

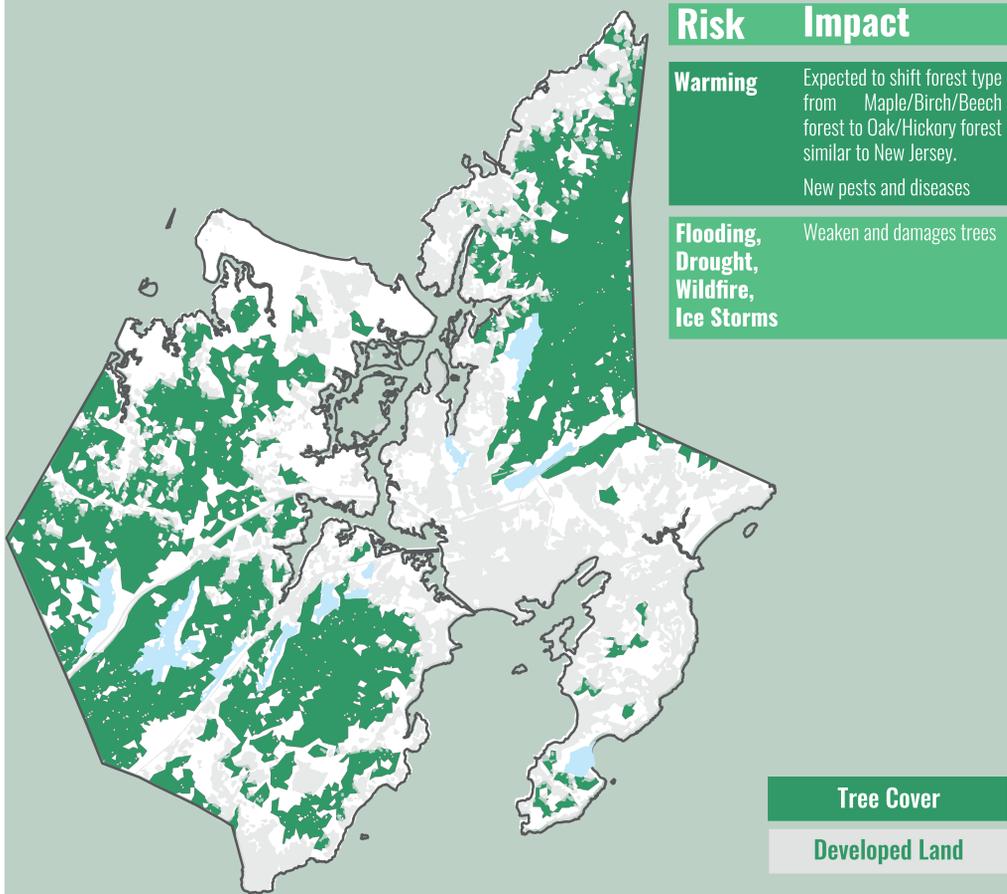
Gloucester

Natural Resources

Natural Resources lessen climate impacts by absorbing and storing carbon dioxide and by serving vital protective functions. Forests, open space, wetlands, rivers, and streams protect drinking water quality and quantity, provide flood control, and give relief from extreme heat. Healthy ecosystems are more resistant to stresses from a changing climate and better able to protect against heat and flooding.

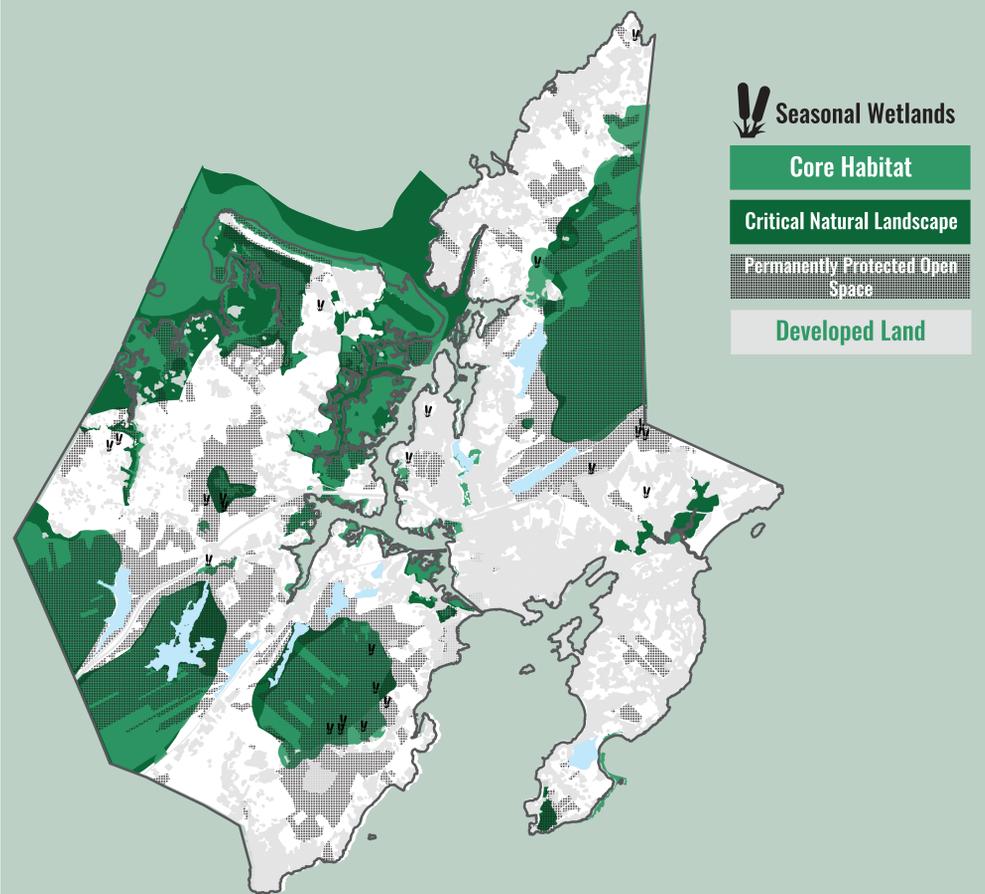
Trees

Trees are important in mitigating the impact of heat waves. According to the EPA, suburban areas with mature trees are 4-6 degrees cooler than new suburbs without trees. Shaded surfaces can be 25-40 degrees cooler than the peak temperatures of unshaded surfaces. Trees also absorb remarkable quantities of precipitation. Research has shown that a typical medium-sized tree can intercept as much as 2,380 gallons of rain per year (USDA Forest Service).



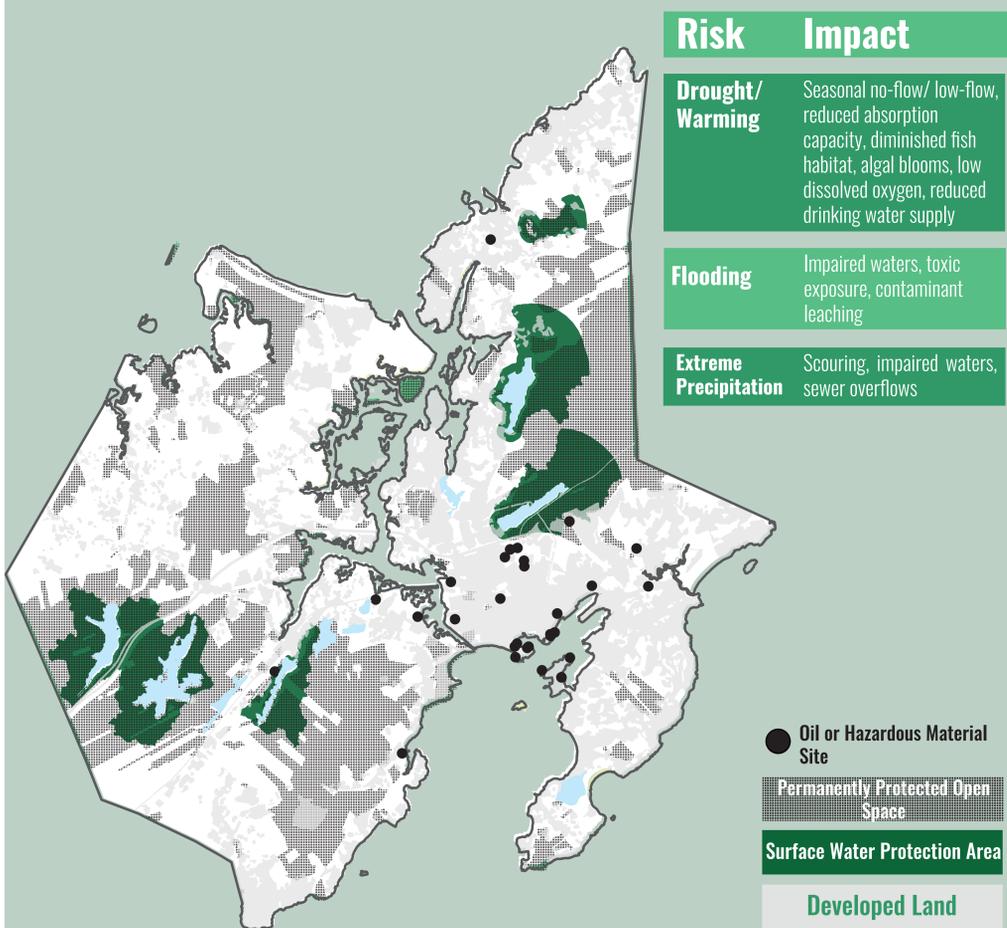
Terrestrial Resources

The areas of Core Habitat and Critical Natural Landscape in Gloucester demonstrate a contiguous track of exemplary ecosystems that weave a fabric of resilience. These areas can endure climate change stressors to continue to provide important ecosystem services such as flood control, clean water, clean air, species diversity, and cooling temperatures. They also sequester and store carbon dioxide. Vernal pools, or small seasonal wetlands, are crucial habitats for species such as salamanders.



Freshwater Resources

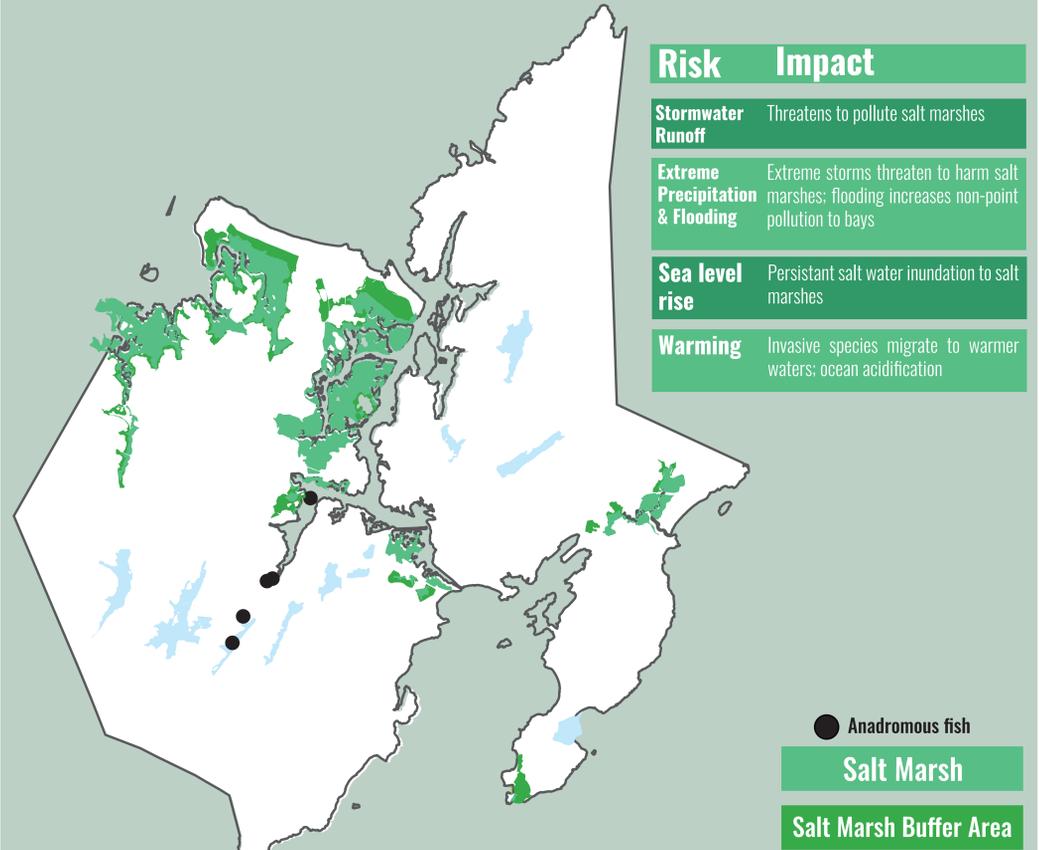
Gloucester contains healthy, intact freshwater wetland systems that sustain critical ecosystem functions in climate change. These ecological assets protect drinking water quality and quantity, provide flood control, and maintain overall ecosystem health for climate resilience.



Coastal Resources

Salt marshes and estuaries are complex and highly productive ecosystems generally resilient to wide variations in temperature, salinity, and inundation. Ecological benefits of salt marshes include: floodwater storage, storm surge protection, carbon sequestration/storage, nutrient removal, water quality improvements, and commercial fish and shellfish habitat.

Coastal bays host critical ecosystems for coastal resilience: shellfish growing areas, eel grass meadows, anadromous fish (saltwater fish that spawn in fresh water), and resident and migratory birds, some of which are threatened and endangered.



Sources

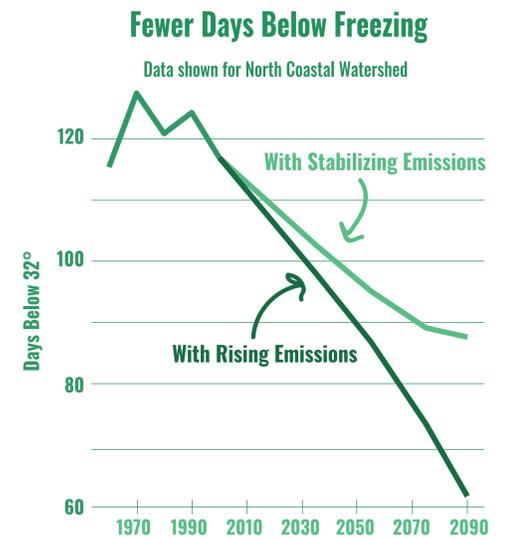
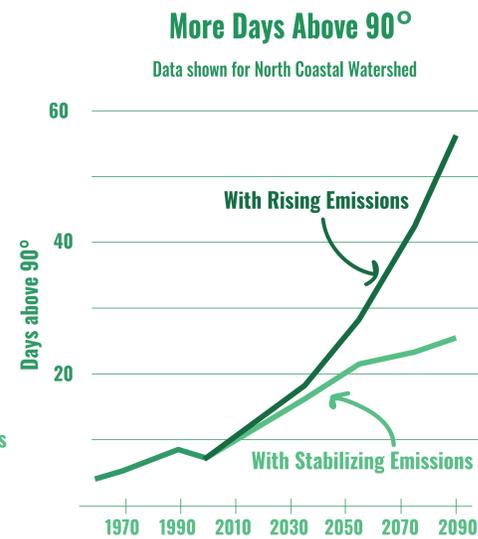
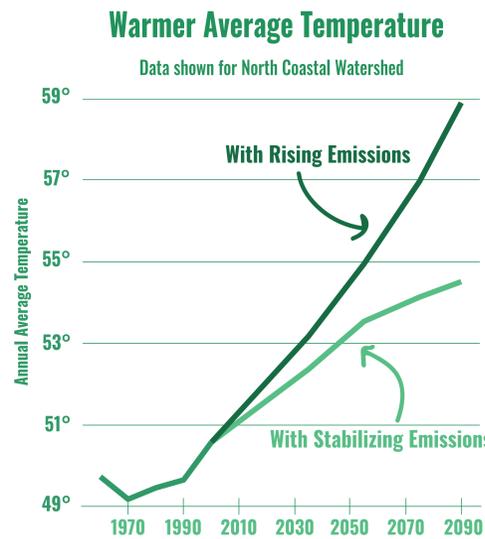
MassGIS (Bureau of Geographic Information); BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World; Massachusetts Department of Fish and Game; Massachusetts Department of Environmental Protection; MassGIS (Bureau of Geographic Information); National Land Cover Database (NLCD); Trust for Public Land; MAPC; University of Vermont

Climate Change

Gloucester and the North Coastal Watershed

Our climate is regulated by “greenhouse gases (GHGs)” that trap heat, including carbon dioxide, methane, and nitrous oxide. In the past century, the combustion of fossil fuels, our primary energy source in the age of industrialization, has increased the concentration of GHGs in the atmosphere, which has caused global temperatures to rise. If people stabilize GHG emissions, global temperatures may rise more slowly. If emissions continue increasing at the same rate, we can expect more extreme changes in the climate.

Higher Temperatures



As the climate changes, Gloucester can expect...

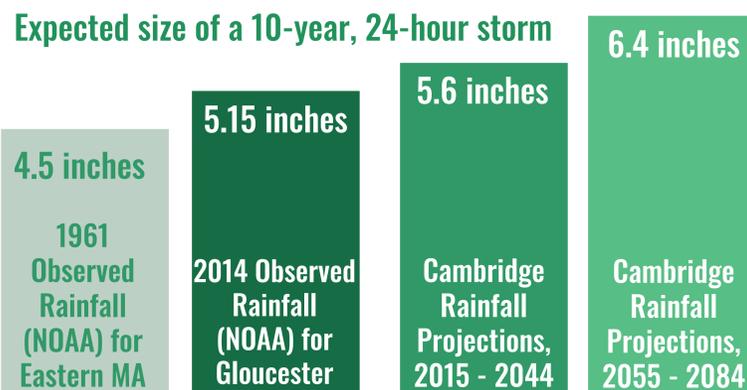
More Large Storm Events

In addition to increasing annual precipitation, climate change will bring more large storm events.

This will lead to more stormwater flooding, as most stormwater drainage has been sized to 1961 standards.

10-year, 24 hour storms refer to the 24-hour rainfall total for the biggest storm expected in a 10-year period.

Storm drains built for 1961 standards will be inadequate



More Annual Precipitation

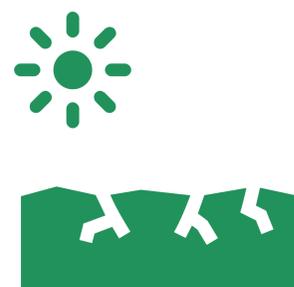
But less in the summer and fall...



While total annual rainfall and large rainfall events are projected to increase, summer and fall rain is projected to decrease slightly.

And more frequent droughts...

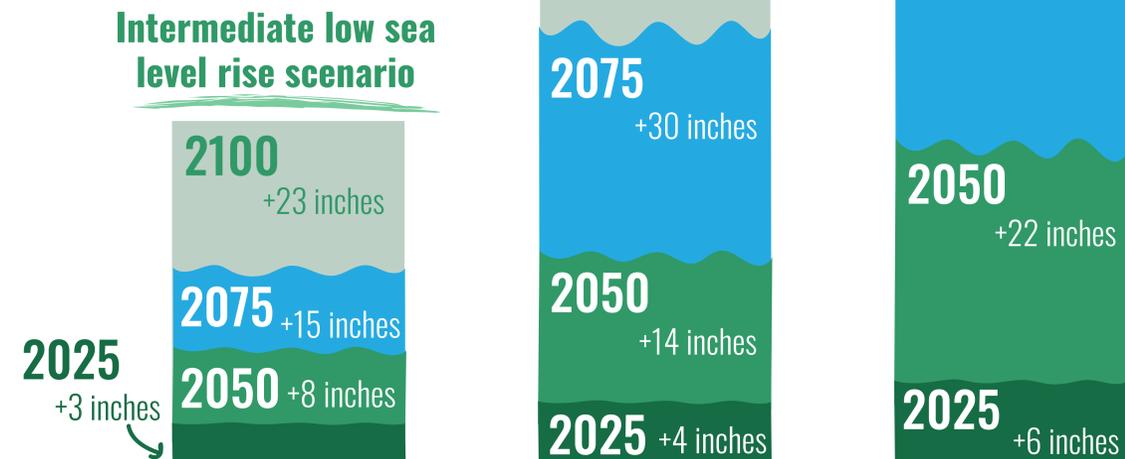
Due to the combined effects of earlier snowmelt, less rain, and higher temperatures, summer and fall droughts may become more frequent.



Rising Seas

Projections for sea level rise vary dramatically depending on future greenhouse gas emissions, melting ice in the arctic, ocean currents, and other factors. The charts below represent high, intermediate high, and intermediate low scenarios.

*Sea level rise bars are 1/4 scale



Gloucester

Social Vulnerability

Social vulnerability refers to social, economic, demographic, or health factors that may make groups of people less resilient to climate change impacts. Certain vulnerabilities tend to be correlated; for example, older adults are more likely to have a disability and live alone than younger adults.

Our strategies for adapting to a changing climate should protect these populations in addition to our natural and built environment.

Who is most at risk from climate change impacts?

People who may be more susceptible to negative health effects: These can include older adults, young children, pregnant women, people with disabilities, and people with pre-existing health conditions, as they are more likely to be physically vulnerable to the health impacts of extreme heat and poor air quality caused by climate change. Individuals with physical mobility constraints, such as people with disabilities and seniors, may need additional assistance with emergency response.

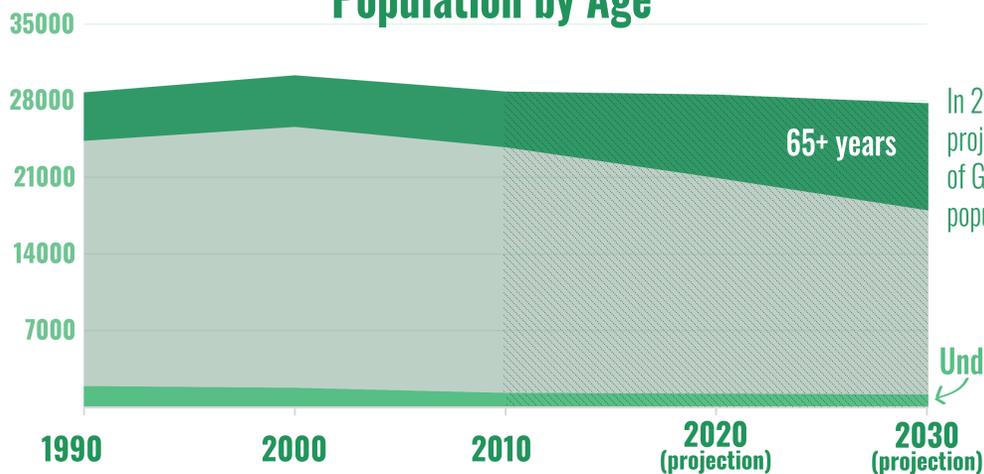
People who may have more difficulty adapting to, preparing for, or recovering from extreme weather events: Socioeconomic characteristics such as income and race can influence vulnerability to climate change. Low-income people are often more susceptible to financial shocks, which can occur after extreme weather and which can impact financial security and the ability to secure safe shelter and meet medical needs. Social isolation can also influence vulnerability, as it limits access to critical information, municipal resources, and social support systems. People at the most risk for social isolation include those living alone and people with limited English language proficiency.

People who live or work in vulnerable locations: Historic or predicted floodplain, urban flooding locations, areas prone to wildfire, heat islands, neighborhoods prone to power outages. Outdoor workers, first responders, those working in hot indoor environments.

Older Adults and Young Children

Adults over 65 and children under 5 are more likely to develop health problems on very hot days or during heat waves. Older adults are also more likely to have disabilities or mobility constraints and may need additional assistance during emergencies. They are also more likely to live alone than younger adults.

Gloucester Recent and Projected Population by Age



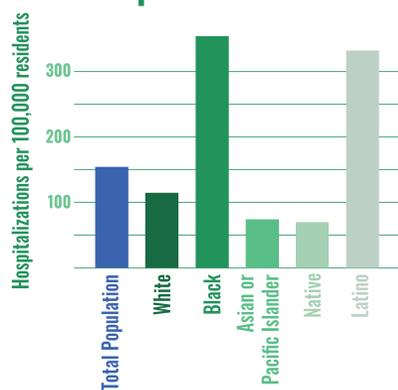
In 2030, seniors are projected to be 35% of Gloucester's total population.

Under 5 years

People with Health Conditions

People who are already in poor health are more likely to be harmed by hot weather and resulting poor air quality.

Massachusetts Asthma Hospitalizations



People Living Alone



As of 2010, about 1/3 of Gloucester households consisted of someone living alone.

About 40% of people living alone were over 65.

Seniors living alone

Communities of Color

Particular racial or ethnic groups may also be more likely to have certain social vulnerabilities than others. For example, Black and Latino populations have a much higher rate of asthma hospitalizations than other groups.

Gloucester is becoming more diverse...

Although over 94% of the town's population is white...

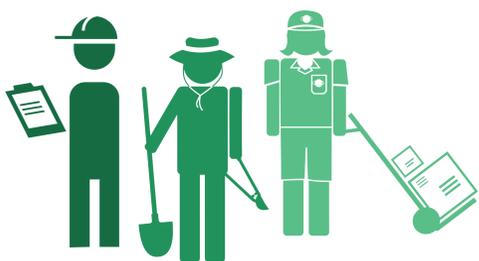
Populations of color have increased since 1990.

3x
African American population increase since 1990

3x
Latino population increase since 1990

4x
Asian population increase since 1990

People Who Work Outside



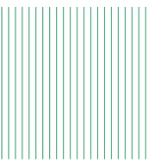
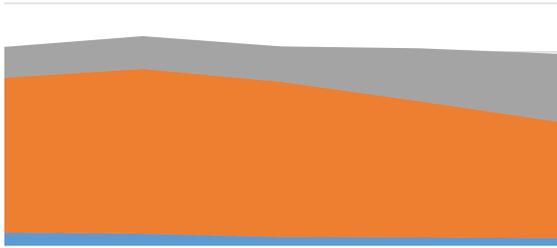
People who primarily work outside, such as parcel delivery people, construction workers, or farmers, may be at added risk from extra exposure to high heat and poor air quality.

Low Income Households

Households that earn low incomes are more susceptible to financial shocks triggered by extreme weather, which can cause long-lasting financial insecurity and can make it hard to secure safe shelter, sufficient food, and medical care.

48% ± 4%
Households in Gloucester that are low-income

*A four-person household earning less than \$78,150 is considered low-income



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Critical Infrastructure and Hazard Areas

Type of Critical Facility

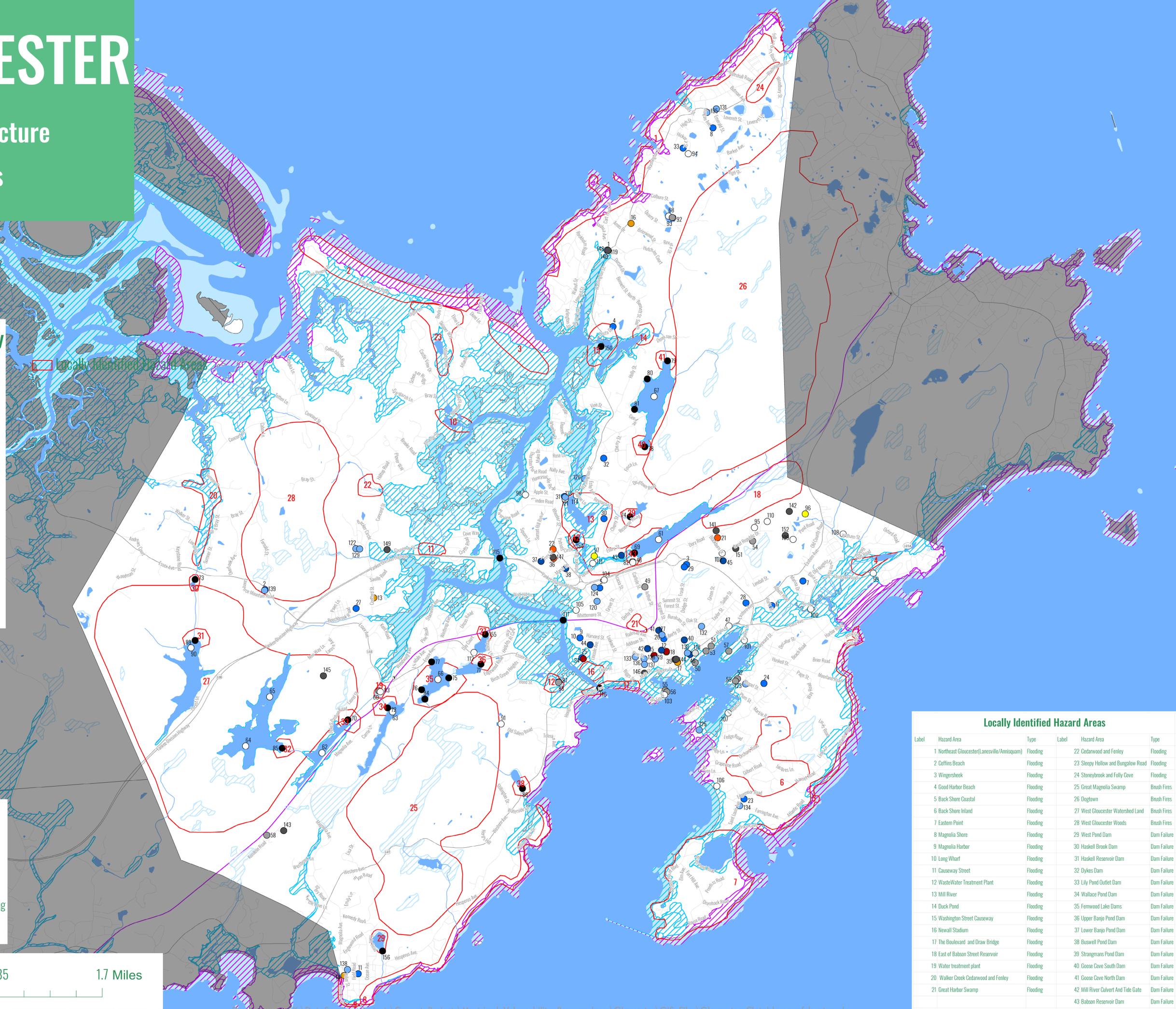
- Elder Care or Adult Day Care
- Child Care or School
- Church
- Emergency Operations
- Medical Facility
- Public Safety
- Municipal
- Bridge or Dam
- Communication Tower
- Hazardous Material Site
- Power Substation
- Water or Sewer Infrastructure

Hazards

- A: 1% Annual Chance of Flooding
- VE: High Risk Coastal Area
- X: 0.2% Annual Chance of Flooding
- Locally Identified Hazard Areas



Locally Identified Hazard Areas



Locally Identified Hazard Areas

Label	Hazard Area	Type	Label	Hazard Area	Type
1	Northeast Gloucester(Lanesville/Amisquam)	Flooding	22	Cedarwood and Fenley	Flooding
2	Coffins Beach	Flooding	23	Sleepy Hollow and Bungalow Road	Flooding
3	Wingersheek	Flooding	24	Stoneybrook and Folly Cove	Flooding
4	Good Harbor Beach	Flooding	25	Great Magnolia Swamp	Brush Fires
5	Back Shore Coastal	Flooding	26	Dogtown	Brush Fires
6	Back Shore Inland	Flooding	27	West Gloucester Watershed Land	Brush Fires
7	Eastern Point	Flooding	28	West Gloucester Woods	Brush Fires
8	Magnolia Shore	Flooding	29	West Pond Dam	Dam Failure
9	Magnolia Harbor	Flooding	30	Haskell Brook Dam	Dam Failure
10	Long Wharf	Flooding	31	Haskell Reservoir Dam	Dam Failure
11	Causeway Street	Flooding	32	Dykes Dam	Dam Failure
12	WasteWater Treatment Plant	Flooding	33	Lily Pond Outlet Dam	Dam Failure
13	Mill River	Flooding	34	Wallace Pond Dam	Dam Failure
14	Duck Pond	Flooding	35	Fernwood Lake Dams	Dam Failure
15	Washington Street Causeway	Flooding	36	Upper Banjo Pond Dam	Dam Failure
16	Newall Stadium	Flooding	37	Lower Banjo Pond Dam	Dam Failure
17	The Boulevard and Draw Bridge	Flooding	38	Buswell Pond Dam	Dam Failure
18	East of Babson Street Reservoir	Flooding	39	Strangmans Pond Dam	Dam Failure
19	Water treatment plant	Flooding	40	Goose Cove South Dam	Dam Failure
20	Walker Creek Cedarwood and Fenley	Flooding	41	Goose Cove North Dam	Dam Failure
21	Great Harbor Swamp	Flooding	42	Mill River Culvert And Tide Gate	Dam Failure
			43	Babson Reservoir Dam	Dam Failure

GLOUCESTER

Critical Infrastructure

Increasing large rainfall events and the rising sea level may subject roads, bridges, dams and buildings to more frequent or severe flooding. Areas that don't flood today may become vulnerable. FEMA flood zones reflect only current conditions, and do not generally capture stormwater flooding, or flooding that exceeds the capacity of current stormdrains and culverts. Power outages affecting infrastructure and communications may become more frequent as result of high energy demand during heat waves. Winter outages could be caused by ice storms if warming results in temperatures hovering around freezing. The potential for more intense hurricanes could cause outages due to falling trees. Finally, buildings, roadways, and railways can be stressed by extreme heat. Heat can cause damage to expansion joints on bridges and highways, and may cause roadways to deteriorate more rapidly.

Type of Critical Facility

- Elder Care or Adult Day Care
- Child Care or School
- Church
- Emergency Operations
- Medical Facility
- Public Safety
- Municipal
- Bridge or Dam
- Communication Tower
- Hazardous Material Site
- Power Substation
- Water or Sewer Infrastructure

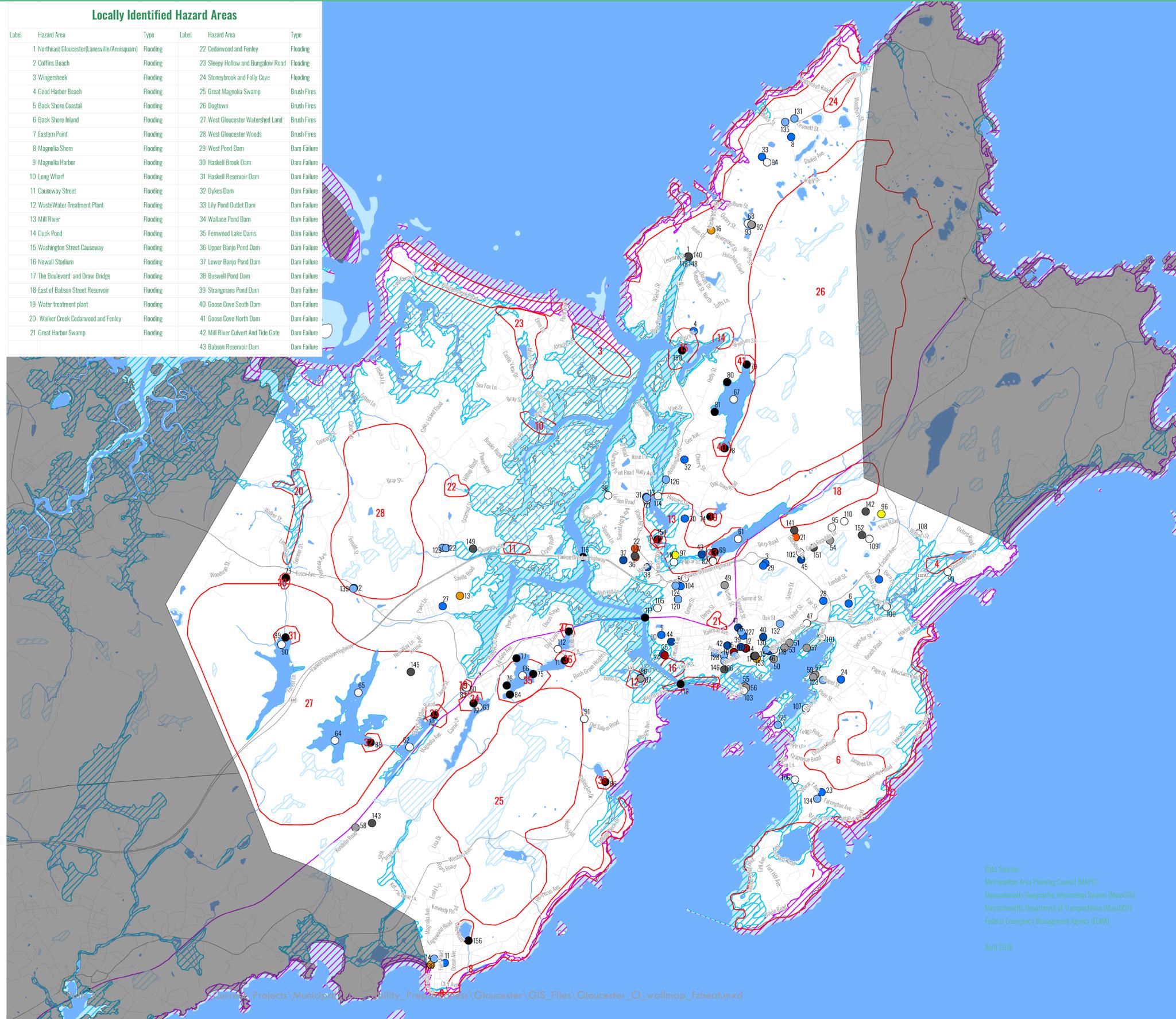
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3	Wingersleek	Flooding	24	Stoneybrook and Folly Cove	Flooding
4	Good Harbor Beach	Flooding	25	Great Magnolia Swamp	Brush Fires
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6	Back Shore Inland	Flooding	27	West Gloucester Watershed Land	Brush Fires
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9	Magnolia Harbor	Flooding	30	Haskell Brook Dam	Dam Failure
10	Long Wharf	Flooding	31	Haskell Reservoir Dam	Dam Failure
11	Causeway Street	Flooding	32	Dykes Dam	Dam Failure
12	Waste/Water Treatment Plant	Flooding	33	Lily Pond Outlet Dam	Dam Failure
13	Mill River	Flooding	34	Wallace Pond Dam	Dam Failure
14	Duck Pond	Flooding	35	Ferwood Lake Dams	Dam Failure
15	Washington Street Causeway	Flooding	36	Upper Banjo Pond Dam	Dam Failure
16	Newall Stadium	Flooding	37	Lower Banjo Pond Dam	Dam Failure
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18	East of Babson Street Reservoir	Flooding	39	Strangmans Pond Dam	Dam Failure
19	Water treatment plant	Flooding	40	Goose Cove South Dam	Dam Failure
20	Walker Creek Cedarwood and Fenley	Flooding	41	Goose Cove North Dam	Dam Failure
21	Great Harbor Swamp	Flooding	42	Mill River Culvert And Tide Gate	Dam Failure
			43	Babson Reservoir Dam	Dam Failure

Label	Facility	Label	Facility	Label	Facility
1	Annisquam Kindergarten/ Nursery School	53	Gorton Seaford	105	Riverside Avenue Sewer Pump Station
2	Essex Community Nursery School	54	Good Harbor Fish	106	Miles Beach Sewer Pump Station
3	Gloucester Alternative @ Fuller School	55	North Blinetic Fish	107	Black Horse Sewer Pump Station
4	Gloucester Day Nursery School	56	Cam Pond Inc	108	Wilson Street Sewer Pump Station
5	Happy Day School	57	Alford Cold Storage	109	Pond Road Sewer Pump Station
6	Harts Street Nursery School	58	Alford Cold Storage	110	Heritage Way Sewer Pump Station
7	Horizon Children's Center	59	National Fish Company	111	DPW Sewer Pump Station
8	Lanesville Preschool Center	60	West Gloucester Treatment Plant	112	Banjo Pond Sewer Pump Station
9	Pathways for Children/School Age Care	61	Babson Reservoir	113	Hodgkins Street Sewer Pump Station
10	Pathways for Children: Head Start At One	62	Lily pond	114	Rayard Street Sewer Pump Station
11	The Sheehan Montessori School, Inc.	63	Wallace Pond	115	Rte 128 Bridge
12	EOC-City Hall	64	Dykes meadow	116	Dykes Bridge
13	Gloucester Fire Department	65	Dykes meadow	117	Rte 127 Bridge
14	Gloucester Fire Department	66	Ferwood Lake	118	Electric Sub Station
15	Gloucester Fire Department	67	Goose Cove Reservoir	119	Annisquam Village Church
16	Gloucester Fire Department	68	Knoxville Quarry	120	Assembly of God
17	Gloucester Police Department	69	Babson Reservoir Dam	121	Cathary Baptist Church
18	Gloucester City Hall	70	Lily Pond Dam	122	Cape Ann Bible Church
19	EOC-Secondary	71	Upper Banjo Dam	123	Community Church of East Gloucester
20	City Hall-EOC	72	Wallace Pond Dam	124	First Baptist Church
21	Cape Ann Medical Facility Center, Inc.	73	Haskell Brook Dam	125	First Church of Christ Scientist
22	Gloucester Family Health Center	74	Strangmans Pond Dam	126	Gloucester United Methodist Church
23	Saint Mel Day School	75	Ferwood Lake Dam-east	127	Holy Family Parish - St. Ann's Church
24	East Gloucester Elementary School	76	Ferwood Lake Dam-west	128	Independent Christian Church
25	Gloucester High School	77	Ferwood Lake Dam-north	129	Jehovah's Witnesses
26	Saint Ann Elementary School	78	Goose Cove Reservoir-north dam	130	Lighthouse Baptist Church
27	West Parish School	79	Goose Cove Reservoir-north dam	131	Orthodox Congregational Church of Lanesville
28	Waters Memorial School	80	Goose Cove Reservoir-northeast dike	132	Our Lady of Good Voyage
29	William I. Fuller Elementary School	81	Goose Cove Reservoir-southwest dike	133	Safe Harbor Christian Church
30	Ralph B. O'Rourke Middle School	82	Babson Water Treatment Plant	134	St. Anthony's Chapel
31	Faith Christian School	83	West Gloucester Treatment Plant	135	St. Paul's Lutheran Church
32	Beehan Memorial School	84	Ferwood Lake Dam-South Dike	136	St. John's Episcopal Church
33	Pinn Cove School	85	Dykes Dam	137	Trinity Congregational Church
34	Emergency Dispensing Site	86	Buswell Pond Dam	138	Union Congregational Church
35	Gloucester Alternative School	87	Water Pollution Control Facility	139	West Gloucester Trinitarian Congregational
36	Addison Gilbert Hospital	88	Water Pollution Control Facility	140	Annisquam Village Church
37	Seacoast Nursing Home	89	Haskell Reservoir Dam	141	Blackburn Drive Cell Tower
38	Day Off at Cape Ann	90	Haskell Reservoir	142	Water Storage Tank
39	Saints Condominium Apartments	91	Haskell Reservoir	143	Haskell Drive Cell Tower
40	Carroll B. Clark Building	92	Knoxville Water Treatment Plant	144	Spring Cell Tower
41	Shady Park	93	Knoxville Water Treatment Plant	145	Vortex AT&T Cell Tower 1
42	McPherson Park	94	Pinn Cove WaterTower	146	Omniport Cell Tower 1
43	Fogler Park	95	Blackburn Water Storage Tank	147	Omniport Cell Tower - Hospital
44	Lincoln Park	96	Gloucester City Hall Annex	148	ATT Cell Tower - Annisquam Village Church
45	Day By Day Adult Care	97	Department of Public Works	149	Sudbay Dealership Cell Tower
46	Carewell on Aging Senior Center	98	Carroll Avenue Sewer Pump Station	150	Shore Bridge
47	Action, Inc. Shelter	99	Good Harbor Sewer Pump Station	151	Coastal Dish Farm
48	Babson Water Treatment Plant	100	Thatcher Road Sewer Pump Station	152	Cell Tower
49	Methuen Tru Gas	101	Parker Street Sewer Pump Station	153	Cell Tower
50	Americanold Logistics	102	Blackburn Water Sewer Pump Station	154	Mill River Dam
51	Americanold Logistics	103	Camden Street Sewer Pump Station	155	Lower Banjo Pond Dam
52	Americanold Logistics	104	Jake Saunders Sewer Pump Station	156	West Pond Outlet Dam



Data Sources:
 Metropolitan Area Planning Council (MAPC)
 Massachusetts Geographic Information System (MassGIS)
 Massachusetts Department of Transportation (MassDOT)
 Federal Emergency Management Agency (FEMA)
 April 2018

