Health and Economic Vulnerabilities to COVID-19

CLIENT:
CITY OF MILWAUKEE - DEPARTMENT OF CITY DEVELOPMENT (DCD)

Project Team:
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Introduction

Health & Economic Effects of COVID-19

As of May 6, 2020:

- 2,567 confirmed COVID-19 cases in city of Milwaukee[1]

- 132 deaths due to virus in city[1]

- Over 500,000 unemployment claims in WI since outbreak began[2]

- WI Department of Workforce Development estimated unemployment rate could reach 27%[2]

- "Safer at Home" order extended until May 26, many businesses will remain closed

[1]https://city.milwaukee.gov/coronavirus [2]Milwaukee Journal Sentienel

Source: Washington Post / Getty Images

Project Goals

- Conduct a GIS analysis of potential health and economic vulnerabilities to COVID-19 in Milwaukee

- Provide the Milwaukee DCD GIS outputs that illustrate geospatial relationships between COVID-19 vulnerabilities and affected populations

- Help better inform the DCD's decision making in their response to the effects of COVID-19 in areas such as housing, employment, and small business assistance.

Source: Milwaukee County
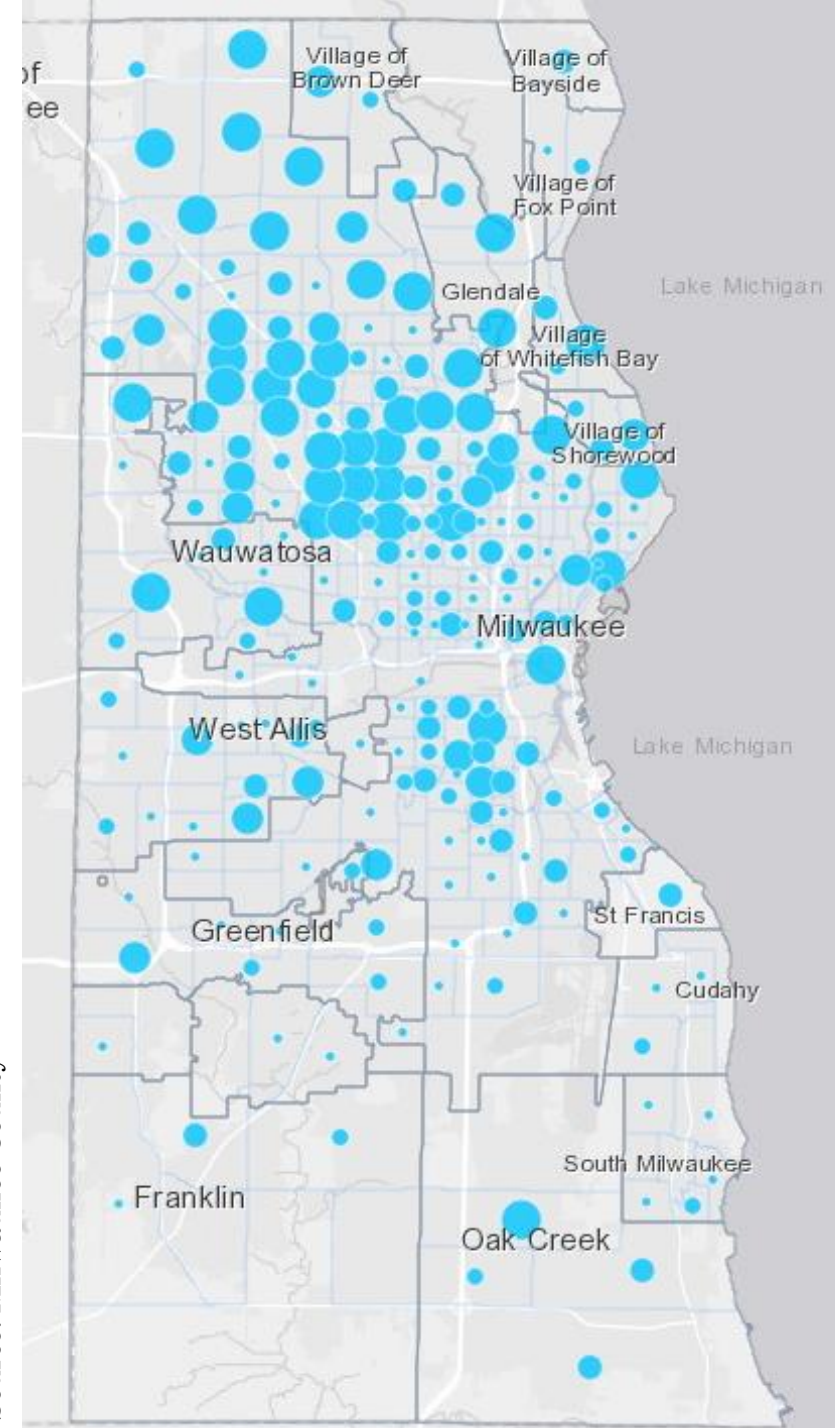
Background

Social Vulnerability

"The inability of people, organizations, and societies to withstand adverse impacts from multiple stressors to which they are exposed."[1]

Social Vulnerability Index

- A quantitative assessment of social vulnerability

- Combines measurements of vulnerability and geospatial data to map vulnerable populations.

- The most notable social vulnerability index is produced by the Center for Disease Control

- Can be used to measure general social vulnerability or tailored towards specific stressors

[1]Warner, Koko (2007). *Perspectives on social vulnerability*. UNU-EHS.
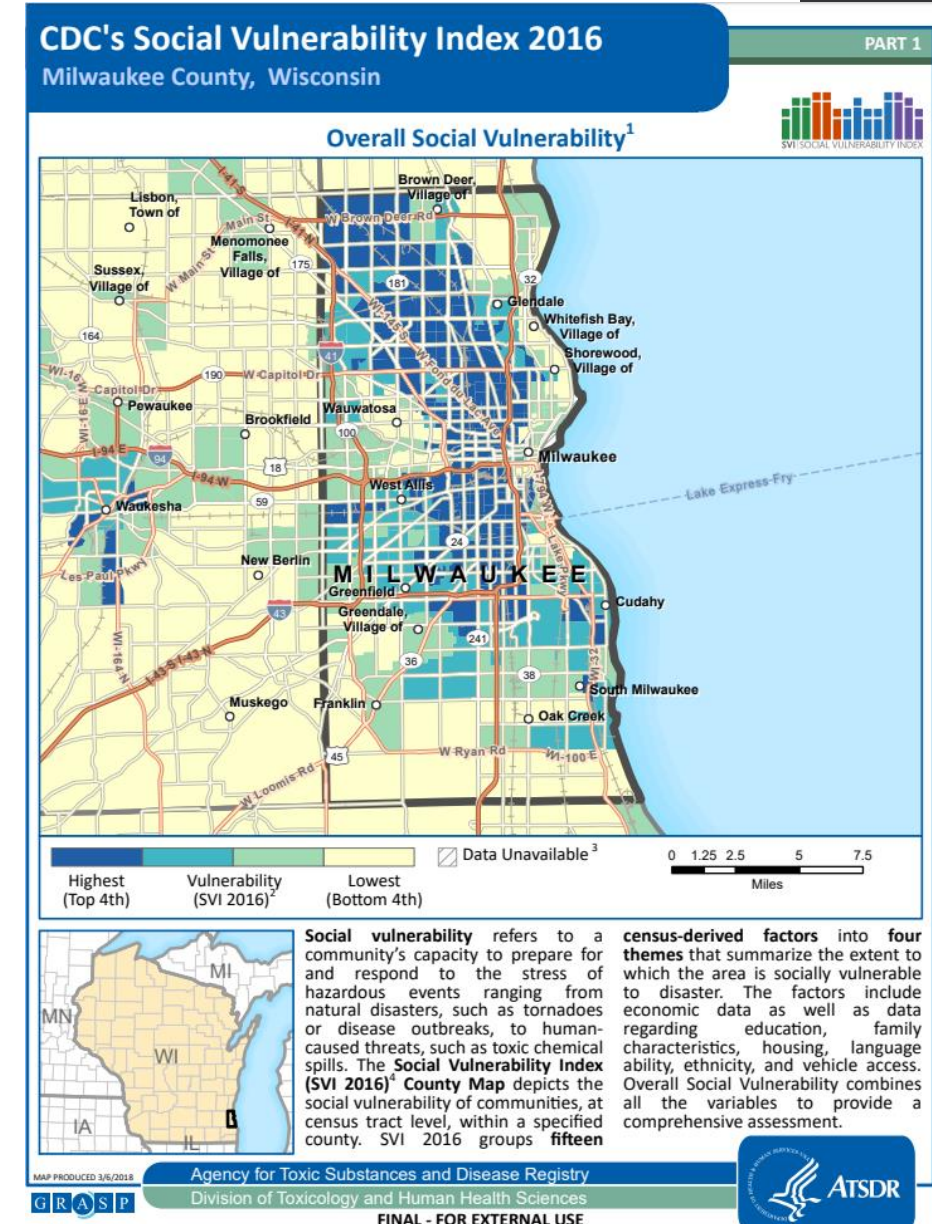
CDC's Social Vulnerability Index Map

Approach

- Identify variables for health & economic vulnerabilities to COVID-19
  - General social vulnerability *(existing research)*
  - Pandemic vulnerability *(existing research)*
  - COVID-19 specific vulnerability *(current reporting)*

- Group variables according to relationship to vulnerabilities

- Identify demographic attributes that might help inform response

Model

Classification	Grouping	Variable
Health Vulnerabilities	**Pre-Existing Conditions**	Obesity
		Diagnosed Diabetes
		COPD
		Coronary Heart Disease
		Kidney Disease
	Demographic Contributors	Age Over 65
		Male
		Disabilities
		No Health Insurance
	Increased Exposure Risk	Job in Health Care and Social Assistance
		Population Density

Model

Classification	Grouping	Variable
Economic Vulnerabilities	**Works in Highly Affected Industry**	Job in Retail Trade
		Job in Arts, Entertainment, and Recreation
		Job in Accommodation and Food Services
	Existing Economic Vunerabilities	Housing Cost Burdened
		Median Income
	Employment Accessibility	No Access to Vehicle
		No Internet Access
		No High School Diploma

Model

	Variable
Demographic Profile Characteristics	Race and Ethnicity
	English Proficiency
	Households with Elderly
	Households with Children
	Occupants per Room
	Poverty
	Public/Private Health Insurance
	Owner or Renter

Methods

- **Data Processing:**

  - Data gathered from:
    - CDC 500 Cities dataset (2019)
    - US Census LEHD (2017)
    - ACS 5-year estimates (2018)
    - ESRI Business Analyst (2018)

  - Data for index analyses clipped to City of Milwaukee boundary.

  - Data available at Milwaukee County extent displayed for comparison.

  - Variables organized into three classifications and joined to Census Tract shapefiles.

  - Combination of variables weighted equally within indices.

Methods

- **Health Vulnerability Index (HVI):**

  - Normalize variable raw values by total population/household.

  - Top 10% of those values assigned a 'flag'.

  - 'Flags' recorded in binary format:
    - Above 90th percentile = 1.
    - Below 90th percentile = 0.

  - Index created by adding all 'flags' in each Census Tract.

  - Identifies Tracts with highest health vulnerability to COVID-19.

Tract	Total Pop	Age Over 65	% Pop Age Over 65	90th Percentile 'Flag'
101	4476	694	15.5%	0
102	3468	723	20.3%	1
201	5561	326	5.9%	0

Methods

- **Economic Vulnerability Index (EVI):**

  - Replicate analysis process of HVI.

  - Normalize raw values by total population/households.

  - Top 10% assigned a 'flag'.

  - Total all 'flags' in each Census Tract.

  - Identifies Tracts with highest economic vulnerability to COVID-19.

Tract	Total Households (HH)	No Access to Vehicle	% HH No Access to Vehicle	90th Percentile 'Flag'
101	2337	626	25.80%	0
102	1620	307	15.60%	0
2800	824	283	30.36%	1

Methods

- **Total Vulnerability Index (TVI):**

  - The 'flags' from both the HVI and the EVI combined to yield a Total Vulnerability Index (TVI).

  - Identifies Census Tracts which have a higher overall vulnerability to the effects of the COVID-19 crisis.

Tract	HVI Flags	EVI Flags	Total Flags (TVI)
6200	1	2	3
6300	4	2	6
6400	5	4	9
6500	7	2	9
6600	5	2	7

Methods

- **Sociodemographic Characteristics:**

  - Additional exploration of sociodemographic characteristics.

  - Populations which these characteristics describe found to be disproportionately affected by the Coronavirus in preliminary studies.

  - Normalize raw values by total population/household.

  - Highest percentage values of each characteristic highlighted by displaying graduated colors.

  - Characteristics cross referenced to results of index analyses to determine correlation.

Methods

- **Comparison to Reported COVID-19 cases (as of 4/22/20)**

  - Gathered from the Milwaukee County COVID-19 tracking dashboard.

  - Data reported by the Wisconsin Electronic Disease Surveillance System (WEDSS).

  - Comparison of reported cases 'hotspots' to vulnerability indices.
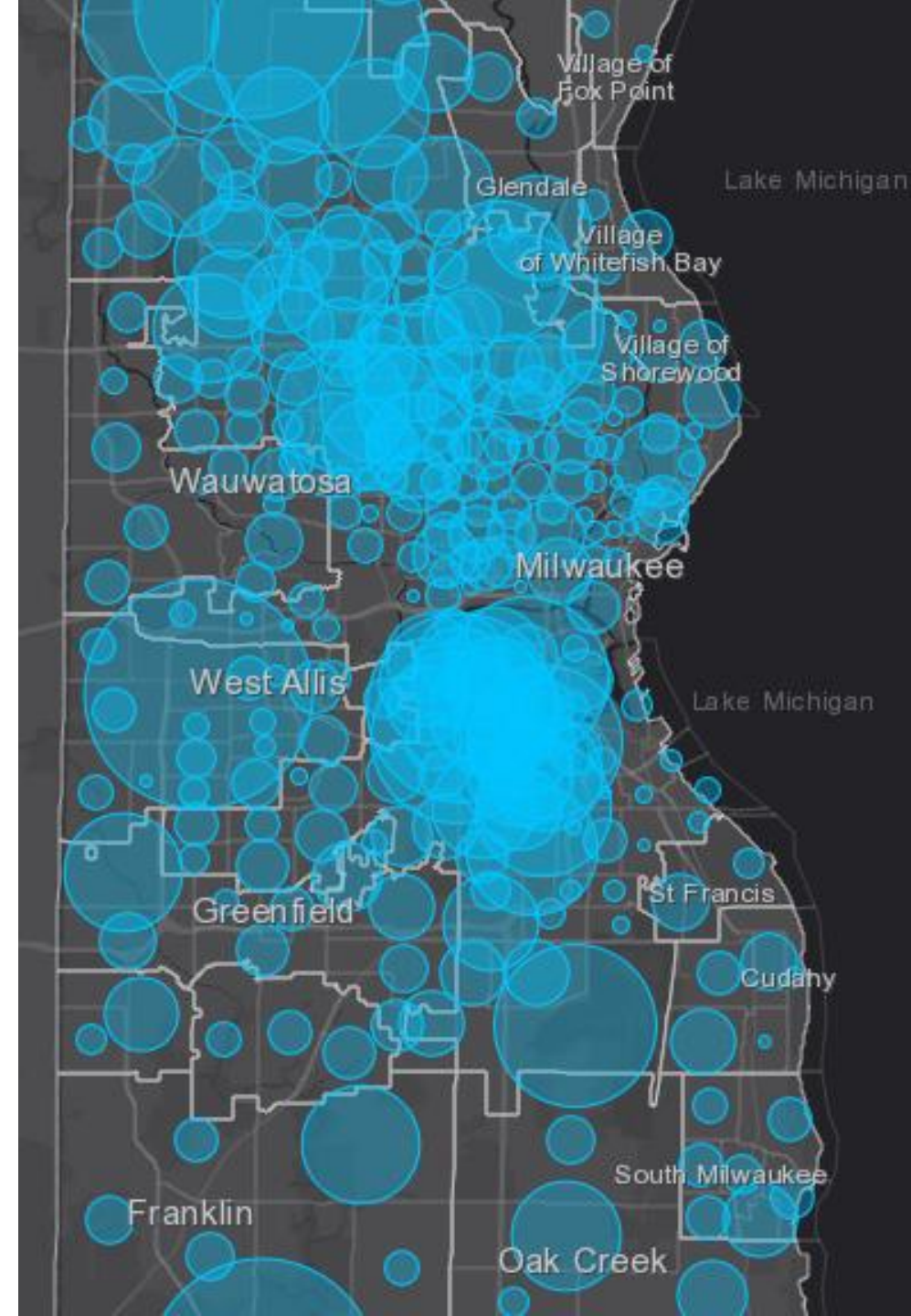
Methods

- **ESRI Business Analyst - Wisconsin Businesses (2018)**

  - Dataset clipped to Milwaukee County.

  - Isolate most vulnerable industries/businesses forced to close.

  - Businesses grouped by Business Improvement District.

  - Kernel Density of "Employee Number" field identifies:
    - Areas of high job density.
    - Areas containing small businesses (likely to be more adversely affected).

Esri® Business Analyst™

Location Analytics for Market Planning and Site Selection

Powered by ArcGIS®

esri

Results

	Census Tracts	Flags
🟥	6	9 - 12
🟧	23	5 - 8
🟨	103	1 - 4
	80	0

Total Vulnerability Index
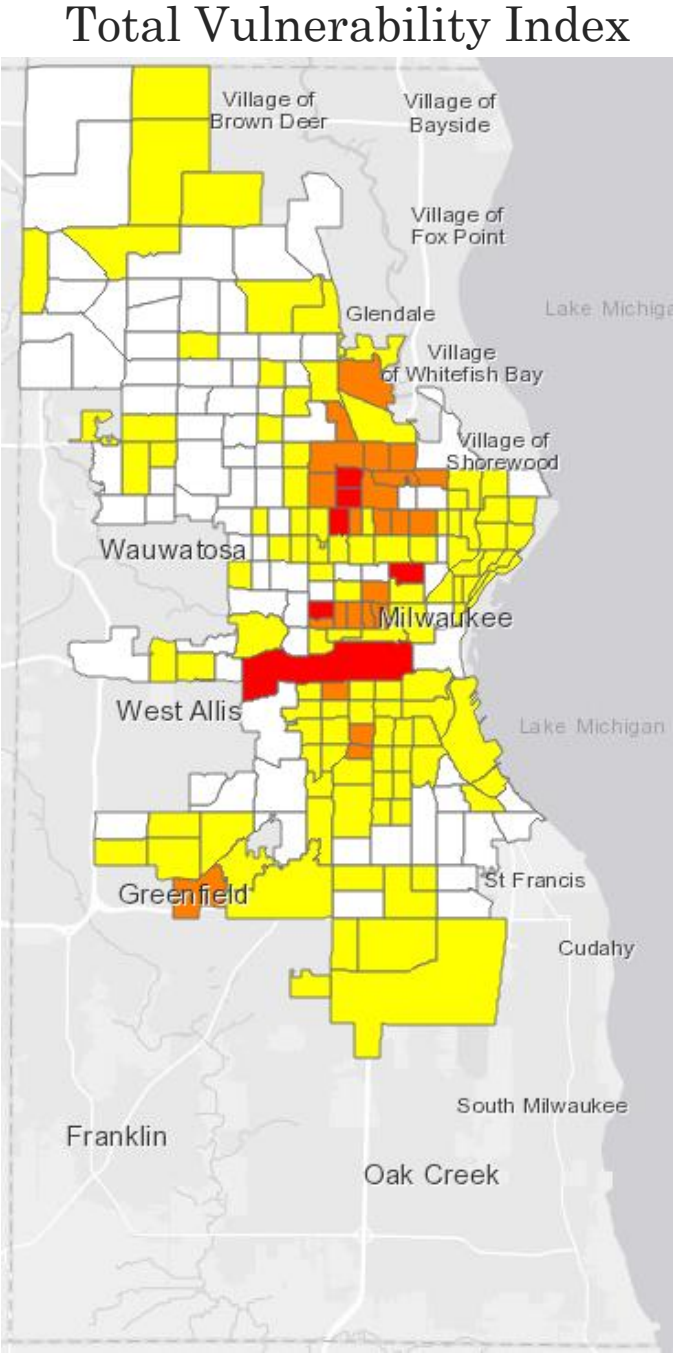
Results

Census Tract 186000

Census Tract 186800
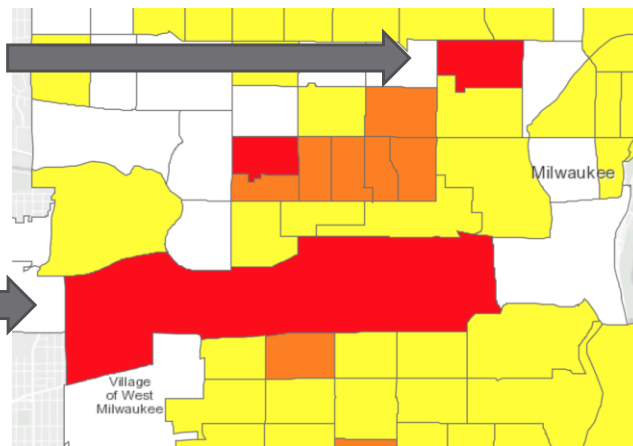
Census Tract 186800 (12)

- Obesity
- Diagnosed Diabetes
- COPD
- Coronary Heart Disease
- Kidney Disease
- No Health Insurance
- Disabilities
- Jobs in Retail
- Jobs in Art, Entertainment
  and Recreation
- Median Income
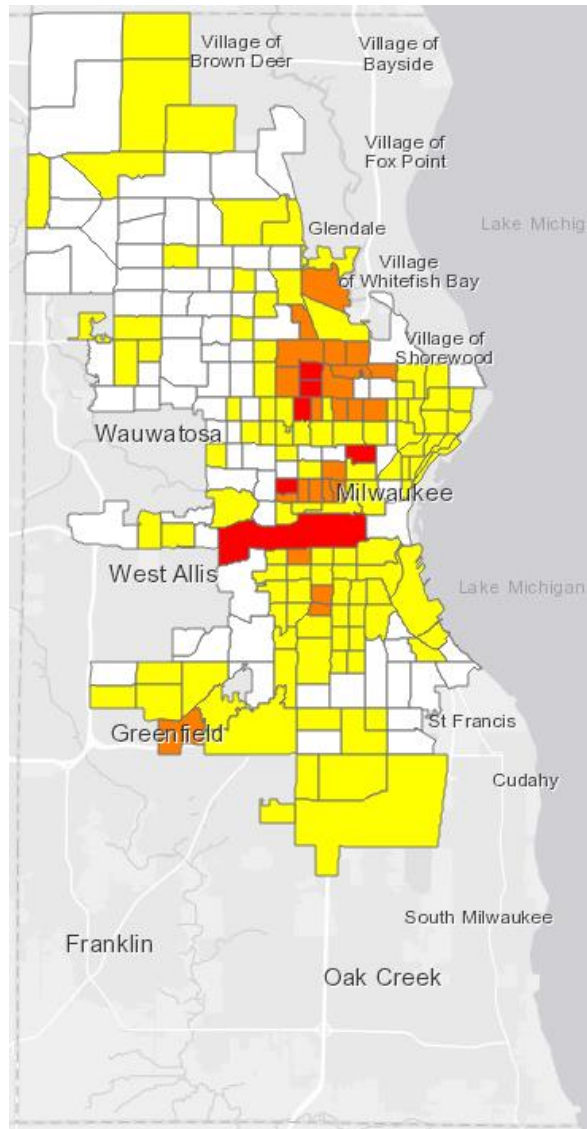- No Access to Vehicle
- No Access to Internet

Census Tract 186000 (11)

- Obesity
- Diagnosed Diabetes
- COPD
- Coronary Heart Disease
- Kidney Disease
- Age Over 65
- Disabilities
- Median Income
- No Access to Vehicle
- No High School Diploma
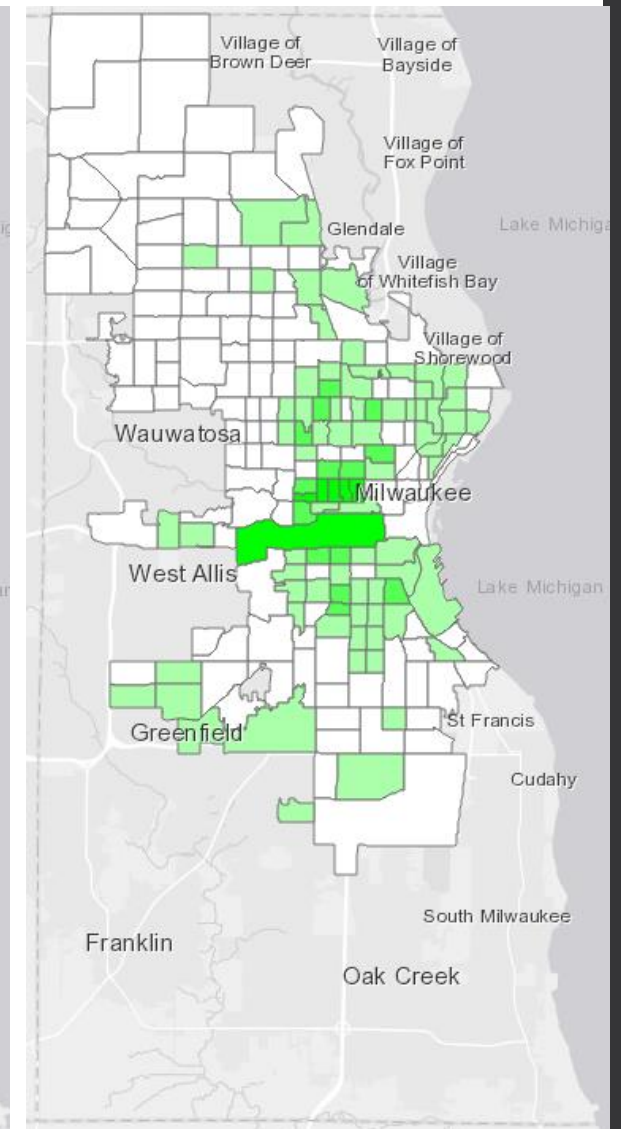- No Access to Internet
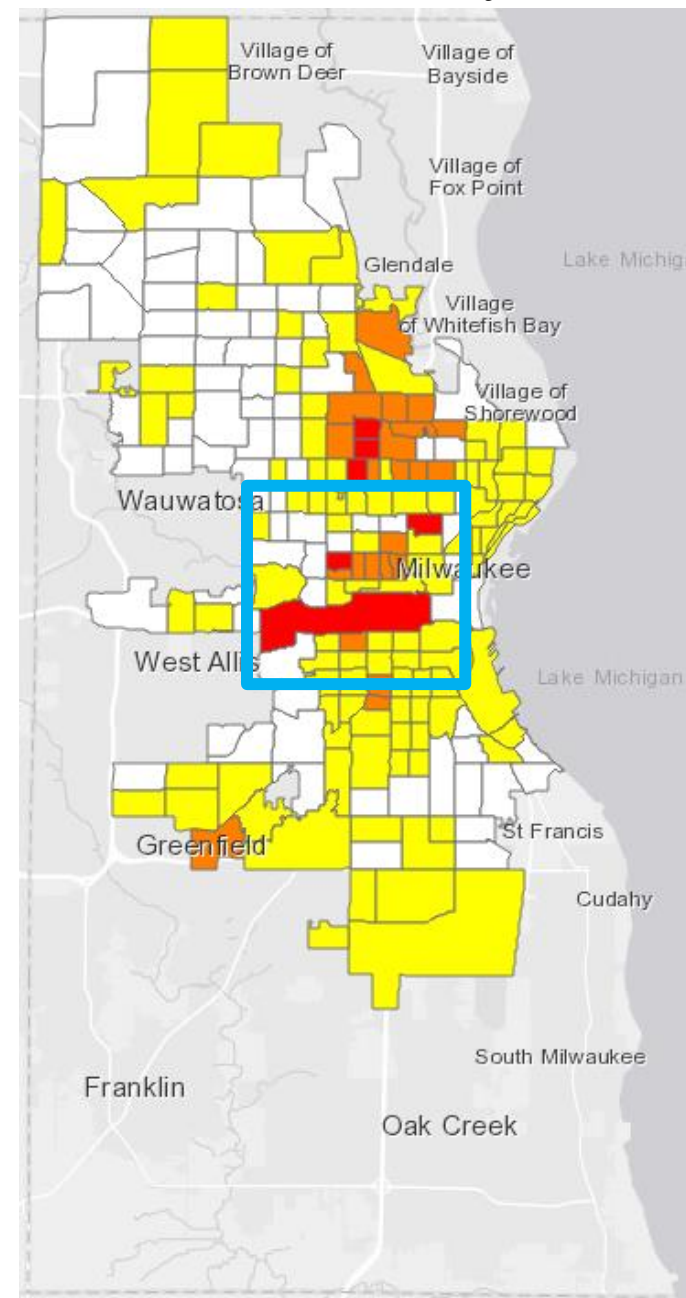
Results

Total Vulnerability Index

Health Vulnerability Index
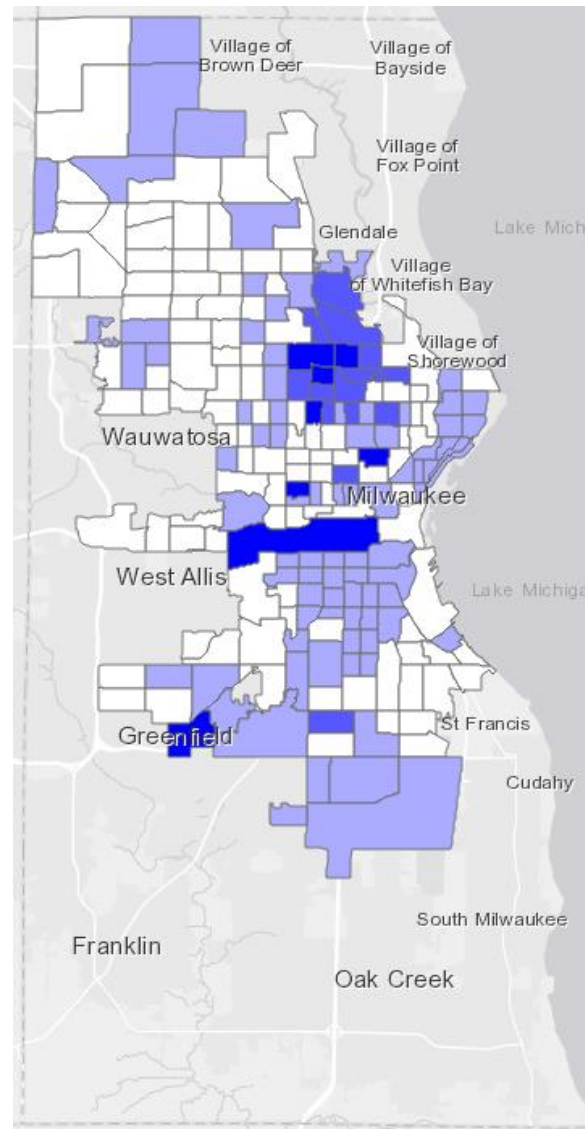
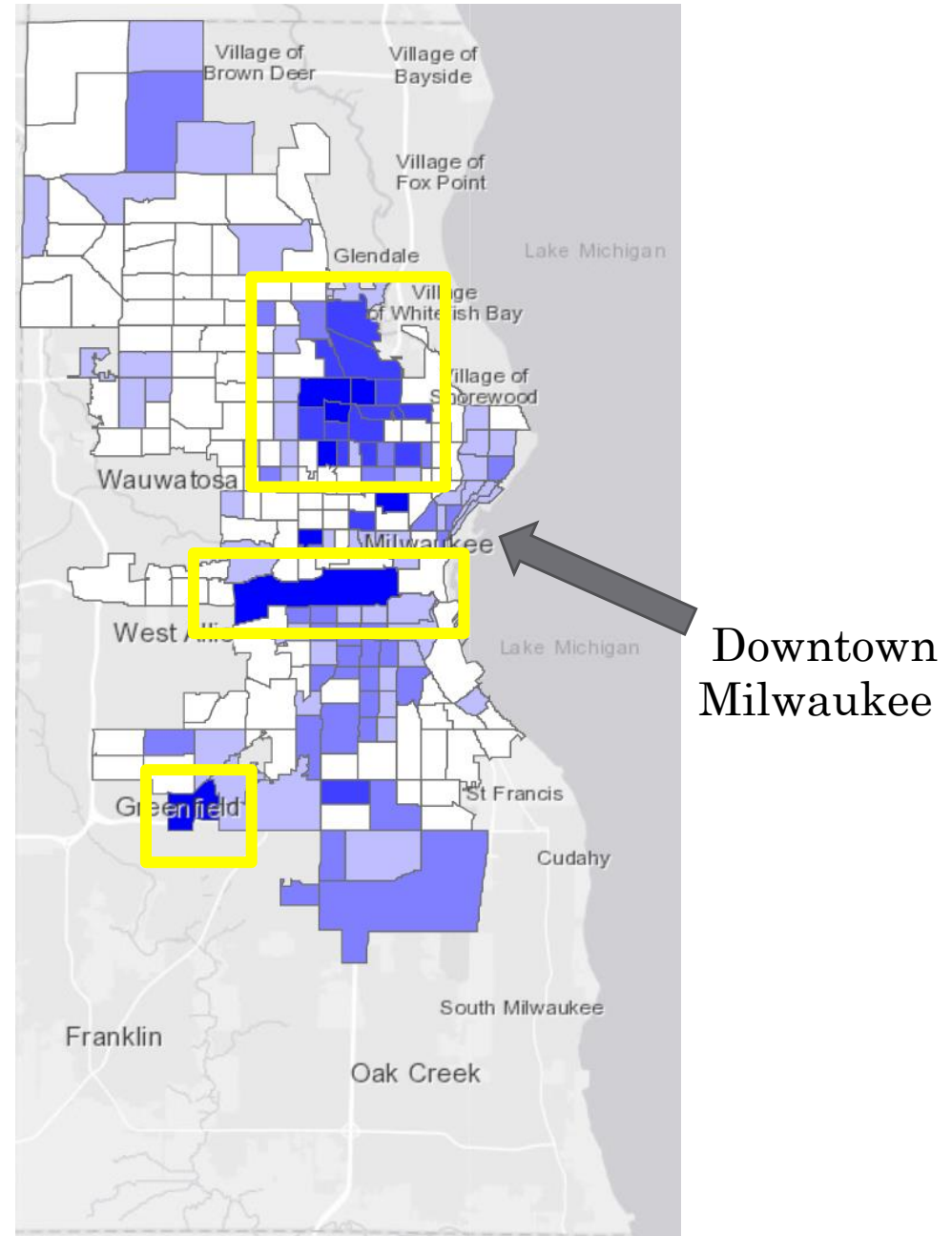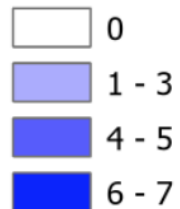Economic Vulnerability Index

Results & Discussion

HEALTH VULNERABILITY INDEX

Of the 212 census tracts in the City of Milwaukee, 104 were flagged as having health vulnerabilities.

8 census tracts had between 6 - 7 flags, 14 census tracts had between 4 - 5 flags, 82 census tracts had between 1 - 3 flags, and 108 census tracts had 0 flags.
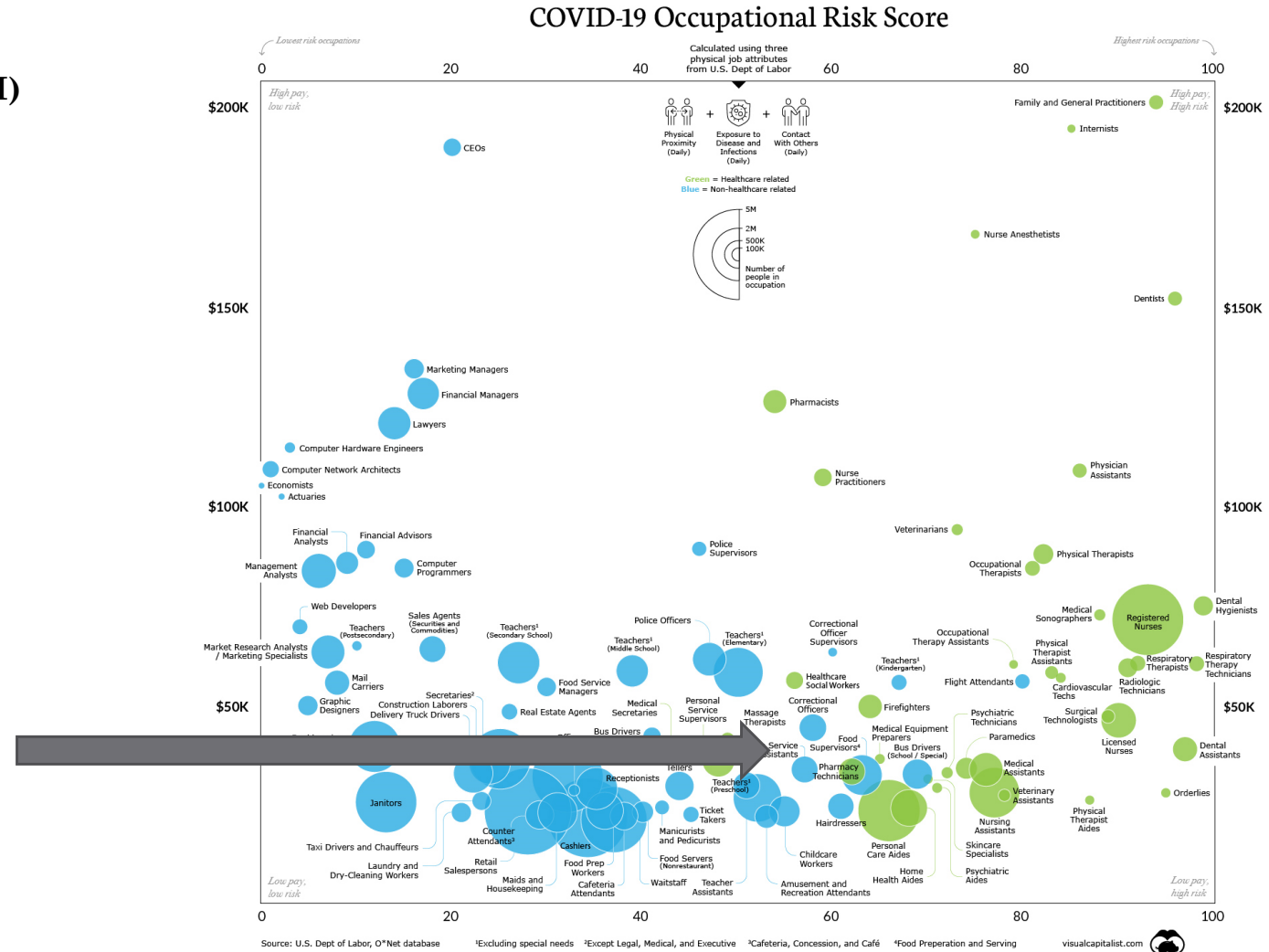
Flags

☐	0
▨	1 - 3
▨	4 - 5
▨	6 - 7

Downtown Milwaukee

Results & Discussion

HEALTH VULNERABILITY INDEX

HEALTH VULNERABILITY INDEX (HVI)

- Pre-Existing Conditions
  - Obesity
  - Diagnosed Diabetes
  - COPD
  - Coronary Heart Disease
  - Kidney Disease

- Demographic Contributors
  - Age Over 65
    - Male
    - No Health Insurance
    - Disabilities

- Increased Exposure Risk
  - Job in Health Care and Social Assistance
  - Population Density

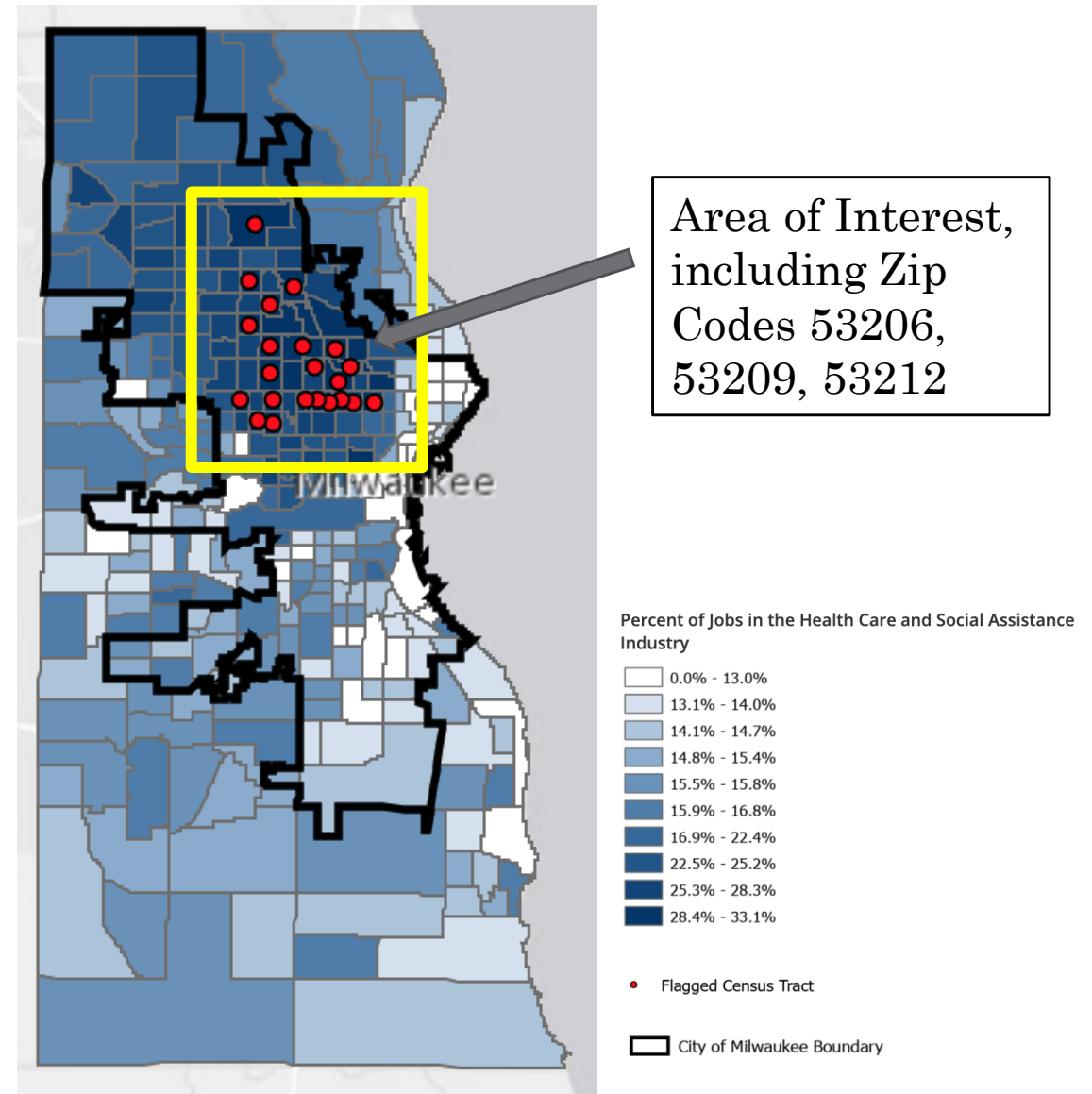COVID-19 Occupational Risk Score

Results & Discussion

HEALTH VULNERABILITY INDEX

HEALTH VULNERABILITY INDEX (HVI)

- Pre-Existing Conditions
  - Obesity
  - Diagnosed Diabetes
  - COPD
  - Coronary Heart Disease
  - Kidney Disease

- Demographic Contributors
  - Age Over 65
  - Male
  - No Health Insurance
  - Disabilities

- Increased Exposure Risk
 - Job in Health Care and Social Assistance
  - Population Density

Area of Interest, including Zip Codes 53206, 53209, 53212

Percent of Jobs in the Health Care and Social Assistance Industry

- 0.0% - 13.0%
- 13.1% - 14.0%
- 14.1% - 14.7%
- 14.8% - 15.4%
- 15.5% - 15.8%
- 15.9% - 16.8%
- 16.9% - 22.4%
- 22.5% - 25.2%
- 25.3% - 28.3%
- 28.4% - 33.1%

• Flagged Census Tract

☐ City of Milwaukee Boundary

Results & Discussion
ECONOMIC VULNERABILITY

Of the 212 census tracts in the City of Milwaukee, 90 were flagged as having economic vulnerabilities.

6 census tracts had between 5 - 6 flags, 14 census tracts had between 3 - 4 flags, 70 census tracts had between 1 - 2 flags, and 122 census tracts had 0 flags.
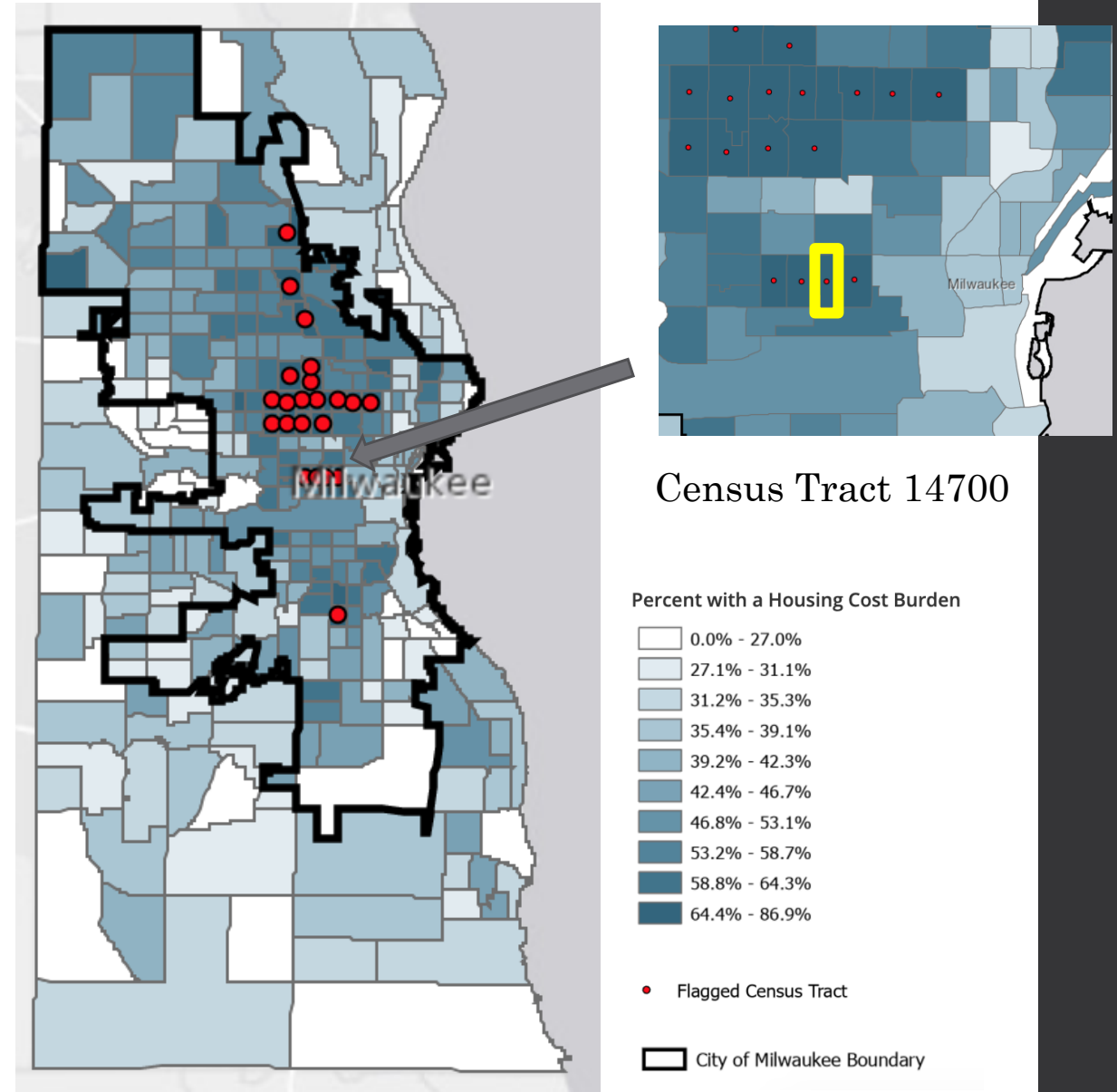
Flags

☐	0
☐	1 - 2
☐	3 - 4
☐	5 - 6
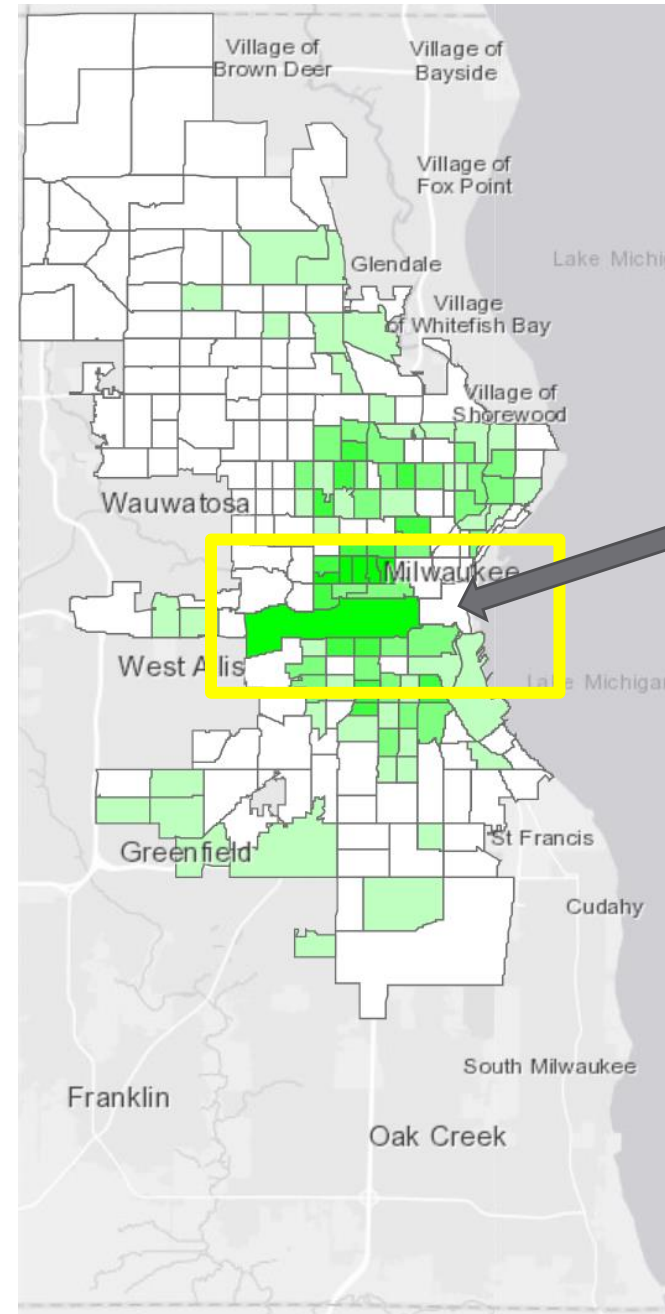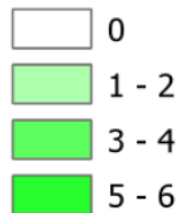
Area of interest, surrounding Menomonee River Valley

Results & Discussion
ECONOMIC VULNERABILITY

ECONOMIC VULNERABILITY INDEX (EVI)

- Works in Highly Affected Industry
  - Jobs in Retail Trade
  - Jobs in Arts, Entertainment, and Recreation
  - Job in Accomodation and Food Services

- Existing Economic Vulnerabilities
  - Housing Cost Burden
  - Median Income

- Employment Accessibility
  - No Access to Vehicle
 - No Internet Access
  - No High School Diploma

Census Tract 14700

Percent with a Housing Cost Burden

- 0.0% - 27.0%
- 27.1% - 31.1%
- 31.2% - 35.3%
- 35.4% - 39.1%
- 39.2% - 42.3%
- 42.4% - 46.7%
- 46.8% - 53.1%
- 53.2% - 58.7%
- 58.8% - 64.3%
- 64.4% - 86.9%

• Flagged Census Tract

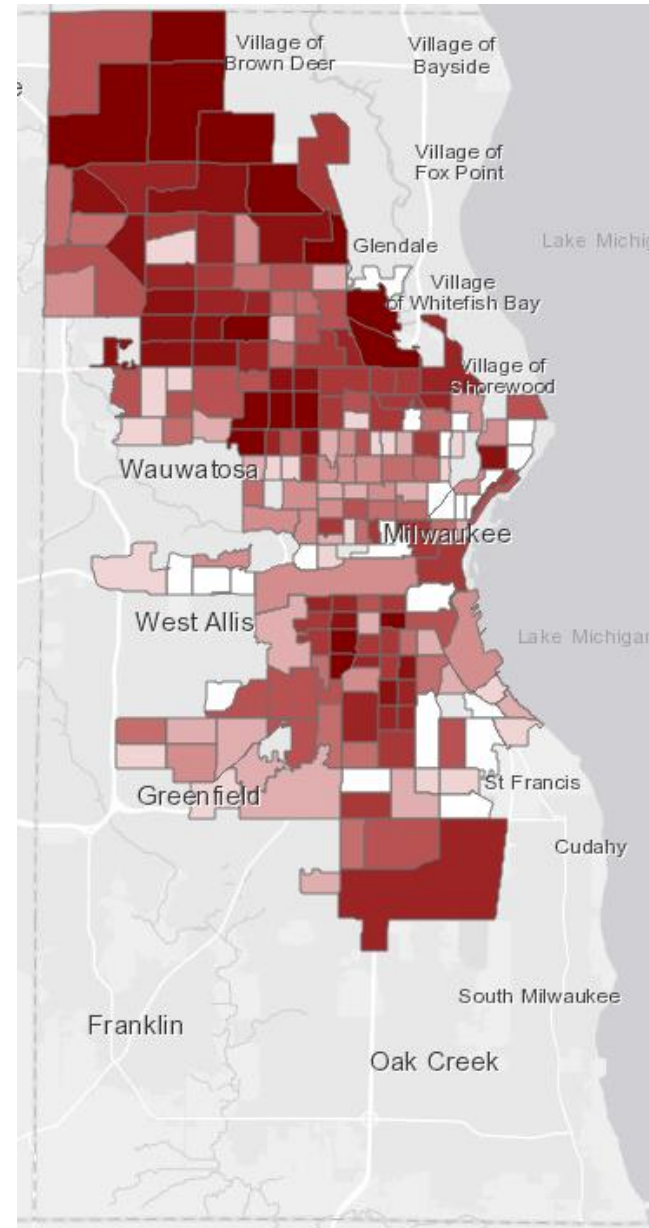☐ City of Milwaukee Boundary

Results & Discussion

COMPARISON TO COVID-19 CASES

As of April 22, 2020, the City of Milwaukee had 1,741 COVID-19 cases and Milwaukee County had 2,357 COVID-19 cases.
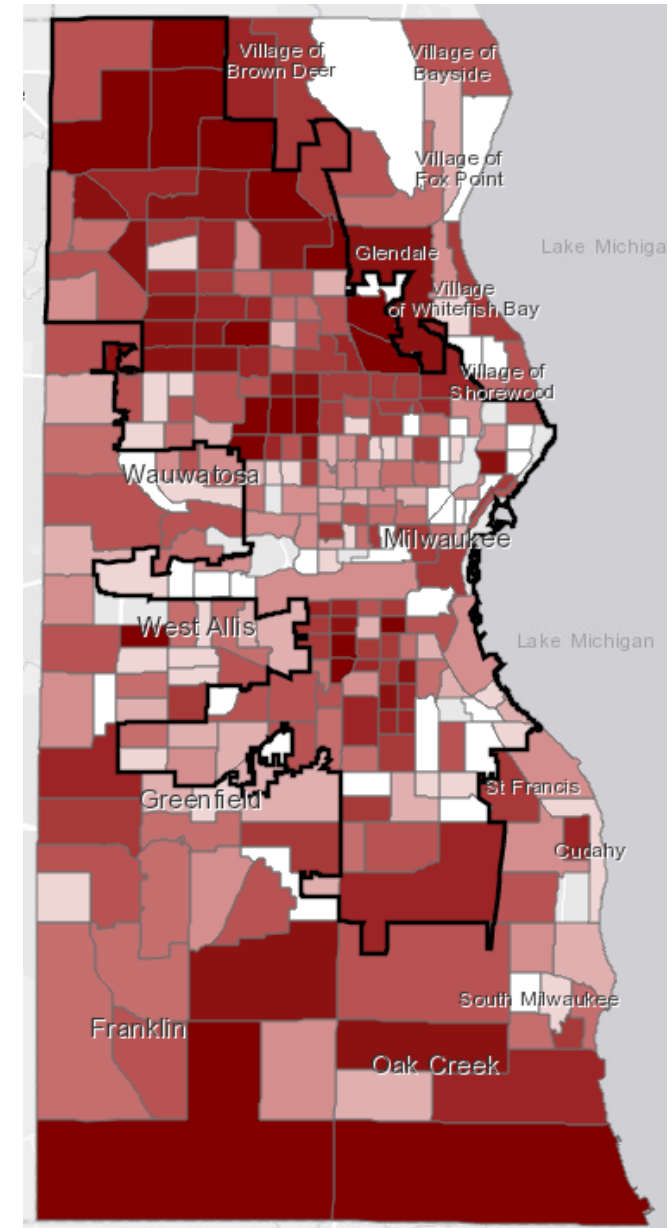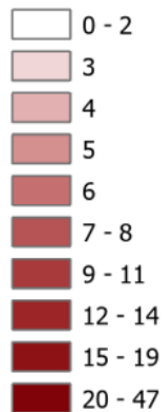
Cases

- 0 - 2
- 3
- 4
- 5
- 6
- 7 - 8
- 9 - 11
- 12 - 14
- 15 - 19
- 20 - 47
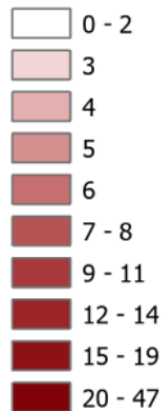
City of Milwaukee Boundary

City of Milwaukee
COVID-19 Cases

Milwaukee County
COVID-19 Cases
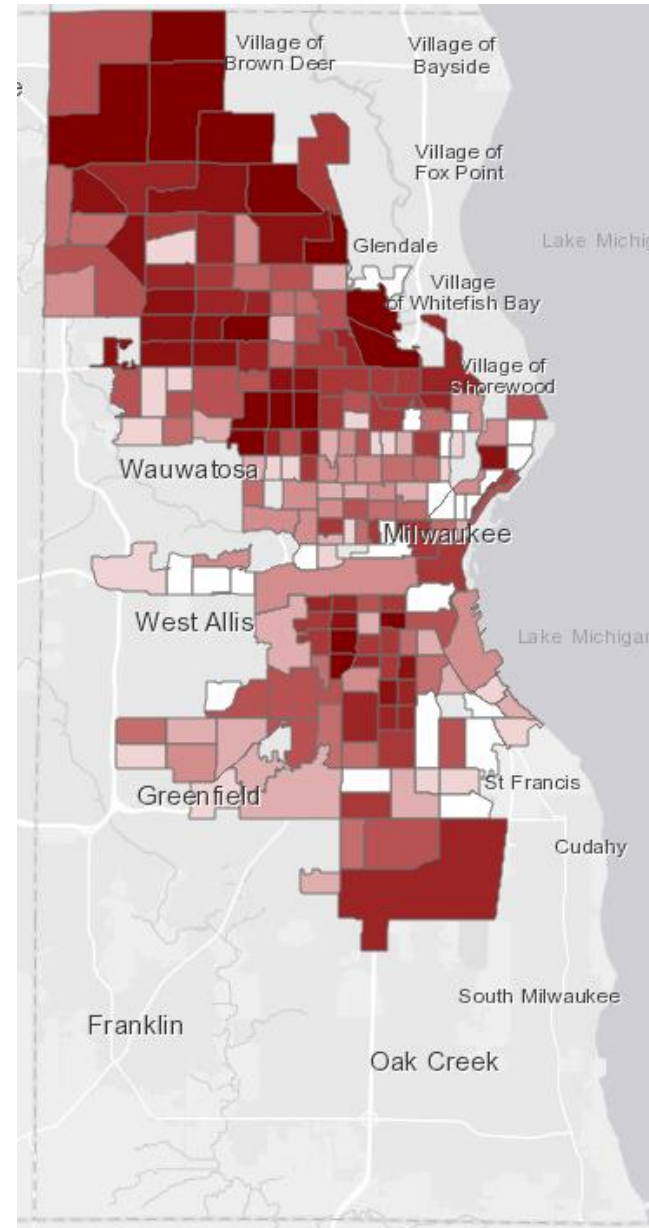
Results & Discussion

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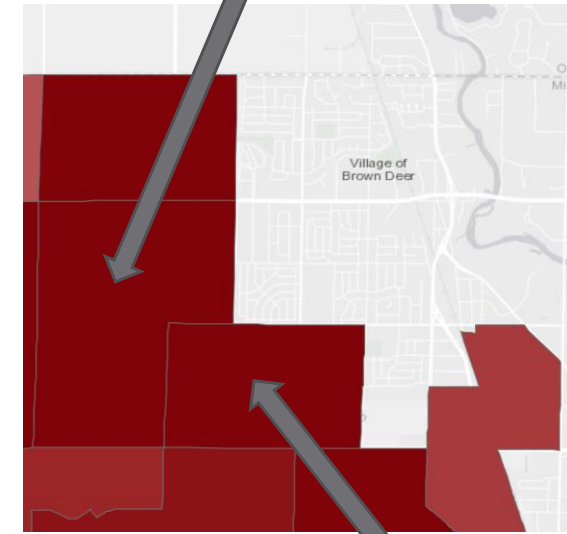
City of Milwaukee COVID-19 Cases

Cases
- 0 - 2
- 3
- 4
- 5
- 6
- 7 - 8
- 9 - 11
- 12 - 14
- 15 - 19
- 20 - 47

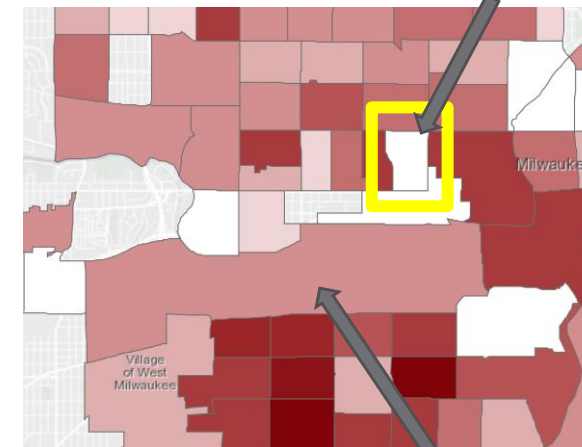☐ City of Milwaukee Boundary

Census Tract 102

Census Tract 700

Census Tract 186000

Census Tract 186800

Results and Discussion
SOCIODEMOGRAPHIC CHARACTERISTICS

- Race and Ethnicity

- Language Spoken

- Households with Elderly

- Households with Children

- Occupants Per Room

- Owner or Renter

- Public vs Private Health Insurance

- High Poverty

Multigenerational Family in Florissant, MO. Photo Credit: Michael B. Thomas for KHN, April 5, 2020

Results and Discussion
SOCIODEMOGRAPHIC CHARACTERISTICS

**Sociodemographic Profile - City vs. Most Vulnerable Tracts (7+ flags)**

	White	Black	Hispanic/Latino	Asian	Am. Indian	Other	Lack English Proficiency	Households w/ Children
City	45.47%	40.72%	18.78%	4.71%	1.60%	7.66%	7.53%	31.46%
Tracts w/ 7+ Flags	30.37%	57.28%	19.54%	1.72%	1.36%	8.89%	8.67%	27.58%

	Households w/ Elderly	w/o High School Diploma or GED	Home Owner	Renter	Poverty	>1 per Room	w/ Private Health Insurance	w/ Public Health Insurance
City	20.18%	10.21%	42.05%	57.95%	20.80%	3.17%	54.14%	44.59%
Tracts w/ 7+ Flags	23.34%	16.47%	24.25%	75.75%	42.35%	2.65%	38.36%	57.27%

Results and Discussion
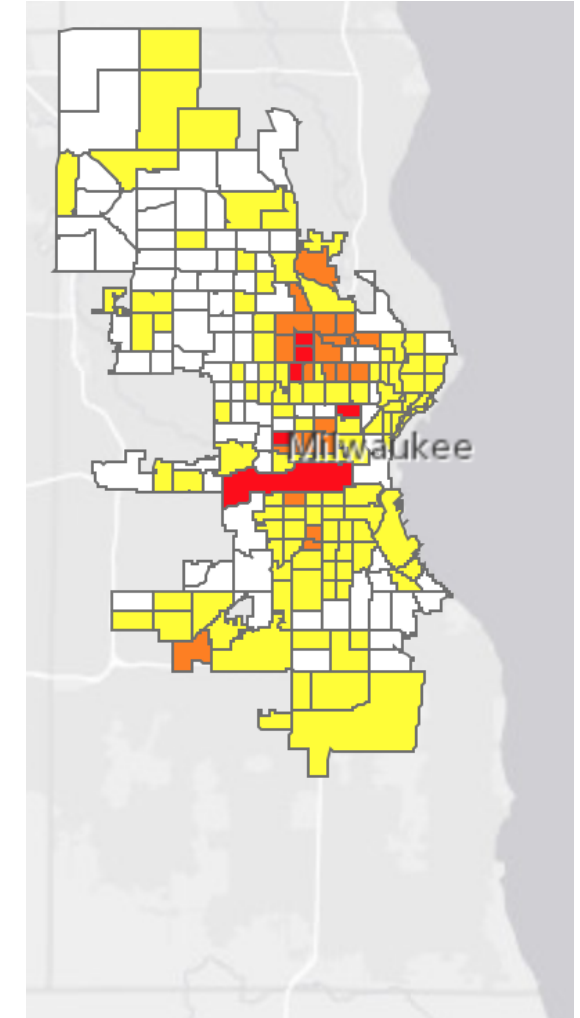## SOCIODEMOGRAPHIC CHARACTERISTICS

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- Language Spoken

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- Occupants Per Room

- Owner or Renter

- Public vs Private Health Insurance

- High Poverty
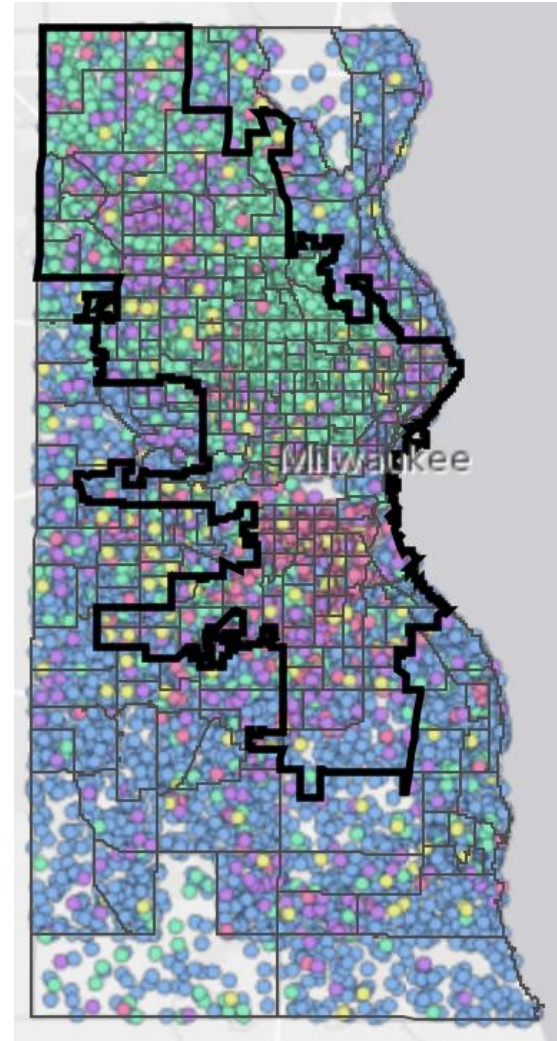
1 Dot = 75 People

- American Indian
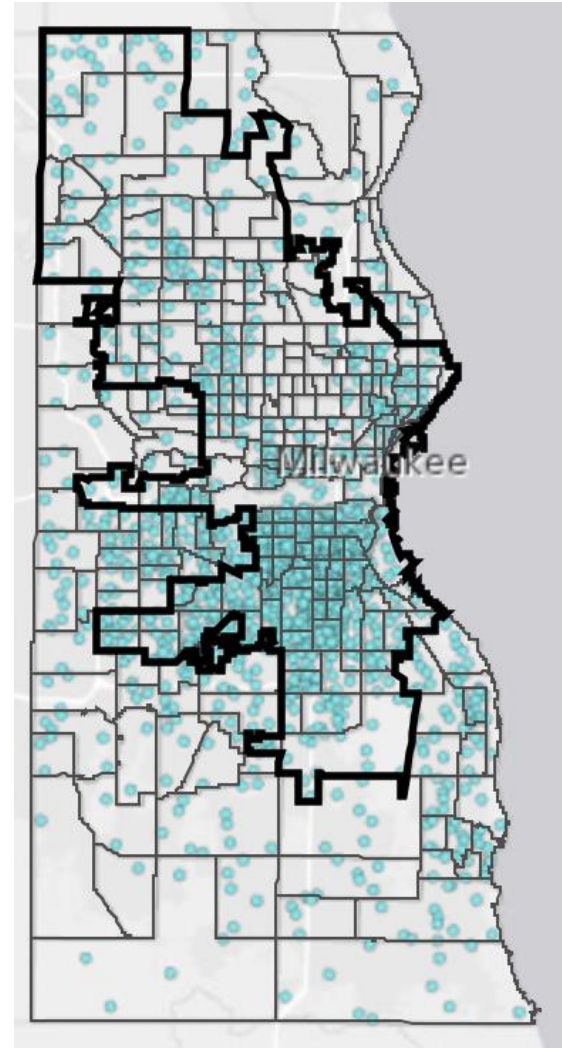- Asian
- Black
- Other
- White

City of Milwaukee Boundary

Results and Discussion
SOCIODEMOGRAPHIC CHARACTERISTICS

- Race and Ethnicity

- Language Spoken

- Households with Elderly

- Households with Children

- Occupants Per Room

- Owner or Renter

- Public vs Private Health Insurance

- High Poverty

1 Dot = 75 People

• Hispanic

☐ City of Milwaukee Boundary

Results and Discussion
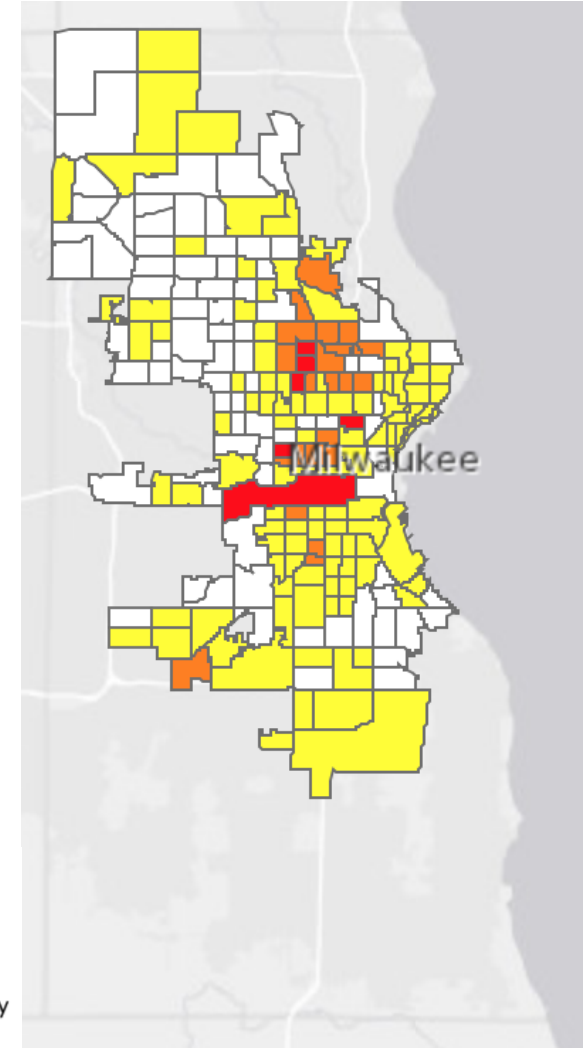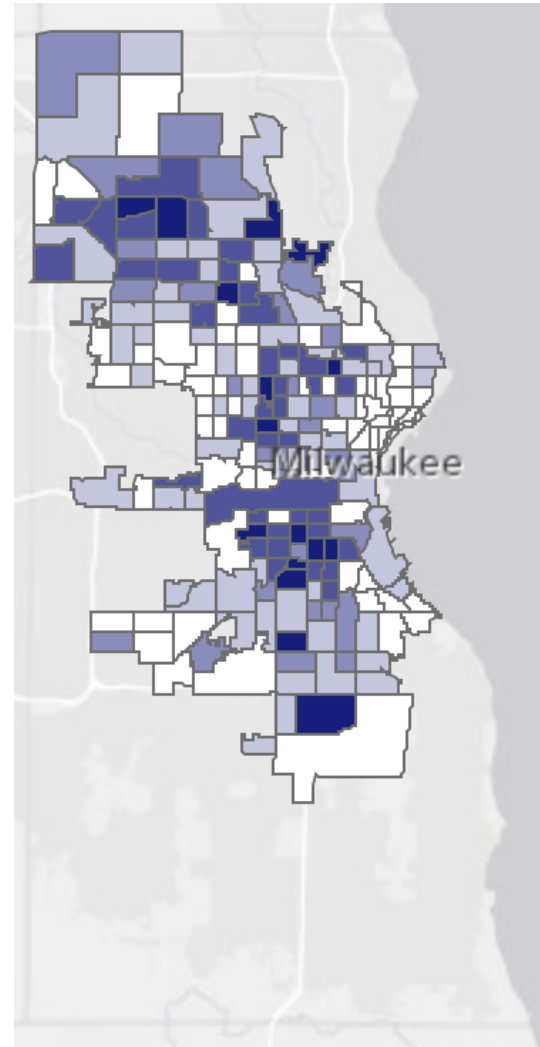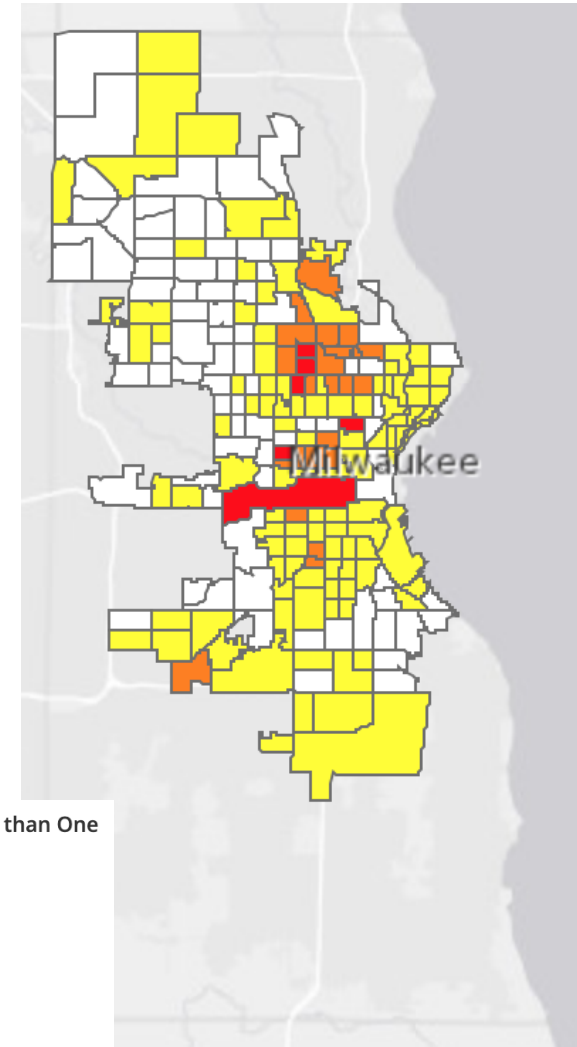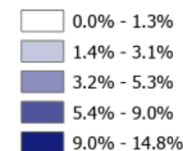## SOCIODEMOGRAPHIC CHARACTERISTICS

- Race and Ethnicity

- Language Spoken

- Households with Elderly

- Households with Children

- Occupants Per Room

- Owner or Renter

- Public vs Private Health Insurance

- High Poverty

Percent of Households with More than One Occupant per Room

- 0.0% - 1.3%
- 1.4% - 3.1%
- 3.2% - 5.3%
- 5.4% - 9.0%
- 9.0% - 14.8%
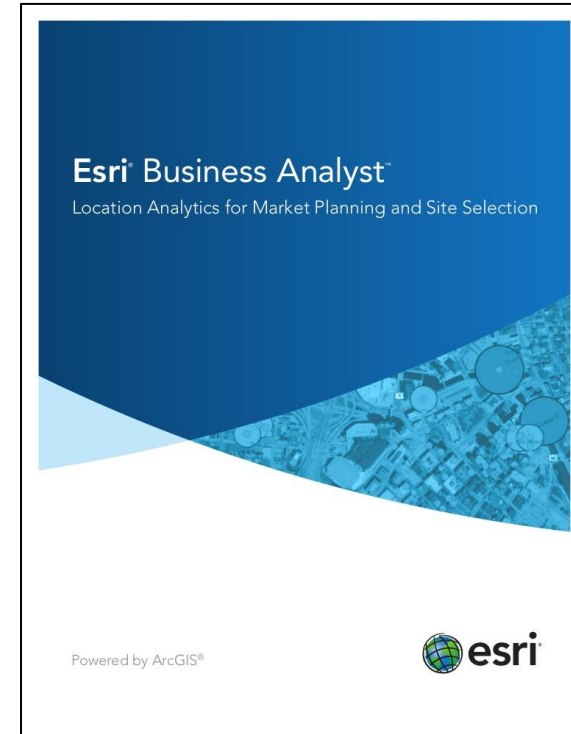
Results & Discussion

ESRI Business Analyst Wisconsin Businesses
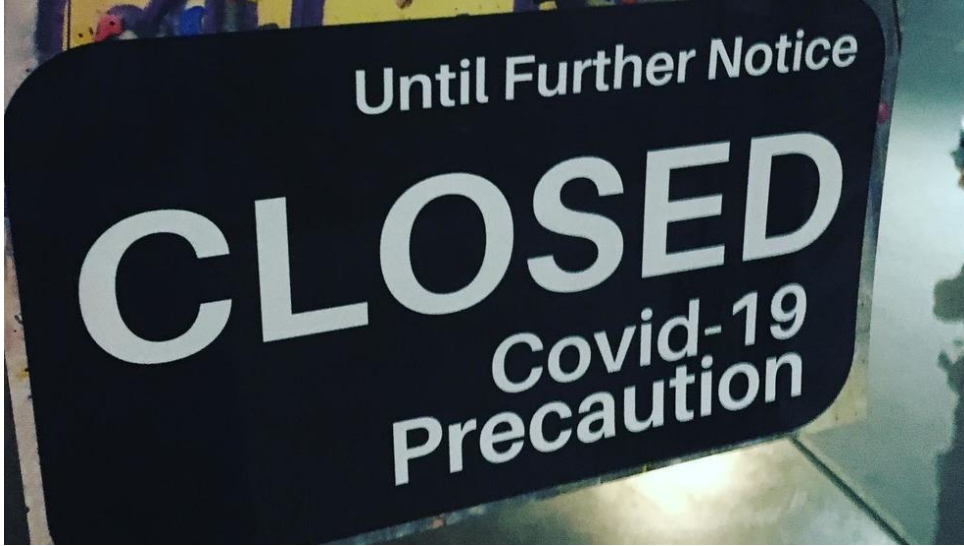
Business closed sign in Kalamazoo, MI. Photo Credit: Jason Puhr for WWWT March 18, 2020

- Business Analyst dataset for Milwaukee County: 30,393 records total

- Selected subset of businesses likely to be closed: 4,481 records

- About 14.7% of businesses are likely directly affected

Results & Discussion

Many small businesses with 0-4 employees are affected by Safer at Home.

Closed Businesses
Business Improvement Districts

EVI Index

Density of Employees/Jobs
Value
2588
0.1

Results & Discussion

North Side   South Side
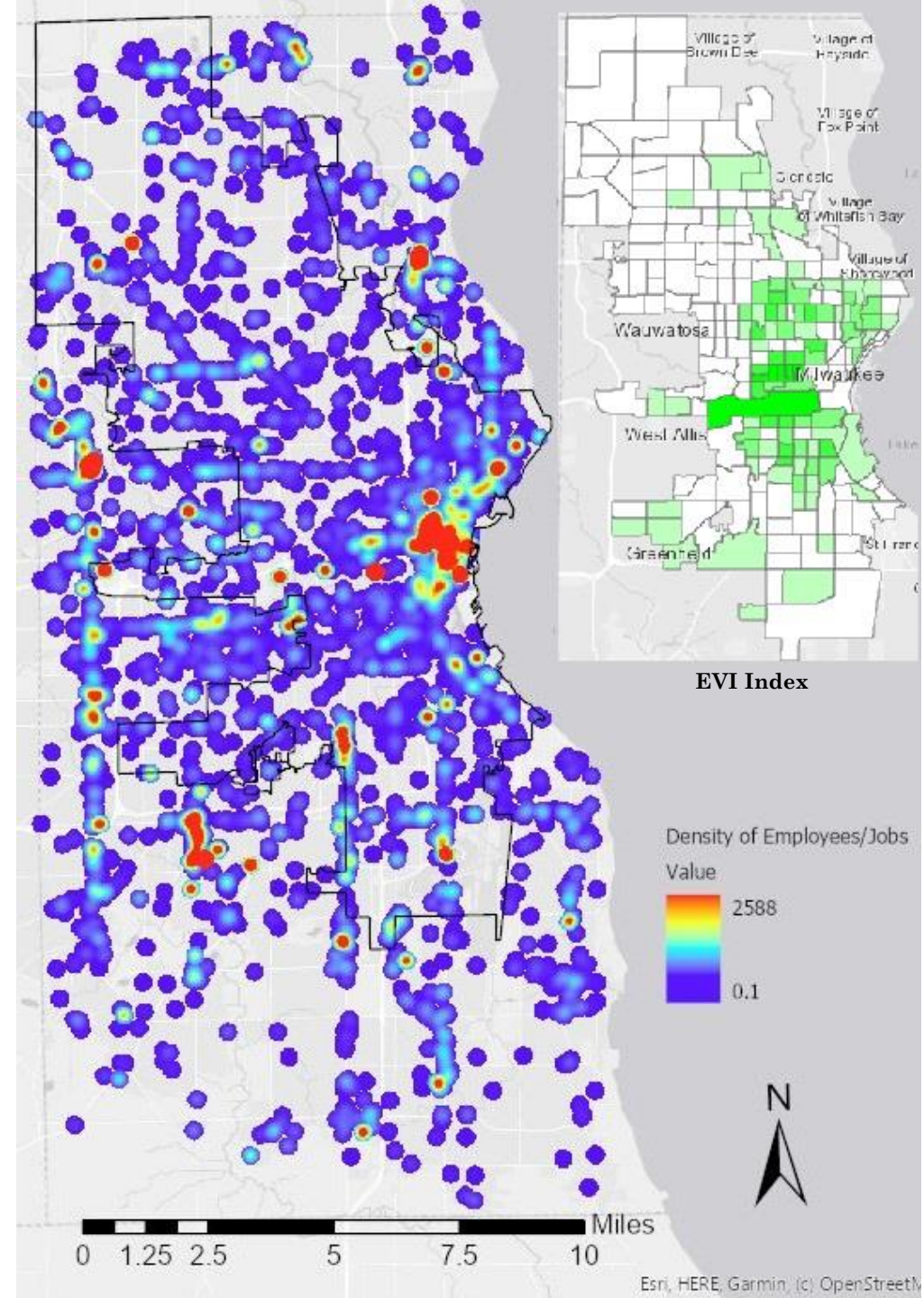
Areas with many violet circles represent areas containing more small businesses.
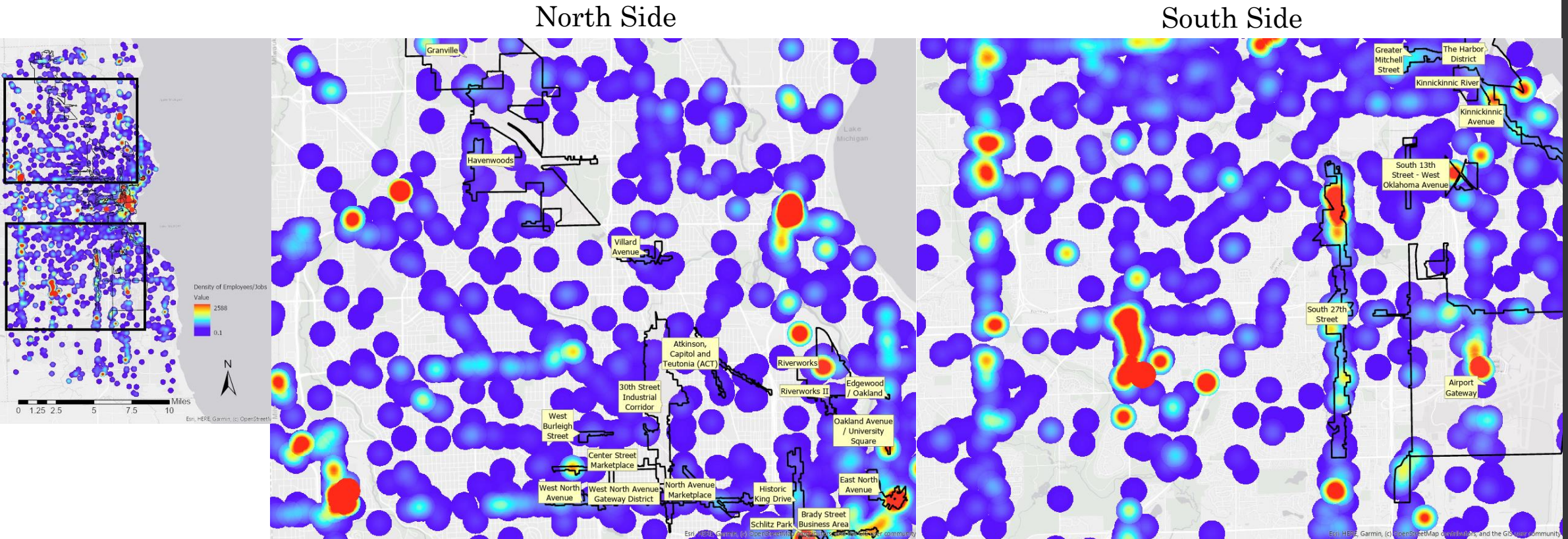
- "...as the majority of COVID-19 rescue loans tie a significant portion of loan forgiveness to employee payments, small and minority-owned businesses without employees are expected to be particularly vulnerable." (Adams, 2020) https://www.marketplace.org/2020/04/07/covid-19-black-owned-businesses/
- Nationally, 96% of Black-owned businesses have no employees.

Limitations

- Covid-19 is a new disease. Research on health risk factors is new, incomplete, and sometimes contradictory.

- Limited testing is occurring.

- Our analysis relied almost entirely on census data. Some areas have lower participation in the census.

- Flagging the top ten percent of each given variable is an arbitrary threshold.

- No demographic data on mortality.

- No air quality or other environmental data.

- No comprehensive list of business closures.

Conclusions
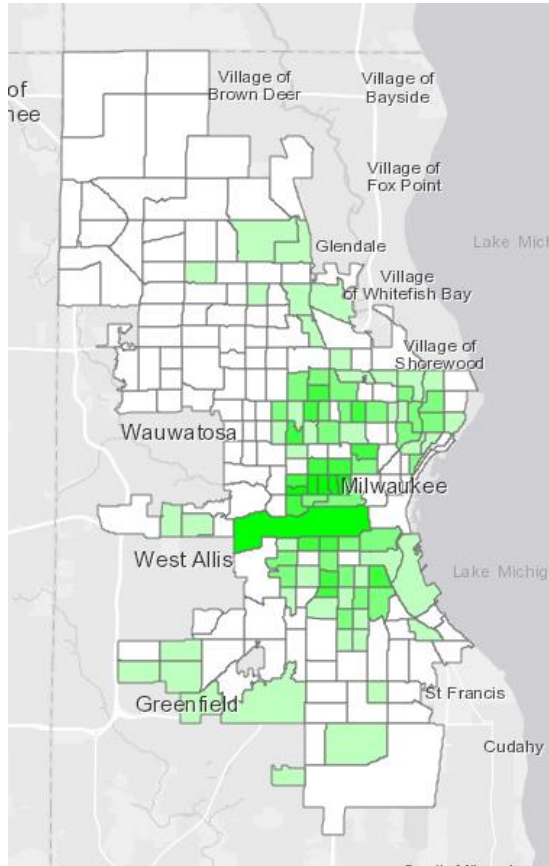
Economic

Significant overlap between tracts with highest economic vulnerability and highest health vulnerability.
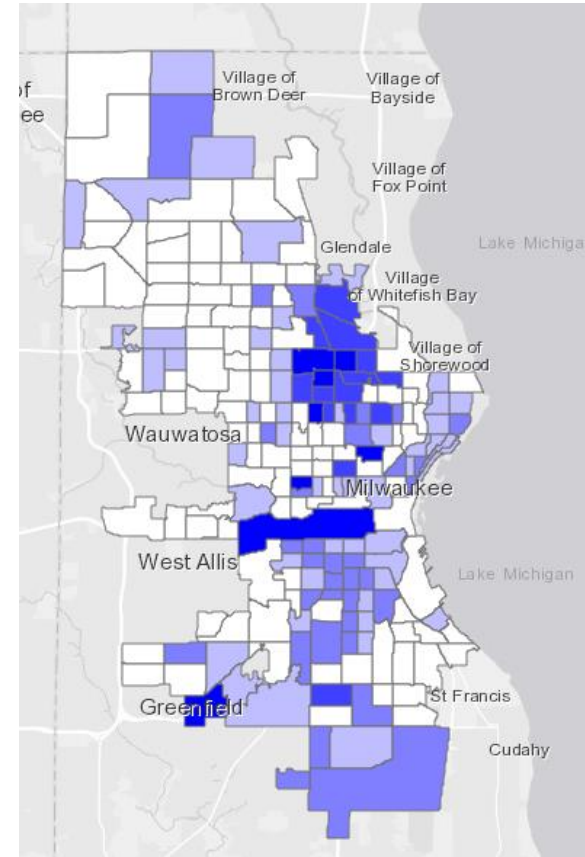
Health

Conclusions

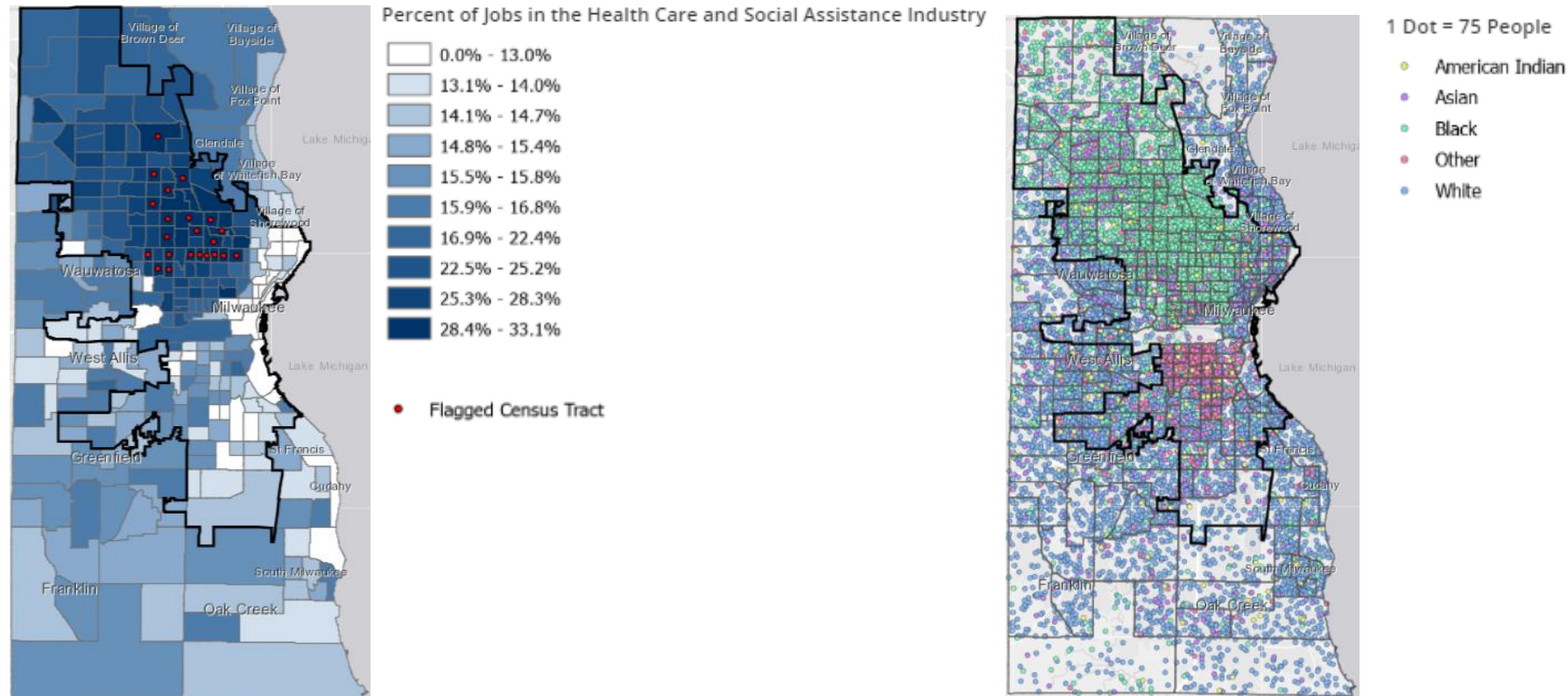• Significant overlap between tracts with 25-32% of workers in Health Care and Social Assistance, and tracts with highest Black population.

• Additional vulnerabilities flags present: Housing Cost Burden above 66.27% of income, Median Income below $21,665, and Pre-Existing Conditions.

Percent of Jobs in the Health Care and Social Assistance Industry

- 0.0% - 13.0%
- 13.1% - 14.0%
- 14.1% - 14.7%
- 14.8% - 15.4%
- 15.5% - 15.8%
- 15.9% - 16.8%
- 16.9% - 22.4%
- 22.5% - 25.2%
- 25.3% - 28.3%
- 28.4% - 33.1%

● Flagged Census Tract

1 Dot = 75 People

- American Indian
- Asian
- Black
- Other
- White

Conclusions

- Significant overlap between tracts with high percentage of people lacking health insurance and high percentage who do not speak English well.
- Additional vulnerabilities present include High Population Density.

Percent with No Health Insurance
- 0.0% - 2.7%
- 2.8% - 3.7%
- 3.8% - 4.7%
- 4.8% - 5.7%
- 5.8% - 6.7%
- 6.8% - 7.8%
- 7.9% - 9.3%
- 9.4% - 11.6%
- 11.7% - 16.5%
- 16.6% - 32.4%

Percent of People Who Do Not Speak English Well
- 0% - 2.9%
- 3% - 6.8%
- 6.9% - 15.2%
- 15.3% - 24.4%
- 24.5% - 36.4%
- City of Milwaukee Boundary