE, MA

CRWA

Katie Friedman, Charles River Watershed Association

Overview

Charles River Watershed Association

City of Cambridge Green Streets Project

Process of developing conceptual GI designs

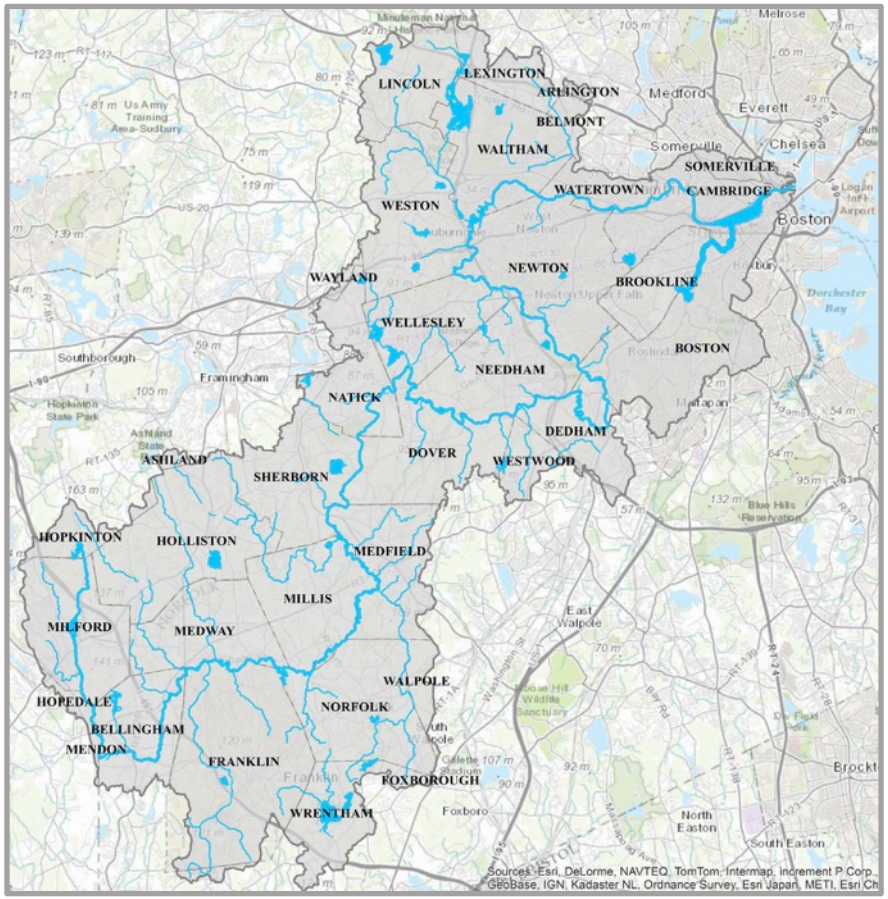
Take-aways

Charles River Watershed Association

- Protecting, preserving and enhancing the Charles River and its watershed through science, advocacy and the law.
  - Founded in 1965 by concerned citizens
  - Focused on a “science-based” understanding of interactions in the watershed
  - Staff includes watershed scientists, a watershed engineer, an attorney, and an urban designer and planner

Charles River Watershed

- 80 miles from Hopkinton to Boston Harbor
- 500 ft elevation drop
- 308 square miles
- 1 million residents
- Encompasses 35 cities and towns, 23 on the river



CRWA

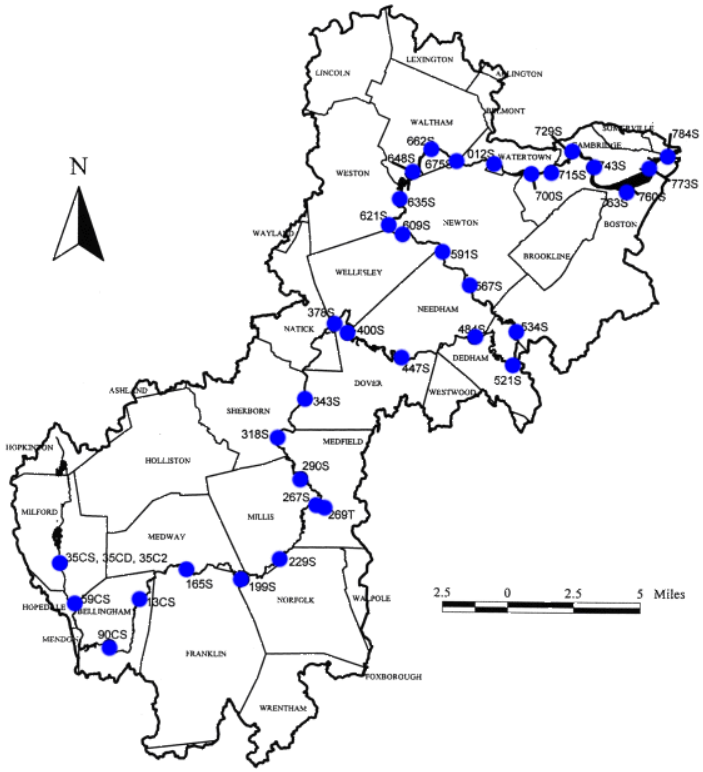

Circa 1960's

Boston

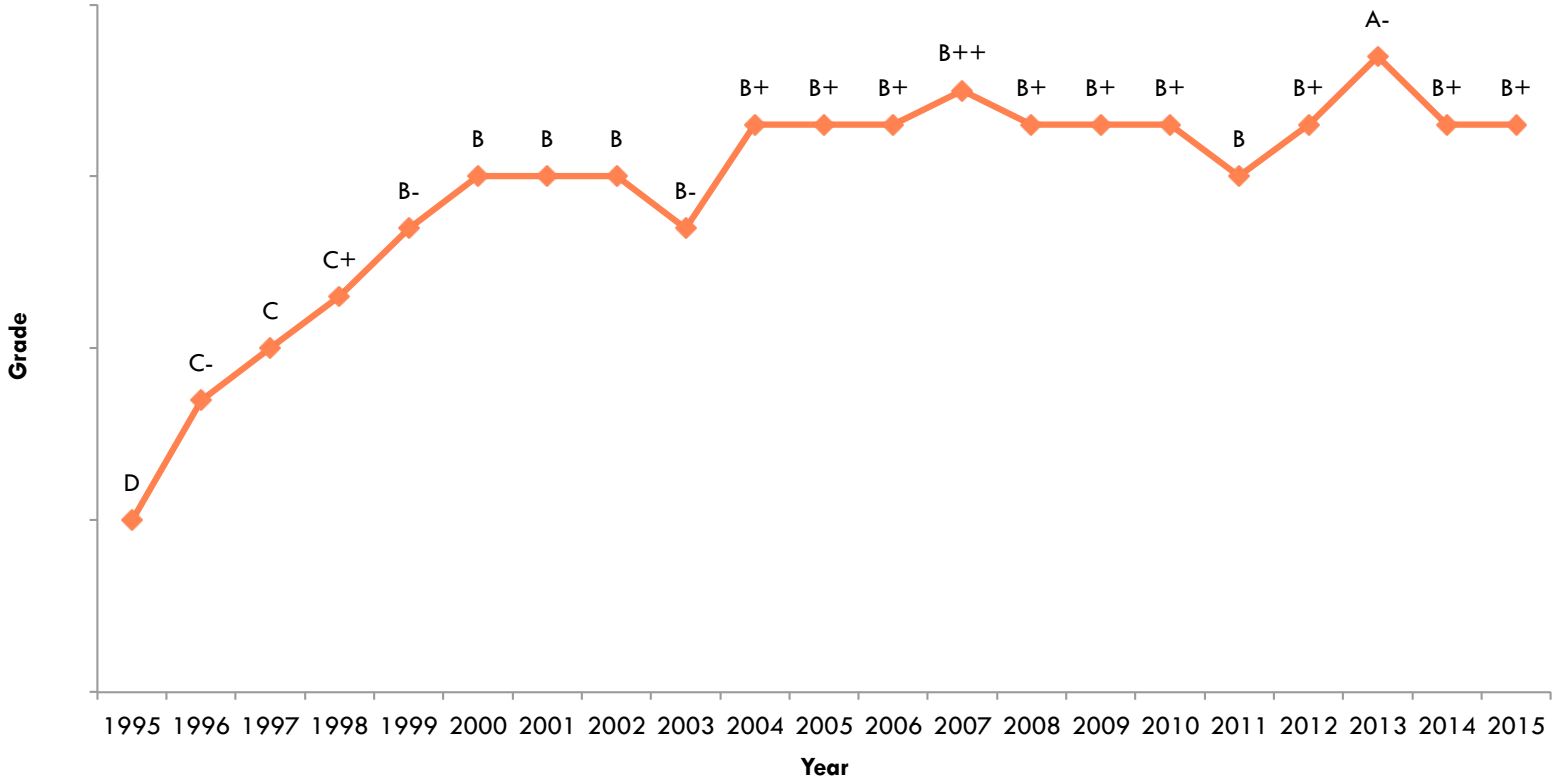
Staff photo by Mark Garfinkel

Water Quality Monitoring

- Began in 1995
- 35 permanent sampling sites on river; 2 additional "roving" samples collected each month
- Currently over 80 active volunteers

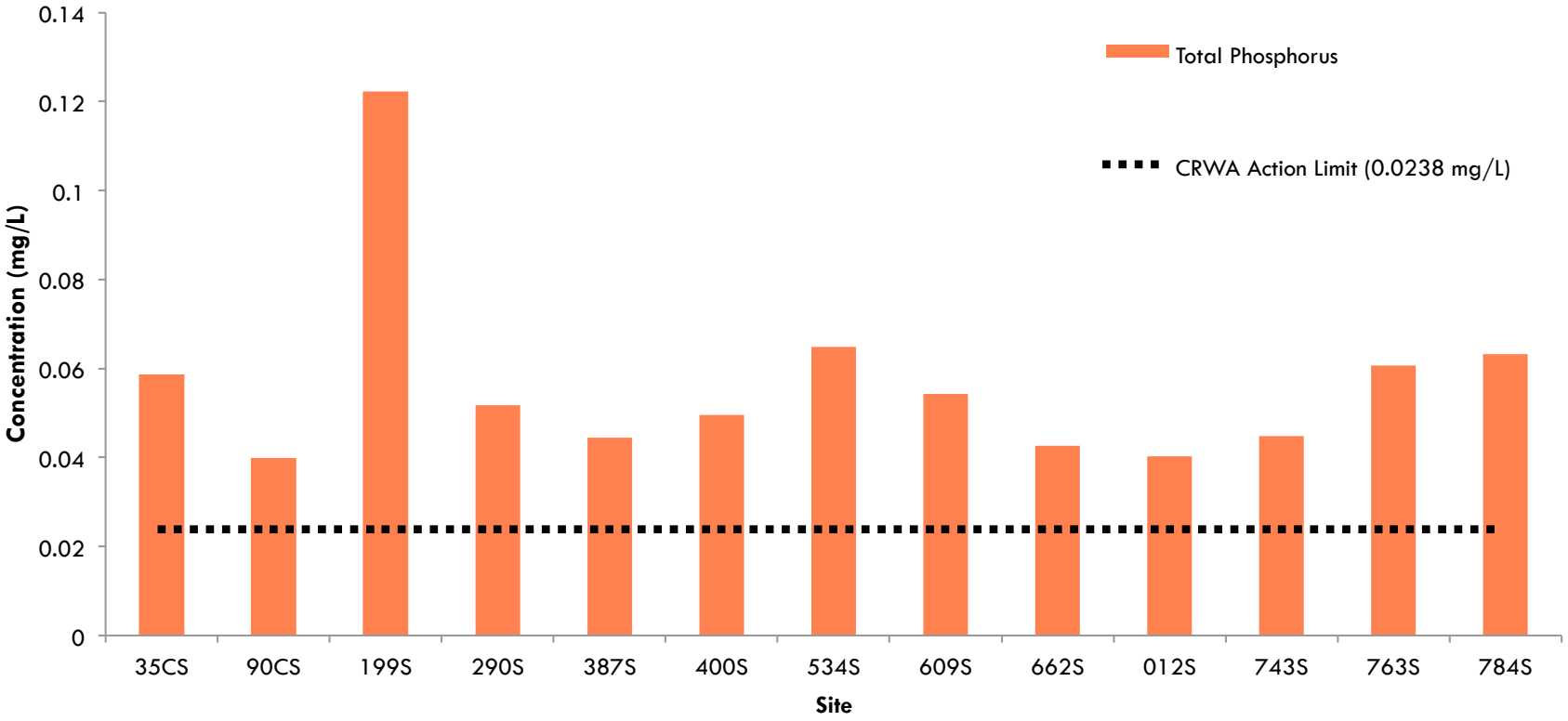


E. coli



Annual EPA Report Card Grades 1995-2015

Phosphorus



Average concentration of total phosphorous at sampling sites in 2016.

Total Maximum Daily Load (TMDL)

- Percent phosphorus reduction required by municipality to meet water quality standards

Charles River Watershed Community	Commercial	Industrial	High Denisty Residential	Medium Density Residential	Low Density Residential	Agriculture	Forest	Open Land	Total	Percent Reduction Required
Belmont										
Drainage Area (ha)	7.2	10.0	105.1	0.9	30.5	0.0	99.9	96.5	350.10	
1998-2002 Loading (kg/yr)	12.3	14.7	118.9	0.5	1.4	0.0	13.0	3.3	164.07	
TMDL Loading (kg/yr)	4.2	5.1	41.0	0.2	0.8	0.0	13.0	2.1	66.40	**59.5%**
Boston										
Drainage Area (ha)	587.1	541.5	2,556.5	43.4	20.2	7.4	688.2	1,444.0	5,888.27	
1998-2002 Loading (kg/yr)	996.4	796.4	2,892.4	24.6	0.9	3.7	89.7	49.6	4,853.77	
TMDL Loading (kg/yr)	343.7	274.7	997.6	8.5	0.5	2.4	89.7	32.0	1,749.04	**64.0%**
Brookline										
Drainage Area (ha)	135.9	10.0	588.2	209.4	254.8	42.9	157.0	357.1	1,755.51	
1998-2002 Loading (kg/yr)	230.7	14.8	665.5	118.5	11.6	21.7	20.5	12.3	1,095.54	
TMDL Loading (kg/yr)	79.6	5.1	229.5	40.9	6.3	14.0	20.5	7.9	403.81	**63.1%**
Cambridge										
Drainage Area (ha)	123.1	126.9	205.7	0.0	0.0	0.0	3.1	181.7	640.42	
1998-2002 Loading (kg/yr)	208.9	186.6	232.7	0.0	0.0	0.0	0.4	6.2	634.84	
TMDL Loading (kg/yr)	72.0	64.3	80.3	0.0	0.0	0.0	0.4	4.0	221.09	**65.2%**

Total Maximum Daily Load (TMDL)

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CRWA's Blue Cities Initiative

Blue Cities is a water-oriented approach to urban development and redevelopment that promote designs for the built environment that engages with every stage of the water cycle. Going beyond "green" building, "blue cities" embraces green infrastructure design with the aim of restoring the natural water cycle in the built environment

Cambridge Green Streets Projects

Cambridge Green Streets Projects

- Federal 604(b) funds via MassDEP
- City of Cambridge DPW partnered with CRWA
- Goal:
  - Develop conceptual green street design plans for three public rights of way
  - Integrate GI guidance with the City's five-year roadway improvement plan.

Project tasks

Project tasks

Task 1: Existing Conditions Assessment

Project tasks

Project tasks

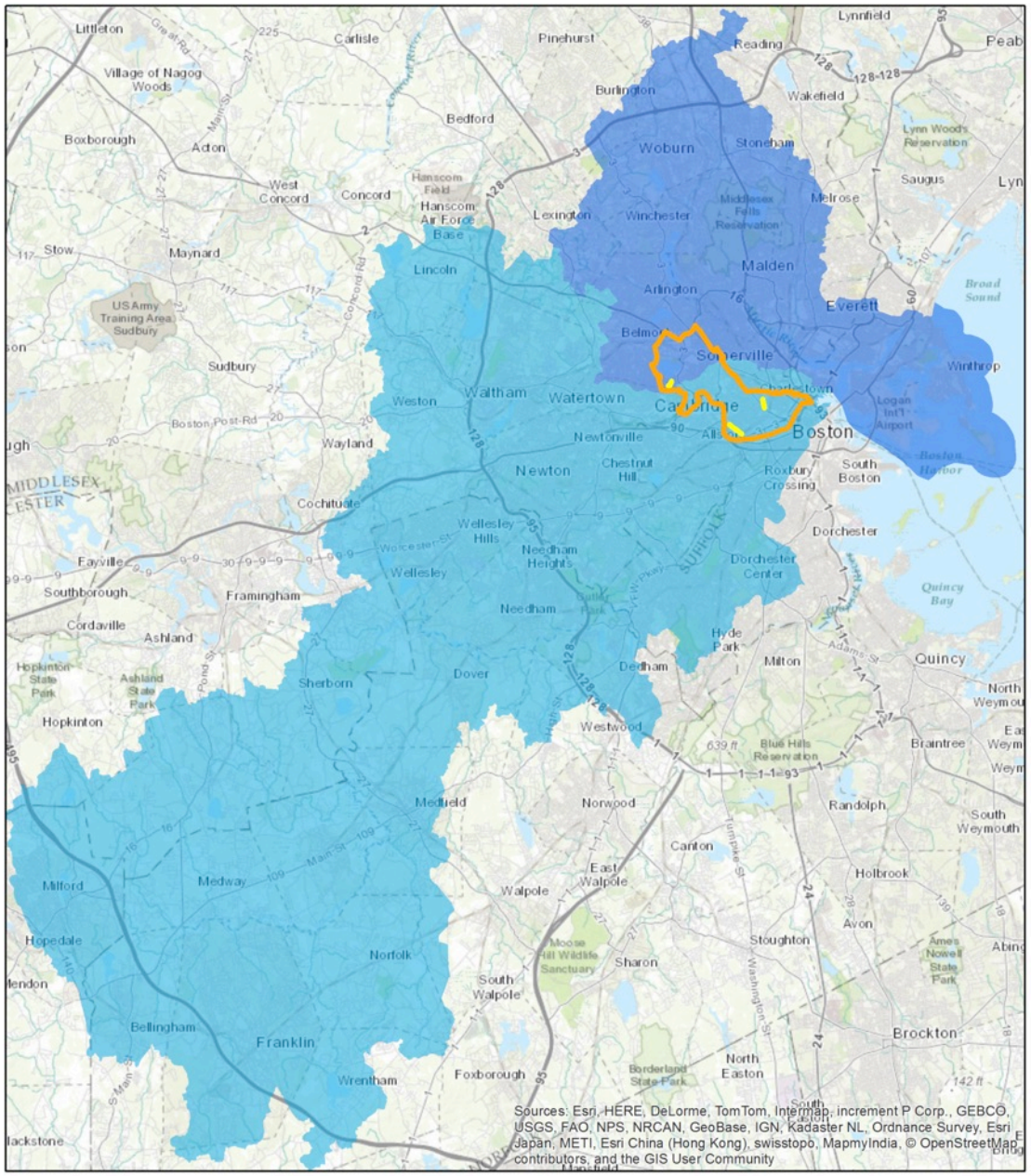
Project tasks

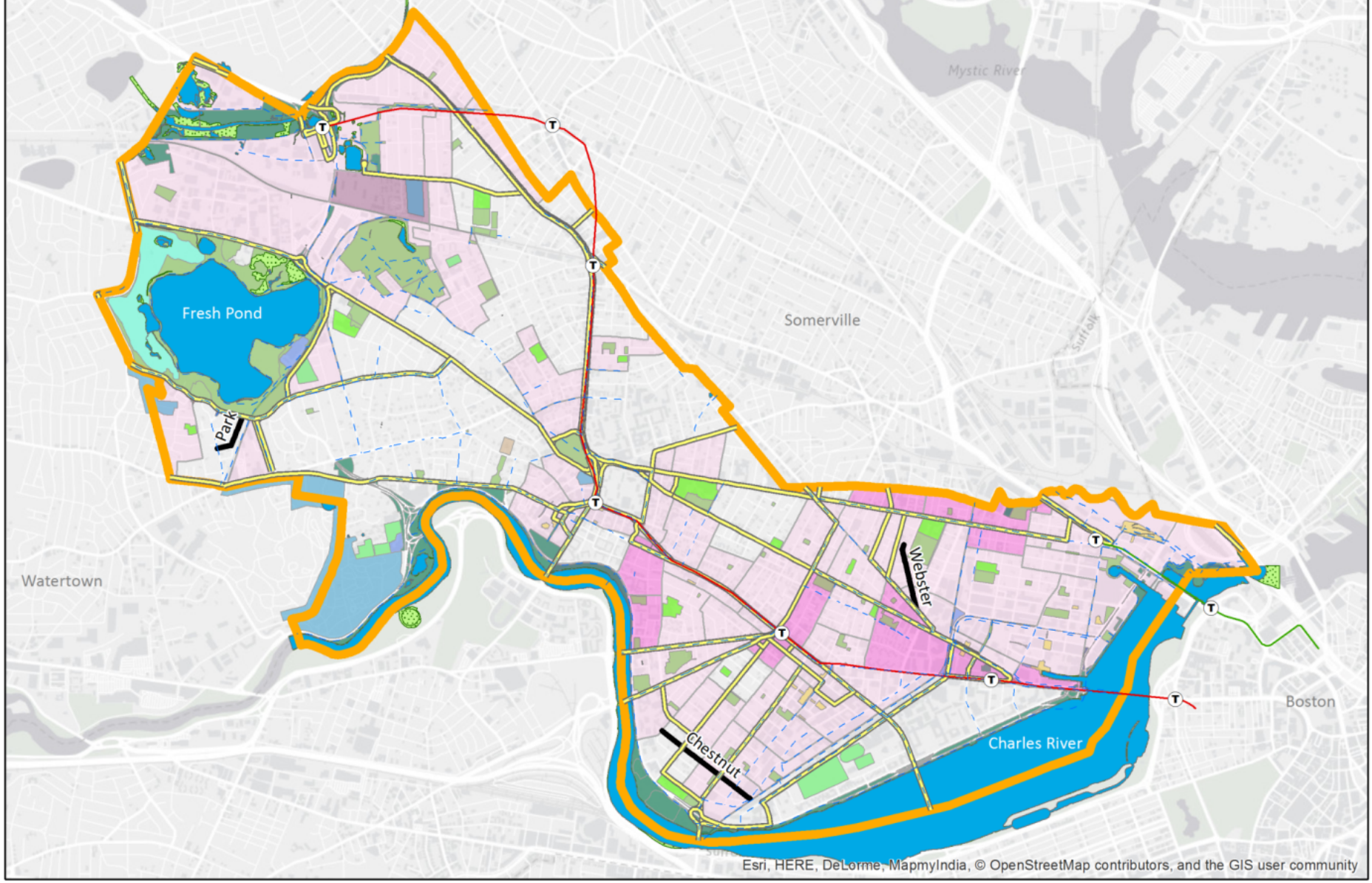
Task 1: Existing Conditions Assessment

Watershed Level

City Level

Street/Neighborhood Level


Littleton
Carlisle
Pinehurst
Reading
Lynnfield
Village of Nagog Woods
Burlington
Wakefield
Bedford
Boxborough
Acton
Woburn
Stoneham
Lynn Woods Reservation
West Concord
Concord
Hanscom Field
Hanscom Air Force Base
Lexington
Winchester
Middlesex Fells Reservation
Melrose
Saugus
Stow
Maynard
Lincoln
Malden
Arlington
Everett
Broad Sound
US Army Training Area Sudbury
Belmont
Somerville
Winthrop
Sudbury
Weston
Waltham
Watertown
Cambridge
Charlestown
Logan Int'l Airport
Boston Post Rd
Wayland
Newtonville
Boston
Boston Harbor
Newton
Chestnut Hill
Roxbury Crossing
South Boston
MIDDLESEX
SUFFOLK
Cochituate
Wellesley Hills
Dorchester
Needham Heights
Fayville
Wellesley
Dorchester Center
Southborough
Framingham
Quincy Bay
Needham
Cordaville
Ashland
Hyde Park
Milton
Quincy
Hopkinton State Park
Ashland State Park
Sherborn
Dover
Dedham
North Weymouth
Hopkinton
Westwood
Braintree
639 ft
Blue Hills Reservation
Medfield
Norwood
Randolph
South Weymouth
Canton
East Walpole
Holbrook
Milford
Medway
Walpole
Avon
Hopedale
Norfolk
Moose Hill Wildlife Sanctuary
Sharon
Stoughton
Ames Nowell State Park
South Walpole
Bellingham
Franklin
Brockton
Wrentham
Foxborough
Borderland State Park
North Easton
142 ft
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Watershed Context
City of Cambridge
Project Streets
City of Cambridge Boundary
Project Streets
Charles River Watershed
Mystic River Watershed
N
W
E
S
Miles
0
5



City of Cambridge
Water Features
Open Space
Transportation
Environ. Justice

Water Features
- Water Bodies
- Wetlands
- Project Streets
- City Boundary

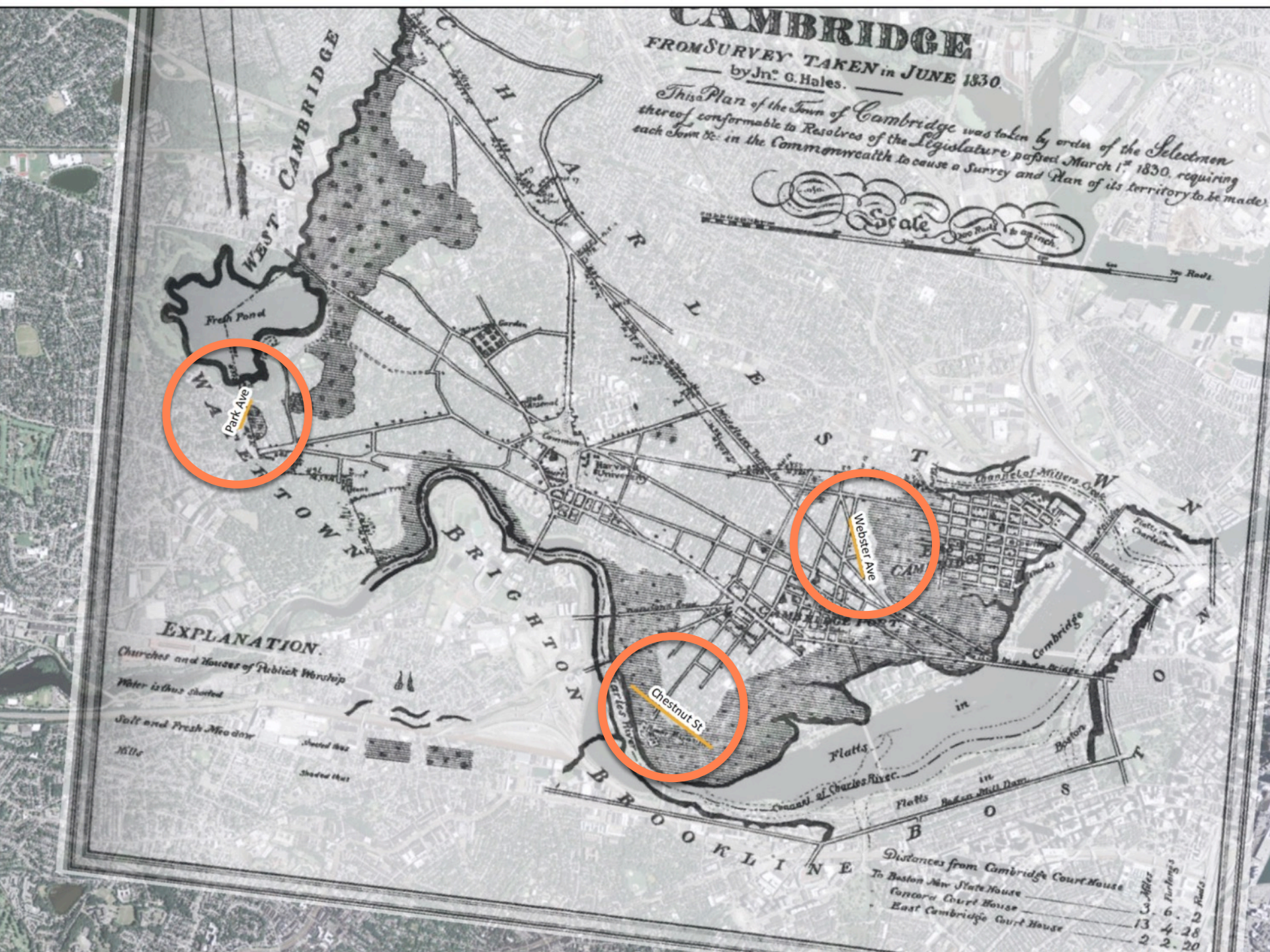
Open Space
- City Park/Playground
- Public School Grounds
- Cemetary
- Urban Plaza
- Traffic Island
- National Park Site
- Golf Course
- DCR-owned Park
- Privately owned, publicly accessible
- Publicly accessible rooftop garden
- Other
- Private school sports field

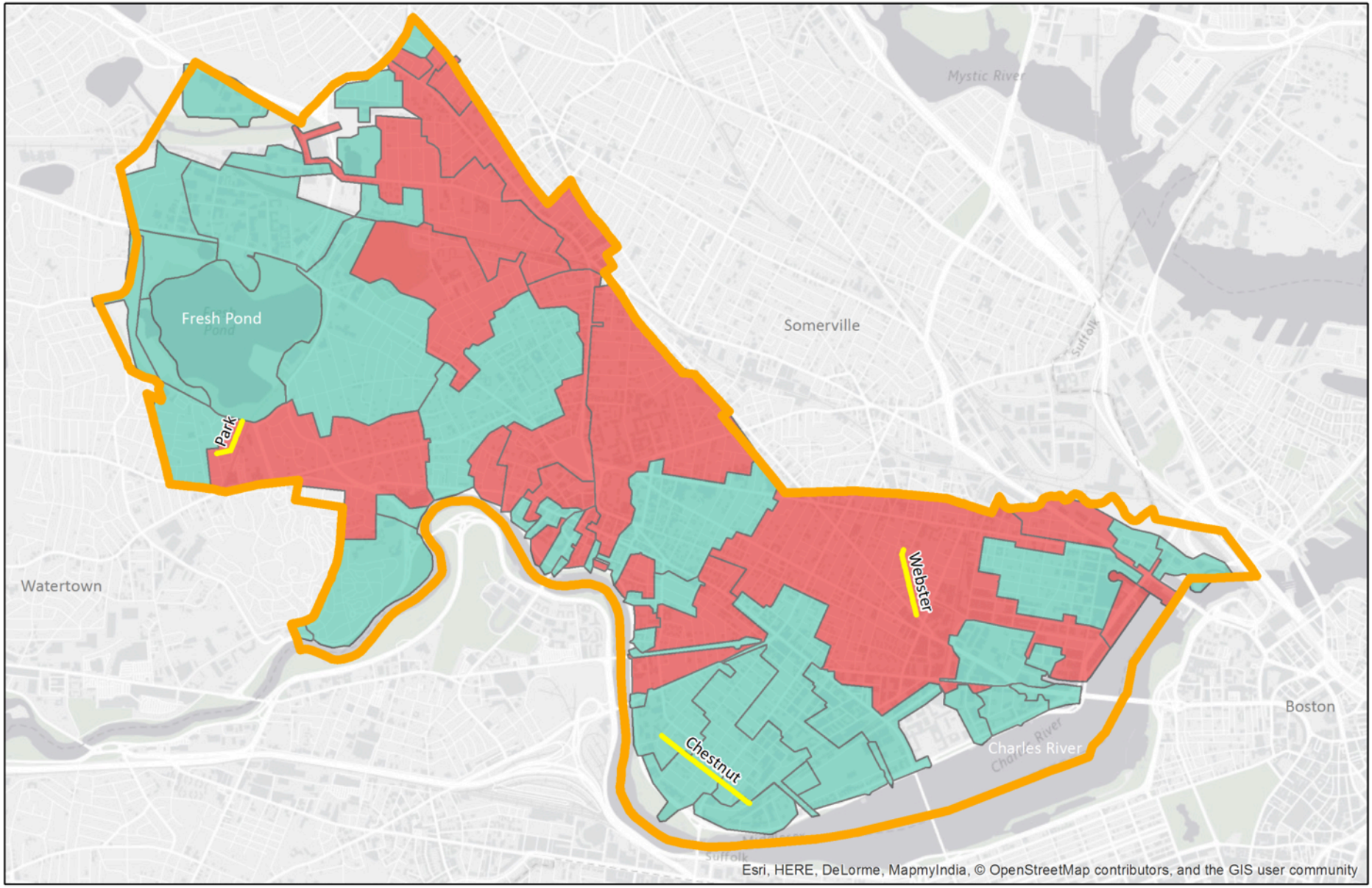
Transportation
- Bike Route
- Red Line
- Green Line
- Bus Route

Environmental Justice Pops
- Income
- Minority Population
- Income, Minority Pop
- Income, Minority Pop, English Prof

N W E S

Miles
0 0.5


CAMBRIDGE
FROM SURVEY TAKEN in JUNE 1830
by Jn.° G. Hales.
This Plan of the Town of Cambridge was taken by order of the Selectmen thereof conformable to Resolves of the Legislature passed March 1st 1830. requiring each Town &c. in the Commonwealth to cause a Survey and Plan of its territory to be made
Scale
WEST CAMBRIDGE
CHARLES RIVER
Fresh Pond
WATERTOWN
BRIGHTON
BROOKLINE
BOSTON
Park Ave
Webster Ave
Chestnut St
EXPLANATION.
Churches and Houses of Publick Worship
Water is thus shaded
Salt and Fresh Meadow
Mills
Distances from Cambridge Court House
To Boston New State House
Concord Court House
East Cambridge Court House



City of Cambridge
Stormwater Catchment Areas
Separated vs. Combined

Project Streets

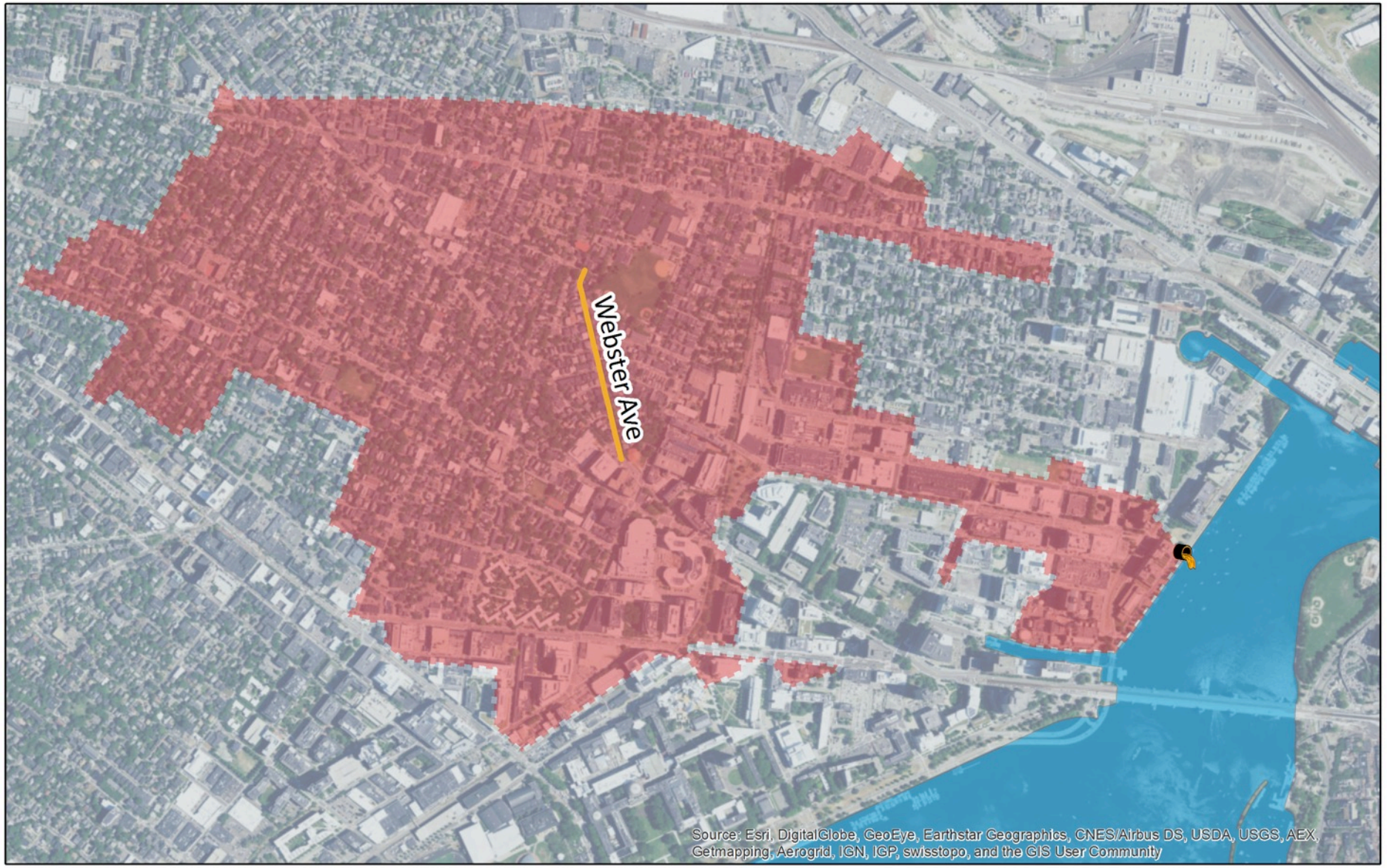
City Boundary

Combined catchment systems

Separated catchment systems

N
W E
S

Miles
0 0.5



Webster Avenue
Stormwater Catchment Area
Water Features

Stormwater Catchment Area: Combined System

Charles River

CSO CAM017

N
W E
S

Miles
0 0.2

Webster Ave
Soils & Topography

Hydrologic Soils

- A
- Unknown

Contour Intervals = 1 Foot

N
W E
S

Feet
0 200

Webster Ave
Soils & Topography

Webster Ave
Sewer Infrastructure

Sewer Lines
- Stormwater
- Sewage
- Combined

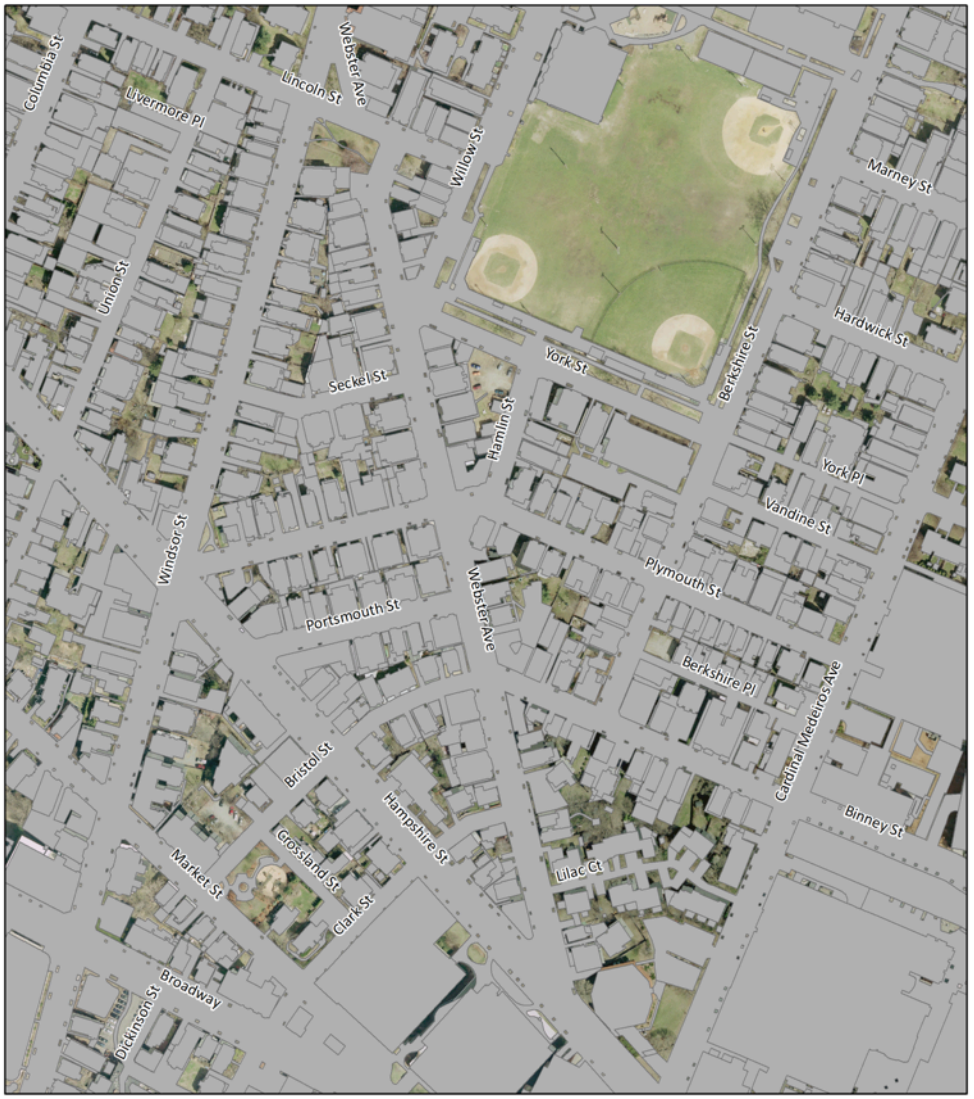
Catch Basins
- Area Drain
- Catch Basin
- Drop Inlet
- Dry well

N
W E
S

Feet
0 200

Webster Ave
Soils & Topography

Webster Ave
Sewer Infrastructure



Webster Ave
Impervious Surface

Impervious Surface

N
W E
S

Feet
0 200

Webster Ave
Soils & Topography

Webster Ave
Sewer Infrastructure

Webster Ave
Impervious Surface

Webster Ave
Groundwater

Depth to Groundwater (cm)

201

N
W E
S

Feet
0 200

Webster Ave
Soils & Topography

Webster Ave
Sewer Infrastructure

Webster Ave
Impervious Surface

Webster Ave
Groundwater

Webster Ave
Street Trees

Tree Features
- Webster Street Trees
- Tree Wells

N
W E
S

Feet
0 200

Webster Ave
Soils & Topography

Webster Ave
Sewer Infrastructure

Webster Ave
Impervious Surface

Webster Ave
Groundwater

Webster Ave
Street Trees

Webster Ave
Land Use

Webster Ave
Soils & Topography

Webster Ave
Sewer Infrastructure

Webster Ave
Impervious Surface

Webster Ave
Groundwater

Webster Ave
Street Trees

Webster Ave
Land Use

Webster Ave
Public & Vacant Parcels

Vacant Parcels
Public Parcels
Vacant Public Parcels

Webster Ave
Soils & Topography

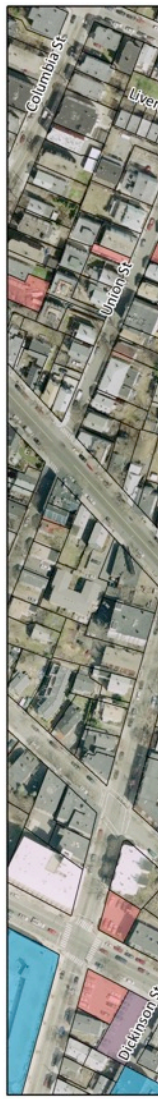
Webster Ave
Sewer Infrastructure

Webster Ave
Impervious Surface

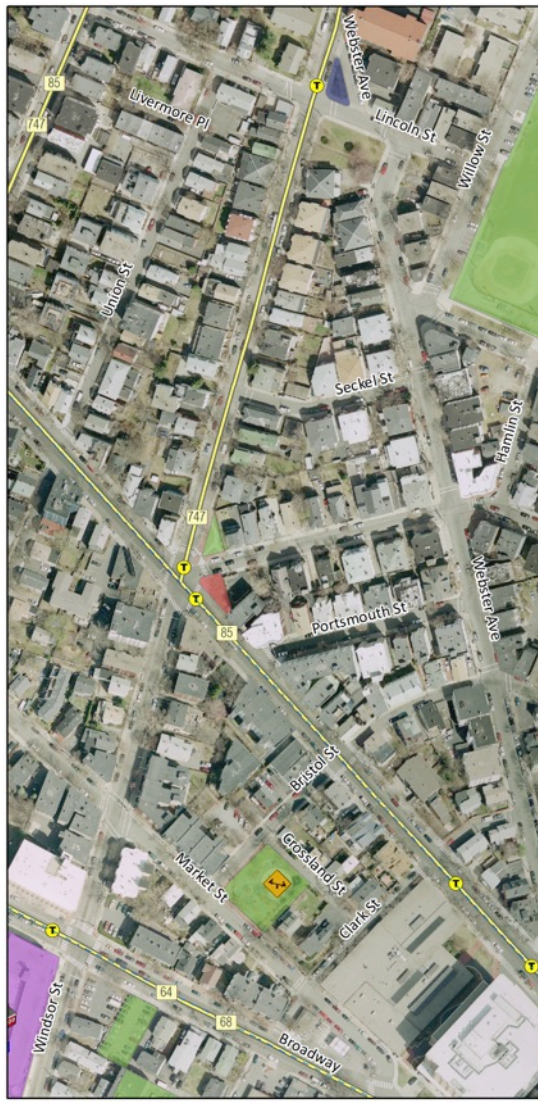
Webster Ave
Groundwater

Webster Ave
Street Trees

Webster Ave
Land Use

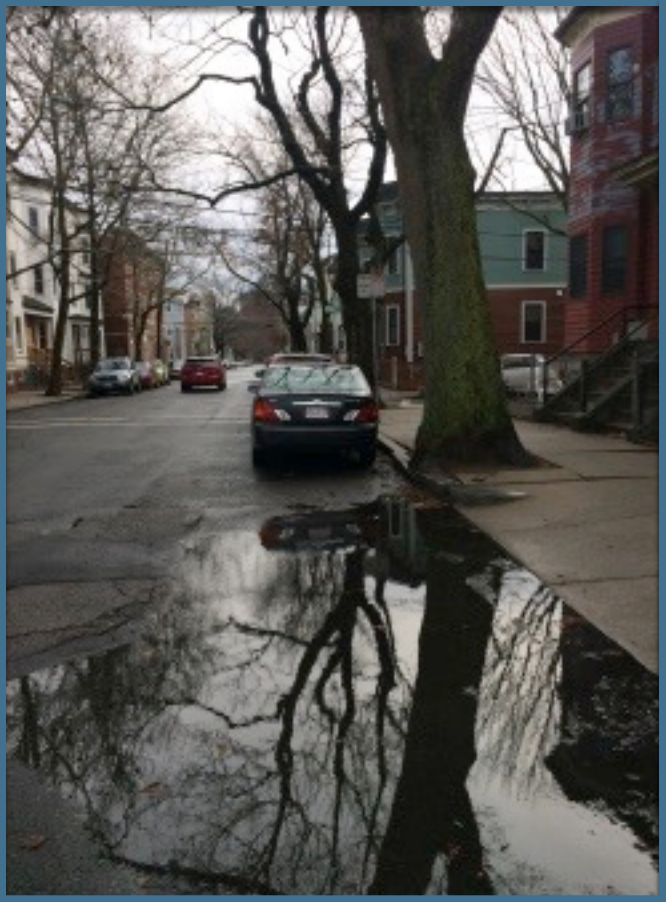


Webster Ave
Public & Vacant Par

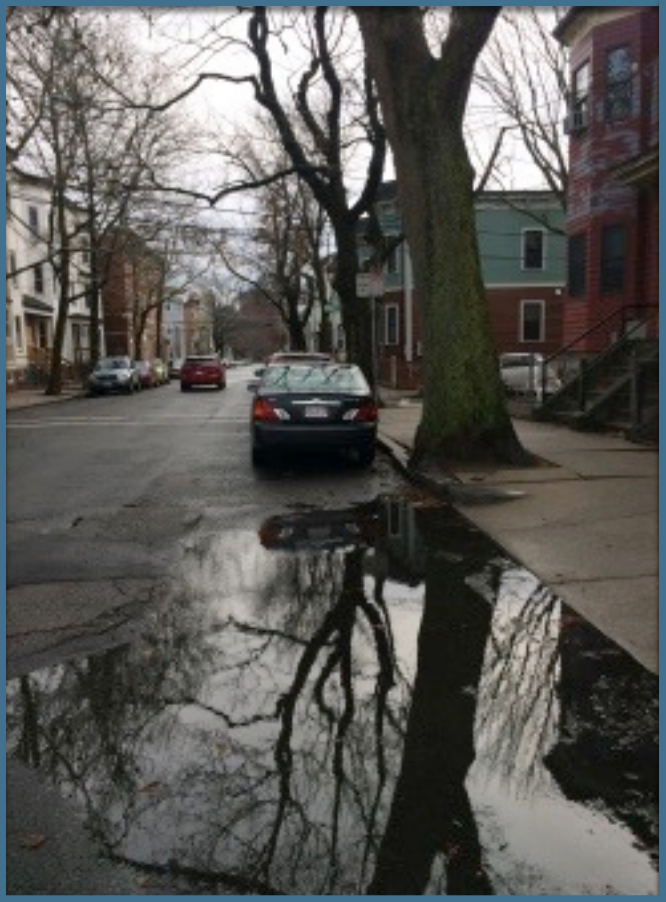


Webster Ave
Open Space &
Public Amenities

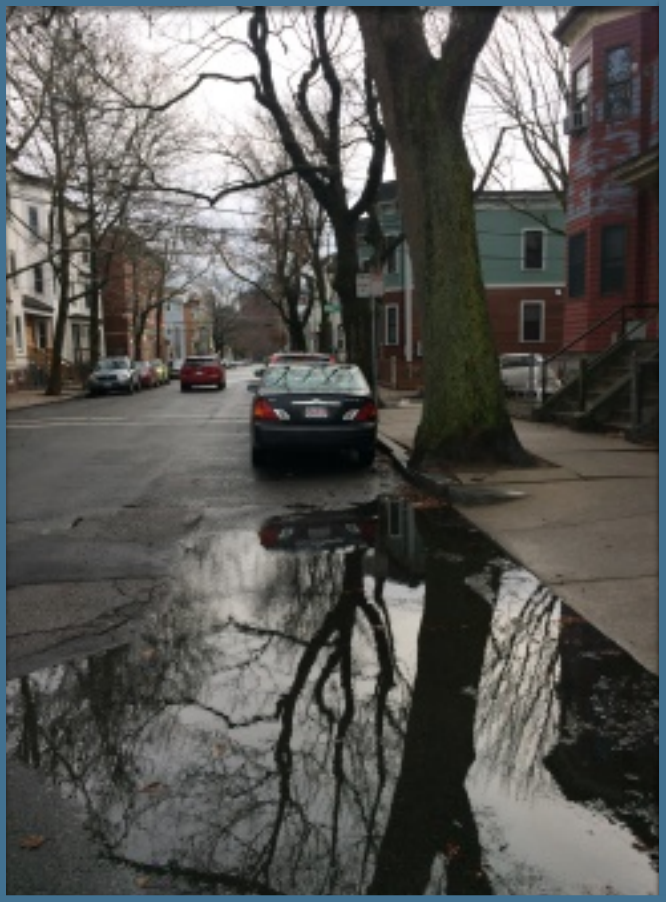
- Playgrounds
- Day Care Facilities
- *Public Schools*
- Youth Centers
- City Park or Play
- Public School Gr
- Urban Plaza
- Traffic Island



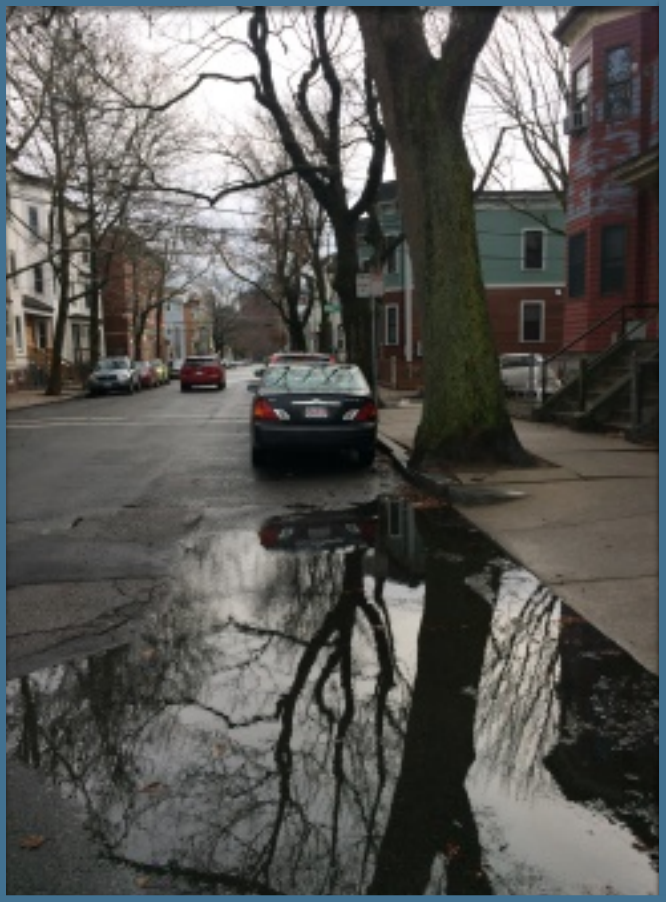
Site visits




YORK ST




YORK ST




YORK ST

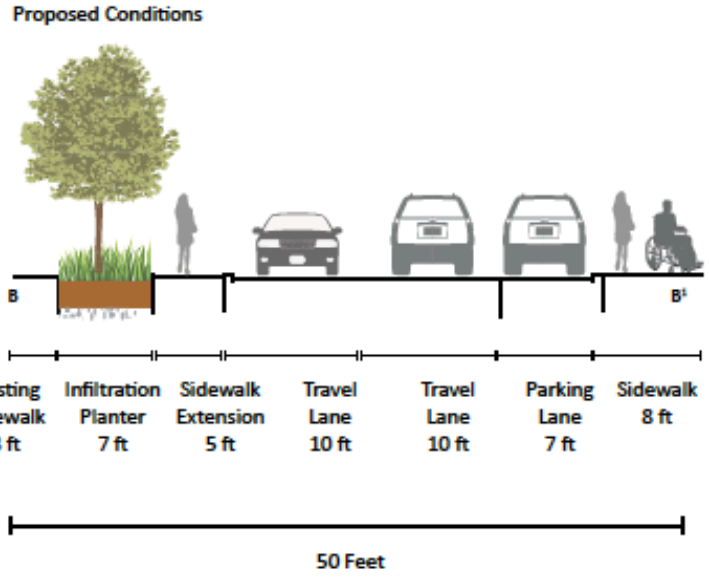
Task 2: Conceptual Green Street Designs

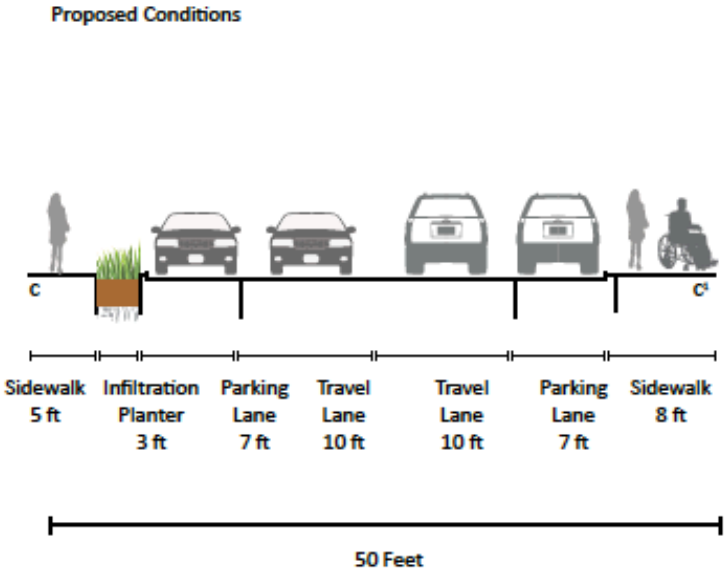
Task 2: Conceptual Green Street Designs

- Develop water quality goals for site specific designs
  - eg. Capture, treat, and store 1” rainfall in24 hrs
- Identify locations for treatment systems and calculate approximate footprints
  - eg. Corner bumpouts, tree trenches, basins
- Calculate expected pollution load reductions from the proposed designs
  - “Simple-dynamic” method for infiltration


High St
Park Ave
Holmes St
Holworthy St

Sizing and siting





Sizing and siting

Task 3: Green Street Guidance Document

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- Guidance document for use by municipal staff, volunteer boards/ commissions and private developers.
- Document challenges to implementing green streets in Cambridge's dense urban environment
- Document low impact development strategies to use as viable tools

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- Document challenges to implementing green streets in Cambridge's dense urban environment

→

- Sidewalk and roadway width
- Parking demand
- Land availability

Task 3: Green Street Guidance Document

- Guidance document for use by municipal staff, volunteer boards/ commissions and private developers.
- Document challenges to implementing green streets in Cambridge's dense urban environment
  - Sidewalk and roadway width
  - Parking demand
  - Land availability
- Document low impact development strategies to use as viable tools
  - Tree trenches
  - Rain garden bump outs
  - Permeable pavement
  - Incentives for private property owners

Task 4: Stakeholder Engagement

Task 4: Stakeholder Engagement

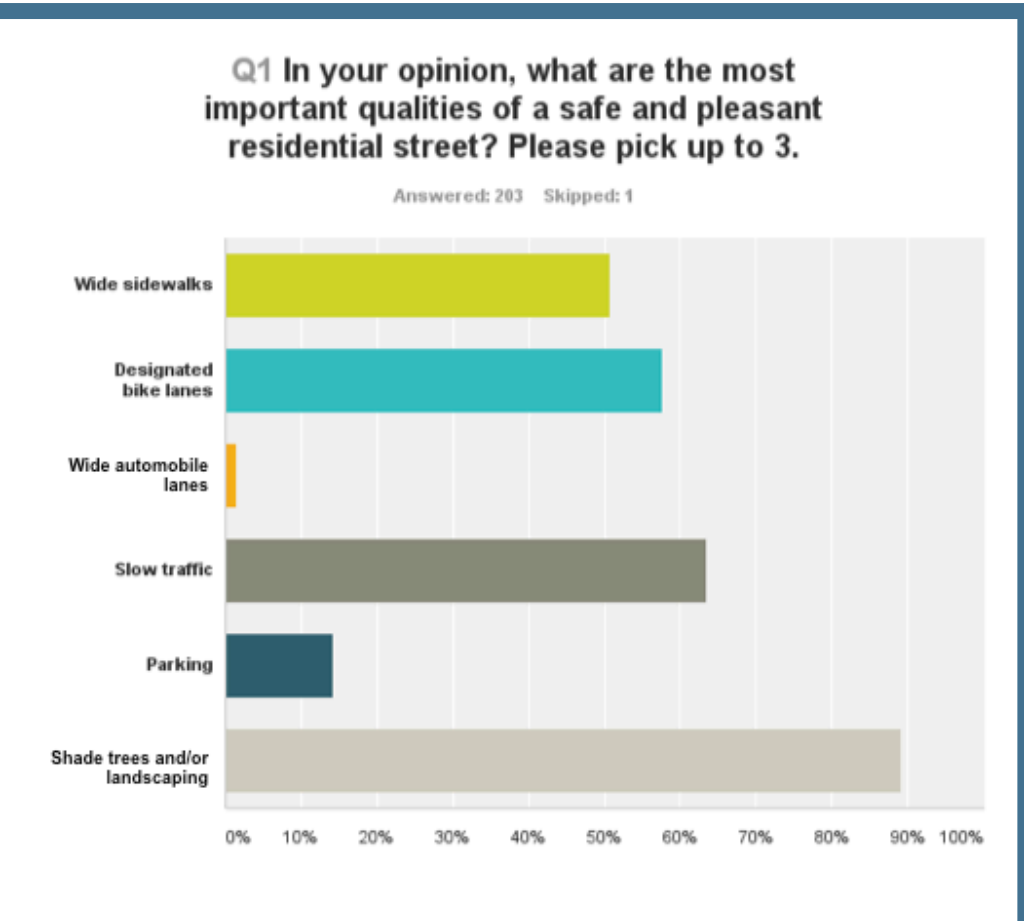
- Identify multi-sector, City-wide goals that green street implementation can help achieve

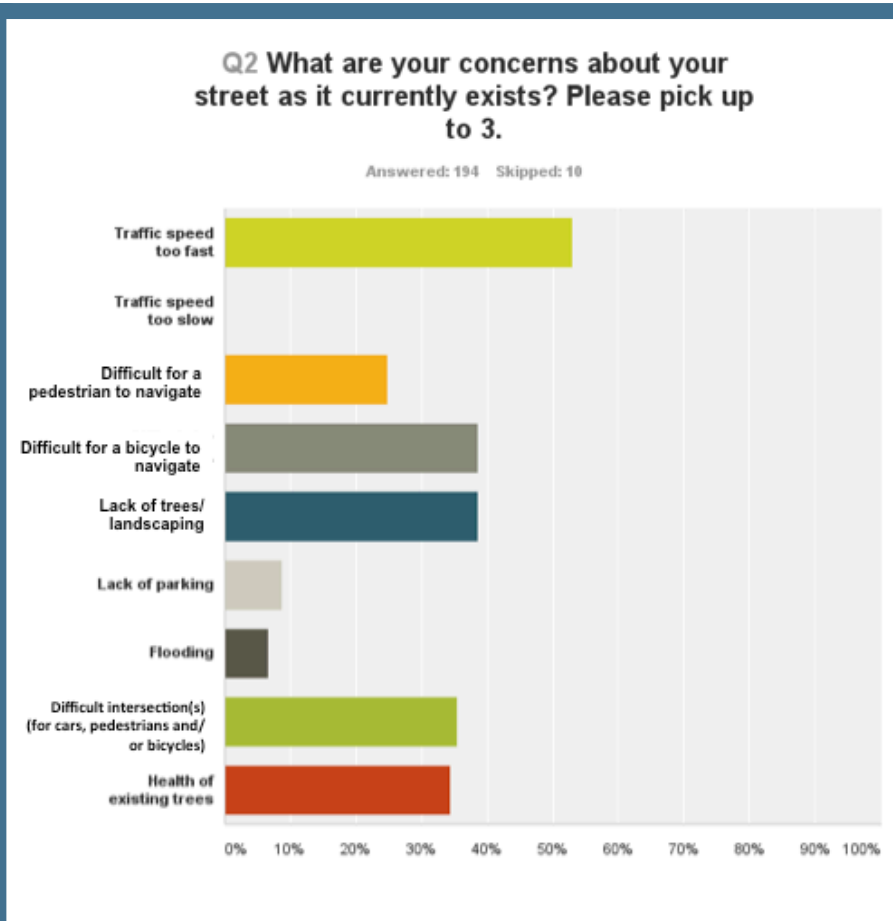
- *Open space plan*
- *Tree canopy goals*
- *Bicycle plan*
- *Climate change preparedness*

Task 4: Stakeholder Engagement

- Identify multi-sector, City-wide goals that green street implementation can help achieve
  - *Open space plan*
  - *Tree canopy goals*
  - *Bicycle plan*
  - *Climate change preparedness*
- Online resident survey to obtain feedback on green street design elements

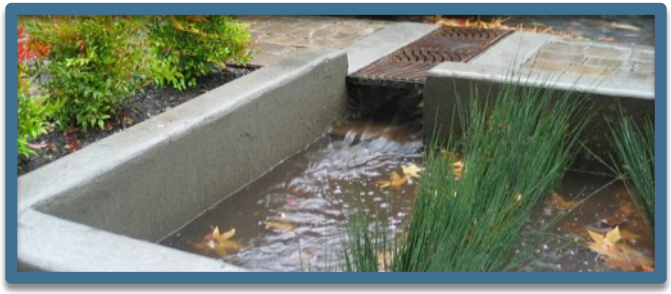
Resident survey



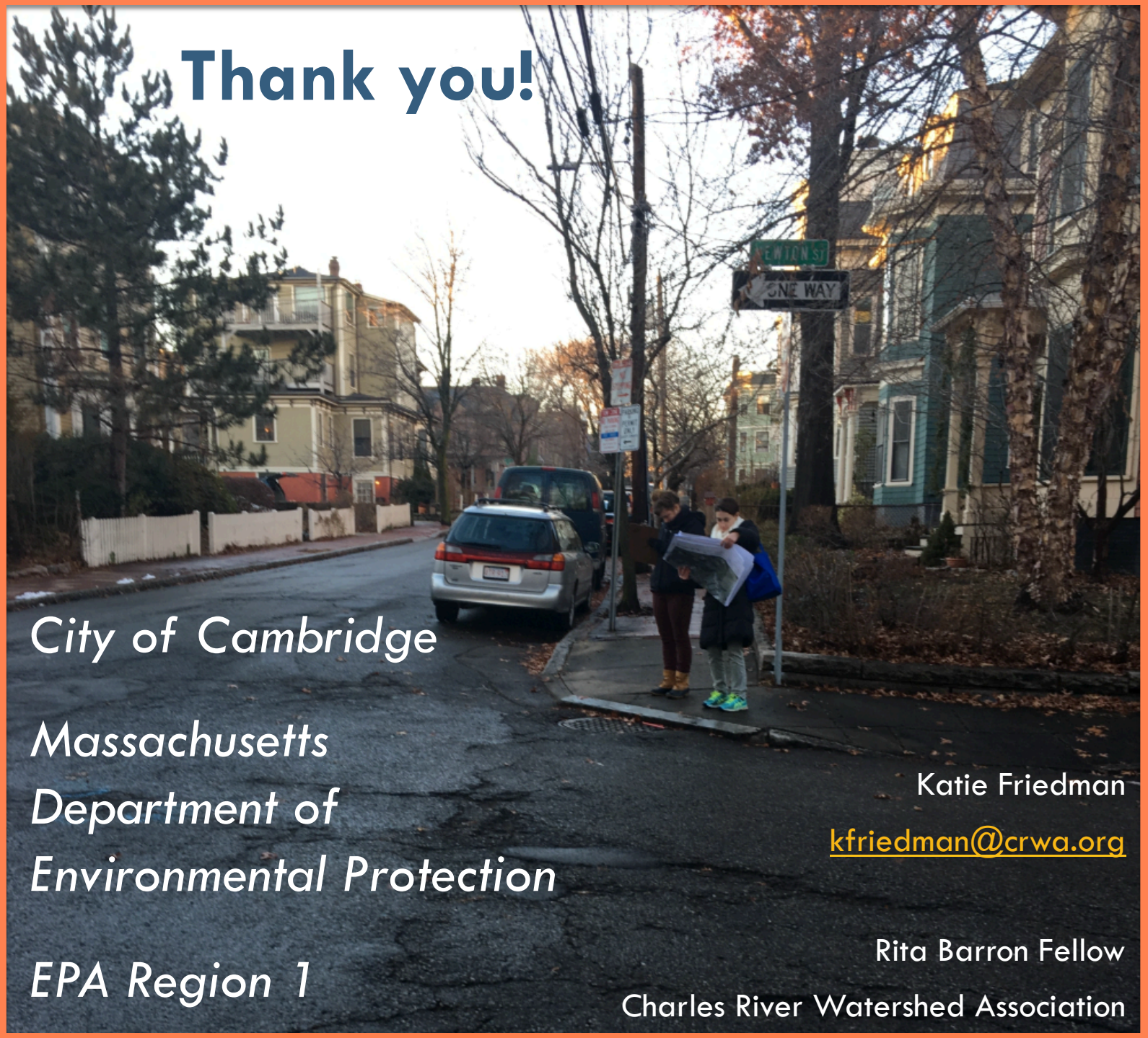


Take-aways

- Buy-in from residents
- Dedication from the City
- Opportunities for GI in densely populated urban environments
- Serve as a case study for municipalities throughout the Charles River watershed and beyond



Thank you!



City of Cambridge

Massachusetts Department of Environmental Protection

EPA Region 1

Katie Friedman

kfriedman@crwa.org

Rita Barron Fellow

Charles River Watershed Association