I. Vulnerable Population

Title VI of the Civil Rights Act of 1964 and the 1994 President’s Executive Order on Environmental Justice (#12898) state that no person or group shall be excluded from participation in, or denied the benefits of, any program or activity utilizing federal funds. Each federal agency is required to identify any disproportionately high and adverse health or environmental effects of its programs on minority and low-income populations. In turn, Metropolitan Planning Organizations (MPOs) are charged with evaluating their plans and programs for environmental justice (EJ) sensitivity, and expanding their outreach efforts to low-income, minority, and other disadvantaged populations, as part of the United States Department of Transportation’s certification requirements.

H-GAC uses data from the US Census Bureau to determine the concentrations of eight sensitive populations for the region and for each census block group. A block group with a concentration of a sensitive population greater than the concentration of the H-GAC region as a whole is considered to be “vulnerable” for the sensitive population. The Vulnerable Population Index (VPI) indicated the number of vulnerable populations for each block group, and thus provides a general indication of the extent to which each block group is vulnerable.

The following eight populations were determined to be sensitive based on understanding of both federal requirements and regional demographics:

- Poverty
- Non-Hispanic, non-white
- Hispanic
- Limited English proficiency
- Disabled family
- Elderly
- Car-less
- Single female householder with child/children in the household.

1. Poverty

The Census Bureau uses a set of income thresholds that vary by household size and composition to determine poverty. If a household’s total income is less than the threshold, then that household and every individual in it is considered in poverty. For example, the threshold for 2015 for a four-person household with two dependents is $24,036. While the thresholds do not vary by place, they are updated for inflation using the Consumer Price Index (CPI-U).
2. **Non-Hispanic, non-white**

The U.S. Department of Transportation (DOT) Order (5610.2) on EJ defines “Minority” as:
- Black: a person having origins in any of the black racial groups of Africa
- Asian American: a person having origins in any of the original peoples of the Far East, Southeast Asia,
- the Indian subcontinent
- Native Hawaiian or Pacific Islander
- American Indian and Alaskan Native: a person having origins in any of the original people of North America who maintain cultural identification through tribal affiliation or community recognition

In addition to the groups mentioned above, the U.S. Census recognizes two additional racial categories:
- Some other race alone and
- Two or more races

2. **Hispanic**

The U.S. Census Bureau defines Hispanic as person(s) of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

3. **Limited English proficiency**

The Limited English Proficiency (LEP) population is defined as households in which no one (14 and over) speaks English only; or speaks a language other than English at home, and speaks English “not well” or “not at all.”

4. **Disabled Family**

The U.S. Census Bureau classifies individuals as disabled if they report difficulties working at a job, leaving home, or report long-lasting sensory, physical, mental, emotional, or self-care disabilities. A disabled family is a family whose head, spouse, or sole member is a person with disabilities. It may include two or more persons with disabilities living together, or one or more persons with disabilities living with one or more live-in aides.

5. **Elderly**

Elderly is defined as age 75 and above.

6. **Car-less**

The U.S. Census Bureau defines car-less as a household with no vehicle access.

7. **Single female householder with child/children in the household**

The number and percent of single mothers with own children under 18 years of age.
II. Calculation of Vulnerable Population Index

The Vulnerable Population Index (VPI) represents the relative degree of vulnerability of population in one area compared to that of the entire region (or County).

The calculation methods are explained as following:

**Step 1:** Extract the demographic and social-economic data from the 2017 American Community Survey and obtain the concentration of vulnerable population in each category for both target regions (block group) and background regions (county or H-GAC area).

\[ BG_{Var\%} = \frac{BG_{Population\ Var}}{BG_{Total\ Population}} \]

\[ Region_{Var\%} = \frac{Region_{Population\ Var}}{Region_{Total\ Population}} \]

**Step 2:** For each vulnerable population category, calculate the vulnerability quotient.

\[ Quotient_{Var} = \frac{(BG_{Var\%})}{(Region_{Var\%})} \]

**Step 3:** For each vulnerable population category, block groups with vulnerability quotient greater or equal to 1 are considered to have a vulnerable population.

*If Quotient_{Var} \geq 1 then VP_{Var}=1; Else if Quotient_{Var} < 1 then VP_{Var}=0*

**Step 4:** Sum up the VP values for all categories and the VPI for each block group is generated.

\[ VPI = \text{Sum}(VP_{all\ vars}) \]

VPI should be integers between 0 and 8.

The steps 5 and onward are used to obtain standardized vulnerability quotient index (VQI).

**Step 5:** Sum up the vulnerability quotient for all vulnerability categories.

\[ Quotient_{Sum} = \text{sum}(Quotient_{all\ vars}) \]

**Step 6:** Rank all block groups in ascending order of Quotient_{Sum}. Sum up the Quotient_{Sum} for all block groups in the background region (county/H-GAC Area) as Quotient_{Total}.

\[ Quotient_{Total} = \text{sum}(Quotient_{Sum}) \text{ (for all block groups)} \]

**Step 7:** Calculate the cumulative percentage of Quotient_{Sum} (for each block group, in ascending order of Quotient_{Sum}) to the background region (Each block group’s respective county or entire H-GAC region) as the VQI. The VQI should be distributed from 0 to 1. The block group that has the greatest Quotient_{Sum} in the background region has a VQI of 1.

\[ VQI = \frac{(Cumulative\ Quotient_{Sum})}{Quotient_{Total}} \]
<table>
<thead>
<tr>
<th>Vulnerable Population</th>
<th>H-GAC Region</th>
<th>Austin</th>
<th>Brazoria</th>
<th>Chambers</th>
<th>Colorado</th>
<th>Fort Bend</th>
<th>Galveston</th>
<th>Harris</th>
<th>Liberty</th>
<th>Matagorda</th>
<th>Montgomery</th>
<th>Walker</th>
<th>Waller</th>
<th>Wharton</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total population (2017)</strong></td>
<td>6,949,959</td>
<td>29,565</td>
<td>353,999</td>
<td>40,292</td>
<td>21,022</td>
<td>739,342</td>
<td>327,089</td>
<td>4,602,523</td>
<td>81,862</td>
<td>36,743</td>
<td>554,445</td>
<td>71,539</td>
<td>49,987</td>
<td>41,551</td>
</tr>
<tr>
<td><strong>Total household population (2017)</strong></td>
<td>6,850,007</td>
<td>29,287</td>
<td>342,408</td>
<td>40,020</td>
<td>20,690</td>
<td>733,624</td>
<td>320,541</td>
<td>4,561,215</td>
<td>74,682</td>
<td>36,359</td>
<td>551,333</td>
<td>53,444</td>
<td>45,422</td>
<td>40,982</td>
</tr>
<tr>
<td><strong>Total households (2017)</strong></td>
<td>2,368,252</td>
<td>11,041</td>
<td>118,762</td>
<td>13,529</td>
<td>7,511</td>
<td>230,381</td>
<td>119,181</td>
<td>1,583,486</td>
<td>26,203</td>
<td>13,636</td>
<td>192,823</td>
<td>14,807</td>
<td>15,256</td>
<td></td>
</tr>
<tr>
<td><strong>1. Population in Poverty</strong></td>
<td>981,475</td>
<td>3,159</td>
<td>31,553</td>
<td>5,072</td>
<td>2,242</td>
<td>57,565</td>
<td>42,158</td>
<td>739,100</td>
<td>11,047</td>
<td>7,293</td>
<td>54,526</td>
<td>12,881</td>
<td>7,697</td>
<td>7,182</td>
</tr>
<tr>
<td>% of Total household population</td>
<td>14.3%</td>
<td>10.8%</td>
<td>9.2%</td>
<td>12.7%</td>
<td>10.8%</td>
<td>7.8%</td>
<td>13.2%</td>
<td>16.2%</td>
<td>16.2%</td>
<td>14.8%</td>
<td>20.1%</td>
<td>9.9%</td>
<td>24.1%</td>
<td>17.5%</td>
</tr>
<tr>
<td><strong>2. Non-Hispanic Minorities</strong></td>
<td>1,821,594</td>
<td>3,221</td>
<td>76,946</td>
<td>4,313</td>
<td>2,967</td>
<td>310,375</td>
<td>59,017</td>
<td>1,259,528</td>
<td>9,939</td>
<td>4,972</td>
<td>52,636</td>
<td>21,636</td>
<td>14,807</td>
<td></td>
</tr>
<tr>
<td>% of Total population</td>
<td>26.2%</td>
<td>10.9%</td>
<td>21.7%</td>
<td>14.1%</td>
<td>12.7%</td>
<td>18.0%</td>
<td>13.5%</td>
<td>27.4%</td>
<td>25.5%</td>
<td>9.5%</td>
<td>20.1%</td>
<td>13.5%</td>
<td>9.9%</td>
<td>17.5%</td>
</tr>
<tr>
<td><strong>3. Hispanic Minorities</strong></td>
<td>2,557,924</td>
<td>7,819</td>
<td>106,731</td>
<td>8,793</td>
<td>6,200</td>
<td>179,653</td>
<td>79,406</td>
<td>1,958,963</td>
<td>19,098</td>
<td>15,441</td>
<td>192,823</td>
<td>14,807</td>
<td>15,256</td>
<td></td>
</tr>
<tr>
<td>% of Total population</td>
<td>36.8%</td>
<td>26.4%</td>
<td>30.2%</td>
<td>21.8%</td>
<td>29.5%</td>
<td>24.3%</td>
<td>24.3%</td>
<td>42.6%</td>
<td>23.3%</td>
<td>42.0%</td>
<td>23.7%</td>
<td>17.9%</td>
<td>25.5%</td>
<td>14.3%</td>
</tr>
<tr>
<td><strong>4. Limited English Proficiency</strong></td>
<td>600,469</td>
<td>1,449</td>
<td>13,581</td>
<td>1,504</td>
<td>932</td>
<td>37,059</td>
<td>11,073</td>
<td>499,288</td>
<td>3,012</td>
<td>2,262</td>
<td>22,785</td>
<td>2,057</td>
<td>3,137</td>
<td>2,330</td>
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<tr>
<td>% of Total population</td>
<td>8.6%</td>
<td>4.9%</td>
<td>3.8%</td>
<td>3.7%</td>
<td>3.4%</td>
<td>5.0%</td>
<td>3.4%</td>
<td>10.8%</td>
<td>6.2%</td>
<td>4.1%</td>
<td>2.9%</td>
<td>6.3%</td>
<td>5.6%</td>
<td></td>
</tr>
<tr>
<td><strong>5. Disable Family</strong></td>
<td>496,116</td>
<td>2,843</td>
<td>25,868</td>
<td>3,586</td>
<td>2,286</td>
<td>41,482</td>
<td>34,048</td>
<td>317,453</td>
<td>9,505</td>
<td>4,447</td>
<td>42,284</td>
<td>3,980</td>
<td>3,844</td>
<td>4,490</td>
</tr>
<tr>
<td>% of Total households</td>
<td>20.9%</td>
<td>25.7%</td>
<td>21.8%</td>
<td>26.5%</td>
<td>20.5%</td>
<td>18.0%</td>
<td>28.6%</td>
<td>20.5%</td>
<td>23.7%</td>
<td>21.9%</td>
<td>18.4%</td>
<td>26.0%</td>
<td>29.4%</td>
<td></td>
</tr>
<tr>
<td><strong>6. Elderly</strong></td>
<td>273,929</td>
<td>2,151</td>
<td>15,201</td>
<td>1,577</td>
<td>1,996</td>
<td>25,231</td>
<td>17,023</td>
<td>169,956</td>
<td>3,934</td>
<td>2,686</td>
<td>25,556</td>
<td>3,520</td>
<td>2,060</td>
<td>3,038</td>
</tr>
<tr>
<td>% of Total population</td>
<td>3.9%</td>
<td>7.3%</td>
<td>4.3%</td>
<td>3.9%</td>
<td>9.5%</td>
<td>4.3%</td>
<td>3.4%</td>
<td>3.7%</td>
<td>4.6%</td>
<td>4.9%</td>
<td>4.1%</td>
<td>7.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>7. Car-less</strong></td>
<td>123,480</td>
<td>490</td>
<td>3,768</td>
<td>588</td>
<td>405</td>
<td>5,052</td>
<td>6,450</td>
<td>95,285</td>
<td>1,617</td>
<td>824</td>
<td>6,577</td>
<td>972</td>
<td>534</td>
<td>918</td>
</tr>
<tr>
<td>% of Total households</td>
<td>5.2%</td>
<td>4.4%</td>
<td>3.2%</td>
<td>4.3%</td>
<td>5.4%</td>
<td>5.4%</td>
<td>5.4%</td>
<td>6.0%</td>
<td>6.2%</td>
<td>5.6%</td>
<td>4.5%</td>
<td>3.6%</td>
<td>6.0%</td>
<td></td>
</tr>
<tr>
<td><strong>8. Single Female Householder with Child/children in the household</strong></td>
<td>228,125</td>
<td>633</td>
<td>8,893</td>
<td>801</td>
<td>485</td>
<td>17,964</td>
<td>9,877</td>
<td>168,819</td>
<td>2,050</td>
<td>967</td>
<td>13,446</td>
<td>1,368</td>
<td>1,203</td>
<td>1,619</td>
</tr>
<tr>
<td>% of Total Households</td>
<td>9.6%</td>
<td>5.7%</td>
<td>7.5%</td>
<td>5.9%</td>
<td>6.5%</td>
<td>7.8%</td>
<td>8.3%</td>
<td>10.7%</td>
<td>7.8%</td>
<td>7.1%</td>
<td>6.3%</td>
<td>8.1%</td>
<td>10.6%</td>
<td></td>
</tr>
</tbody>
</table>

Source: American Community Survey (ACS) 2014-2018