Integrating stormwater drainage into the U.S. Geological Survey's StreamStats application for the Mystic River Watershed

Massachusetts Water Resources Commission

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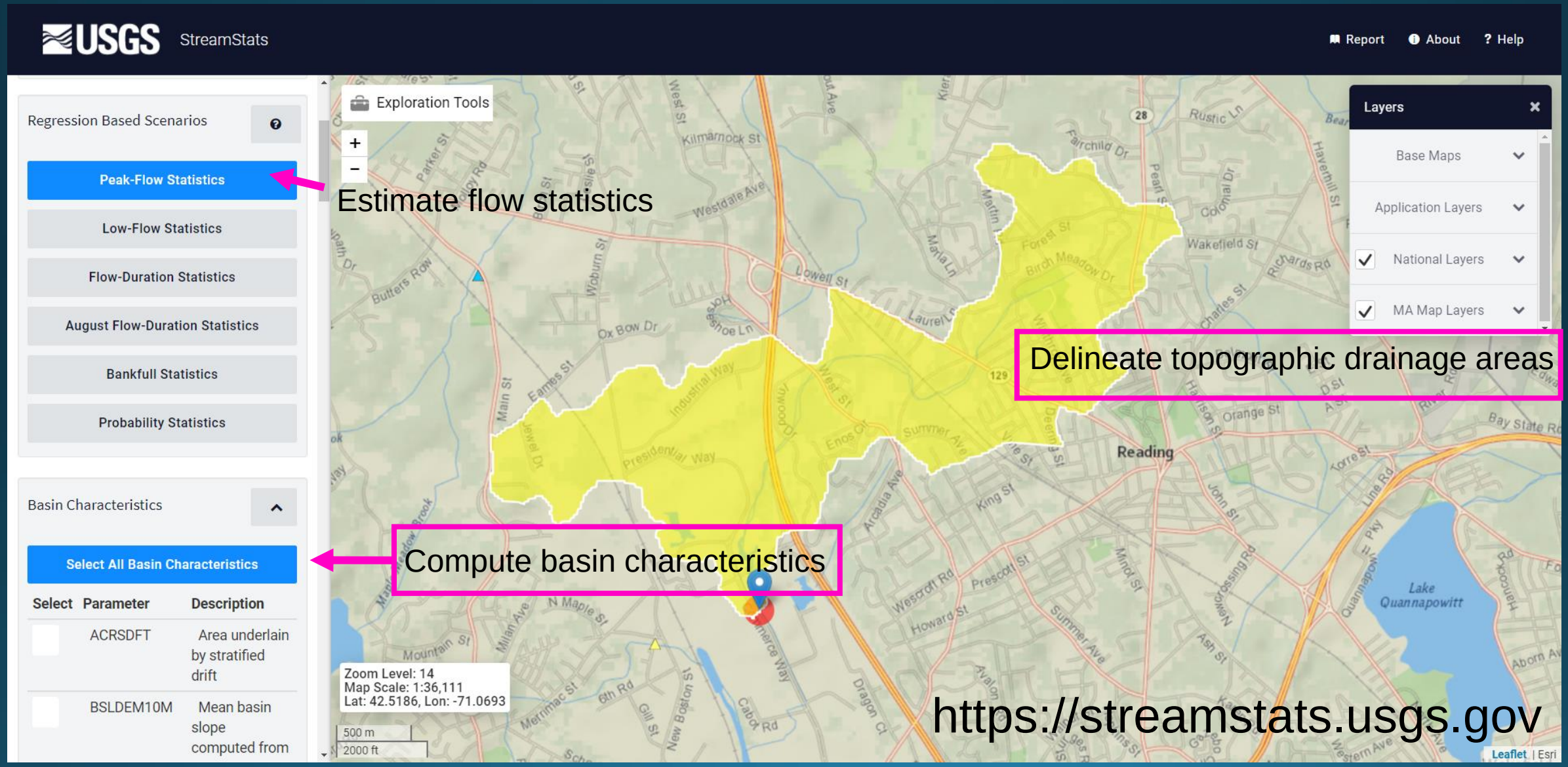
In this presentation we will:

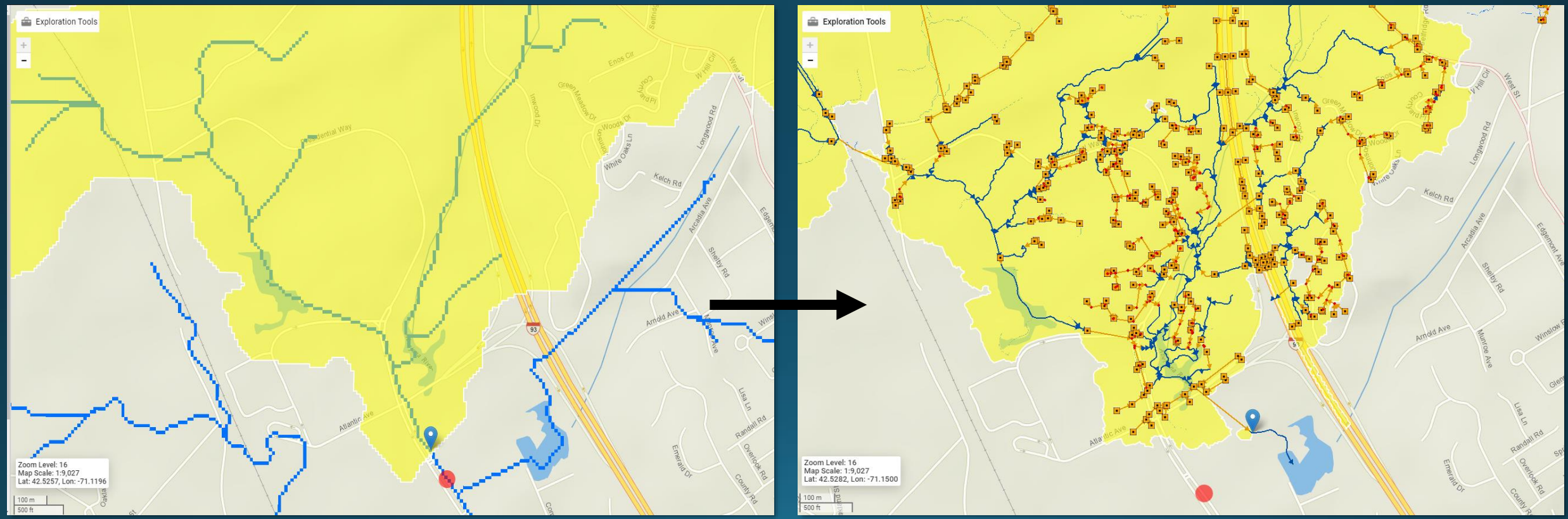
- Provide an overview of StreamStats and the project
- Demonstrate the stormwater functionality in the Mystic River Basin StreamStats application
- Discuss the basin characteristics that are available
- Provide a brief summary of the processing methods
- Identify benefits of StreamStats urban-stormwater applications
- Provide links to the products

StreamStats is a geospatial web app used to delineate basins, compute basin characteristics, and estimate flow statistics.

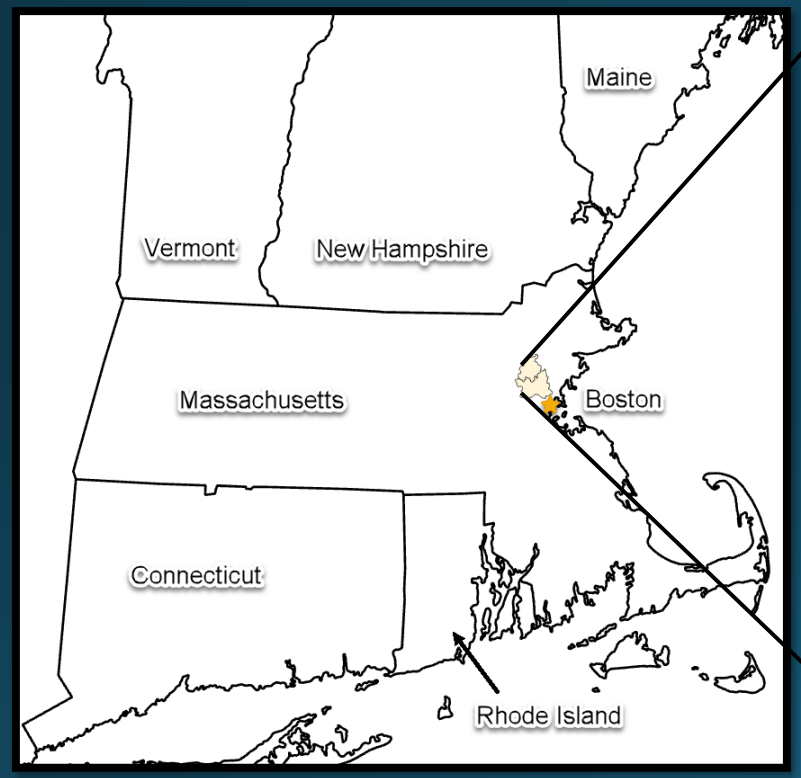


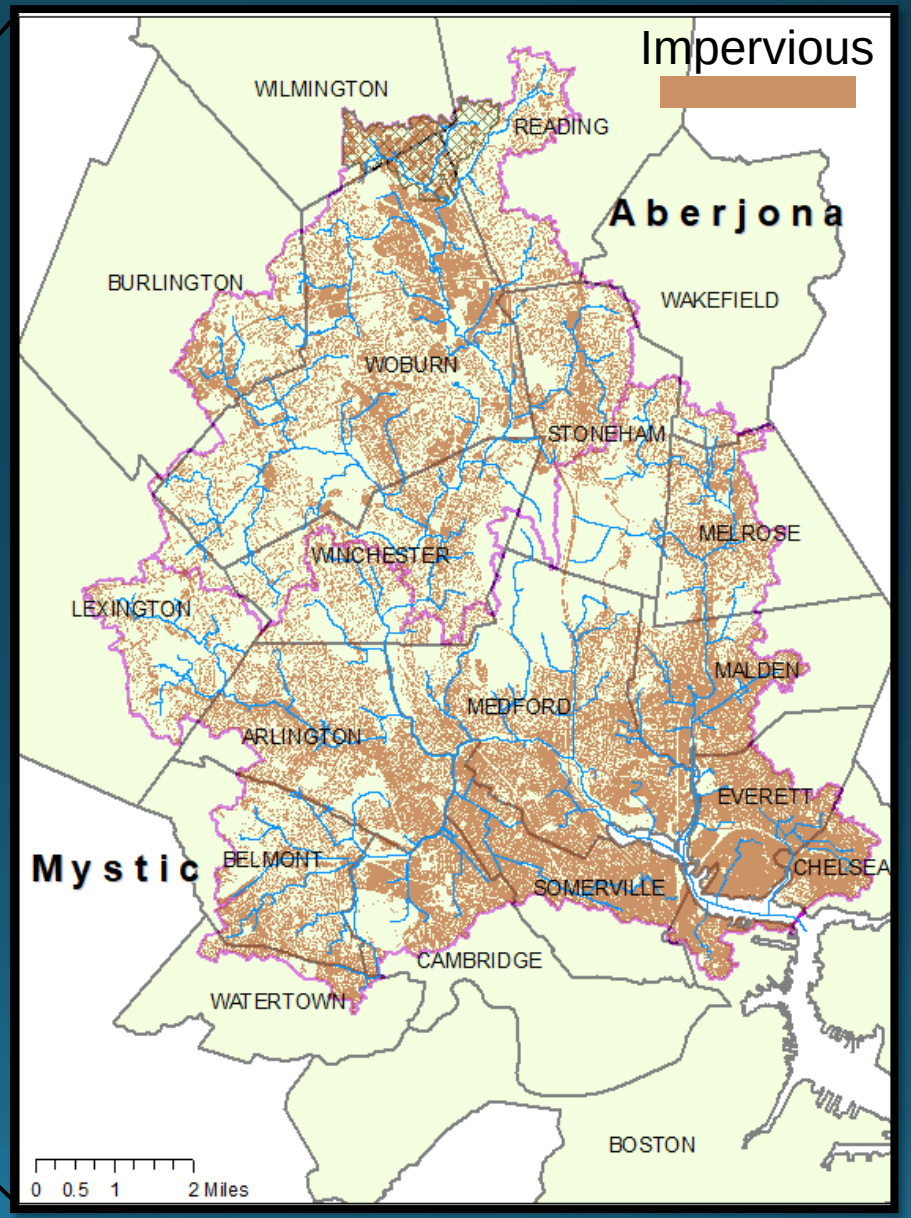
https://streamstats.usgs.gov

We have added municipal storm drain data to the USGS StreamStats application for the Mystic River Watershed.



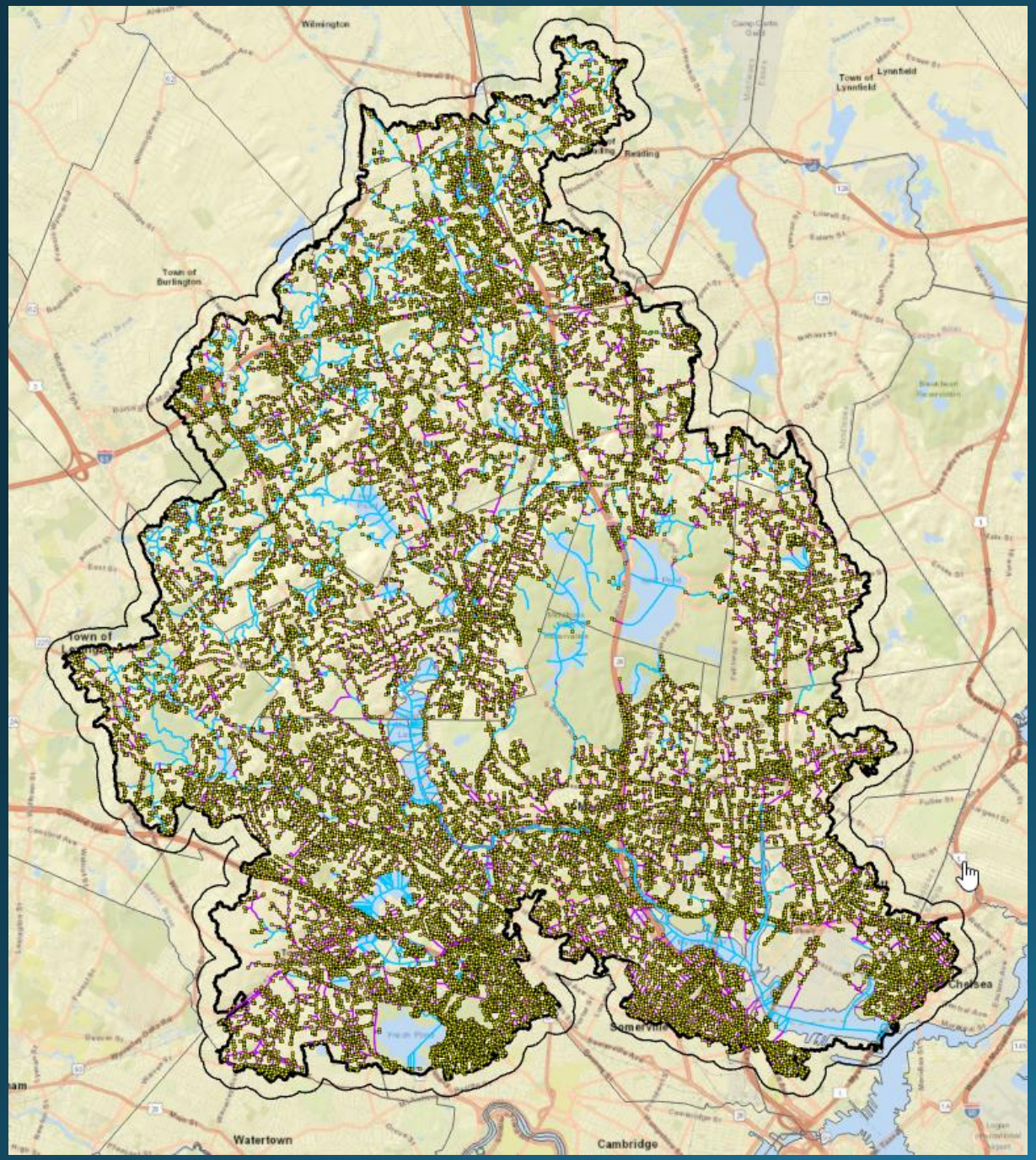
The Mystic River Watershed is a highly urbanized basin north of Boston, Massachusetts.





~ 42 % Impervious area

[1]MassGIS 2016 Land Cover

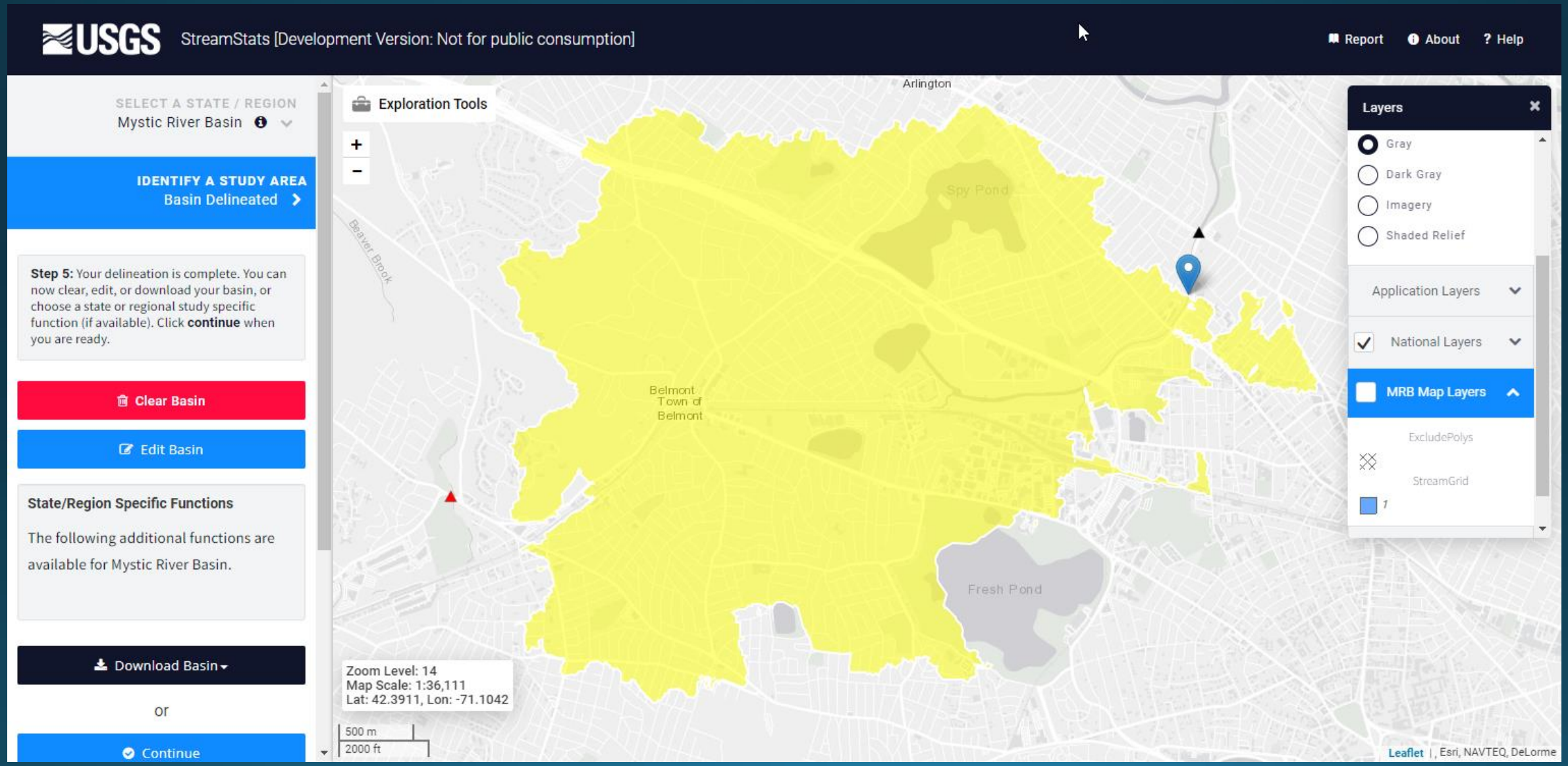


This project is the first watershed-scale effort to represent urban hydrology in StreamStats by incorporating manmade infrastructure such as storm drains and culverts.

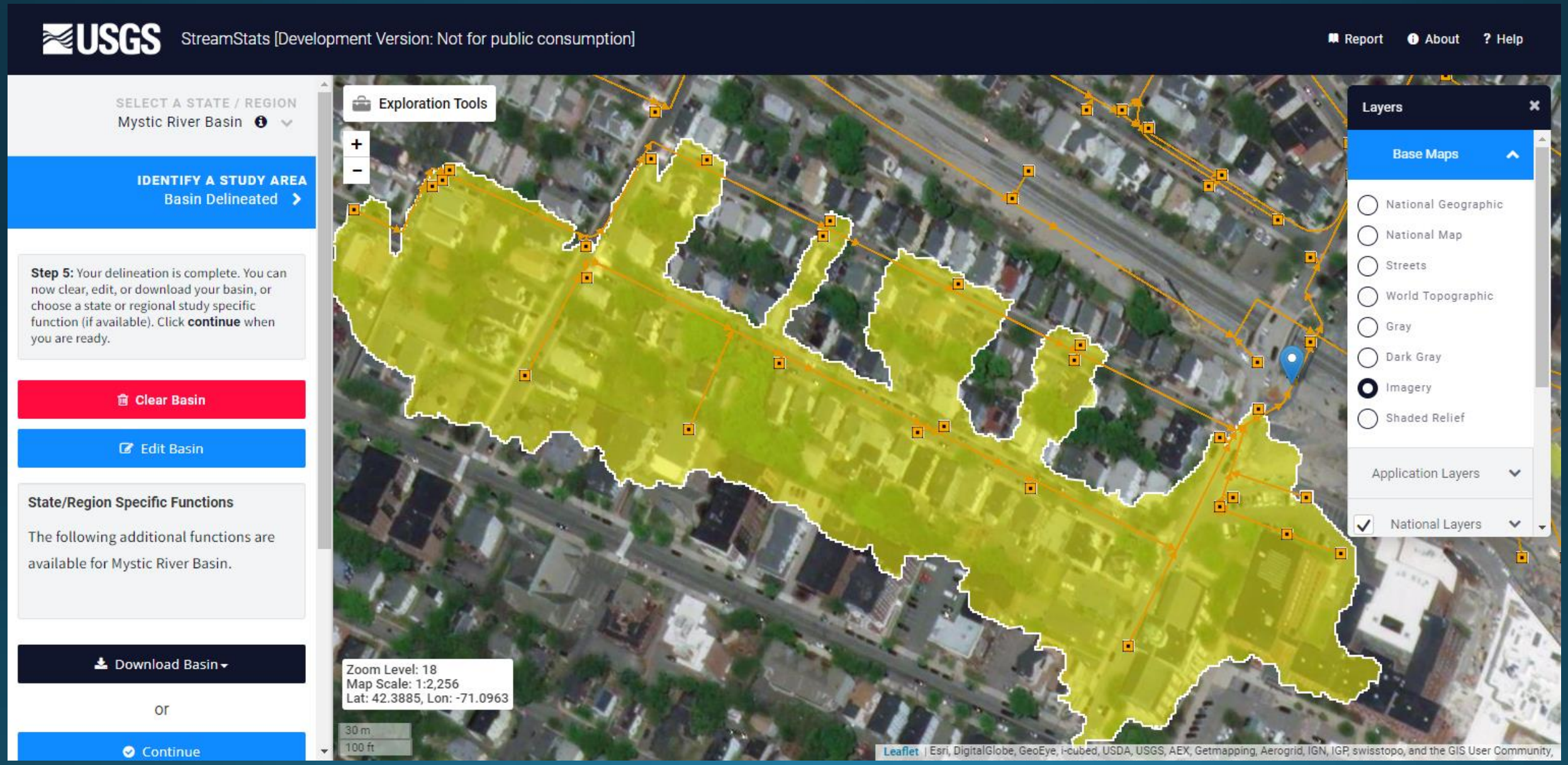
- ~ 36,000 catch basins
- ~ 62,000 pipes (including culverts)
- ~ 5000 stream segments
- data were also reviewed in a 300-meter buffer zone surrounding the basin

We will show examples of delineating with the storm drain functionality in the Aberjona basin.

Flow is diverted away from Fresh Pond in Cambridge.



Water flows solely through a pipe network in Somerville.

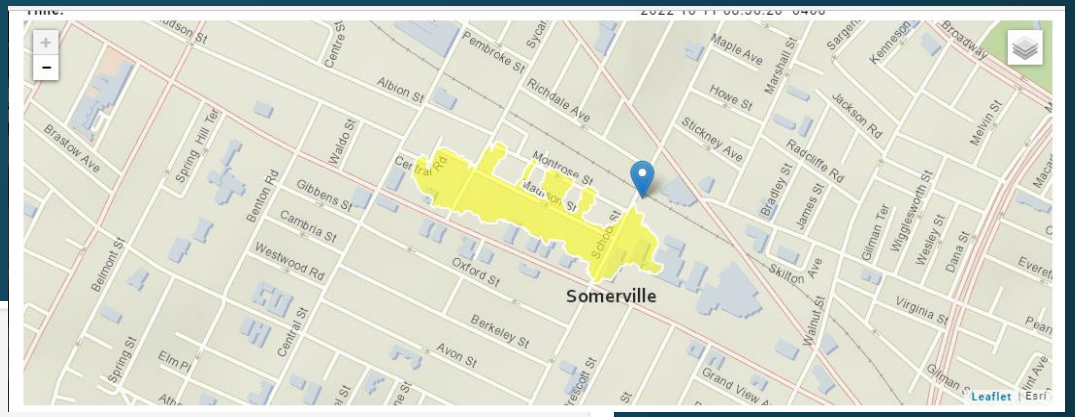


Landcover basin characteristics and nutrient loads can be computed for StreamStats delineations.

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs/acre/year
Commercial and Industrial	Directly connected impervious	1.78
	Pervious	See* DevPERV
Multi-Family and High-Density Residential	Directly connected impervious	2.32
	Pervious	See* DevPERV
Medium -Density Residential	Directly connected impervious	1.96
	Pervious	See* DevPERV
Low Density Residential - "Rural"	Directly connected impervious	1.52
	Pervious	See* DevPERV
Highway	Directly connected impervious	1.95^
	Pervious	See* DevPERV
Forest	Directly connected impervious	1.52
	Pervious	0.13
Open Land	Directly connected impervious	1.52
	Pervious	See* DevPERV
Agriculture	Directly connected impervious	1.52
	Pervious	0.45
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group A	Pervious	0.03
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group B	Pervious	0.12
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C	Pervious	0.21

Excerpt, 2016 MA MS4 General Permit, Appendix F

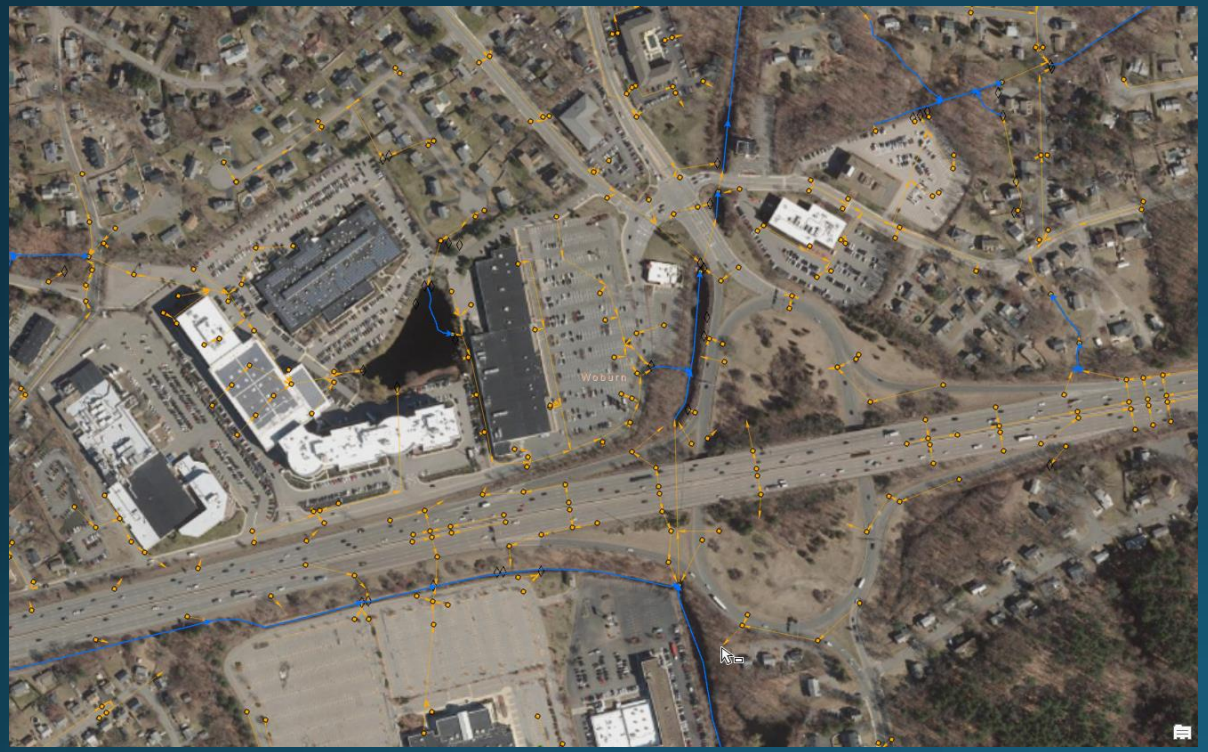
A StreamStats report provides basin characteristics and drainage area.



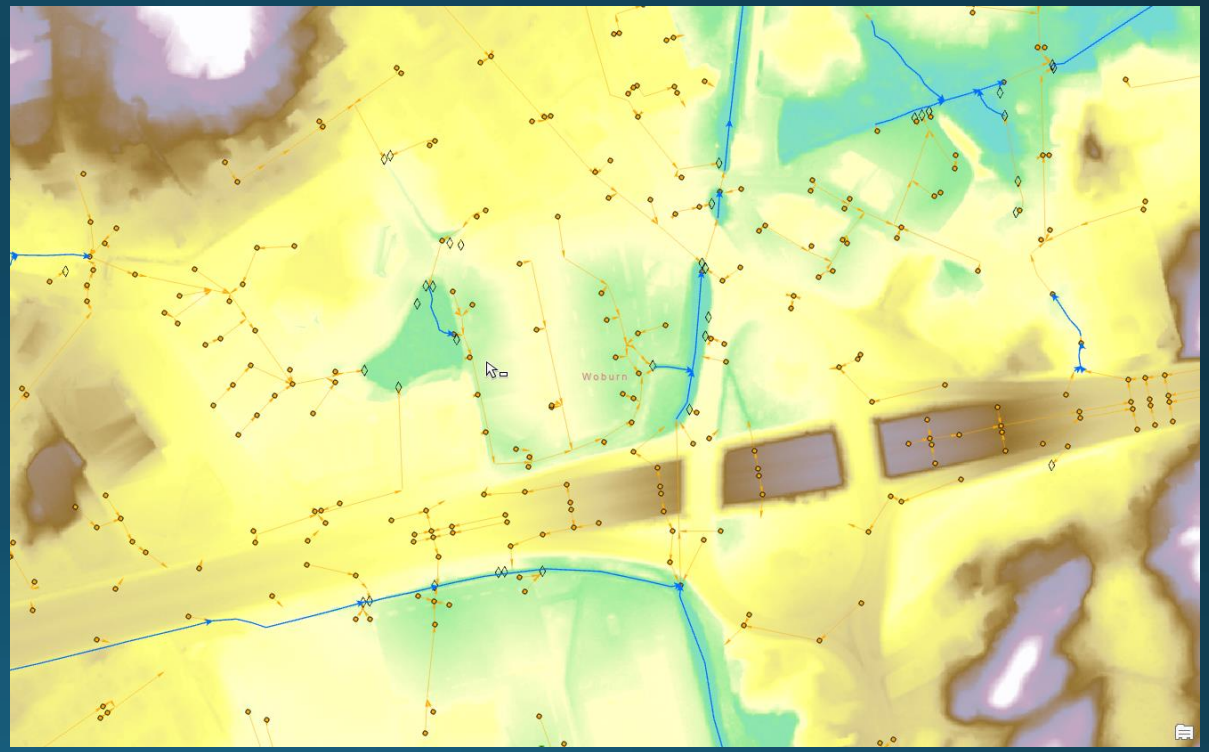
Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
AG_IMPERV	Percentage of area covered by agricultural land that is also impervious	0	percent
AG_PERV	Percentage of area covered by agricultural land that is also not classed as impervious	0	percent
COMM_IND	Percent of area covered by commercial and industrial land uses	15.95	percent
DEV_OP_IMP	Percent of area classed as developed open land that is also impervious	0	percent
DRNAREA	Area that drains to a point on a stream	0.0172	square miles
FOR_PERV	Percentage of area covered by forest land that is also not classed as impervious	13.56	percent
FRST_IMPRV	Percentage of area covered by forest land that is also impervious	0	percent
HIGHWAY	Percent of area covered by highways and their associated right-of-way areas	20.31	percent
MD_RES	Percent Medium-Density Residential	9.47	percent
MF_HD_RES	Percent Multi-Family and High-Density Residential	33.68	percent
PV_HSG_A	Percent of area in SSURGO hydrologic soils group A and not classed as impervious	0	percent
PV_HSG_B	Percent of area in SSURGO hydrologic soils group B and not classed as impervious	0	percent
PV_HSG_C	Percent of area in SSURGO hydrologic soils group C and not classed as impervious	0	percent
PV_HSG_D	Percent of area in SSURGO hydrologic soils group D and not classed as impervious	7.03	percent
WATER	Percent of area covered by open water (lakes, ponds, reservoirs)	0	percent

High-resolution elevation and hydrography data were used in conjunction with municipal data to build a geometric network.

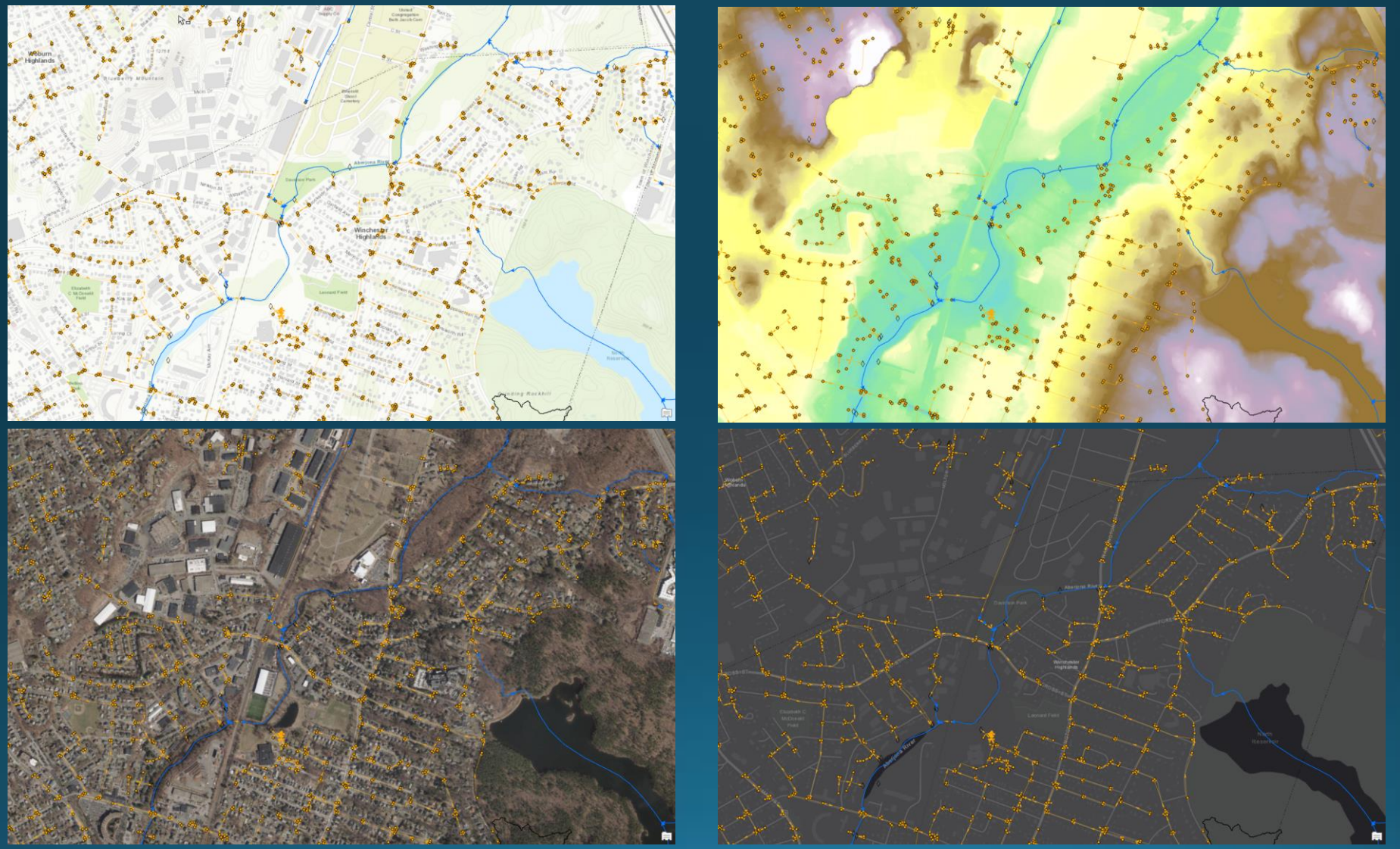


Route 38 Underpass and Middlesex Canal, Woburn



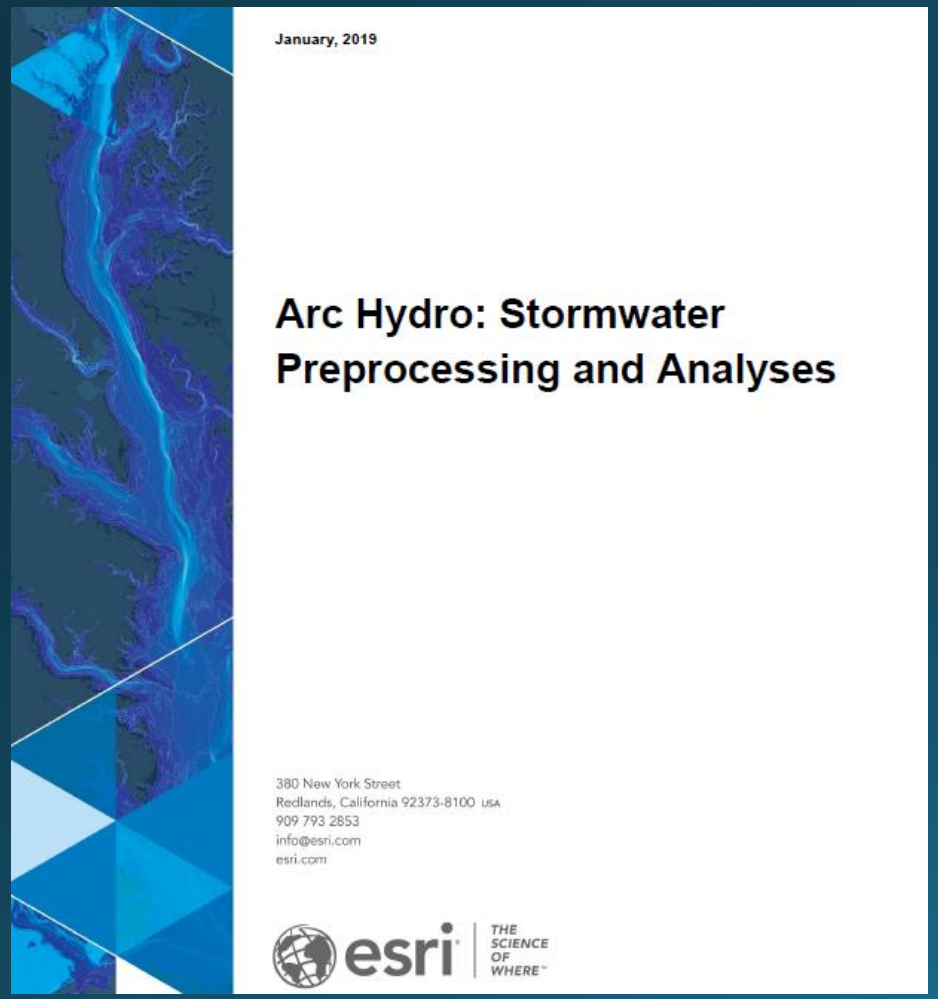
1-meter-resolution digital elevation model (DEM)

Editing is required to ensure connectivity within the network. We used several base maps to help make editing decisions.



Winchester Highlands and the Aberjona River

ArcHydro tools were used to create the stormwater network through iterative processing.



http://downloads.esri.com/archydro/archydro/Doc/Arc%20Hydro%20-%20Stormwater%20Processing.pdf

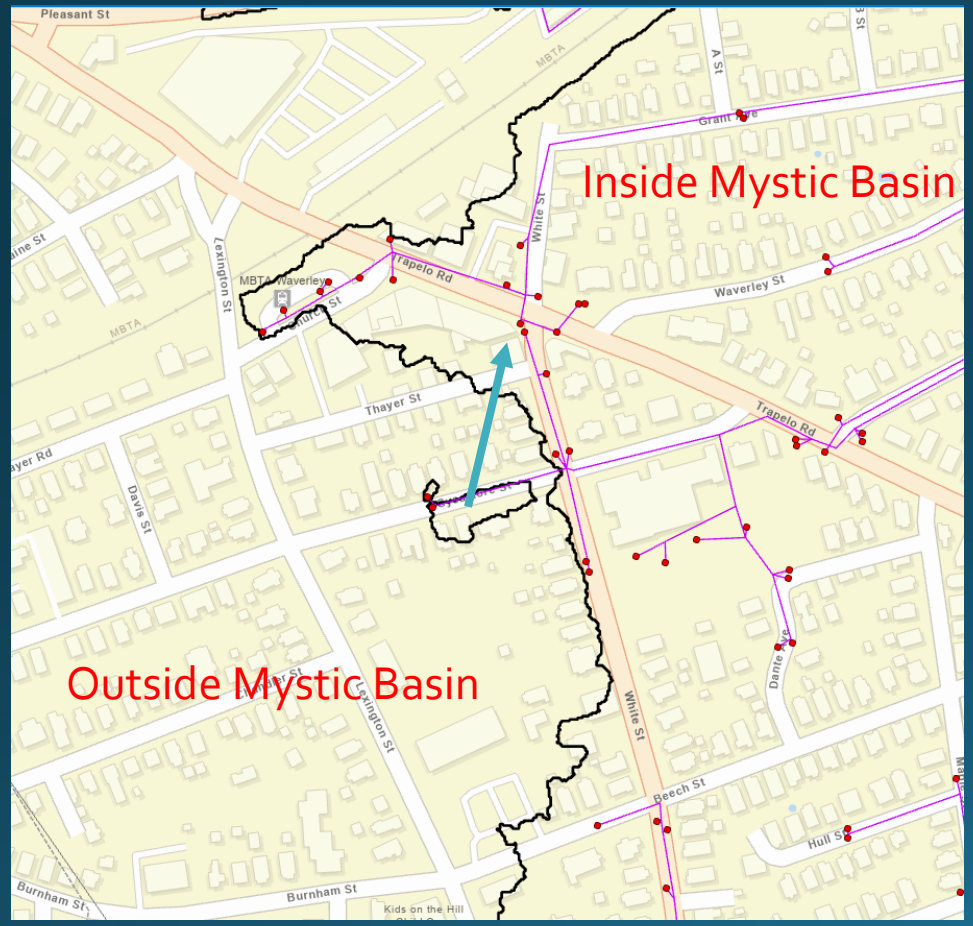
Inputs:
DEM
Pipes
Streams
Inlets
Outlet

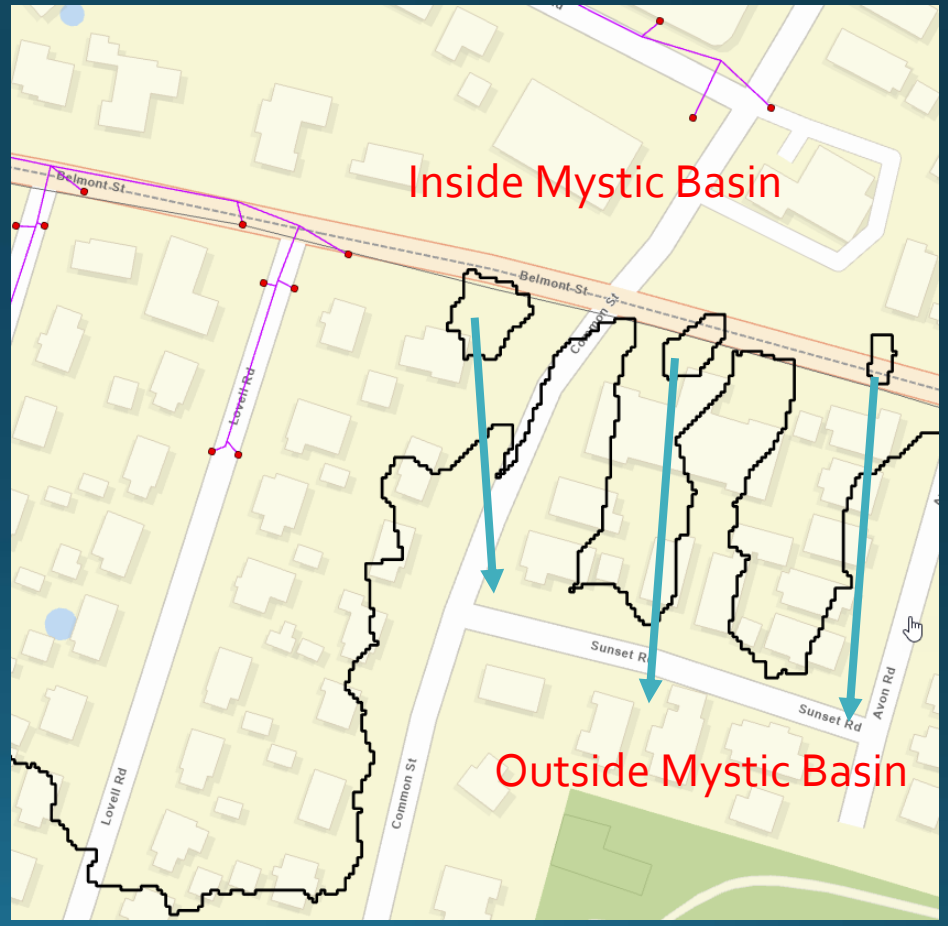
→

Outputs:
DEM derivatives
Catchment polygons
Overland connectors*
ArcHydro Stormwater Network*

* Unique to the Stormwater Preprocessing and Analysis tools

In some places the Mystic Basin was modified in uniquely-urban ways.





Enhancing StreamStats with urban infrastructure data can support efforts to:

- Mitigate flooding
- Map culverts
- Identify illicit discharges
- Meet permit requirements
- Address water-quality concerns
- …. and the foundation for much more

Collaboration at Federal, State and local levels was integral to the success of the project.

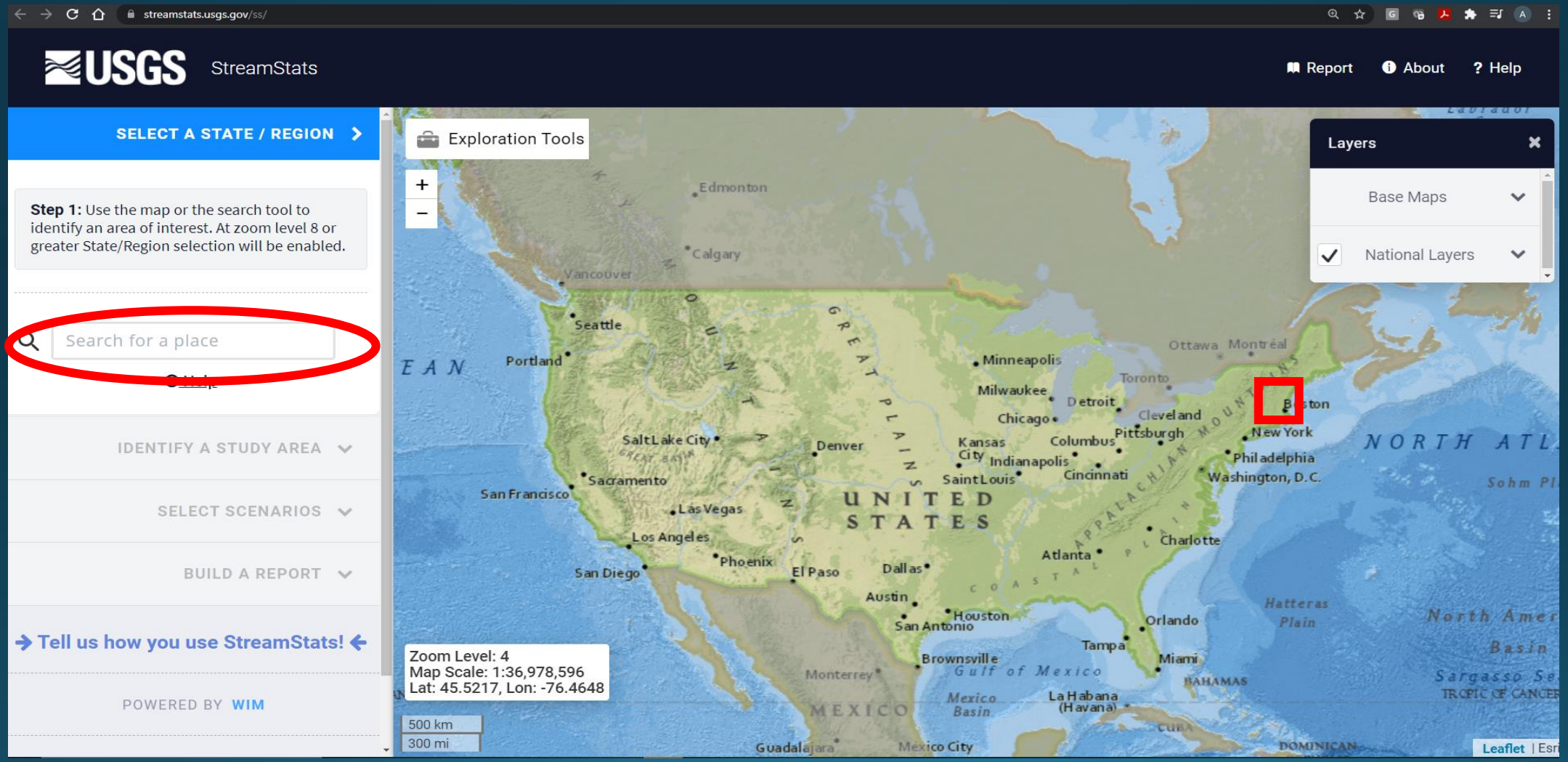
- Collaborators:
  - USGS “Mystic” Team
  - EPA Region 1
  - Laura Schifman – MA DEP Statewide Stormwater Program Manager
  - Neil MacGaffey MassGIS
  - Municipalities
  - Mystic River Watershed Association
  - Mystic River Steering Committee
  - ESRI (ArcHydro Team)

There are two new data releases associated with the project.

- DEM and derivatives data release
  - Digital Elevation Model (DEM)
  - Flow Direction Grid
  - Catchment areas (to catch basins and streams)
  - https://doi.org/10.5066/P9FHAFG7

- Basin Characteristics data release
  - Landcover characteristics for Massachusetts Small MS4 Permit Pollutant Loading Export Rates
  - https://doi.org/10.5066/P9HJSN2Q

Access the development version of this tool at https://streamstats.usgs.gov/ss/



Thank you

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