



Climate Change and its Effects

*An informational guide to adapting to climate change in
Chelsea, Massachusetts for the City's Zoning Board of
Appeals, Planning Board and Conservation Commission*

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This document was designed and produced by Jillian Hennessy, Lauren Richard, Santiago Rojas, and Keith Guay as part of an Interactive Qualifying Project at Worcester Polytechnic Institute with the help of the Massachusetts Institute of Technology Sea Grant College Program and the City of Chelsea, Massachusetts.

THE BASICS

Climate change causes warming temperatures, rising sea levels, increasing number of extreme heat events, increasing number of severe storms, and increasing number of heavy precipitation events. Locally, along with climate change, land subsidence is going to increase the impacts of sea level rise.

WHY SHOULD WE CARE?

- ❖ Increased number of severe storms and flooding will damage infrastructure and property
- ❖ Severe storms, especially flooding, are directly related to injury and loss of life in a community (See [population density of Chelsea](#))
- ❖ Even with no change in frequency or intensity of storms, a sea level rise of 2 ft. would more than triple the frequency of dangerous coastal flooding throughout most of the Northeast
- ❖ Increased precipitation from storms may overwhelm combined sewer systems, releasing untreated water into local bodies of water
- ❖ Increased precipitation may generate more runoff, causing more water to be sent to the Deer Island treatment facility for treatment and costing the city of Chelsea more money
- ❖ Increased heat days (over 90 °F) and poor air quality can pose health risks to the young, elderly and those with preexisting health conditions
- ❖ New areas, such as the Everett Ave. area, have been included by FEMA in the 100yr flood zone. With climate change, the likelihood of this event may increase and the flood depths may be higher (See [100yr flood maps](#))

There is much you can do to protect the City of Chelsea from the impacts of climate change. These guidelines provide adaptation and mitigation strategies in order to reduce risks associated with climate change impacts.

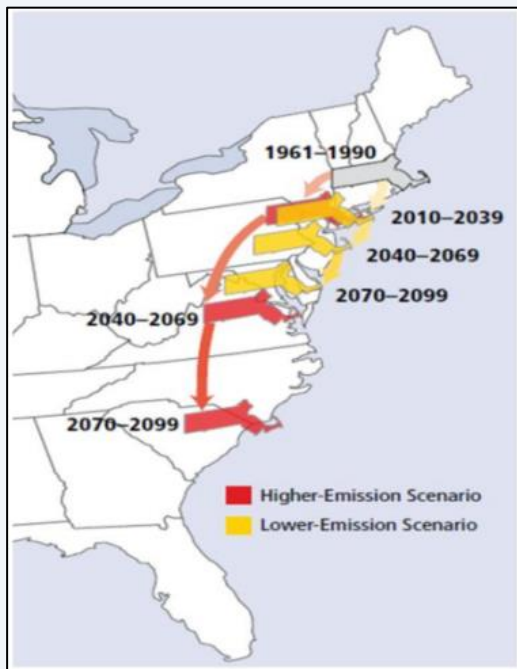
THE FACTS

CURRENT CLIMATE OBSERVATIONS IN MASSACHUSETTS

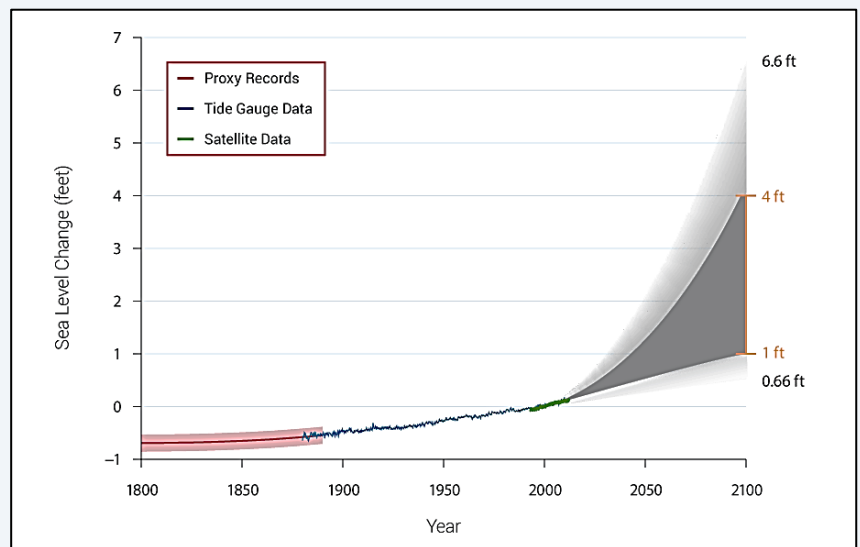
- ❖ Since 1958, precipitation, such as rain and snow, increased 70%; with heavier downfall in fewer events
- ❖ Between 1895 and 2011, New England has experienced an average temperature increase of almost 2°F
- ❖ Since 1900, the sea level in New England has risen 1 ft.
- ❖ Since 1991, Chelsea has experienced 17 natural hazards, primarily flooding, that involved state or federal disaster declarations

PREDICTIONS ABOUT THE FUTURE CLIMATE

- ❖ By 2080 average temperatures are expected to increase between 3 and 10 °F depending on emissions scenarios
- ❖ Global sea levels are expected to rise between one and four feet by 2100, and the Northeast is expected to exceed the global average due to land subsidence



Massachusetts could potentially have temperatures similar to the Carolinas by 2099 if steps are not taken to reduce emissions (Reprinted from UCS and NECIA)



Sea levels are currently predicted to rise between one and four feet by the year 2100 (Melillo et al., 2014)

SOME SOCIAL GROUPS EXPERIENCE MORE DIFFICULTIES THAN OTHERS

It is important to consider the diversity of people living within the community of Chelsea to understand where additional aid may be needed when addressing climate change impacts. The following tables explain how some groups of people are more vulnerable to the impacts of climate change than others.

Socioeconomic Characteristic	How it can affect vulnerability of an area	Map/ Info
Level of Income	Wealth usually allows communities to adapt more easily. Low income areas usually have more difficulty recovering from impacts, which increases their level of vulnerability to future climate change impacts.	Map
Language Barrier	Language barriers may affect the residents' understanding of warning information or evacuation protocols.	Map
Ethnicity	Cultural barriers may affect access to recovery funding.	Map
Education	Education is generally connected to socioeconomic status and earnings. Lower education levels may affect the residents' understanding of warning information, access to recovery resources, or climate change issues in general.	Map
Age	Children may have a more difficult time following evacuation protocols or making informed decisions during a disastrous event; therefore, they may be more susceptible to harm.	More Info
	Elderly people may have a more difficult time evacuating, and they may be more susceptible to harm during an event. Elderly people may be more affected by heat and therefore more vulnerable to heat related illness than younger people. An increasing number of elderly people in the world will be exposed to even more extreme heat conditions, potentially causing more heat related illness and possibly death.	
Gender	Women may have lower wages than men and may take on more family care responsibilities which may make them more vulnerable.	More Info
Disabilities	People with disabilities may have a more difficult time evacuating in the event of a storm. Disabled persons may depend on other people for mobility assistance.	More Info

Note: Certain developments (schools, hospitals, etc.) may lead to increased vulnerability of an area by increasing the population of vulnerable social groups. It is important to consider whether a development will increase the socioeconomic vulnerability when looking into adaptation.

WHAT CAN BE DONE TO LIMIT THE IMPACTS OF CLIMATE CHANGE?

This section provides possible adaptation and mitigation options that developers can implement to address the potential impacts of flooding, damage from storms, and extreme heat.

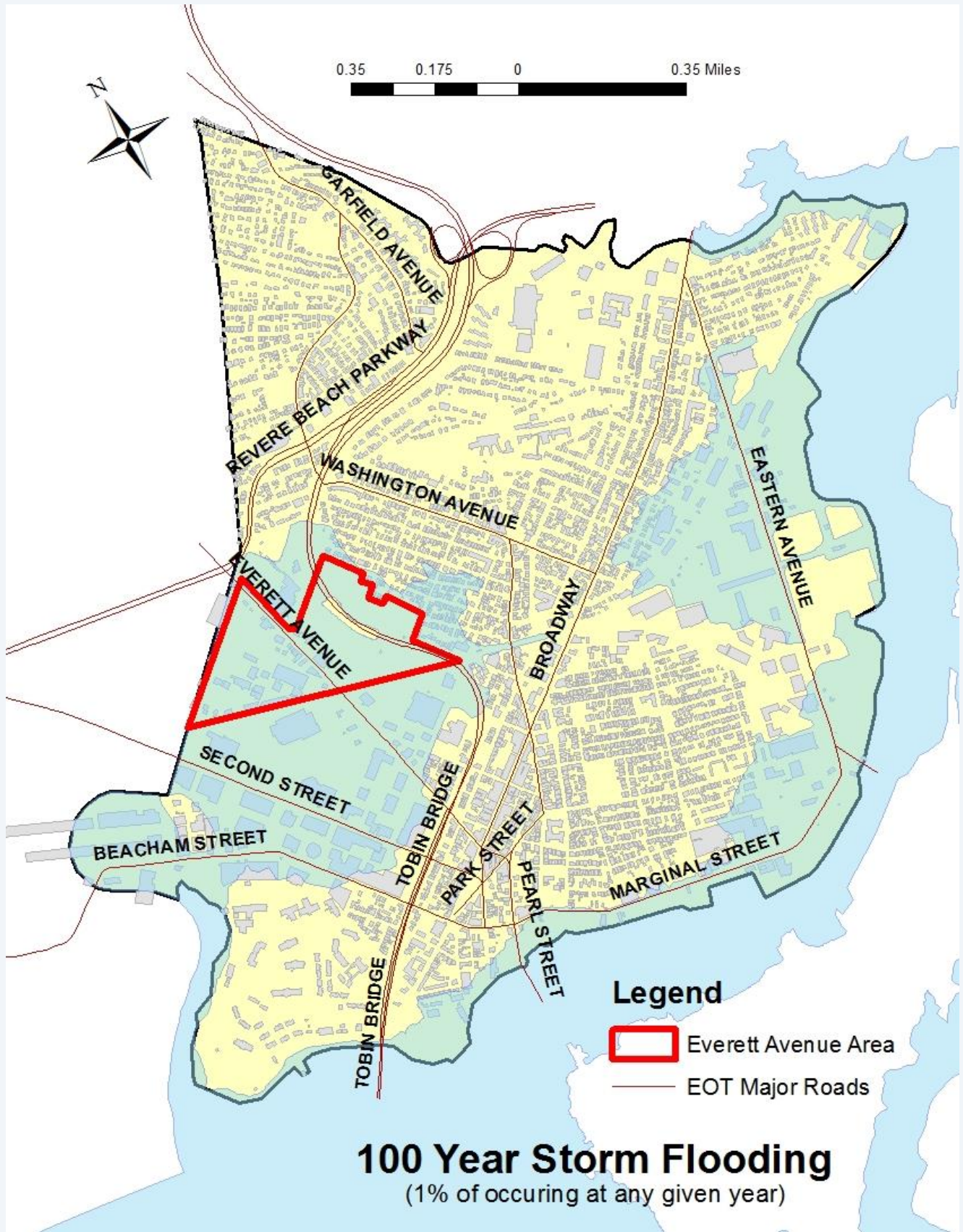
IS THIS AREA IN THE FLOOD HAZARD ZONE?		
Adaptation Strategy	Benefits	More Info
<i>Elevate the building above flood levels</i>	<ul style="list-style-type: none"> • Lowers insurance cost • Avoids damages caused by flooding • Decreases the hazard for the residents/users of the building 	Building Green
<i>Elevate electrical and mechanical equipment</i>	<ul style="list-style-type: none"> • Avoids power outages • Prevents damage to expensive equipment which reduces cost of repair/replacement • Reduces hazards to the population 	Building Green
<i>Add flood proofing components to building</i>	<ul style="list-style-type: none"> • Reduces damages caused by flooding • Decreases the repair costs after a flooding event 	Building Green
<i>Use wall materials that are resistant to flooding</i>	<ul style="list-style-type: none"> • Avoids costs of repairing the structure after a flooding event 	Building Green
<i>Reduce impervious surfaces outside of your building</i>	<ul style="list-style-type: none"> • Aids in reducing stormwater runoff • Reduces the urban heat island effect • Provides aesthetic value 	Low Impact Development
<i>Install a rain garden</i>	<ul style="list-style-type: none"> • Reduces flood water • Reduces maintenance (fertilizers, mowing, etc.) required compared to having lawns • Provides aesthetic appeal • Reduces urban heat island effect with vegetation and possible replacement of pavement 	Low Impact Development
<i>Install below grade storage for stormwater runoff</i>	<ul style="list-style-type: none"> • Reduces flood water • Lessens the amount of water entering combined sewers (limits overflow) 	Low Impact Development
<i>Have backup generators</i>	<ul style="list-style-type: none"> • Prepares buildings for power outages • Allows buildings to maintain functionality in extreme events • Lessens the need for evacuation in situations • Aids in public safety 	Building Green

WHAT CAN BE DONE TO LIMIT THE IMPACTS OF CLIMATE CHANGE?

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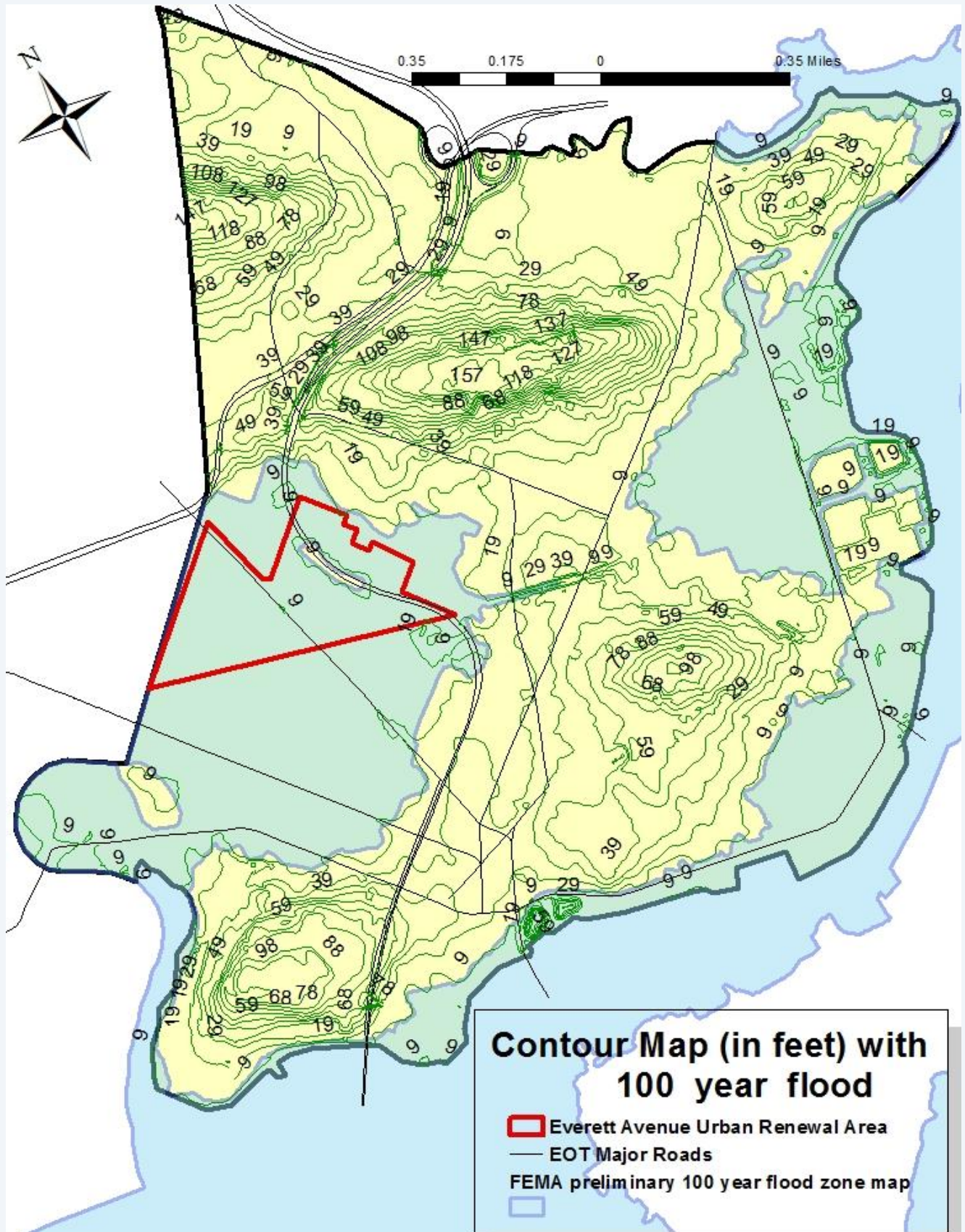
HOW CAN YOU REDUCE THE URBAN HEAT ISLAND EFFECT?		
Adaptation Strategy	Benefits	More Info
<i>Use reflective roofing or “cool roofs”</i>	<ul style="list-style-type: none"> • Reduces heat of a building decreasing need for air conditioning • Reduces greenhouse gas emissions due to lower energy use • Helps prevent heat related illness and death 	EPA Cool Roofs Cool Science
<i>Install a green roof</i>	<ul style="list-style-type: none"> • Lasts for a long period of time, if installed and maintained correctly • Reduces greenhouse gas emissions, energy use • Addresses stormwater management as well • Adds aesthetic value 	EPA Green Roofs
<i>Use “cool pavements” instead of regular pavement surfaces</i>	<ul style="list-style-type: none"> • Reduces emissions and energy use by reducing urban heat island effect • Cools the air and improves people’s health • Aids in stormwater management as well if pervious surfaces • Reduces cost spent on cooling energy 	Cool Science
<i>Plant trees and vegetation</i>	<ul style="list-style-type: none"> • Reduces energy use by shading buildings • Improves air quality and lowers greenhouse gas emissions • Adds aesthetic value 	EPA Trees/ Vegetation
<i>Use efficient electrical and mechanical equipment</i>	<ul style="list-style-type: none"> • Creates less waste heat which can reduce the urban heat island effect • Reduces emissions • Reduces energy needed to cool buildings • Reduces energy costs 	N/A

MAPS



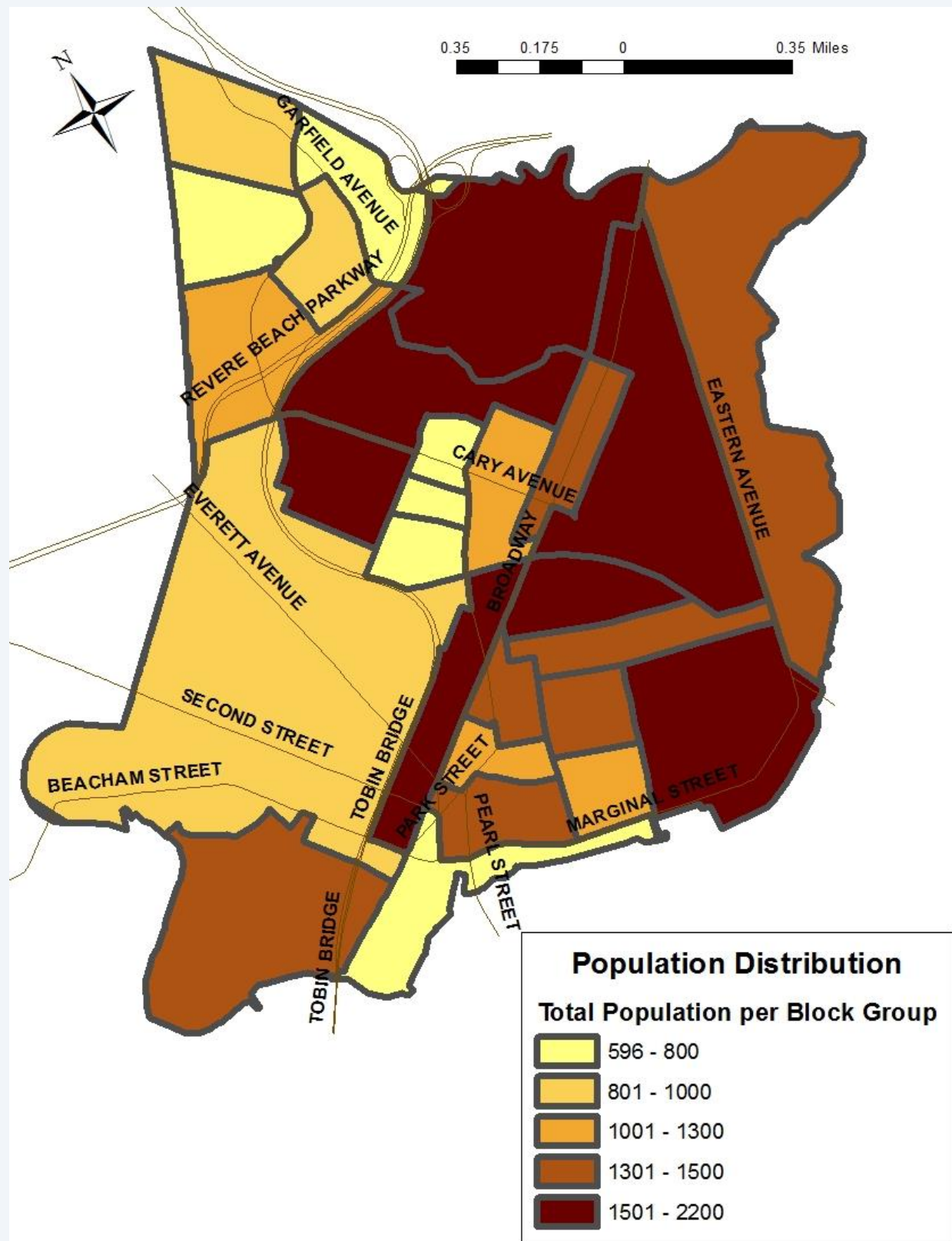
[100 Year Flood Map 1](#) (with major roads)

MAPS



[100 Year Flood Map 2 \(with contours\)](#)

MAPS

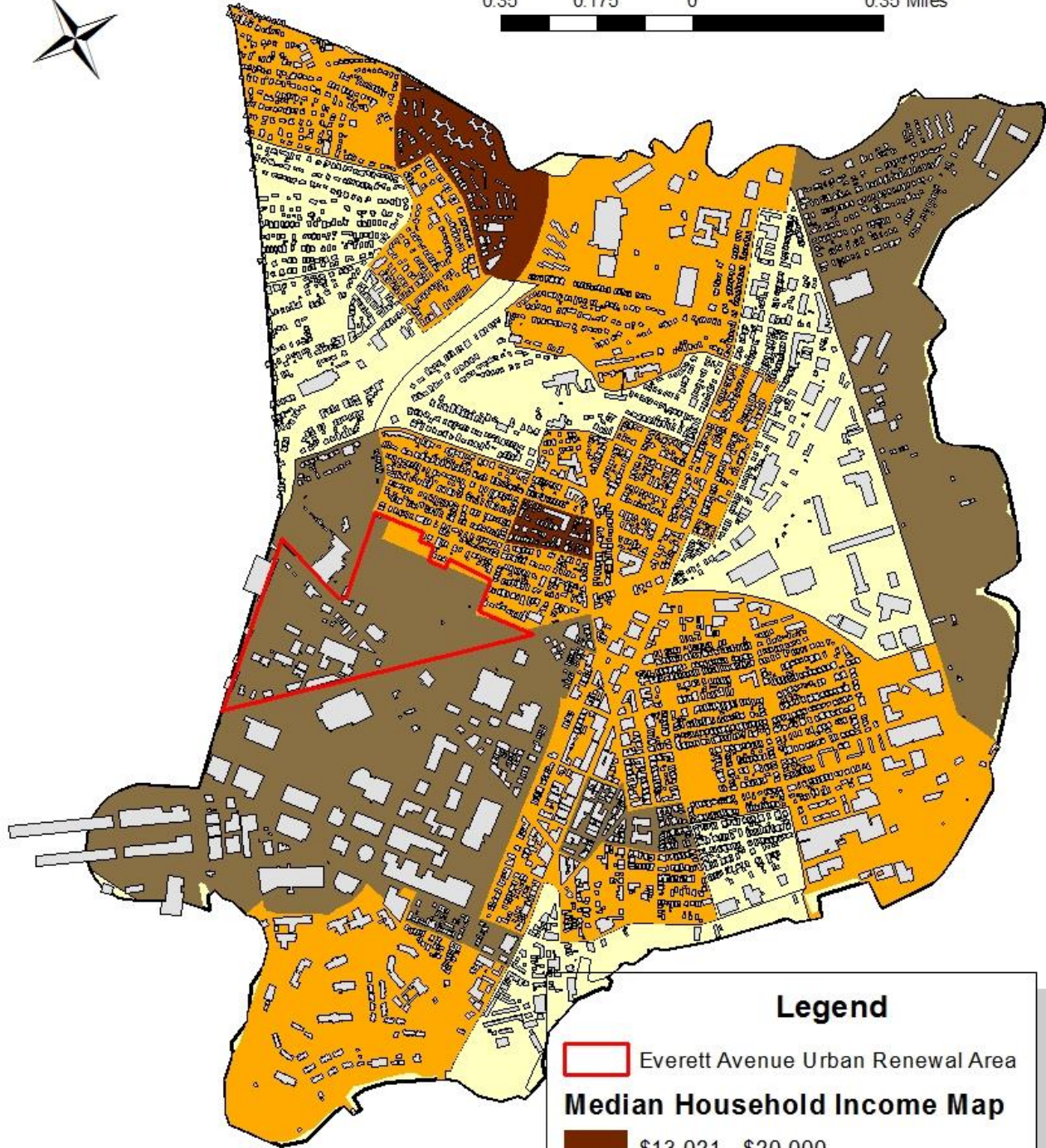


[Population Density](#)


MAPS




0.35 0.175 0 0.35 Miles



Legend

 Everett Avenue Urban Renewal Area

Median Household Income Map

 \$13,021 - \$20,000

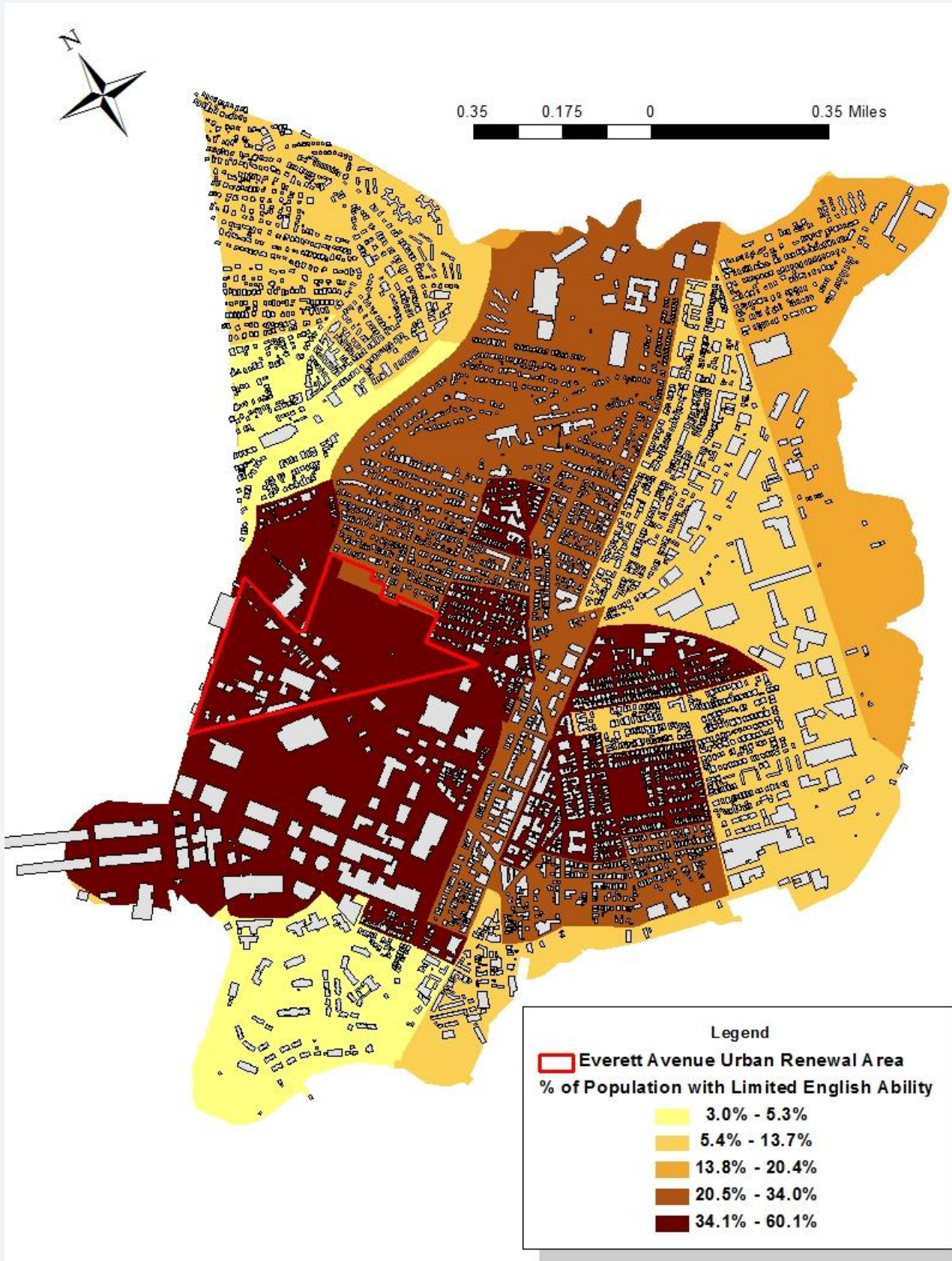
 \$20,001 - \$30,200

 \$30,201 - \$53,300

 \$53,301 - \$66,658

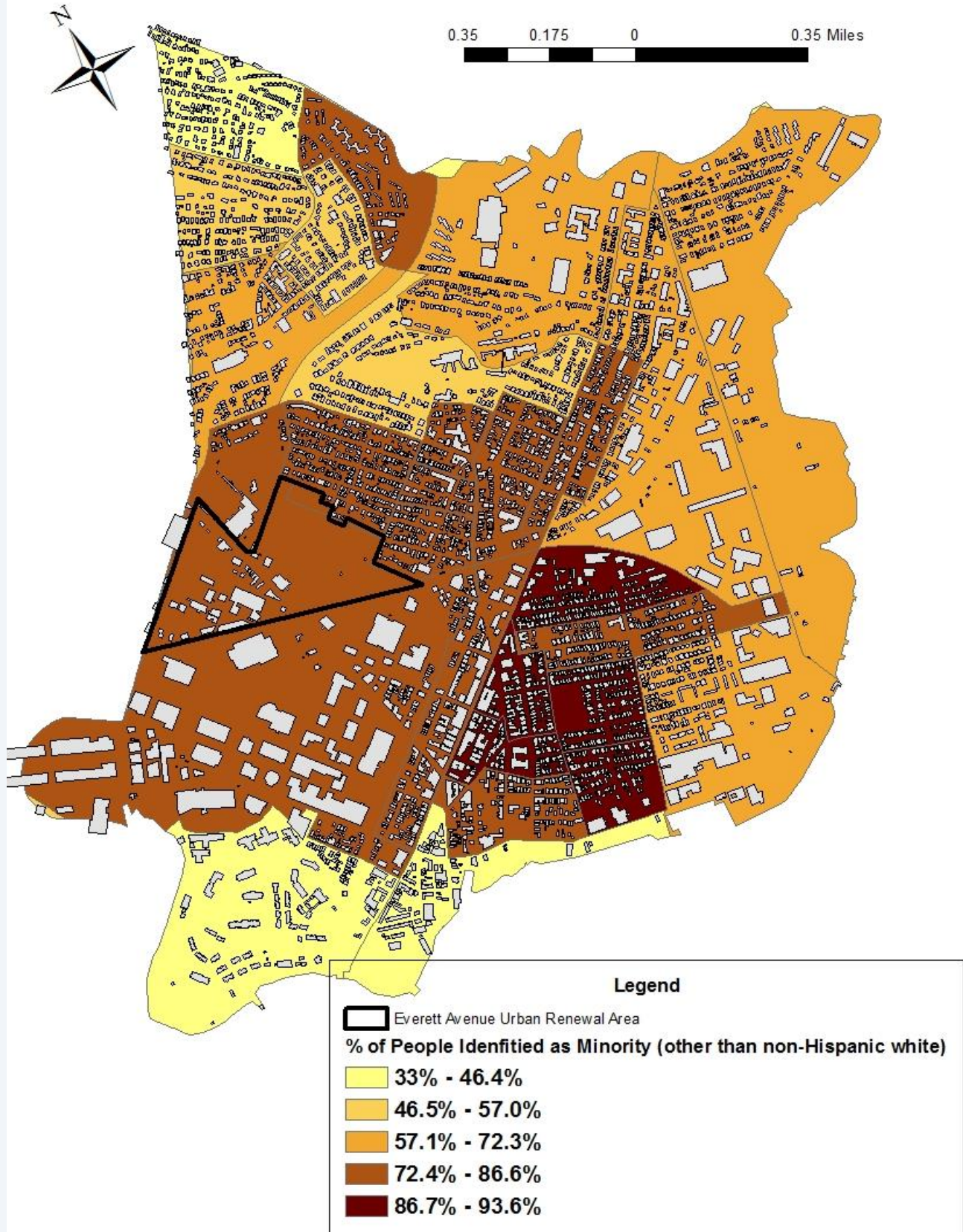
[Income Levels](#)

MAPS



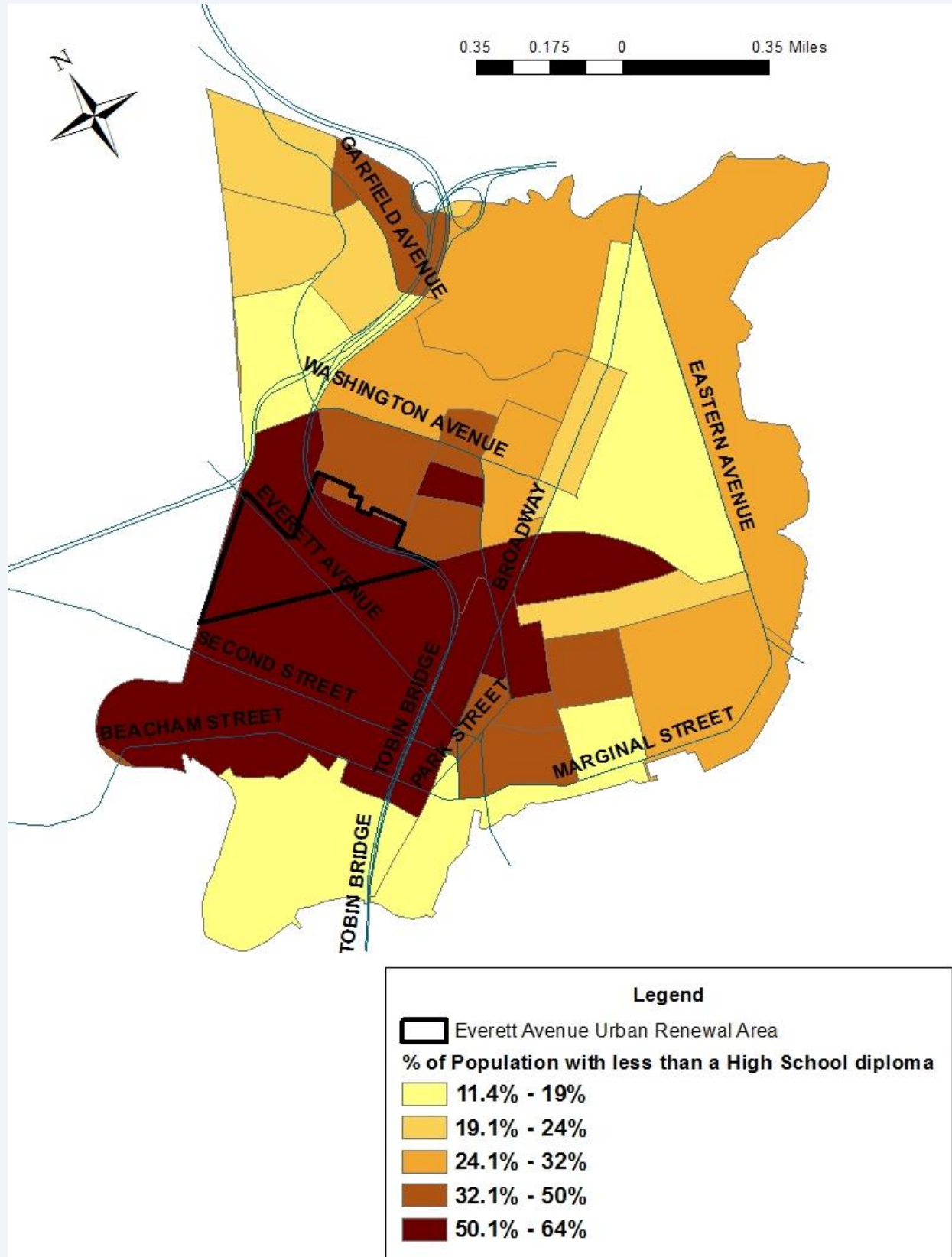
[Language Barriers](#)

MAPS



[Ethnicity](#)

MAPS



[Education](#)

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