Urban Water Transformation:
Designing Infrastructure for a Livable Future

NEWEA 2016 Annual Conference & Exhibit
January 27, 2016

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Charles River Watershed Association

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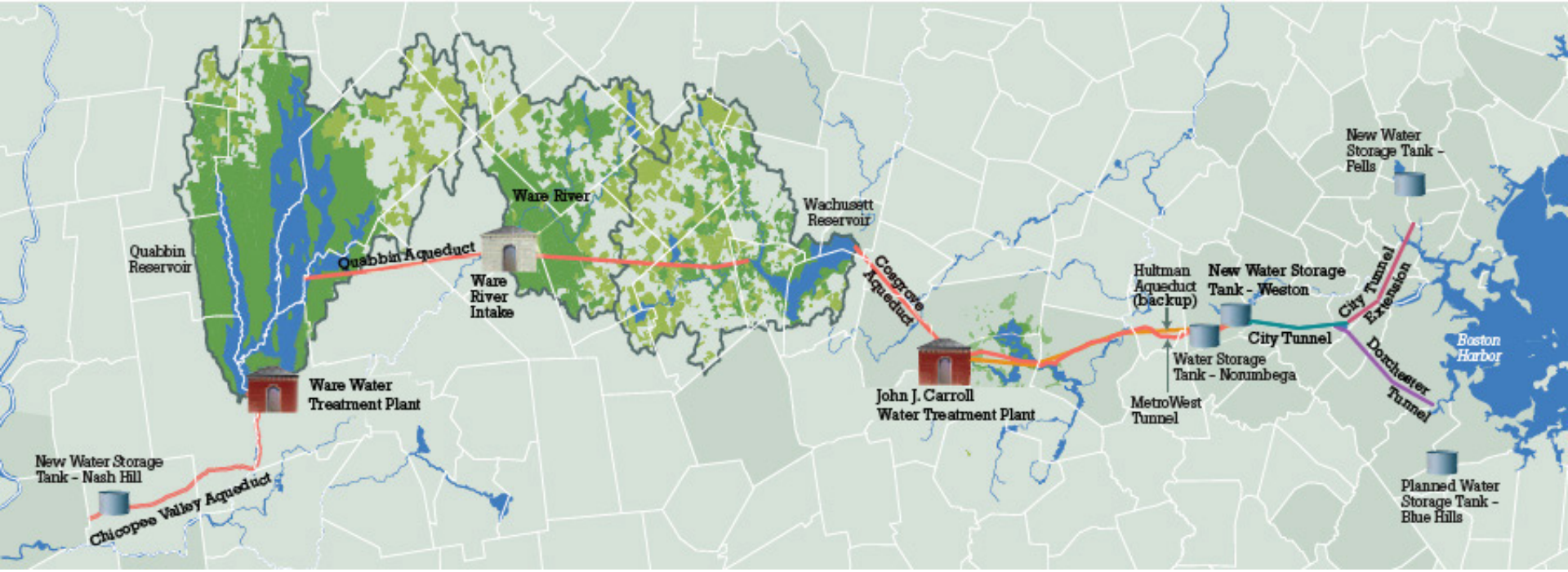
Charles River Watershed Association

Why is CRWA talking about wastewater treatment? What's "wrong" with our existing infrastructure?

BACKGROUND

MWRA Water Supply System



Water flows from Quabbin and Wachusett Reservoirs to 48 communities in the greater Boston area

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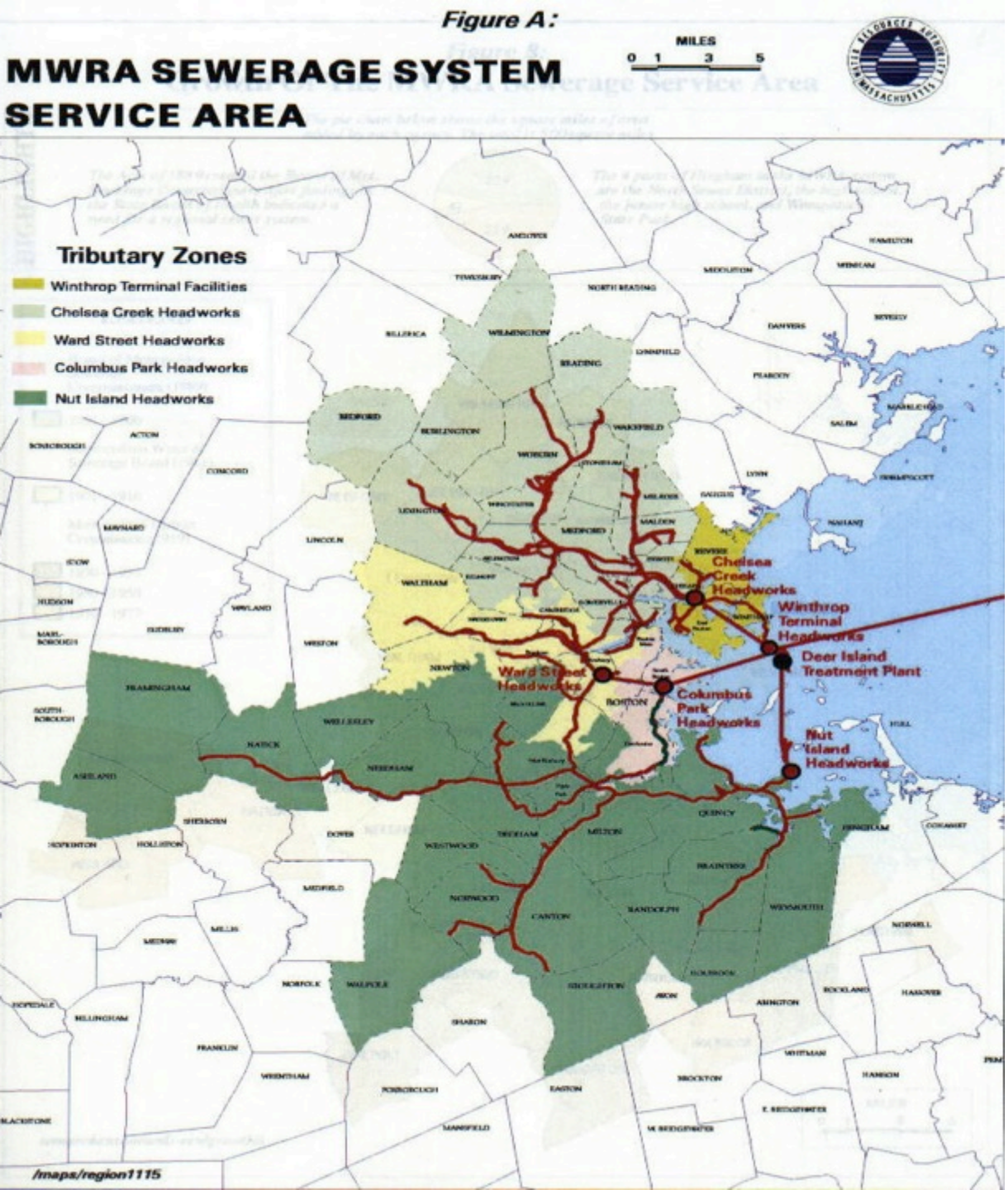

MWRA Wastewater System

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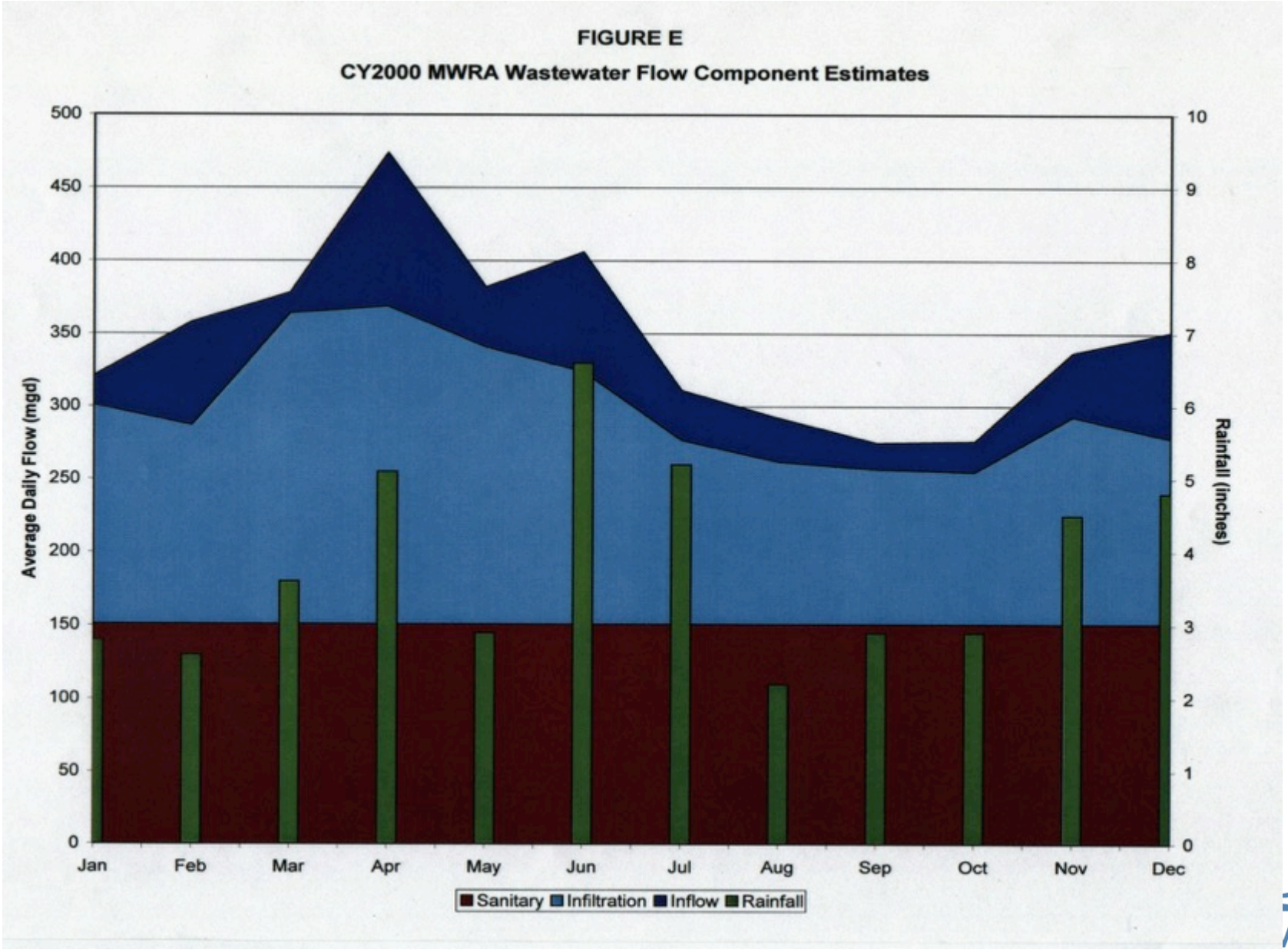
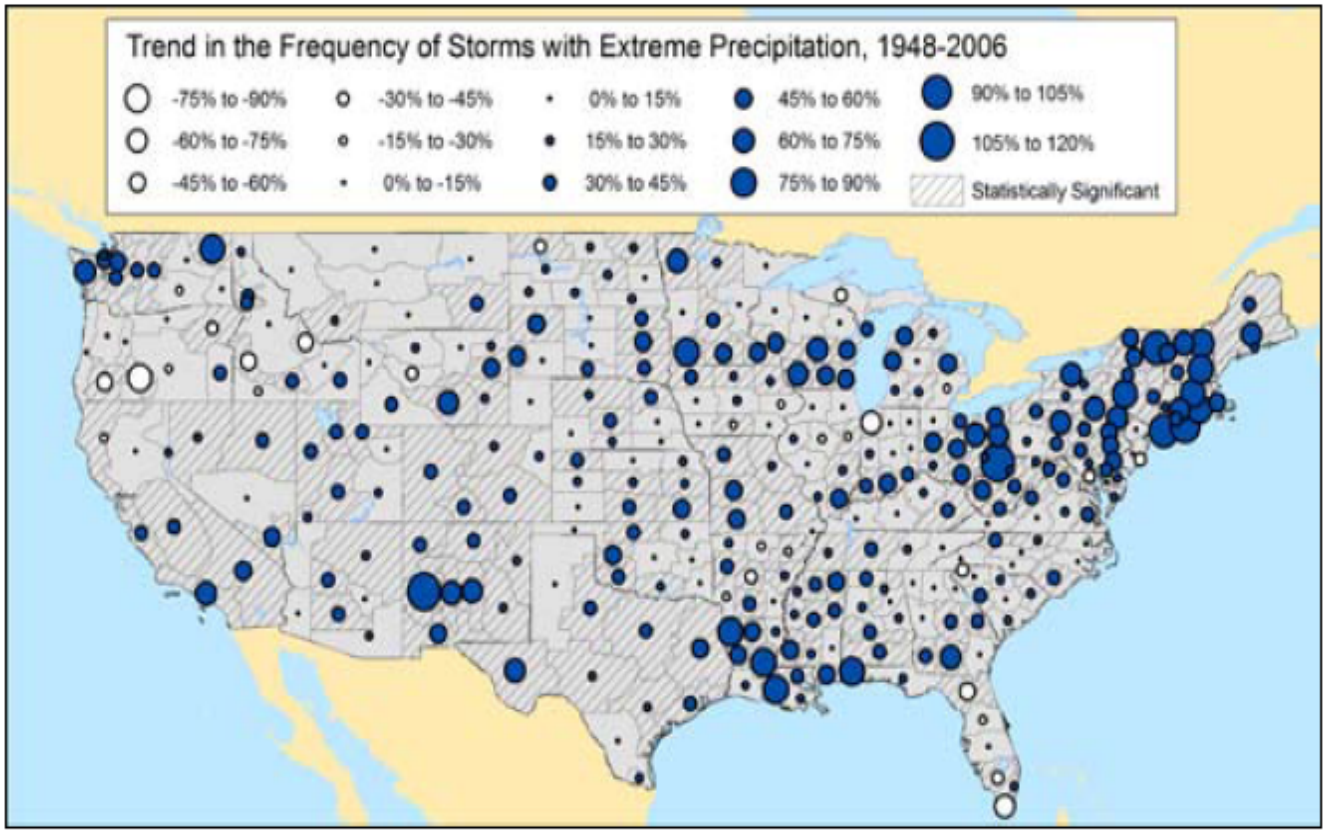
Streamflow Lost to Wastewater System



Climate Change will bring the Northeastern United States

More Large Storms and Floods

Figure ES-2: Trend in Frequency of Extreme Precipitation by Climate Division



Source: *When It Rains, It Pours*. Environment America Research and Policy Center, December 2007

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CRWA: Restoring Nature

Resource-to-Waste-to-Resource - There are no wastewater treatment plants or landfills in nature; each waste product becomes another resource.

Keep Water Local - Water is slowed down, infiltrated, and used several times.

Flexibility, Adaptability, Interconnectedness - Nature handles catastrophic events by lending the capacity of each to all others.

Promote and Support Rich Diversity - Nature celebrates diversity as a strength, a way for communities to be more adaptable, more resilient, and to gain strength through evolution.

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Selecting pilot neighborhoods and developing conceptual CWERC design

INITIATION PHASE

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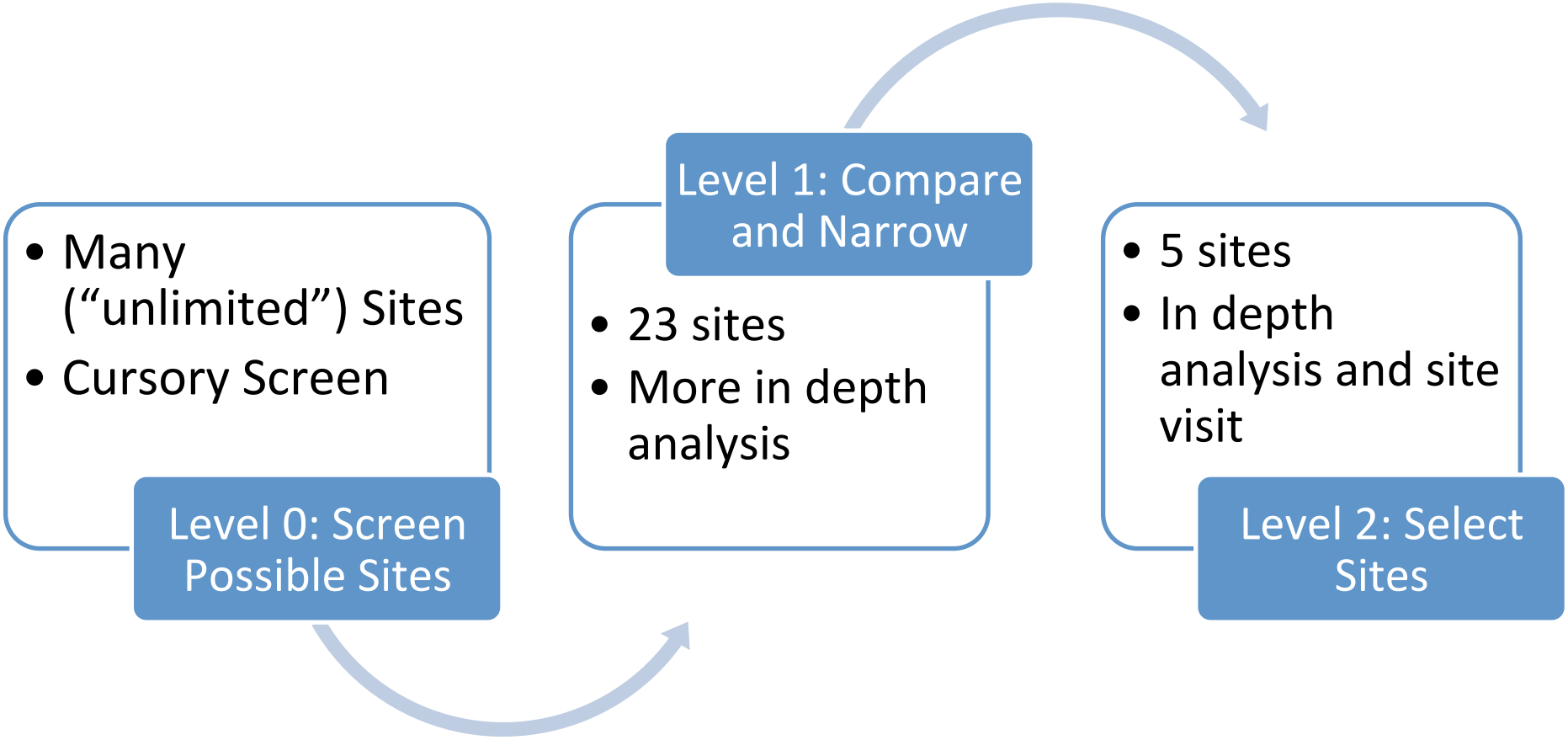
Task 1: Neighborhood Selection
Methodology



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Pilot Neighborhood Selection and Assessment

Pilot Neighborhood #1: Expanded Innovation District

Pilot Neighborhood #2: Lower Stony Brook

Critical Siting Elements:
- Access to adequate sewage volume
- Available space
- Opportunities for reuse of treated water

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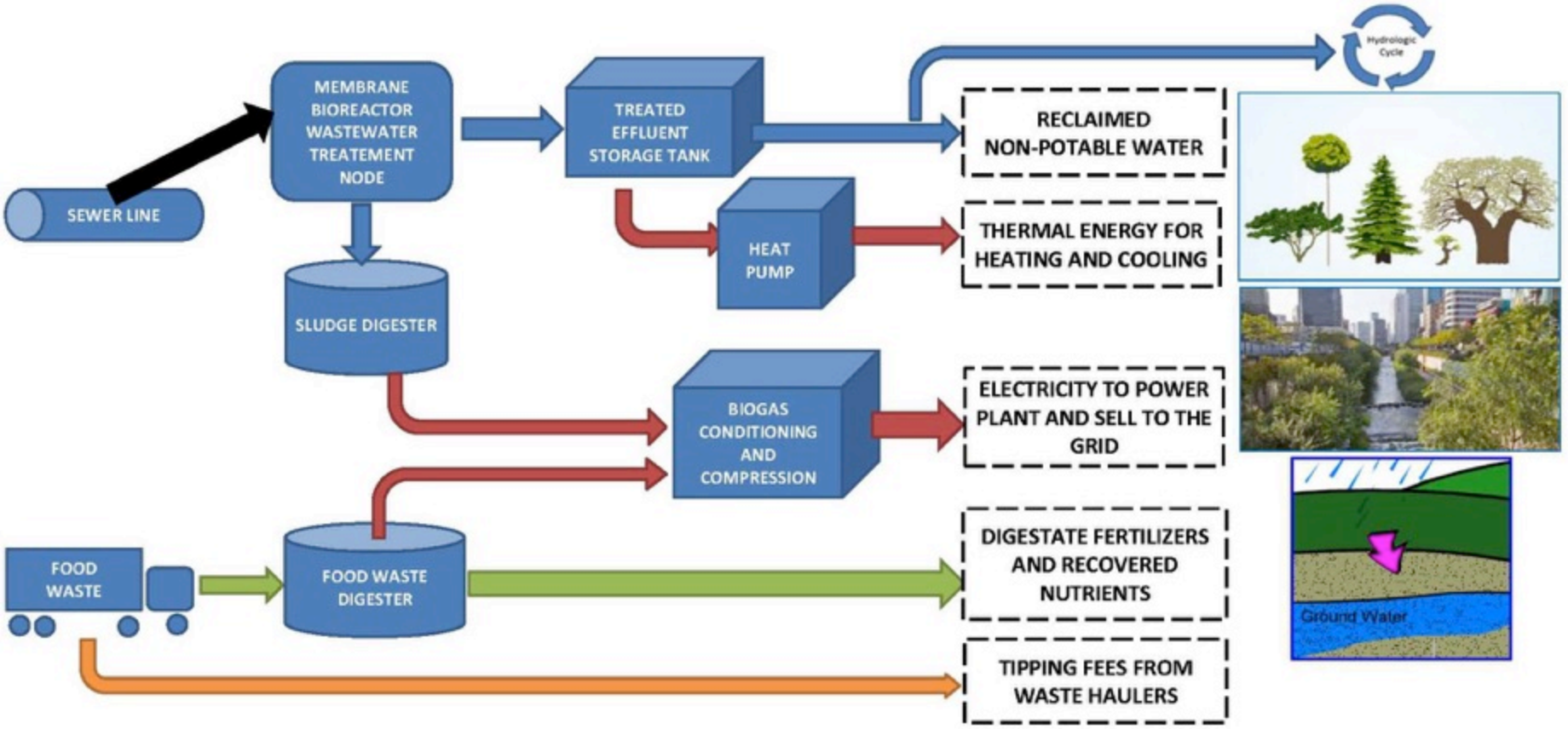
Maximizing Water and Energy Resources

Resource to Waste to Resource



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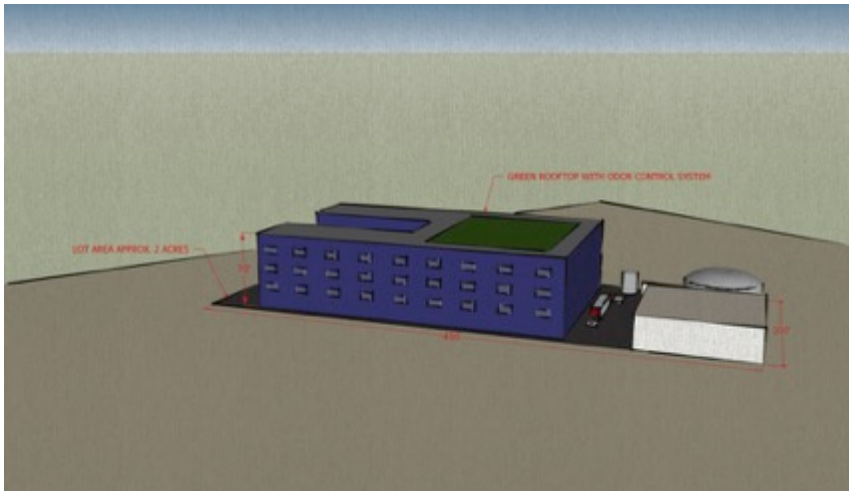
Community Water and Energy Resource Center = CWERC



- Treat and resell a portion of the water (MBR)
- Capture and use/sell thermal energy (heat pump/exchange)
- Produce and use/sell biogas through co-digestion (CHP)
- Capture nutrients (N) for resale
- Produce compost for resale (2 tiers, separating sludge and SSO streams)

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Technical Inputs/Outputs and Business Model Scenarios for CWERC

MODELING

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Modeling CWERC Inputs and Outputs

Neighborhood	1	2
WW Reclamation (MGD)	2	3
Water for Hydrologic Restoration (MGD) (% total)	0.5 (25%)	1 (33%)
Food Waste Processing (Tons/ Day)	80	54
Food Waste Tipping Fee ($/ Ton)	80	60
Electric Rate based on energy production vs. parasitic load	$0.12/kWh	$0.15/kWh
Wastewater Treatment Fee (% Boston Retail Treatment Fee)	0	0 – 31%
Water Reuse Fee (% Boston Potable Water Retail Fee)	30%	50 – 100 %
Approximate Facility Footprint	2 acres	2.5 acres
Food Waste Tipping Fee	$0.04/lb	$0.03/lb

Other Assumptions:

- WW content based on influent at DI WWTP
- Reuse water buyer is onsite or nearby
- Thermal energy sold at $9.77/MMBTU
- Food waste producer location and availability based on MassDEP estimates (no overlap b/ t neighborhood #1 and #2 suppliers)
- No discharge to sewer
- SSO 20% solids as received

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Community Water and Energy Resource Center
Capital Cost and Revenue Summary

- Total capital cost: $46.8 million
  - headworks, MBR, storage tank, heat pump, anaerobic digestor for municipal sludge, food waste digestor, dewater biosolids, dewatering food solids, food receiving station, digester storage tanks (2, 100K gallon tanks) digester pumps, CHP unit, nutrient recovery, composting
  - does not reflect prevailing wage requirements
- Annual O&M costs: $4.9 M
  - wastewater treatment, pumping, energy, chemicals, labor, misc. supplies
  - does not take into account the value of any energy produced on site.
- Annual product fees/revenues: $7.4M
- Conducted financial modeling to determine project viability under various ownership scenarios

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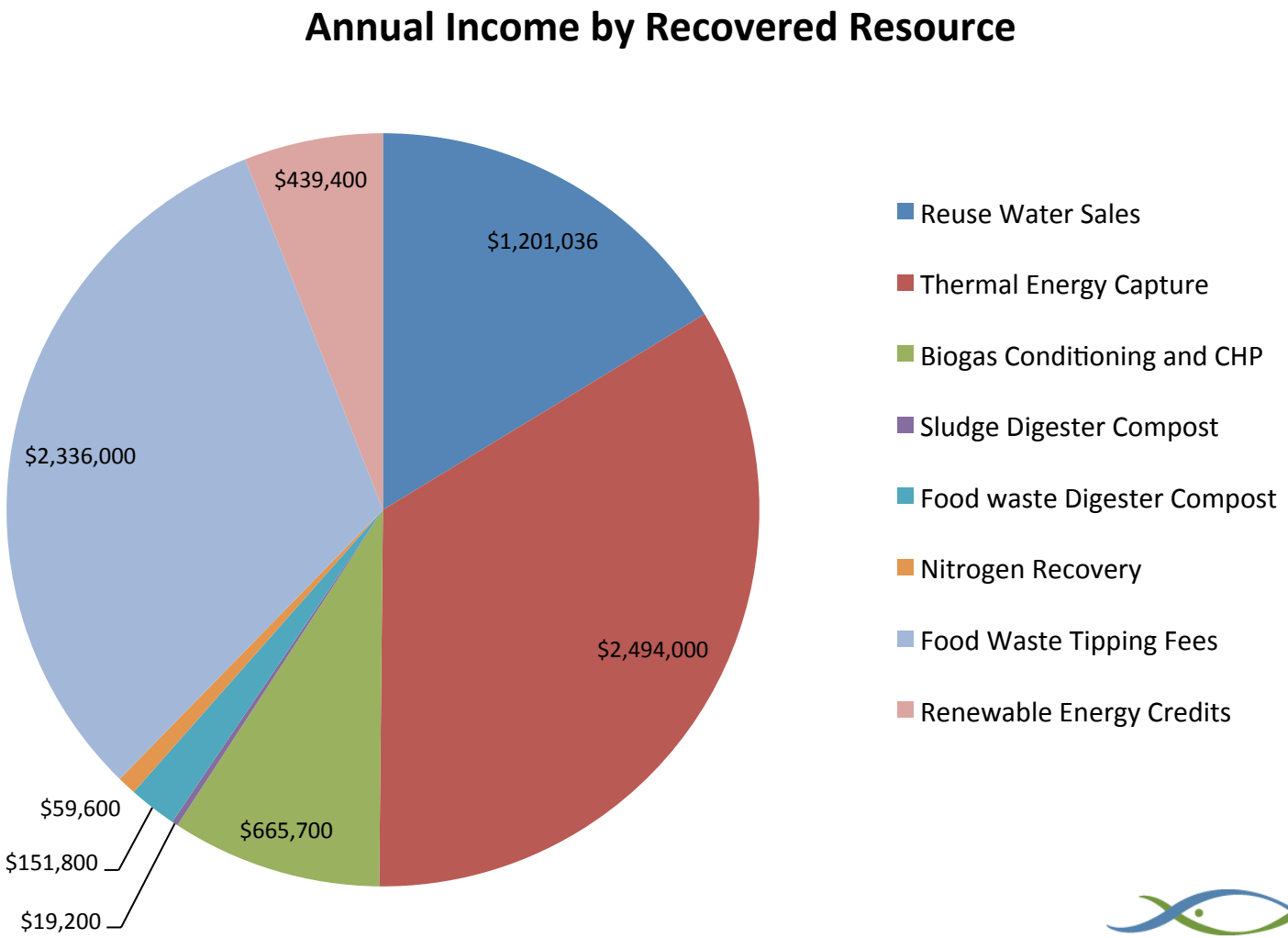
Neighborhood 1 CWERC Output



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Marrying potable, storm-, waste-, ground-, and surface water management to restore the natural water cycle

INTEGRATING STORMWATER MANAGEMENT

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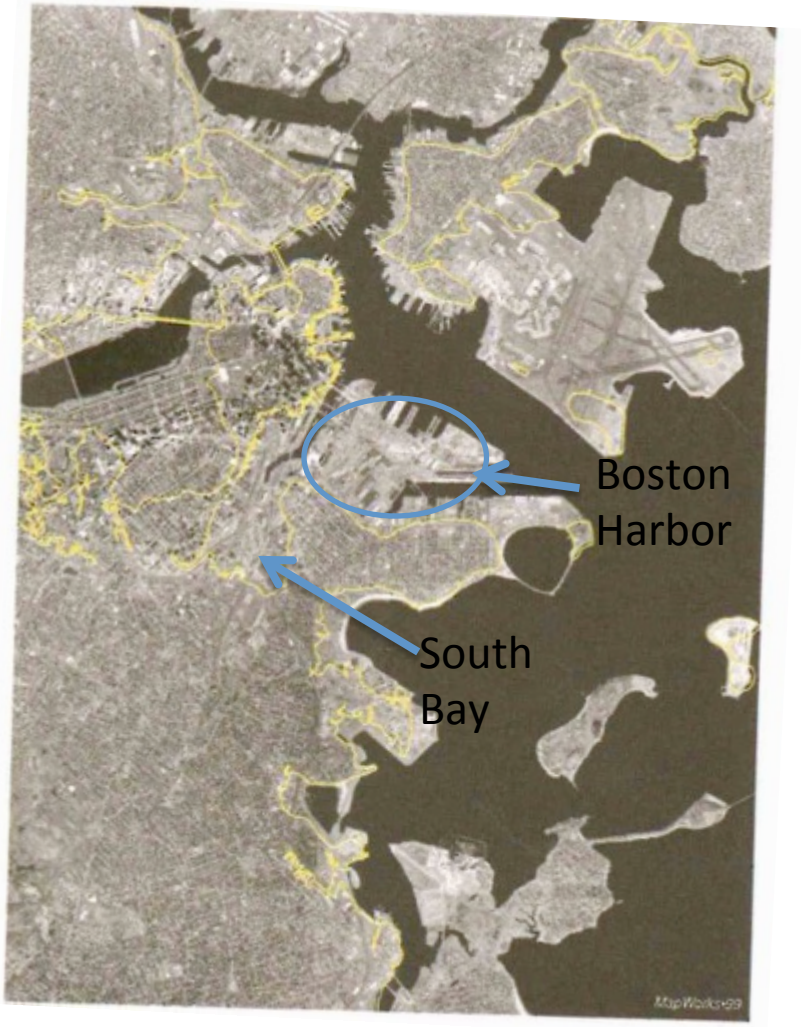
Neighborhood Assessment



1795 coastline (yellow)
1995 aerial image

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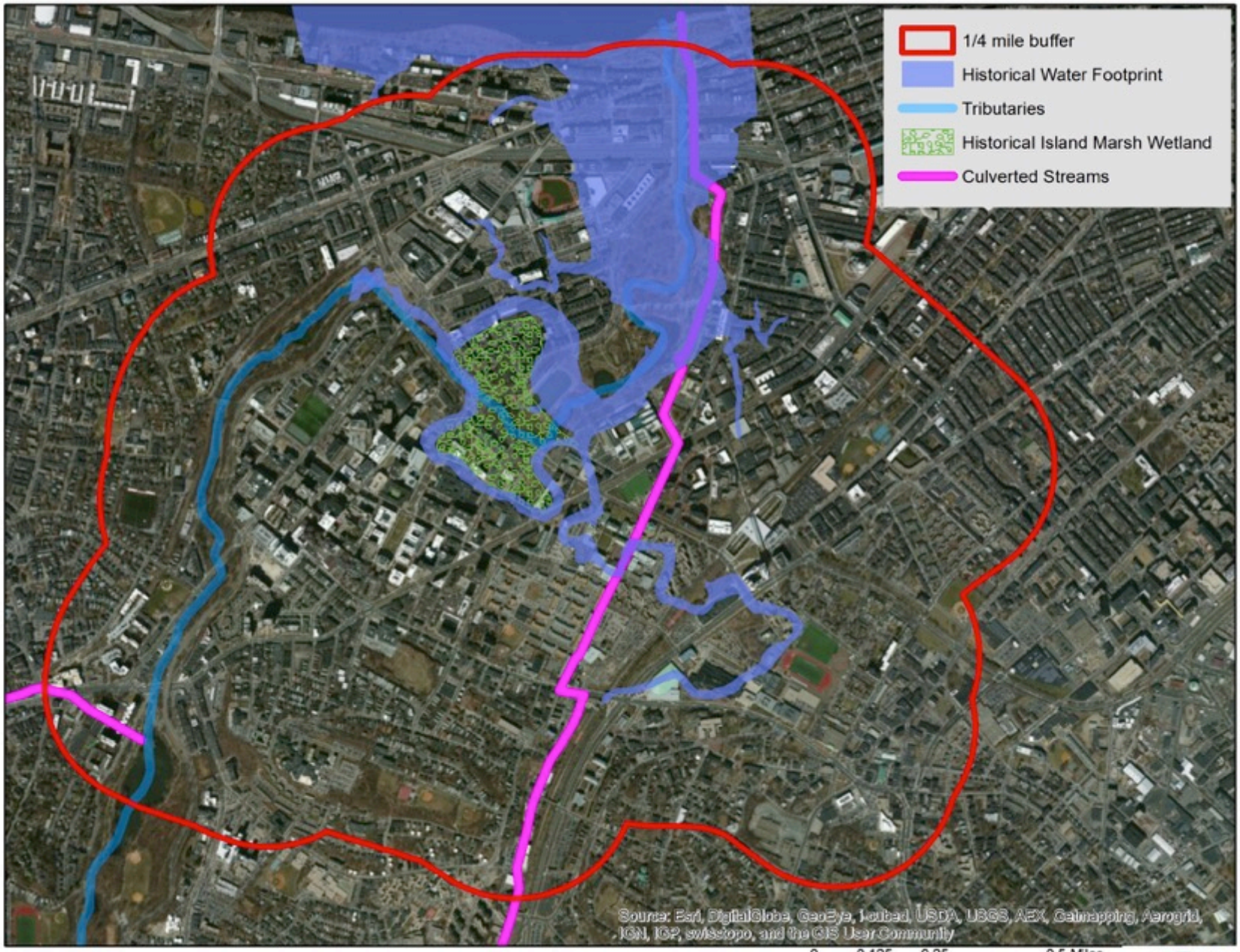
N
1/4 mile buffer
Historical Water Footprint
Tributaries
Historical Island Marsh Wetland
Culverted Streams
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
0
0.125
0.25
0.5 Miles
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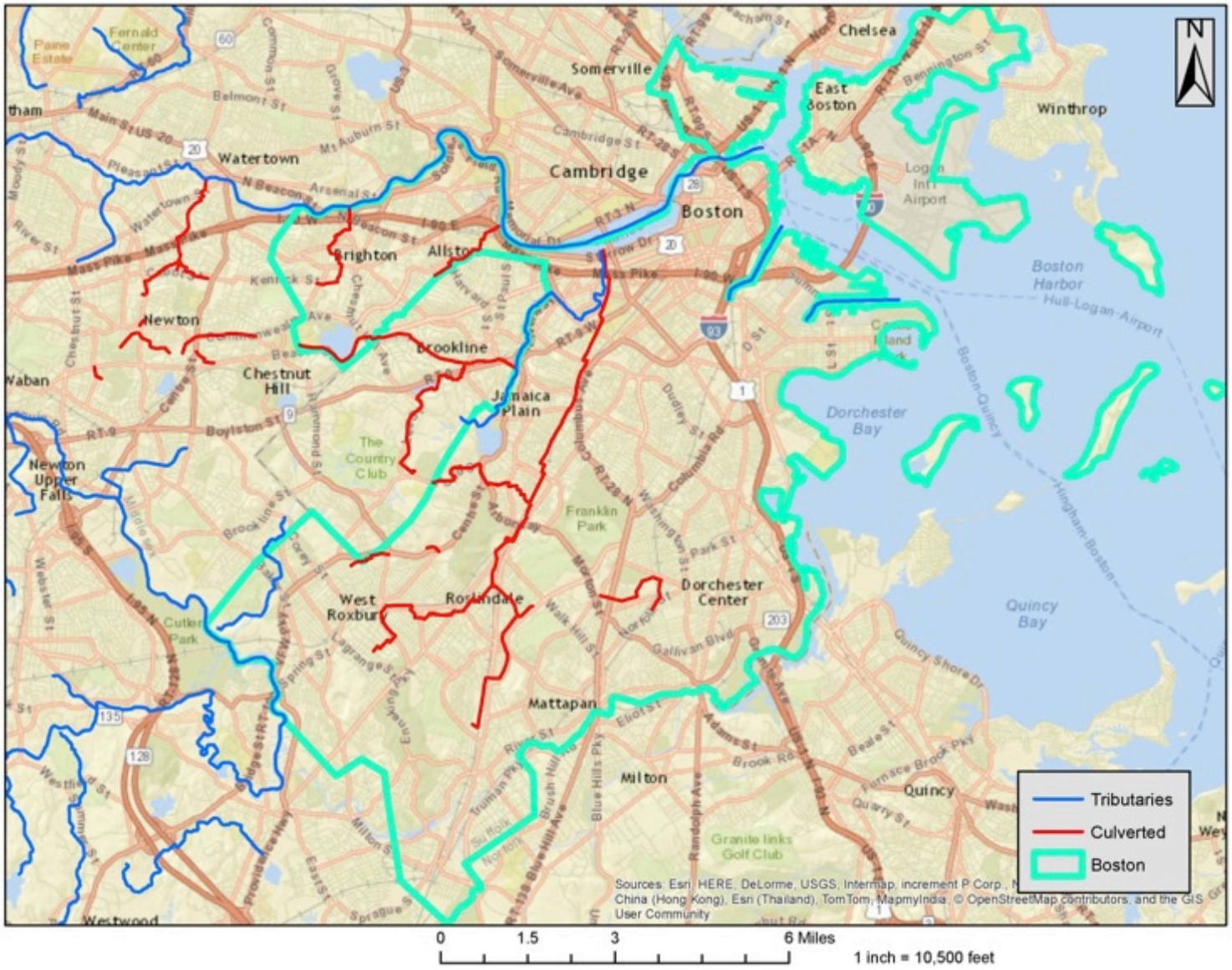
Neighborhood Assessment



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Neighborhood A

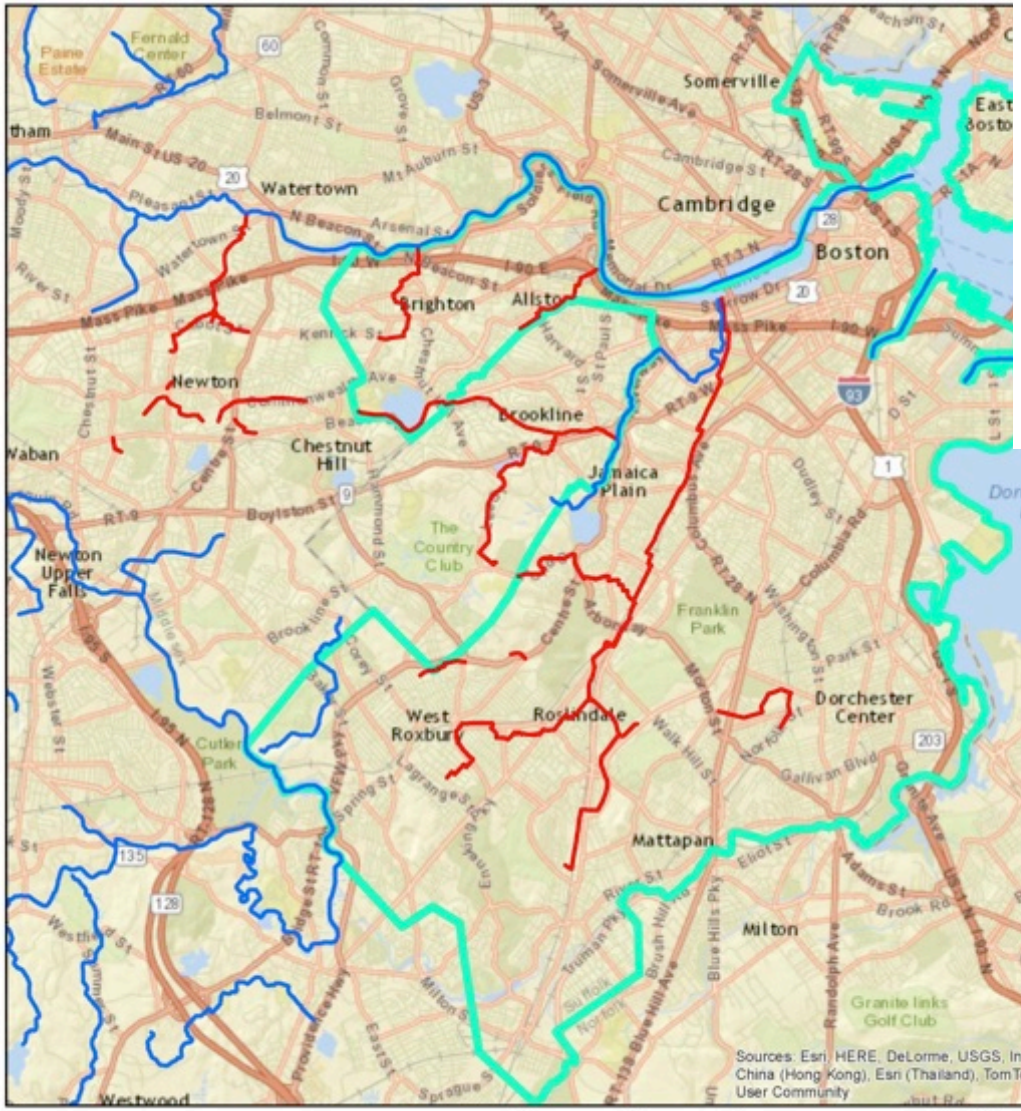
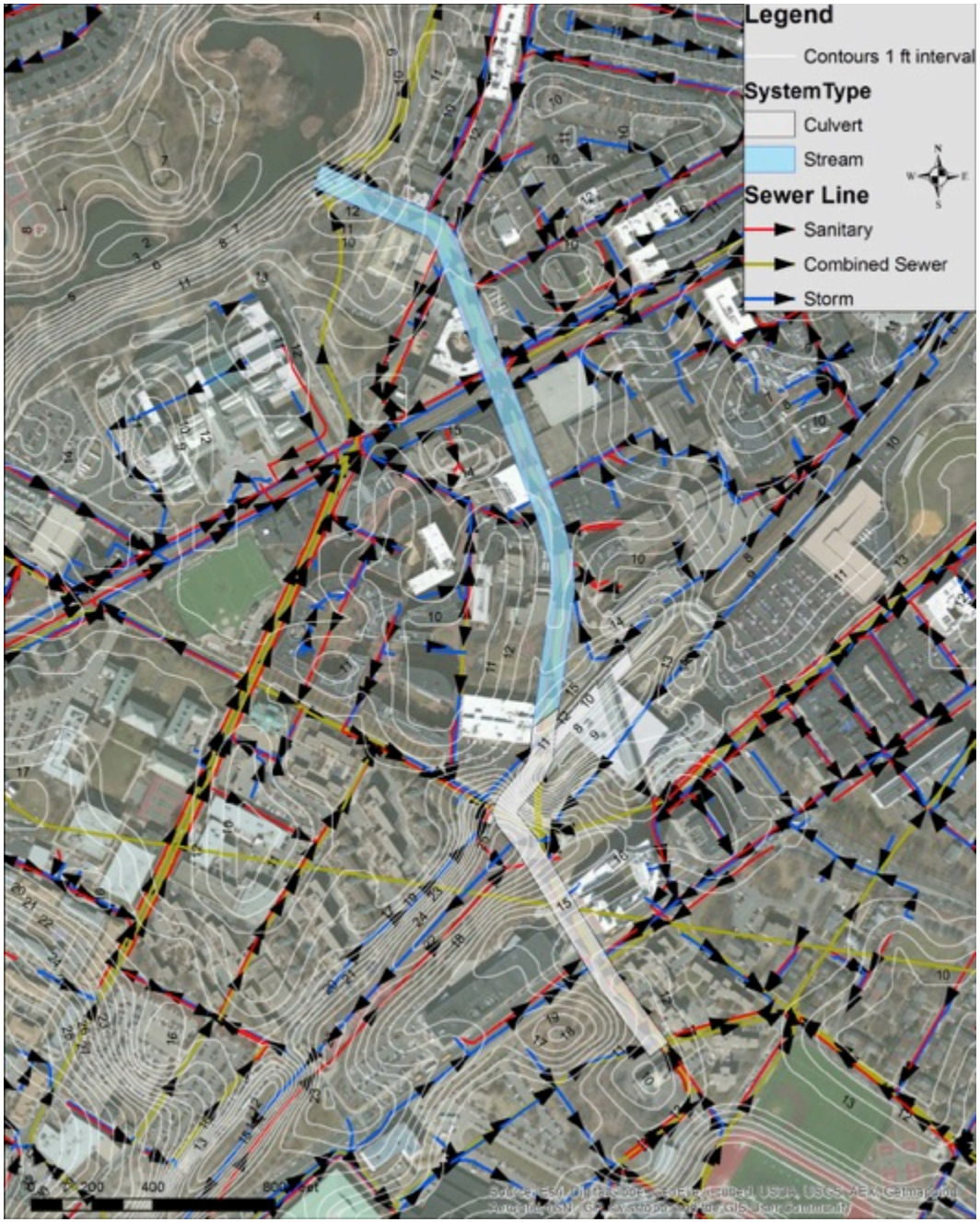


Figure 11. The culverting of Stony Brook at Forest Hills, about 1905.

Stream Restoration or Creation



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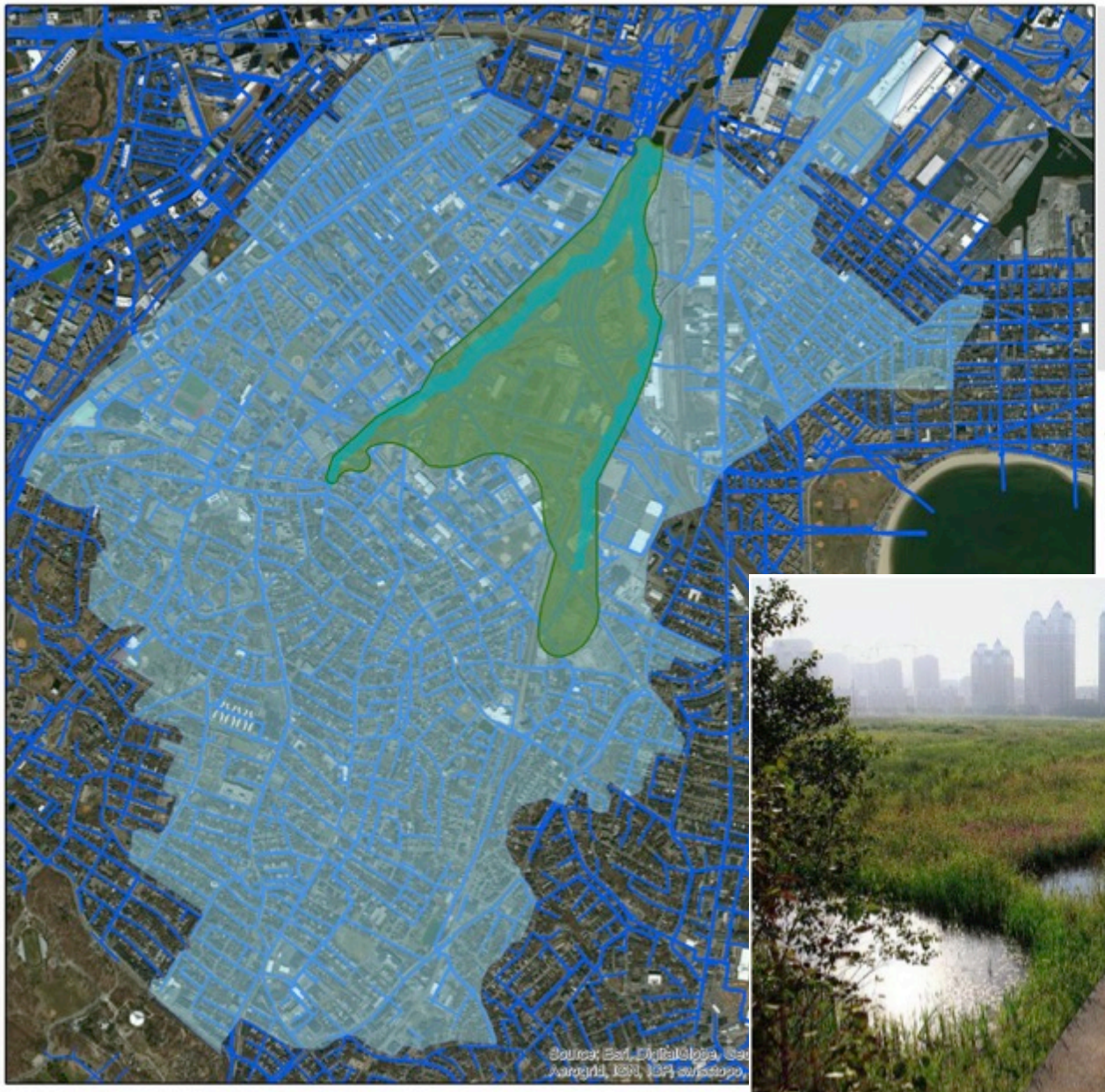
NU Stream Daylighting-Visualization

NU Stream Daylighting-Visualization

Long-Term Flood Control Plans



Additional and Ongoing Work

- Social Welfare Economic Analysis
  - Energy benefits
  - Emissions reduction and climate change benefits
  - Groundwater recharge benefits
  - Functional open space and other GI benefits
  - Estimated $14-33 million in benefits
- Technical Advisory Committee and Citizen's Advisory Group
- Expansion and Replication to Larger Sewer Service Area

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Thank you for your time!

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QUESTIONS AND COMMENTS?

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