Introduction
As the effects of climate change intensify, the Greater Boston Area will experience more frequent intense heat waves and cold freezes. Specific populations vulnerable to extreme temperature events are those with potential for severe, negative health outcomes which include elderly, people with disabilities or chronic diseases, people using and abusing substances, and people experiencing homelessness. Additionally, Massachusetts has designated Environmental Justice (EJ) communities as those who are more vulnerable to environmental scenarios. The criteria to be an EJ community are to be a block group with:
- Block group whose annual median household income is equal to or less than 65 percent of the statewide median ($74,167 in 2017); or
- 25% or more of the residents identify as a race other than white; or
- 25% or more of households have no one over the age of 14 who speaks English only or very well - English isolation.
With this in mind, cities need to be prepared to provide weather-safe places for their residents. With limitations on data about the different vulnerable populations, this project explores:

Where are the EJ communities and elderly (60+) that cannot access warming and cooling centers in Boston, Cambridge, Chelsea, Everett, Malden, Medford, Revere, and Somerville?

Methodology

**Data Sources**
- Demographic data was gathered from Social Explorer Tables: American Community Survey 2017 (5-Year Estimates) at the block group level.
- Center were identified by emailing or calling city halls and geolocating addresses. MassGIS was used to locate libraries in each municipality as an additional location residents could go.
- Street data for network analyst came from MassDOT.

<table>
<thead>
<tr>
<th>Total Population</th>
<th>Population Not Served</th>
<th>Population Not Served (%)</th>
<th>Elderly Population Not Served</th>
<th>Elderly Population Not Served (%)</th>
<th>Number of Block Groups meeting 1 EJ Criterion</th>
<th>Number of Block Groups meeting 2 EJ Criterion</th>
<th>Number of Block Groups meeting All 3 EJ Criteria</th>
<th>Total Number of Block Groups meeting at least 1 EJ Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>669,158</td>
<td>402,229</td>
<td>60.1%</td>
<td>49,364</td>
<td>73.8%</td>
<td>140</td>
<td>83</td>
<td>26</td>
</tr>
<tr>
<td>Cambridge</td>
<td>110,893</td>
<td>90,750</td>
<td>81.84%</td>
<td>10,533</td>
<td>9.50%</td>
<td>45</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Chelsea</td>
<td>39,272</td>
<td>5,331</td>
<td>14.06%</td>
<td>358</td>
<td>0.94%</td>
<td>10</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Everett</td>
<td>45,213</td>
<td>31,040</td>
<td>68.85%</td>
<td>3,170</td>
<td>7.01%</td>
<td>10</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Malden</td>
<td>61,212</td>
<td>40,599</td>
<td>66.33%</td>
<td>4,411</td>
<td>7.21%</td>
<td>19</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Medford</td>
<td>57,700</td>
<td>45,588</td>
<td>79.01%</td>
<td>7,046</td>
<td>12.21%</td>
<td>16</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Revere</td>
<td>53,864</td>
<td>35,491</td>
<td>65.89%</td>
<td>4,931</td>
<td>9.15%</td>
<td>17</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Somerville</td>
<td>79,983</td>
<td>54,439</td>
<td>68.61%</td>
<td>4,303</td>
<td>5.38%</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*All numbers are based of the block groups with data from Social Explorer Tables: ACS 2017 (5-Year Estimates)(SE), ACS 2017 (5-Year Estimates), Social Explorer U.S. Census Bureau.

Results
If vulnerable populations have access to vehicles, almost all block groups are serviced within a 10 min drive shed. However, if populations are dependent on walking then 577 block groups cannot access the centers or libraries at an elderly person’s walking speed. Of these 577, 70% are block groups with EJ communities. Overall, an estimated 10% of elderly cannot access these locations.

Limitations: It is important to note that the demographic and populations numbers are estimates and only representative of the block groups surveyed in the survey. Additionally, in building the network and inserting the centers, locations may not have snapped correctly, thus reducing the size of service area generated. Further, service areas serve some block groups partially, however with GIS tools, the population numbers are not reduced proportionately to the areas of the block group that are not served.

Research & Policy Implications
- Conduct walkshed analysis for other vulnerable populations, especially those experiencing homelessness.
- Conduct a public-transit shed analysis to identify service areas for additional transit modality.
- Designate additional public locations outside of walkshed to be warming and cooling centers in collaboration with community members.
- Identify ways to use shuttles or vehicle pick-up on extreme hot or cold days—either by the city or through a neighborhood volunteer group.
- Ensure that communications about centers are culturally-appropriate so that EJ communities can utilize city resources during extreme temperature.

**Elderly Population (%) in Block Groups outside of 16-Minute Walkshed**

**Elderly Population (Density) in Block Groups outside of 16-Minute Walkshed**