# Breathing Between the Lines

## Methodology

...

Johnathan Padilla, Hadrien Picq

ParsonsTKO-TechSoup Global **2020 Data Strategy Mentorship Program**

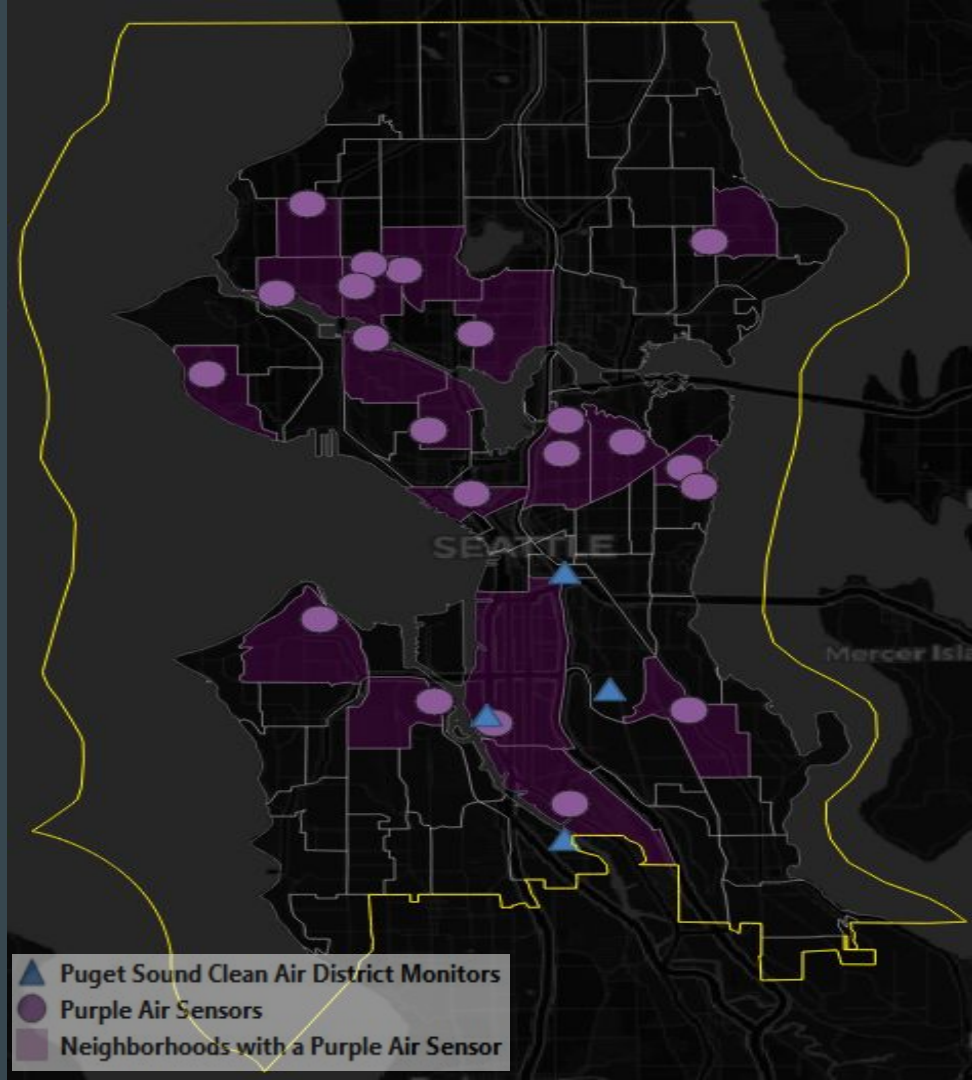
Leveraging Community-Based Participatory Research in air monitoring to identify local burdens of pollution

# Insight #1: Proximity to Purple Air (low-cost) sensors

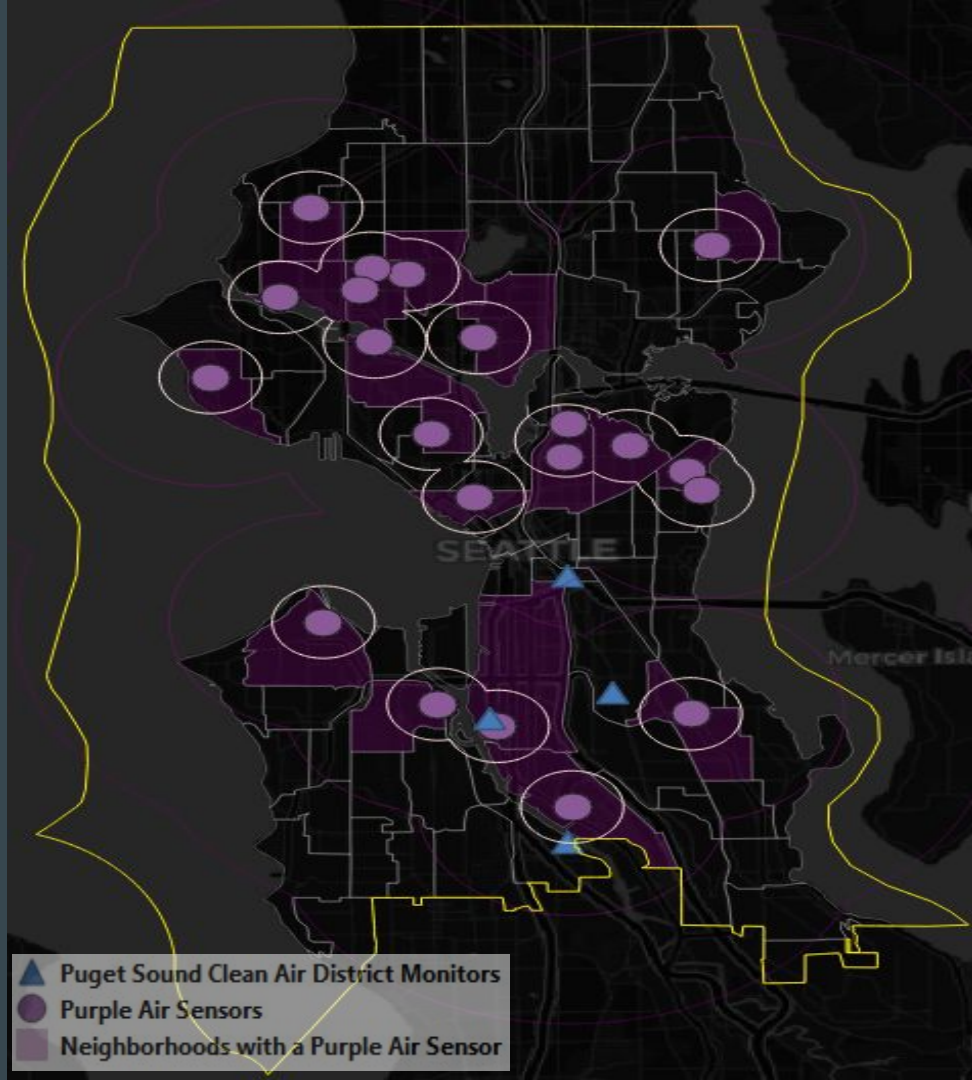
**30%**

of Seattle's population lives within 1,000 m of a Purple Air sensor (2010 Census)

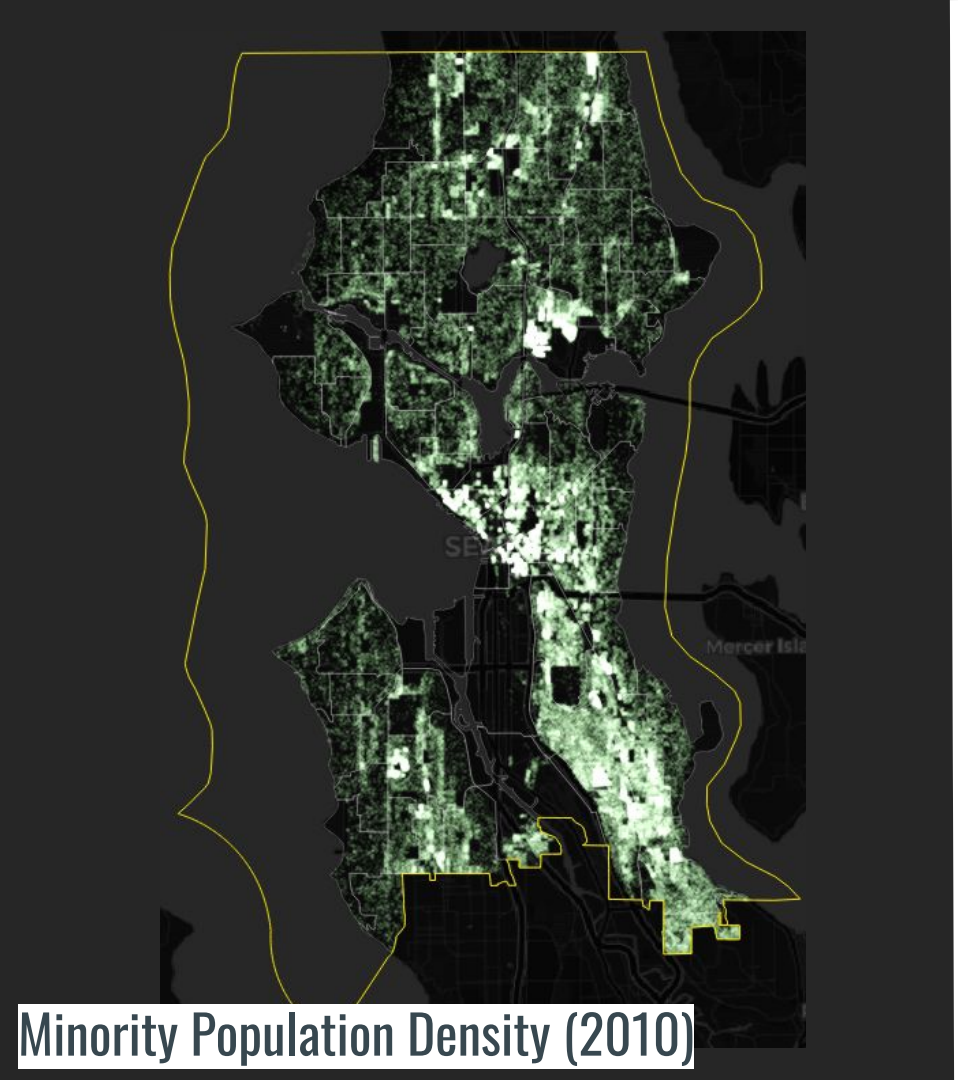
20 sensors across 18 neighborhoods

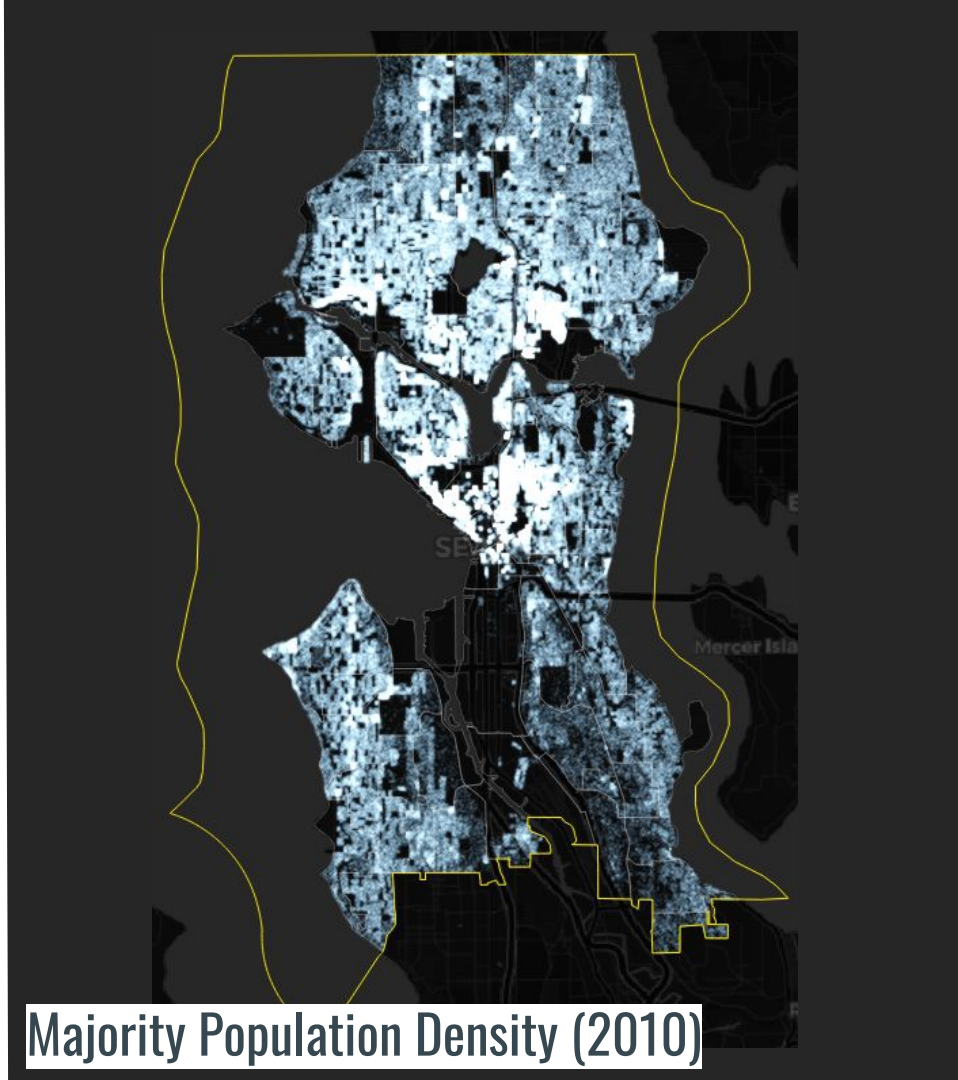


Looking at 1,000 m proximity to a Purple Air sensor

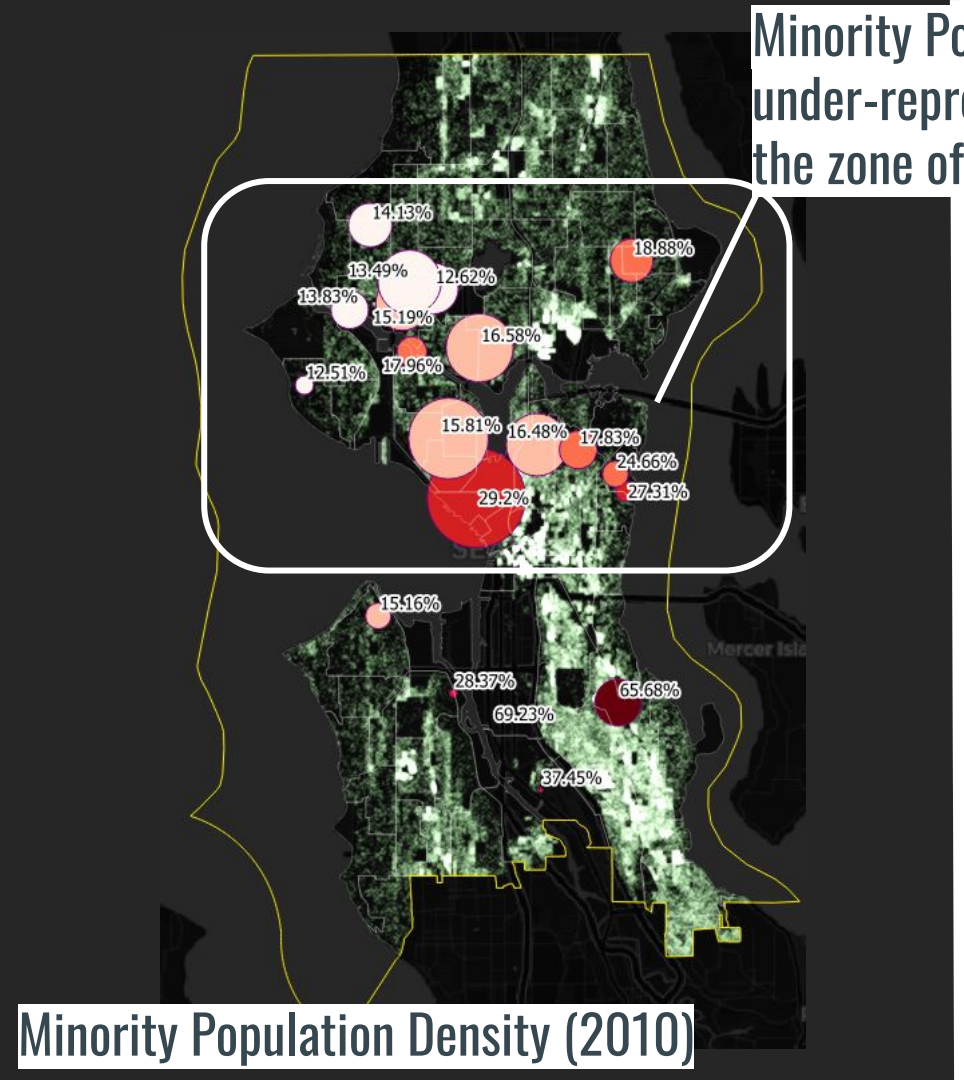


Insight #2: The current distribution of Purple Air does not reflect the representation of Seattle's minority population

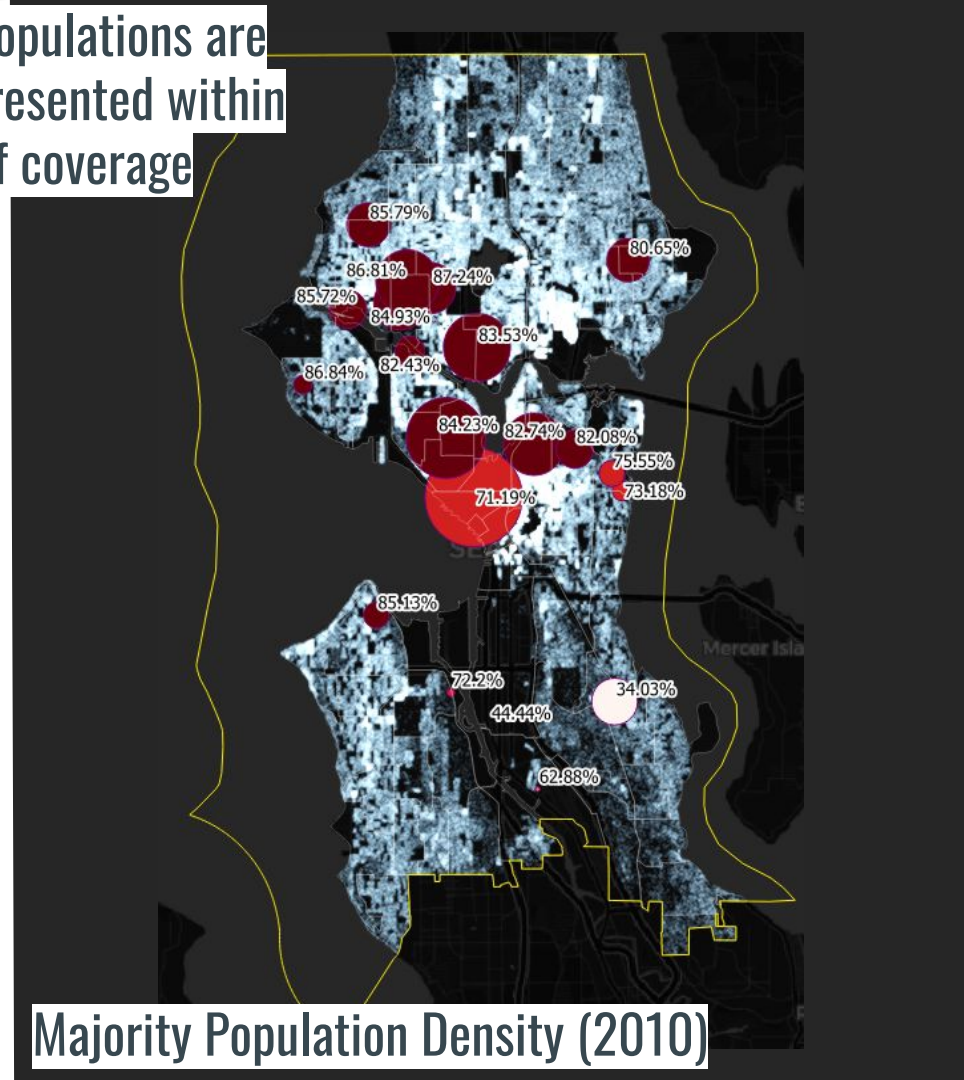

Minority Population Density (2010)


Majority Population Density (2010)

# Minority Populations are under-represented within the zone of coverage

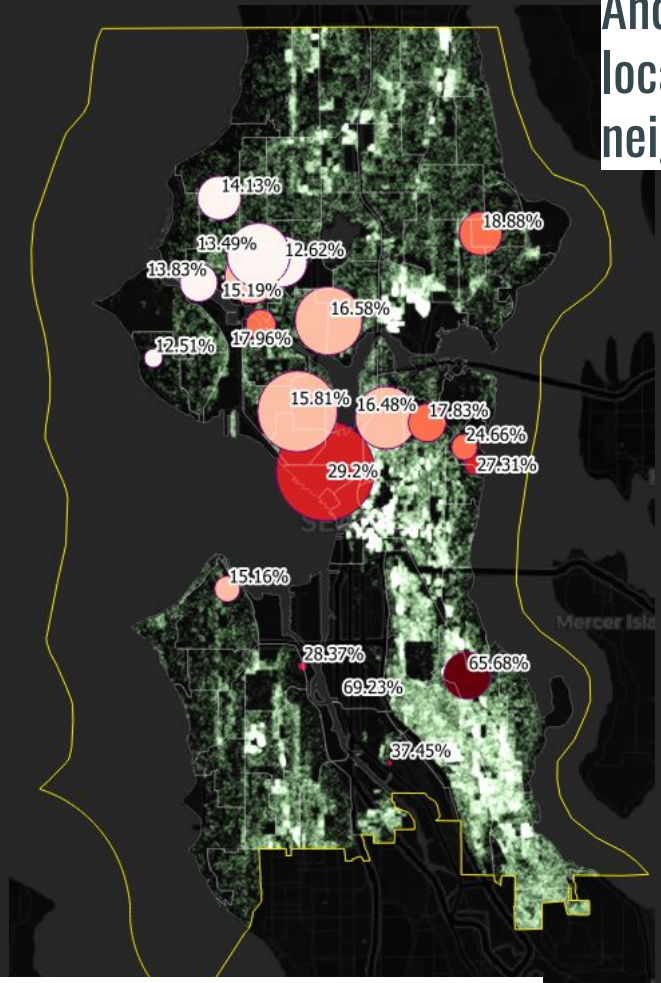



Minority Population Density (2010)

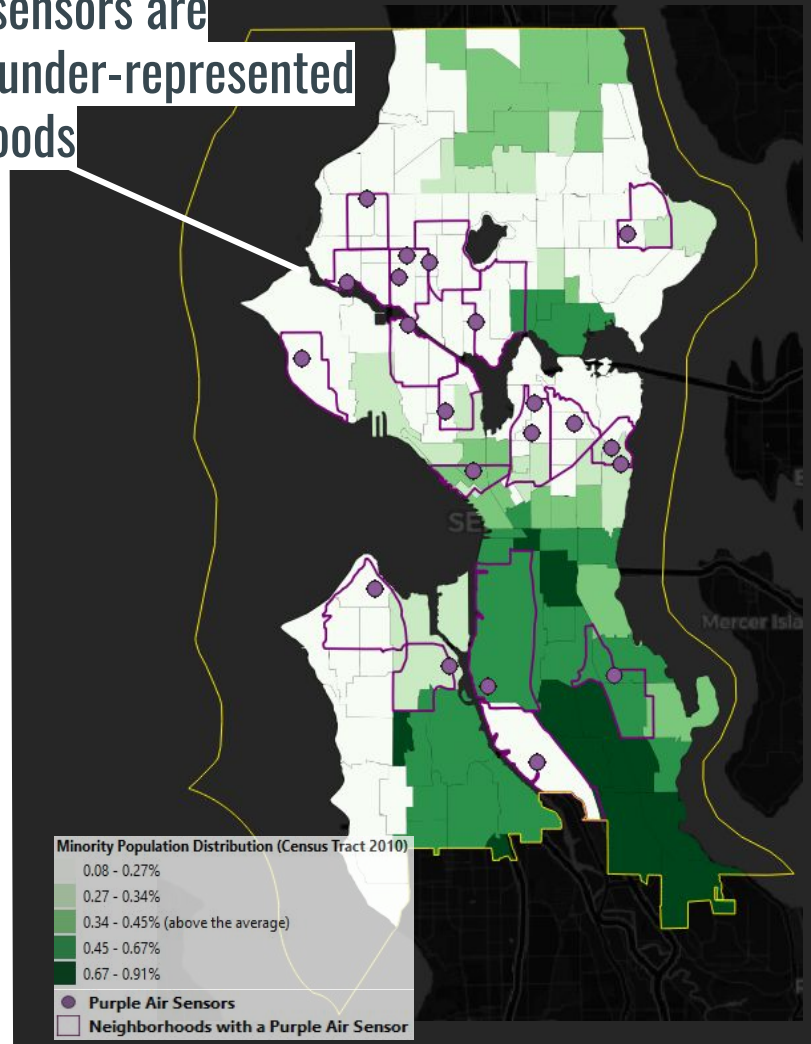



Majority Population Density (2010)

And most sensors are located in under-represented neighborhoods

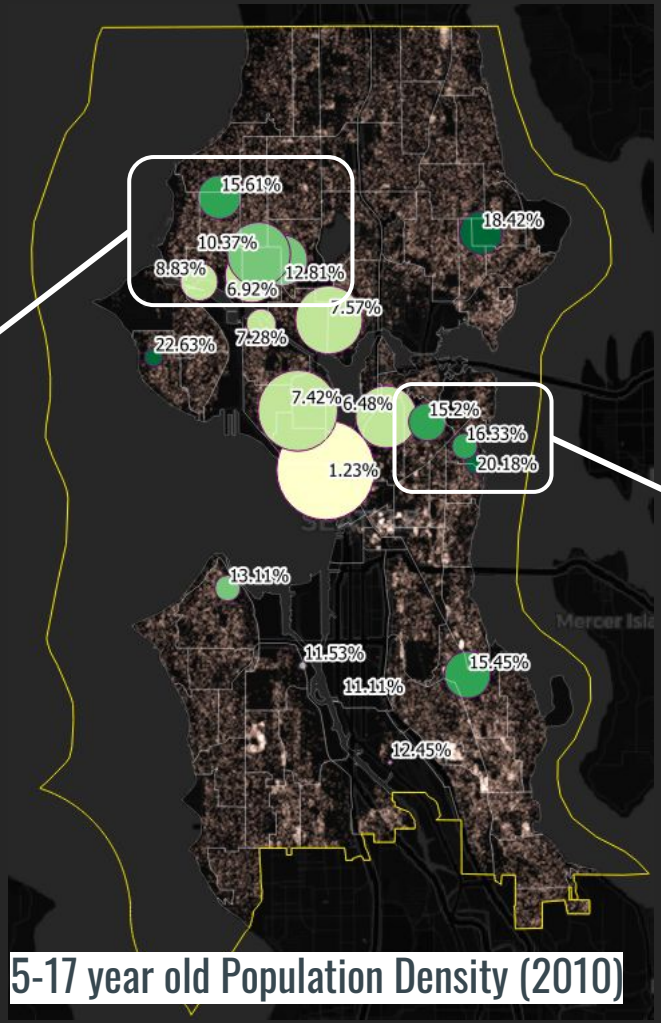



Minority Population Density (2010)



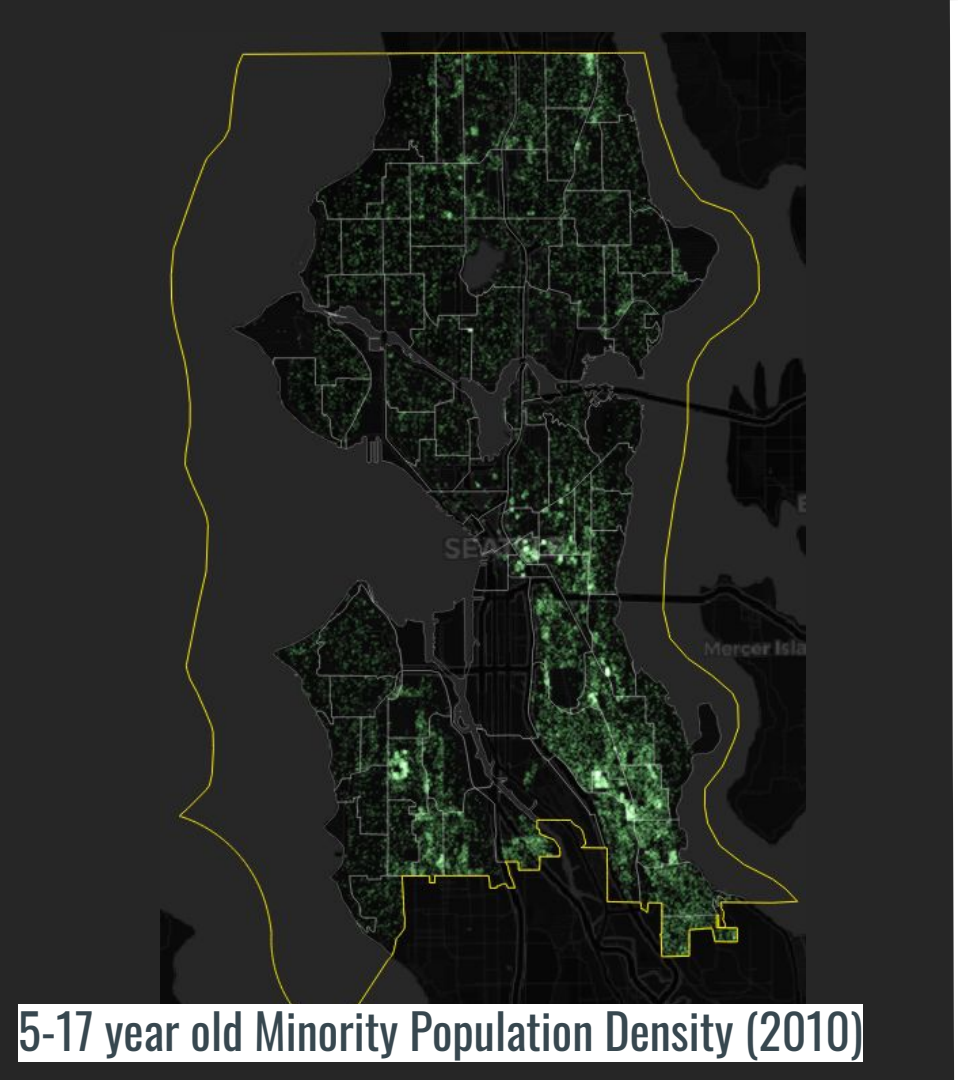
5-17 year old Population Density (2010)

Adequate representation in Ballard District area

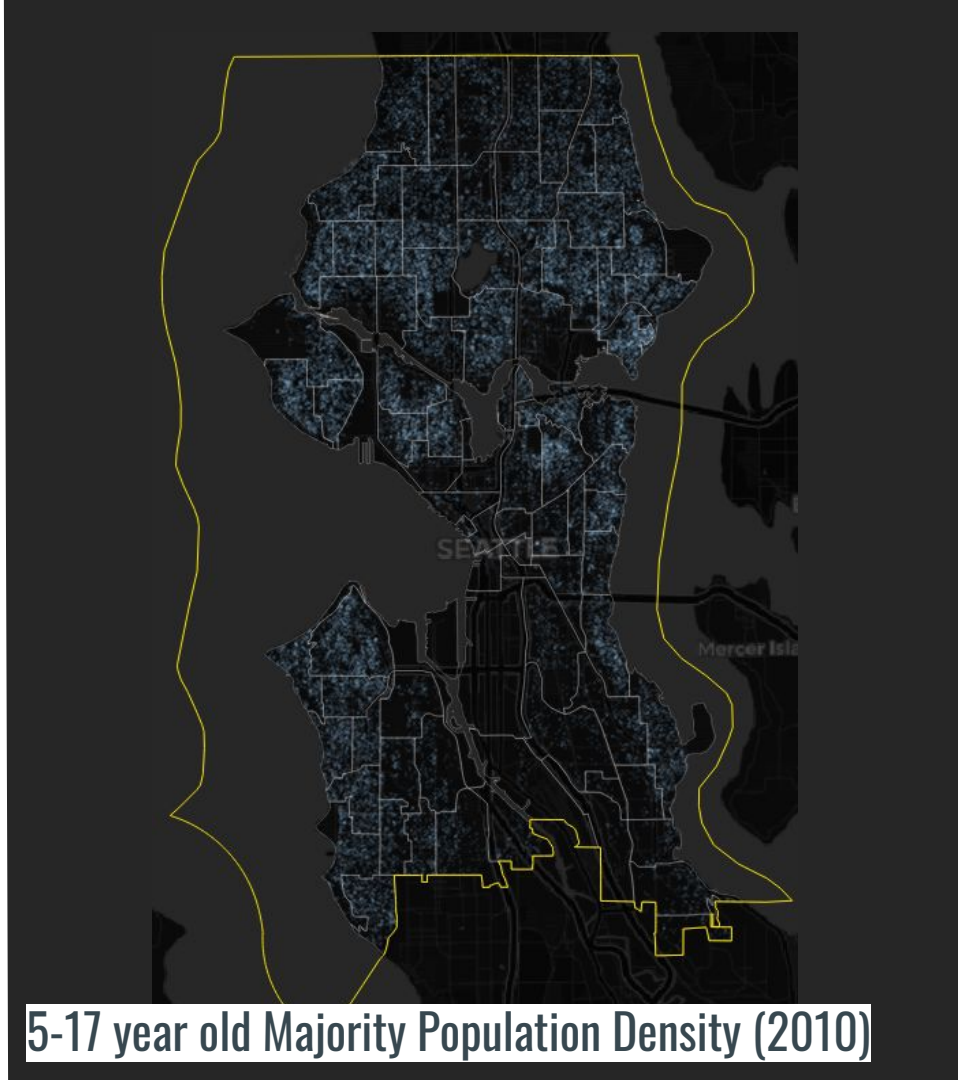



5-17 year old Population Density (2010)

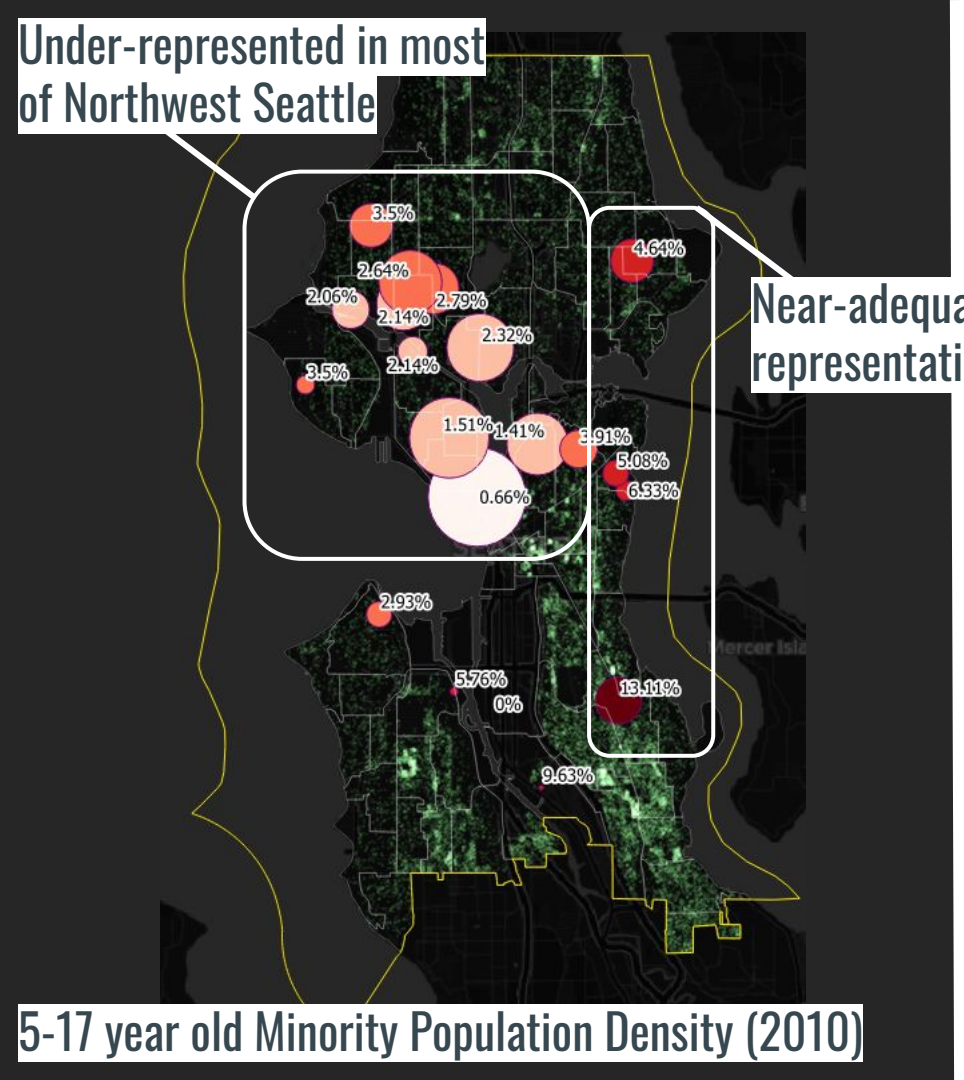
Adequate representation in Capitol Hill District area

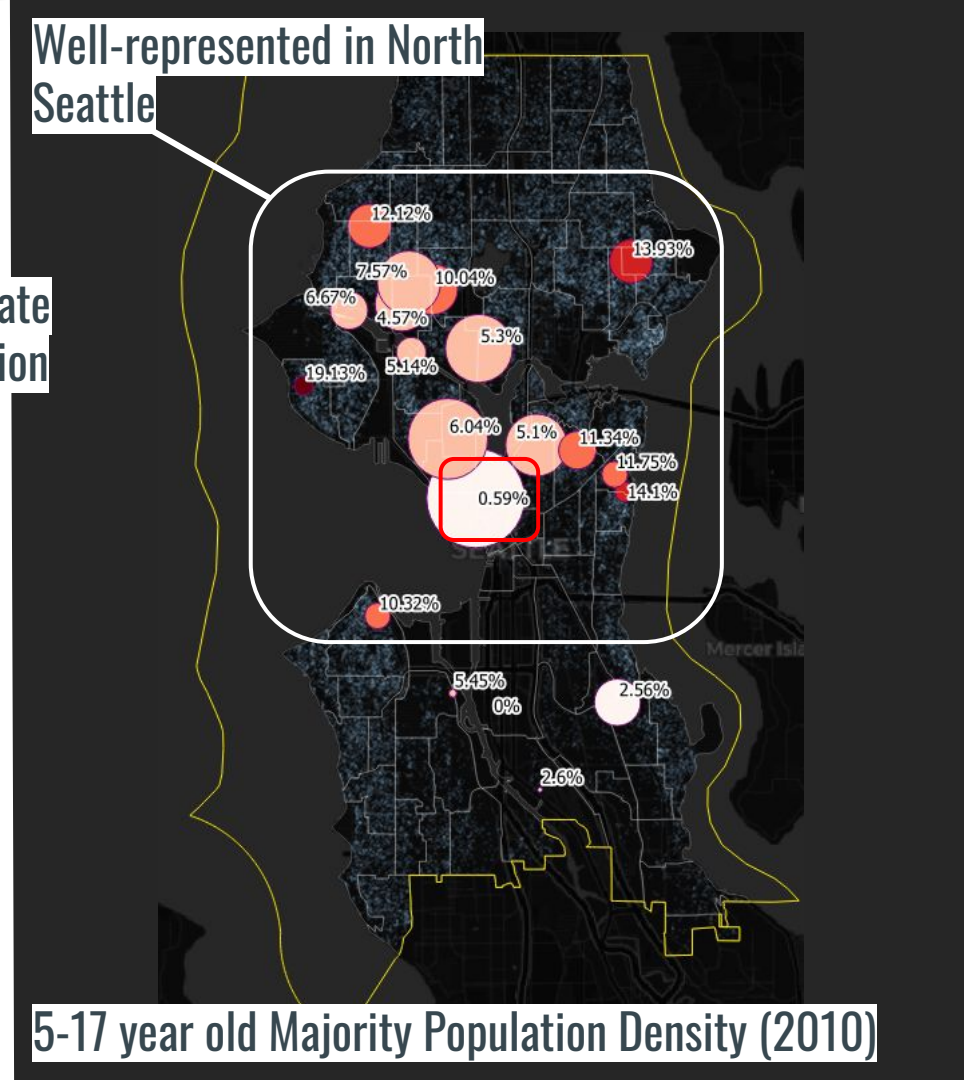


5-17 year old Minority Population Density (2010)

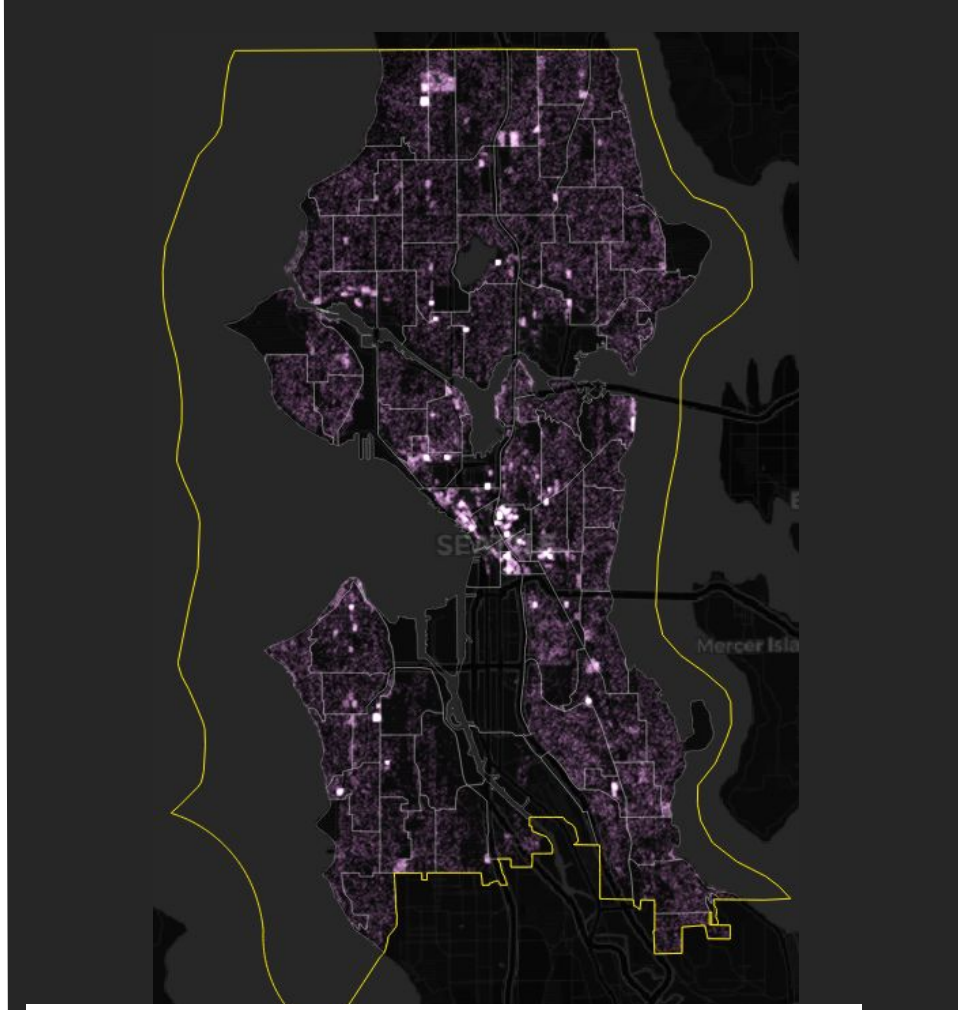


5-17 year old Majority Population Density (2010)

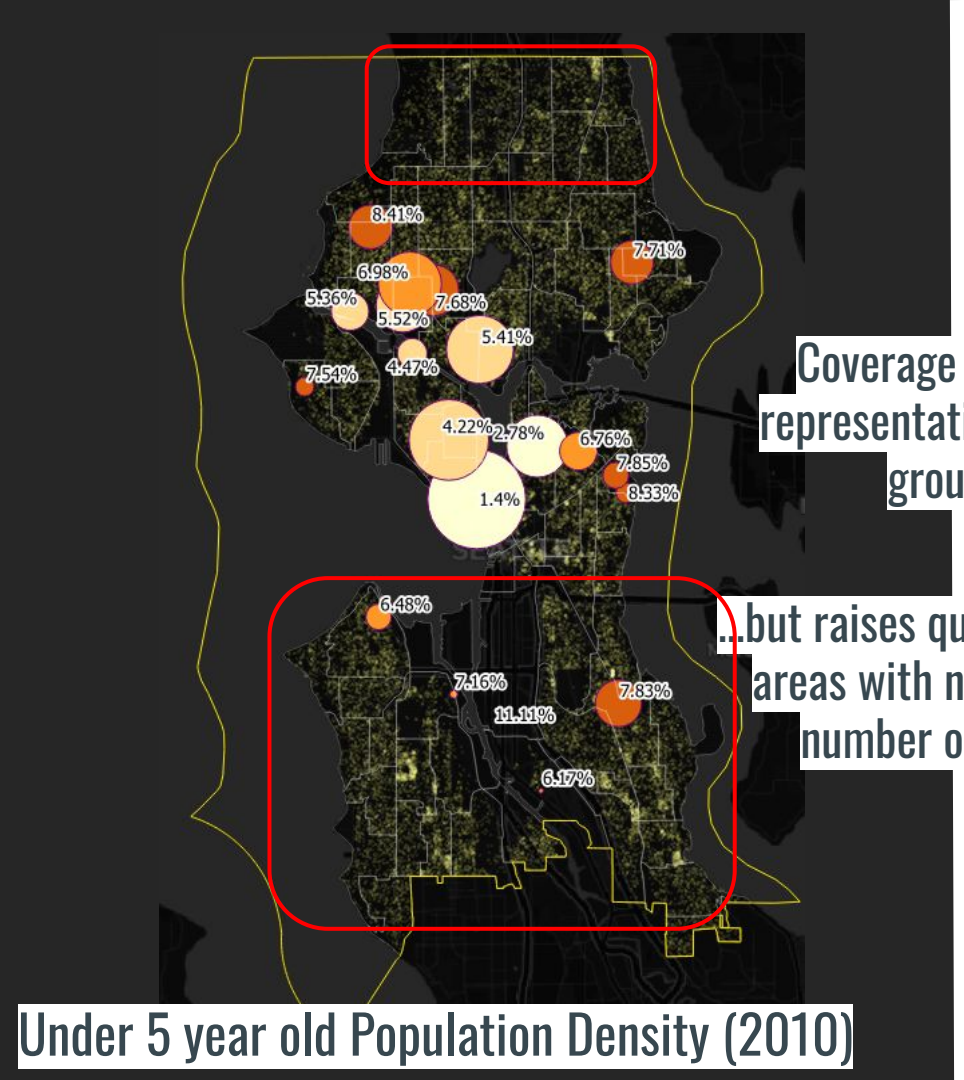

Under-represented in most of Northwest Seattle
Near-adequate representation
3.5%
2.64%
2.06%
2.79%
2.14%
2.32%
3.5%
2.14%
1.51%
1.41%
3.91%
5.08%
6.33%
0.66%
4.64%
2.93%
5.76%
0%
13.11%
9.63%
5-17 year old Minority Population Density (2010)


Well-represented in North Seattle
12.12%
13.93%
7.57%
10.04%
6.67%
4.57%
5.3%
19.13%
5.14%
6.04%
5.1%
11.34%
11.75%
14.1%
0.59%
10.32%
5.45%
0%
2.56%
2.6%
5-17 year old Majority Population Density (2010)

Under 5 year old Population Density (2010)



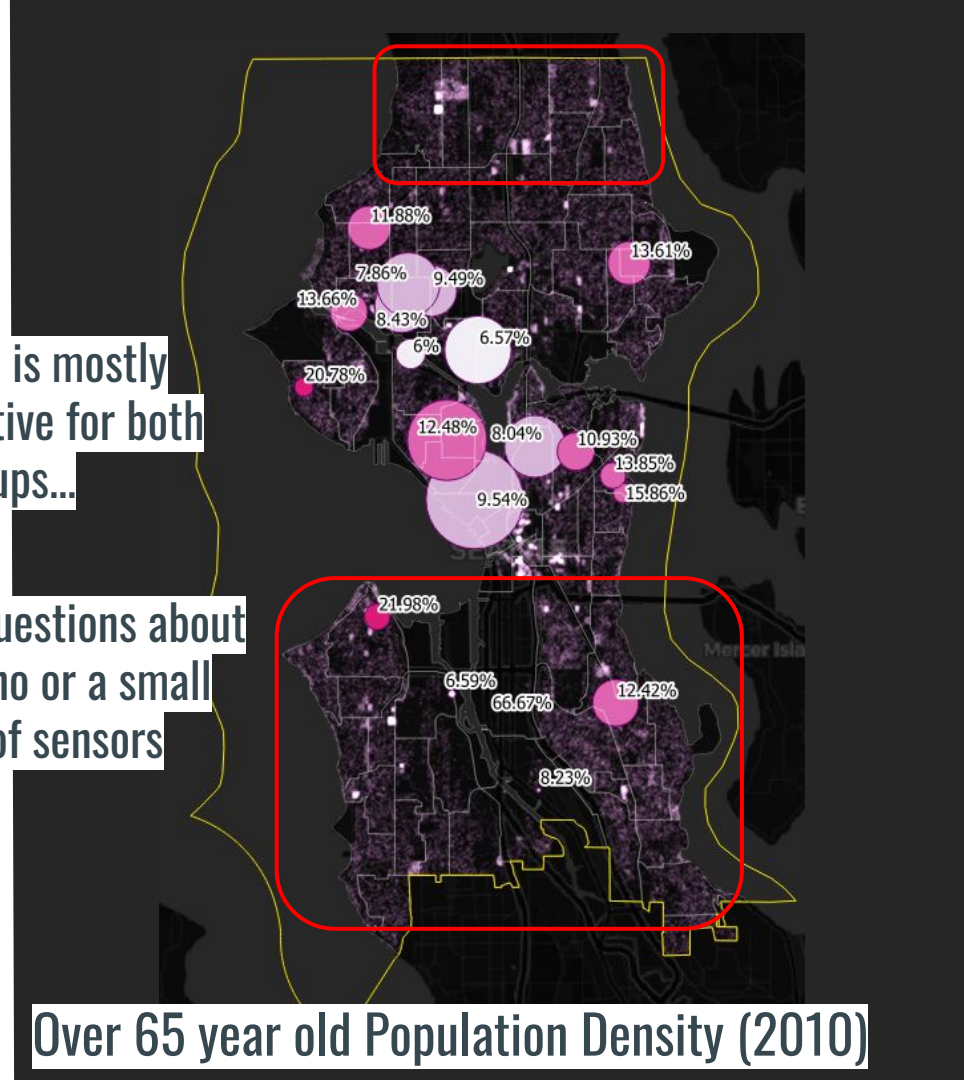
Over 65 year old Population Density (2010)




Under 5 year old Population Density (2010)

Coverage is mostly representative for both groups...

...but raises questions about areas with no or a small number of sensors



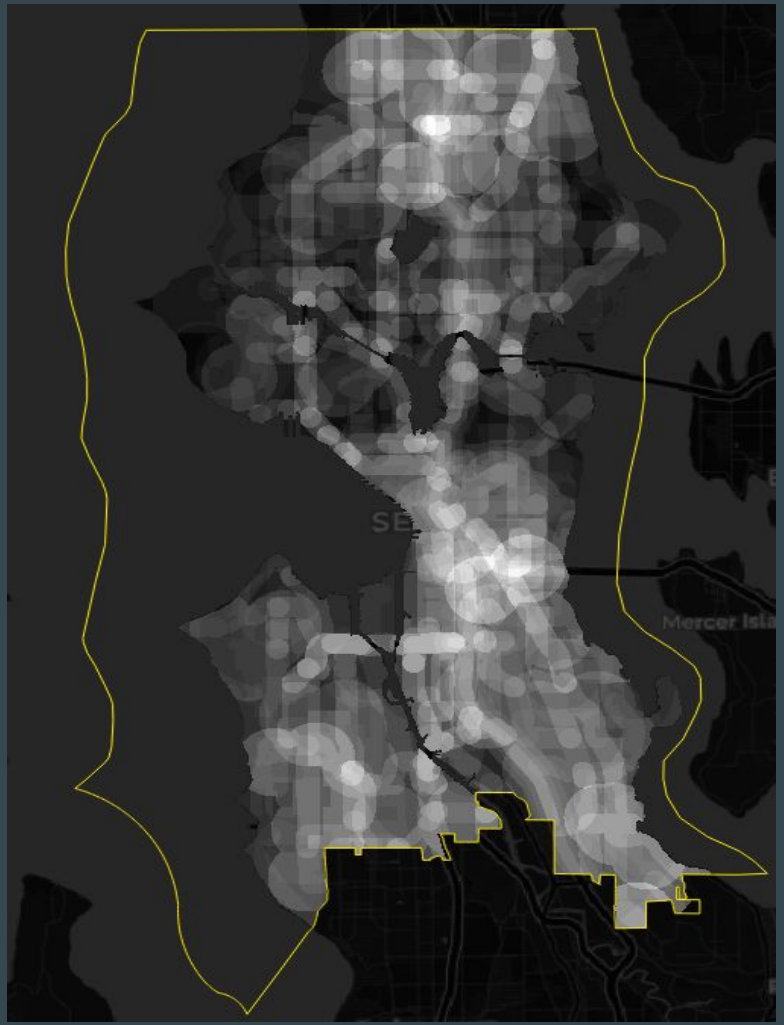

Over 65 year old Population Density (2010)

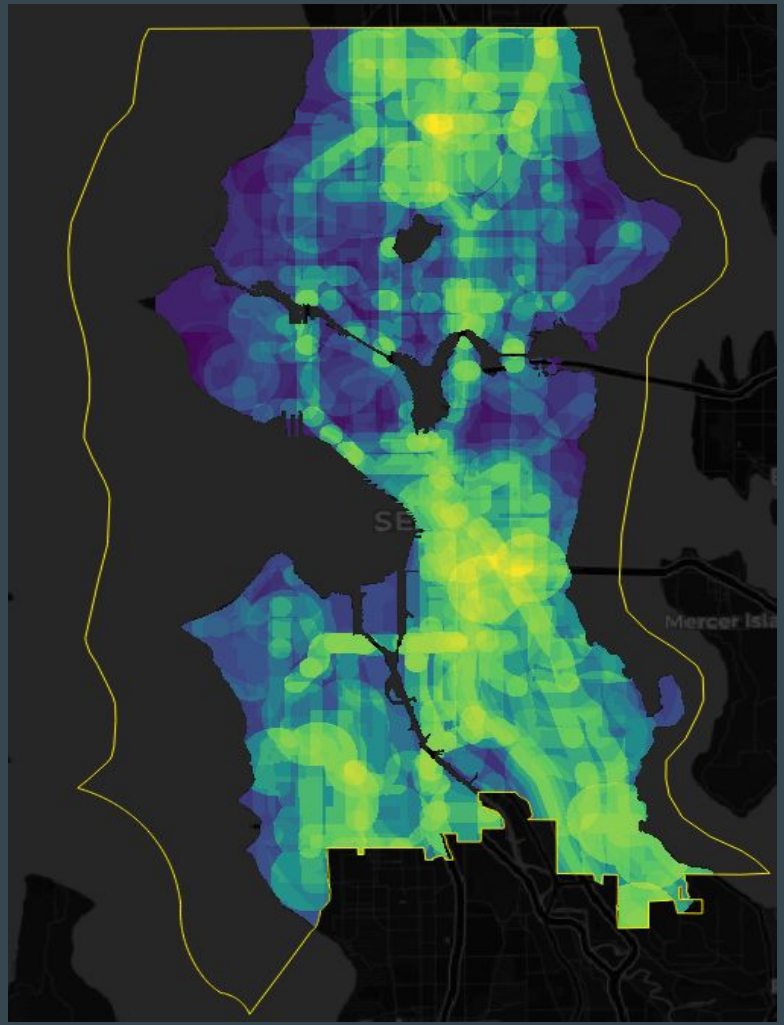
# Identifying zones of community coverage in the city of Seattle, WA

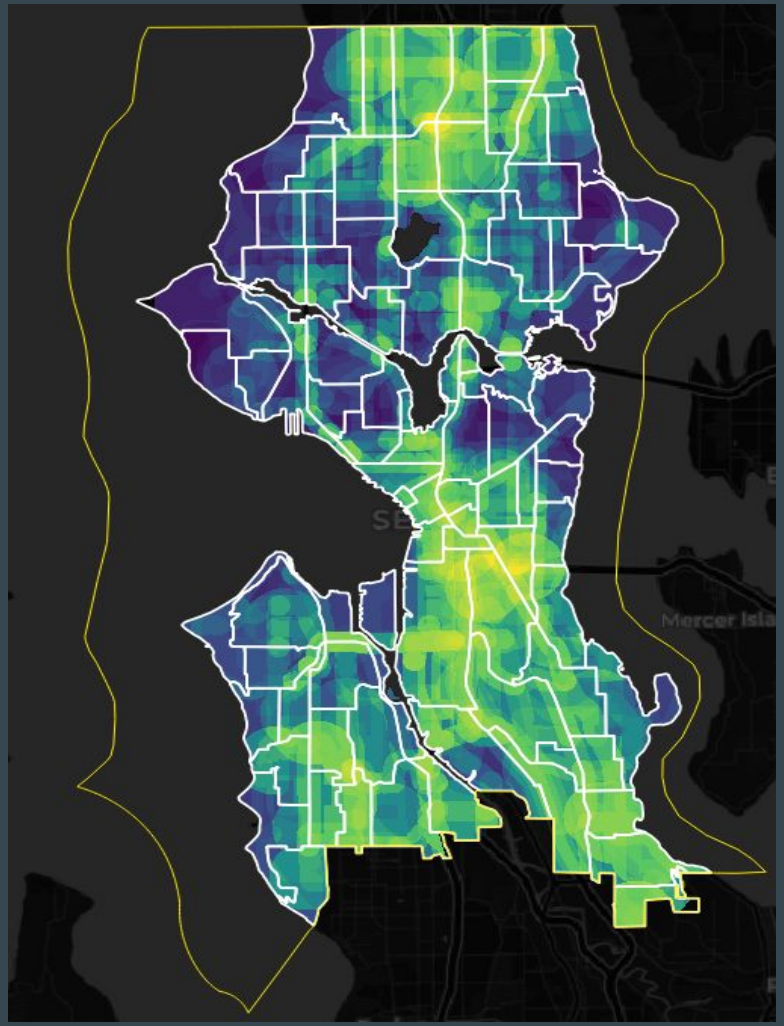
...

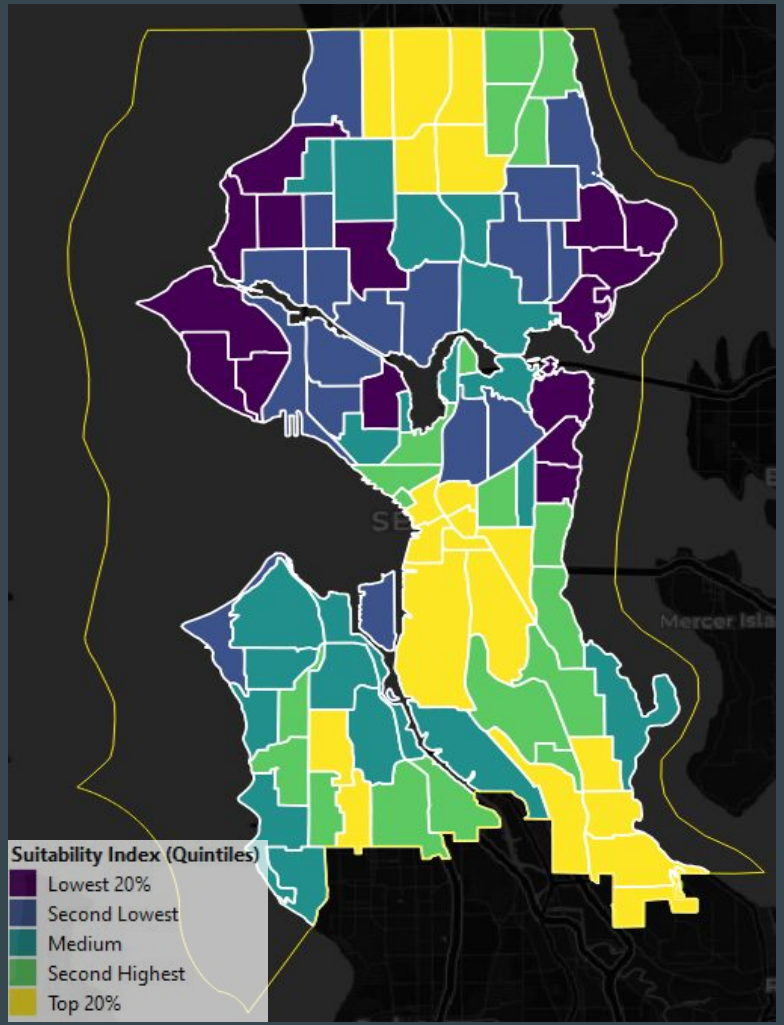
Using multi-criteria weighted-overlay analysis

to generate a site-suitability model


Mercer Isla

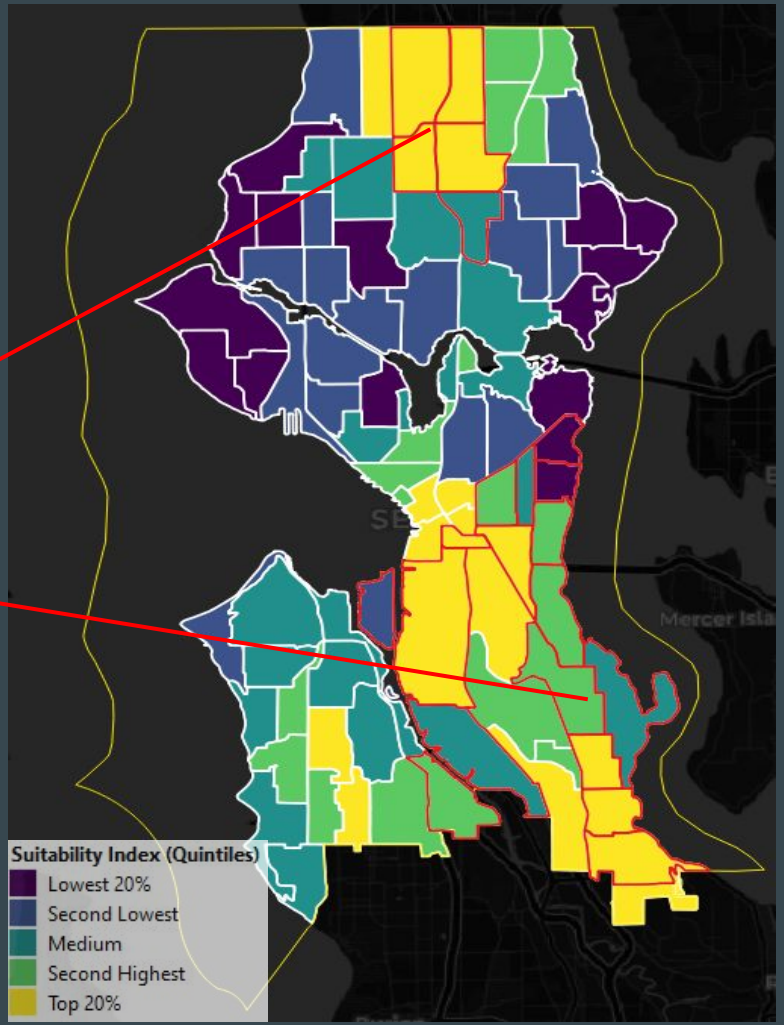

Mercer Isla


Mercer Isla

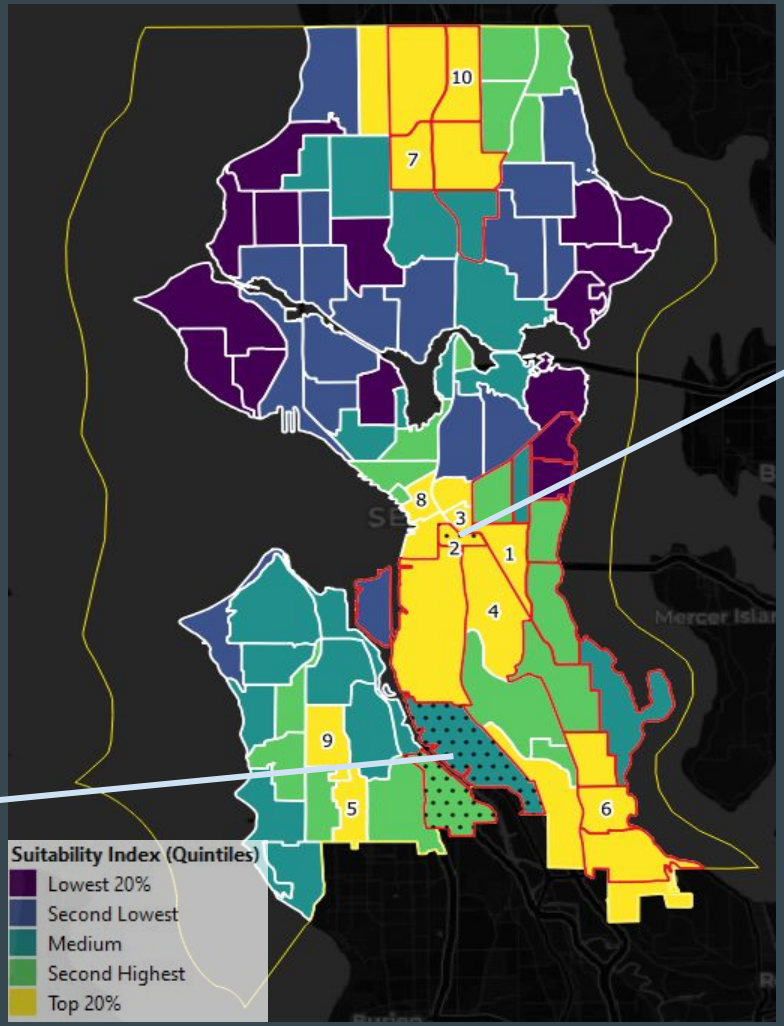

Suitability Index (Quintiles)
Lowest 20%
Second Lowest
Medium
Second Highest
Top 20%

Highly Impacted Communities

CAA (2014)



## Focus Communities Program



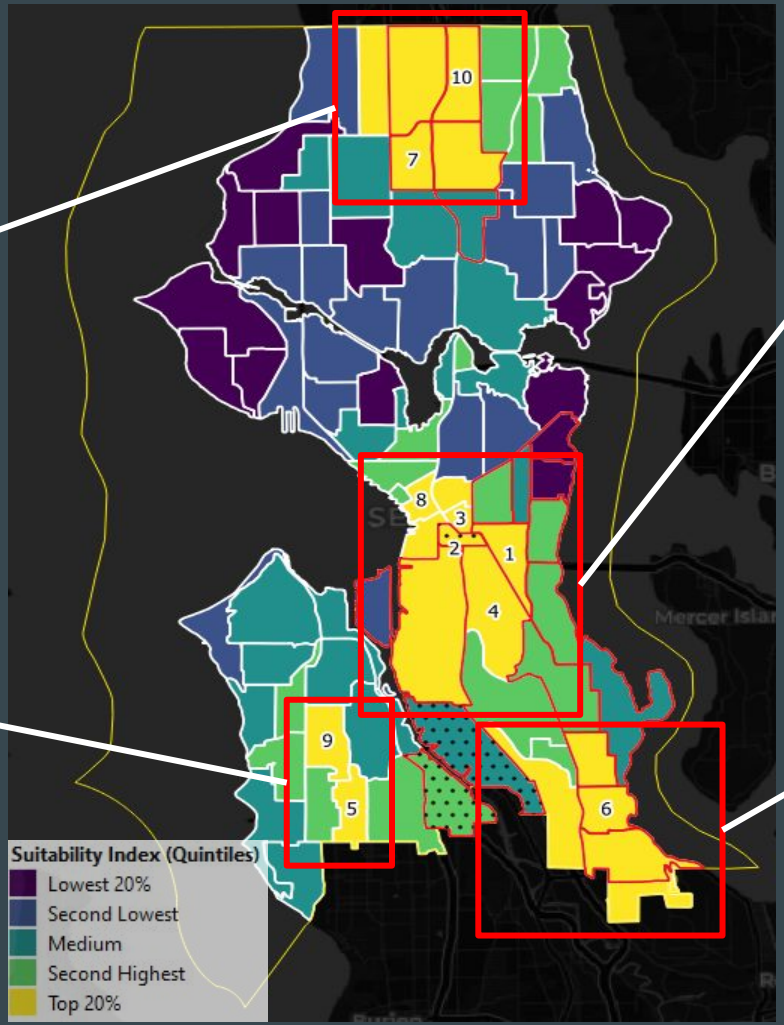

Chinatown-International District

Duwamish Valley

(Georgetown & South Park)

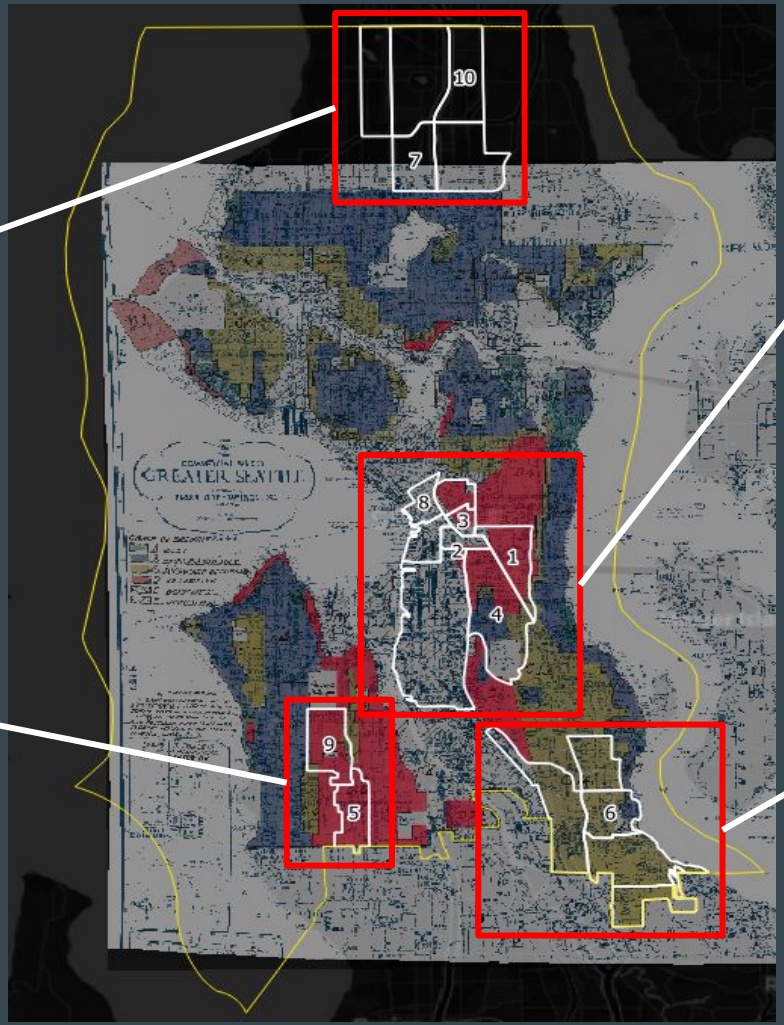
Northgate Area

Delridge Area



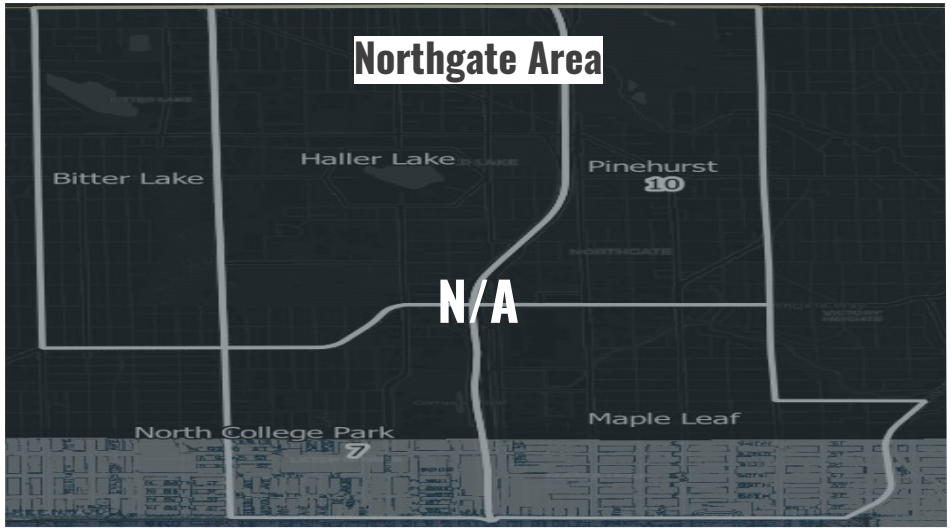

Downtown-Central-Industrial District Area

Rainier Valley Area

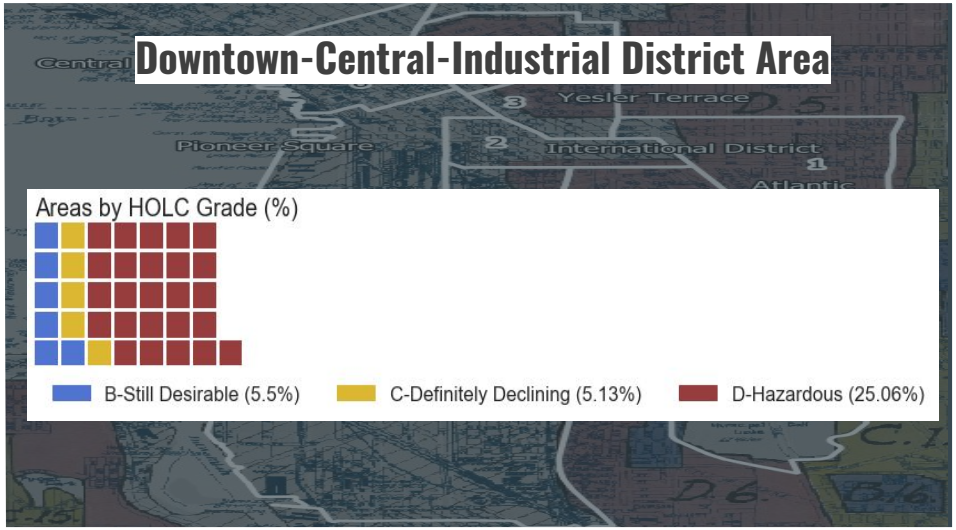

Northgate Area
Downtown-Central-Industrial
District Area
Delridge Area
Rainier Valley Area
10
7
8
3
2
1
4
9
5
6

# Insight #3: Areas ranked in the top quintile bear a strong overlap with unfavorable HOLC-grade zones

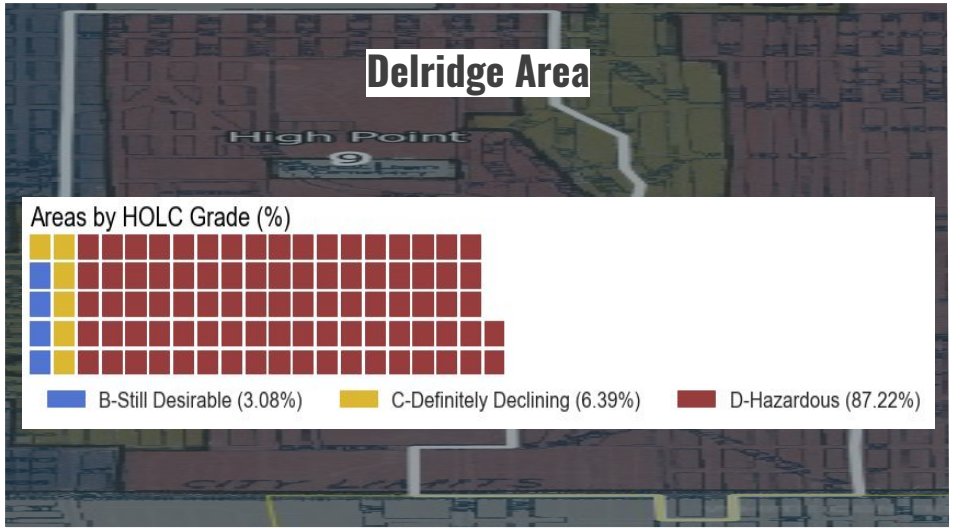
## Northgate Area



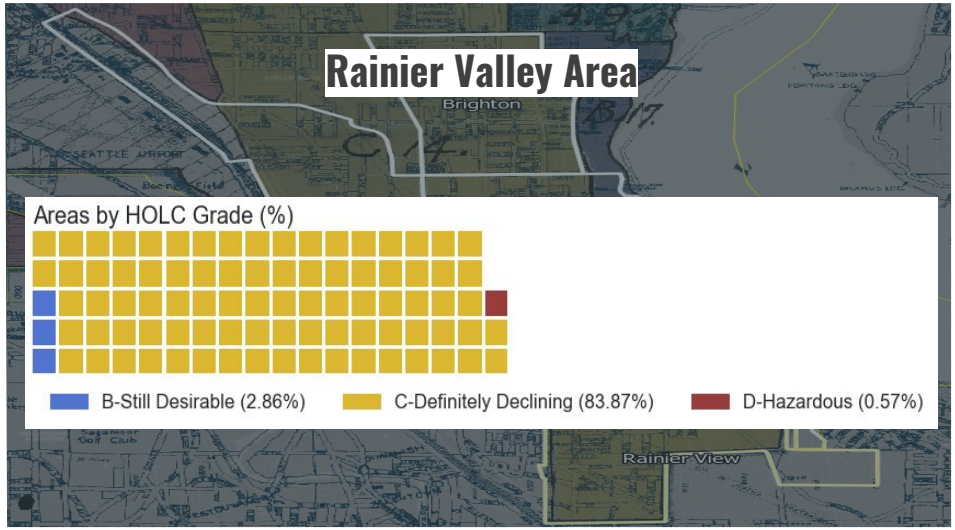

## Downtown-Central-Industrial District Area



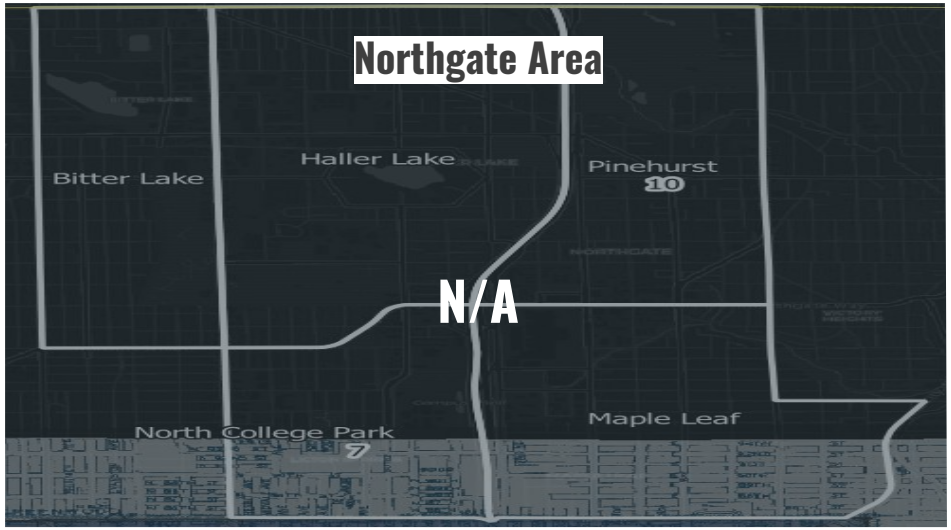

## Delridge Area



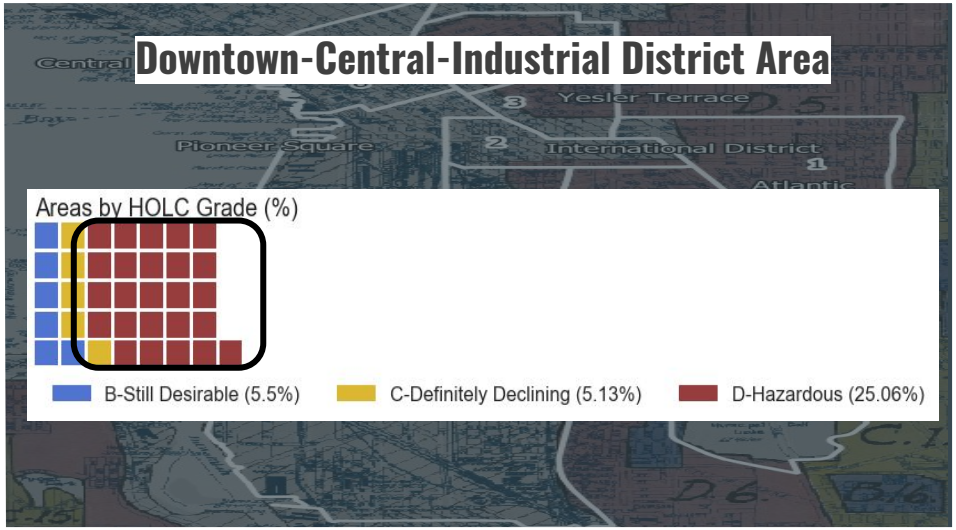

## Rainier Valley Area



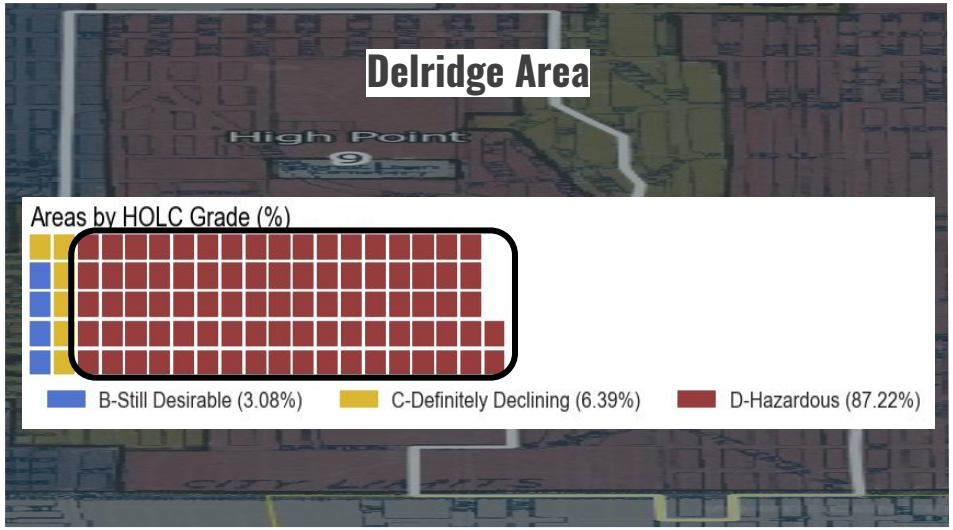
## Northgate Area



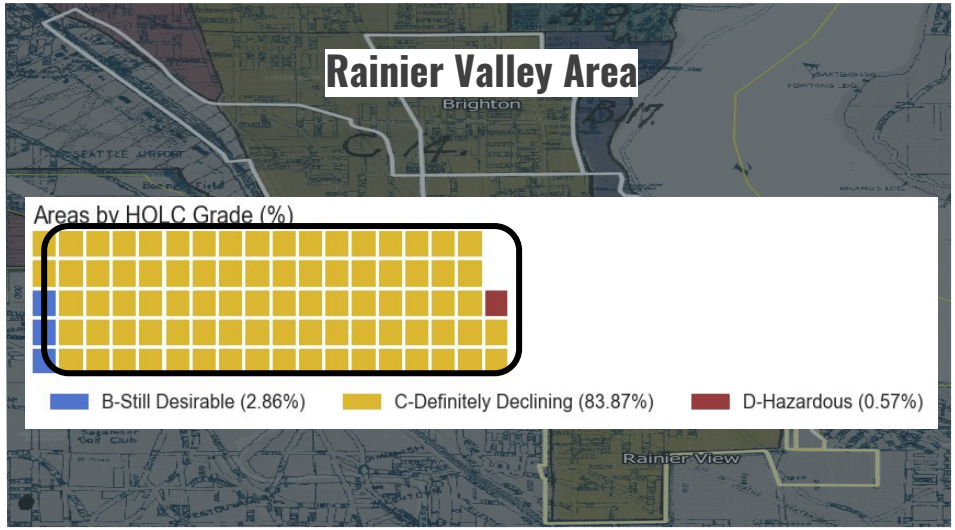

## Downtown-Central-Industrial District Area



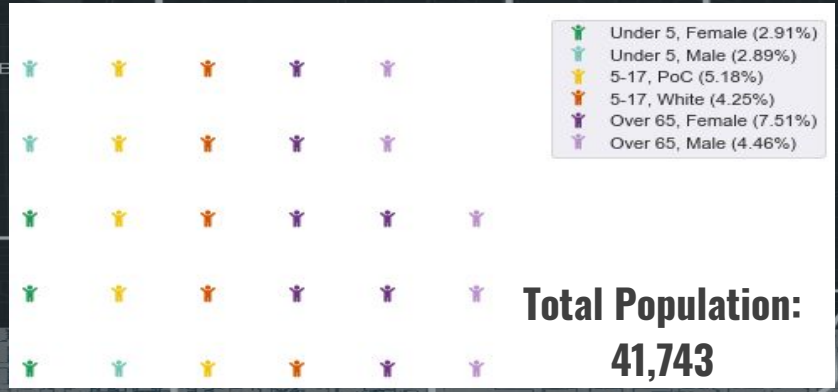

## Delridge Area




## Rainier Valley Area

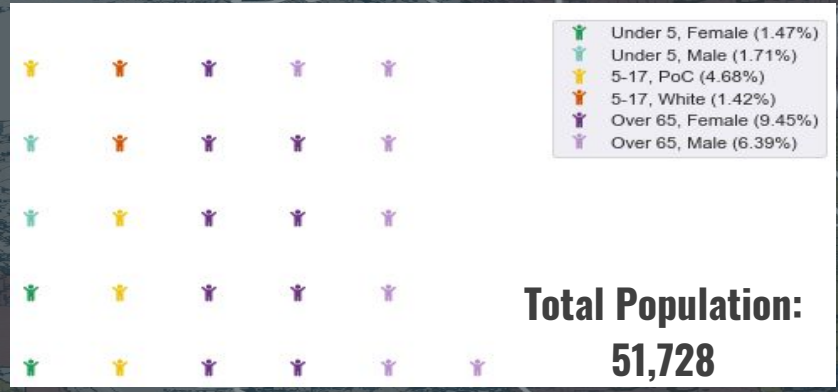


## Northgate Area




**Total Population: 41,743**

## Downtown-Central-Industrial District Area

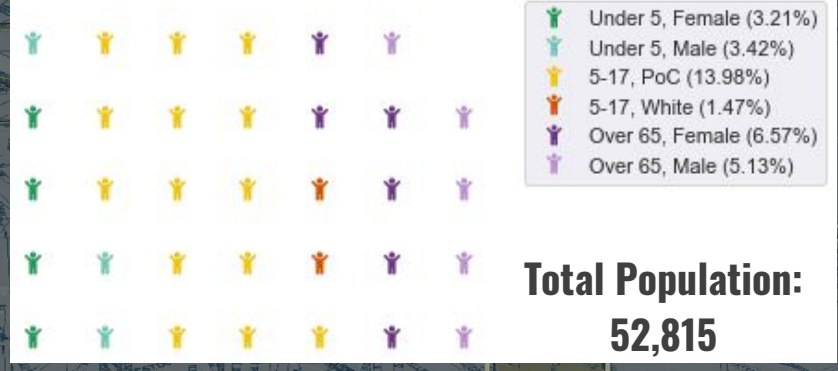



**Total Population: 51,728**

## Delridge Area

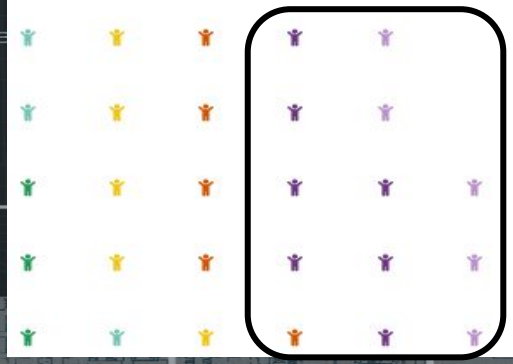
**Total Population: 17,236**

## Rainier Valley Area




**Total Population: 52,815**

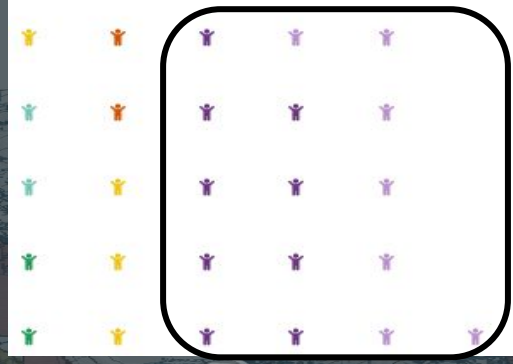
## Northgate Area



- Under 5, Female (2.91%)
- Under 5, Male (2.89%)
- 5-17, PoC (5.18%)
- 5-17, White (4.25%)
- Over 65, Female (7.51%)
- Over 65, Male (4.46%)

**Total Population: 41,743**

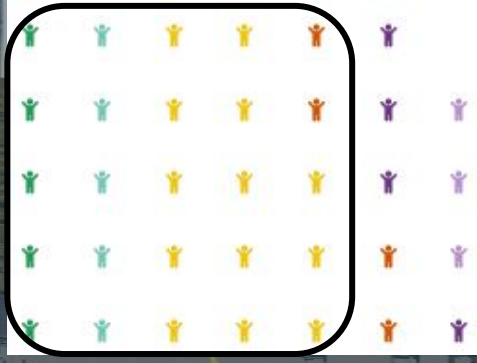
## Downtown-Central-Industrial District Area



- Under 5, Female (1.47%)
- Under 5, Male (1.71%)
- 5-17, PoC (4.68%)
- 5-17, White (1.42%)
- Over 65, Female (9.45%)
- Over 65, Male (6.39%)

**Total Population: 51,728**

## Delridge Area



- Under 5, Female (4.54%)
- Under 5, Male (4.79%)
- 5-17, PoC (13.55%)
- 5-17, White (3.19%)
- Over 65, Female (4.49%)
- Over 65, Male (3.05%)

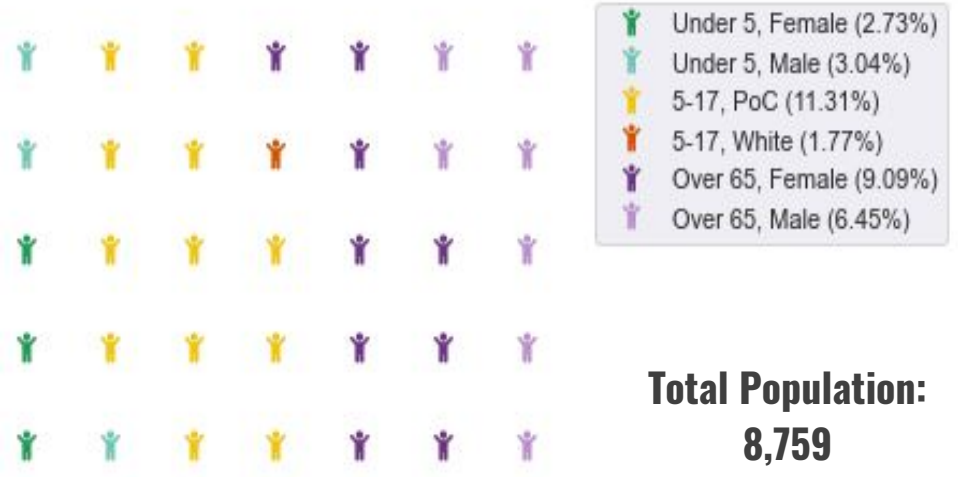
**Total Population: 17,236**

## Rainier Valley Area

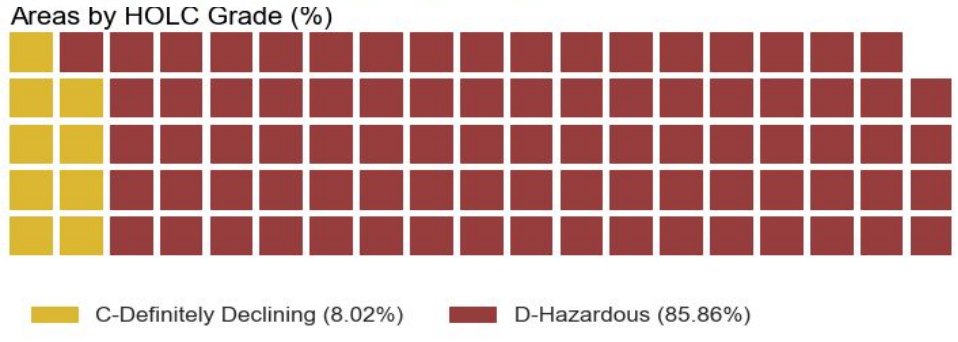
- Under 5, Female (3.21%)
- Under 5, Male (3.42%)
- 5-17, PoC (13.98%)
- 5-17, White (1.47%)
- Over 65, Female (6.57%)
- Over 65, Male (5.13%)

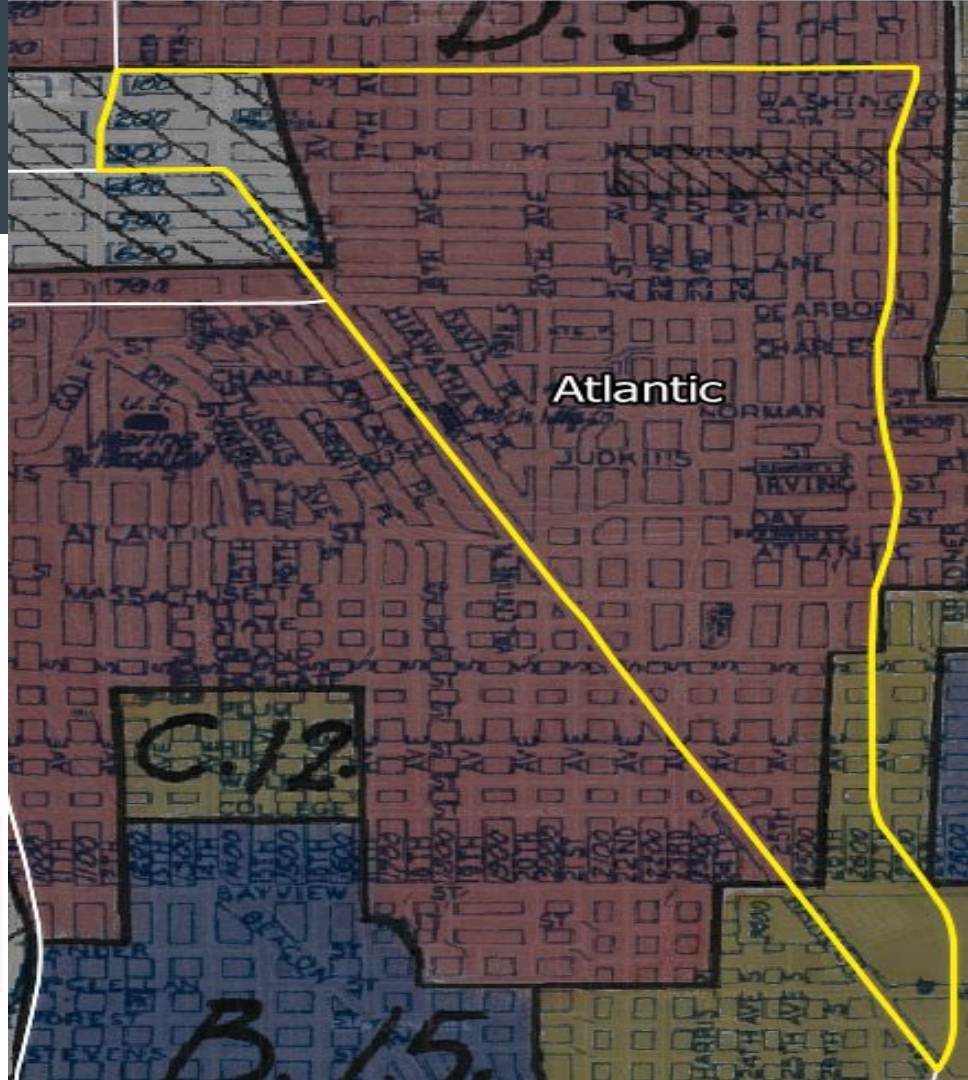
**Total Population: 52,815**

# No. 1 Rank: Atlantic Neighborhood

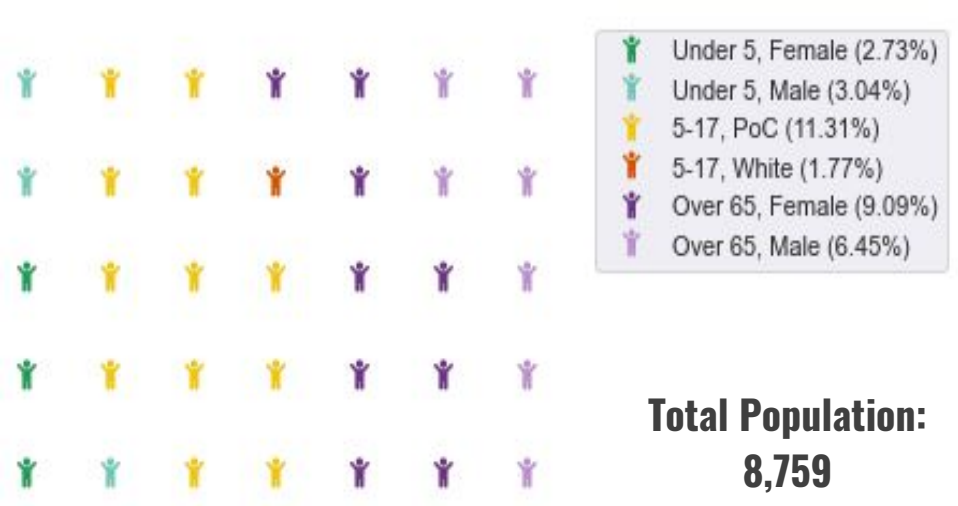



**Total Population: 8,759**

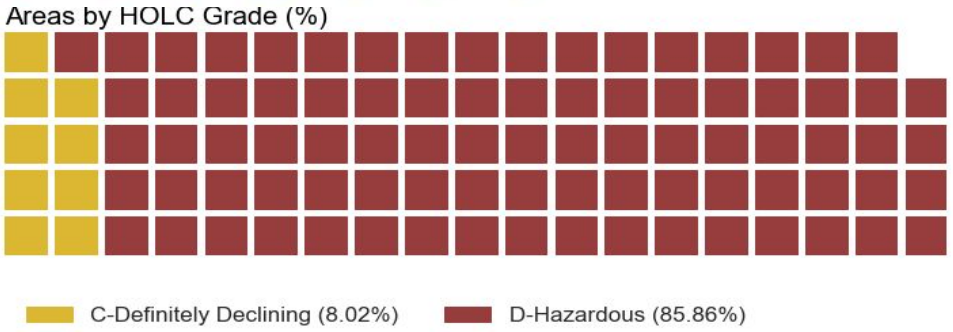


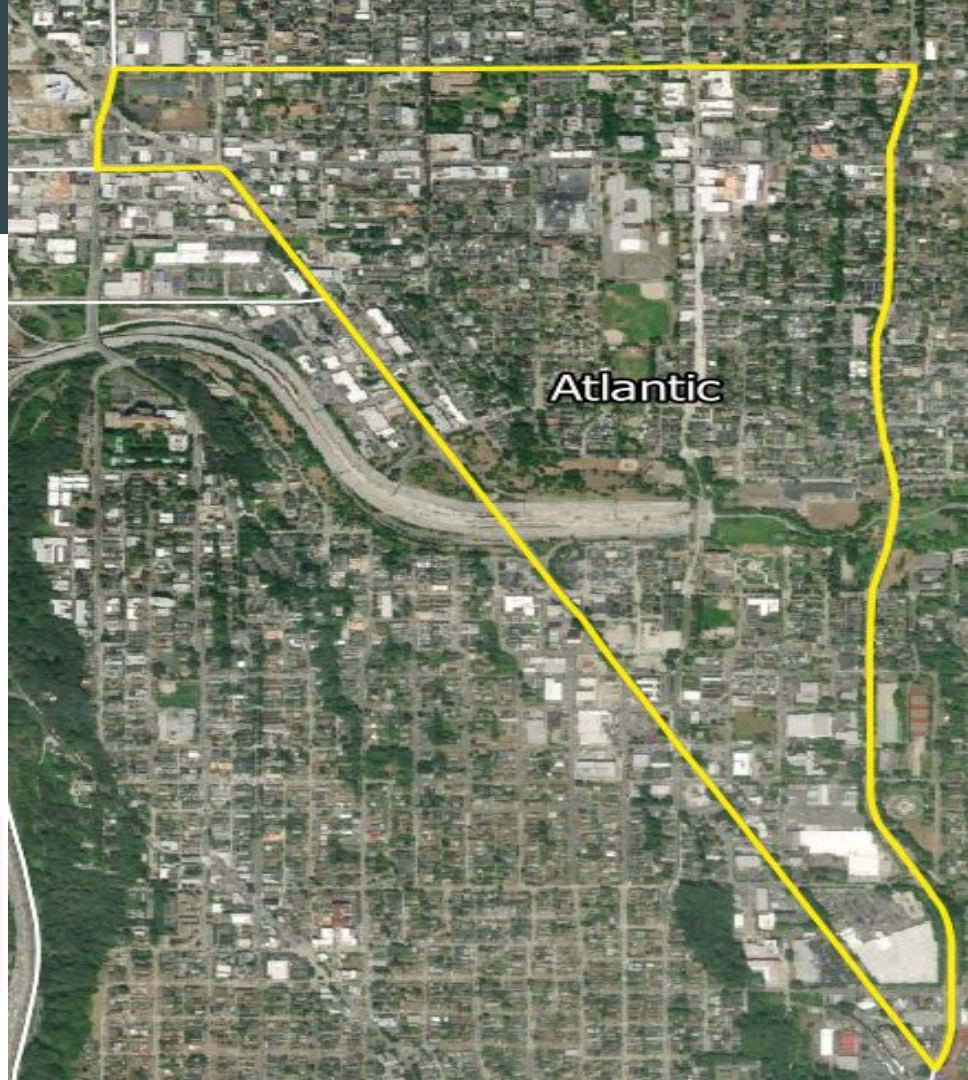



# No. 1 Rank: Atlantic Neighborhood




**Total Population: 8,759**



# Which were the included criteria?

PUGET SOUND

Clean Air Agency

Race

Diesel pollution
(onroad and nonroad)

Health sensitivity
(asthma, cardiac illness, etc)

Household income

CRITERIA

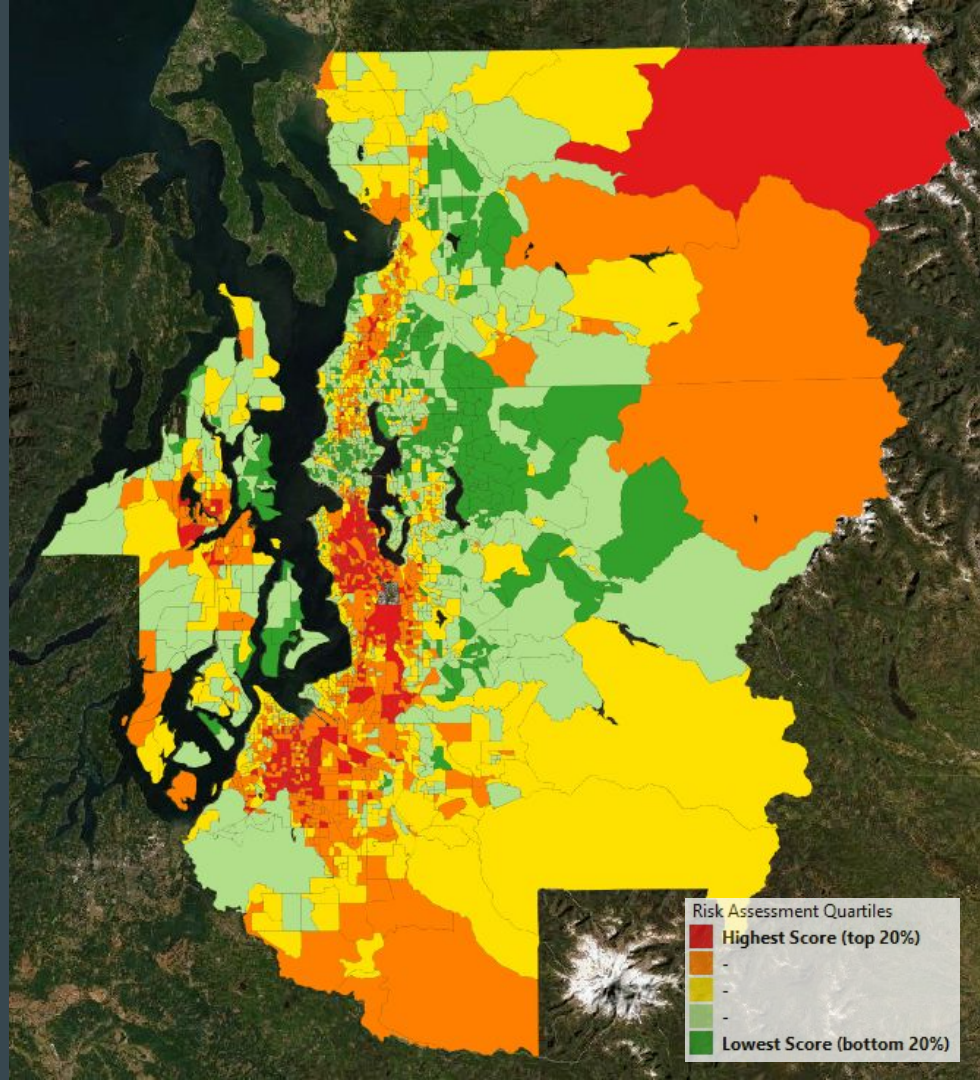
Limited english proficiency

Industrial density
(large & small pollution sources)

Primary wood burning households

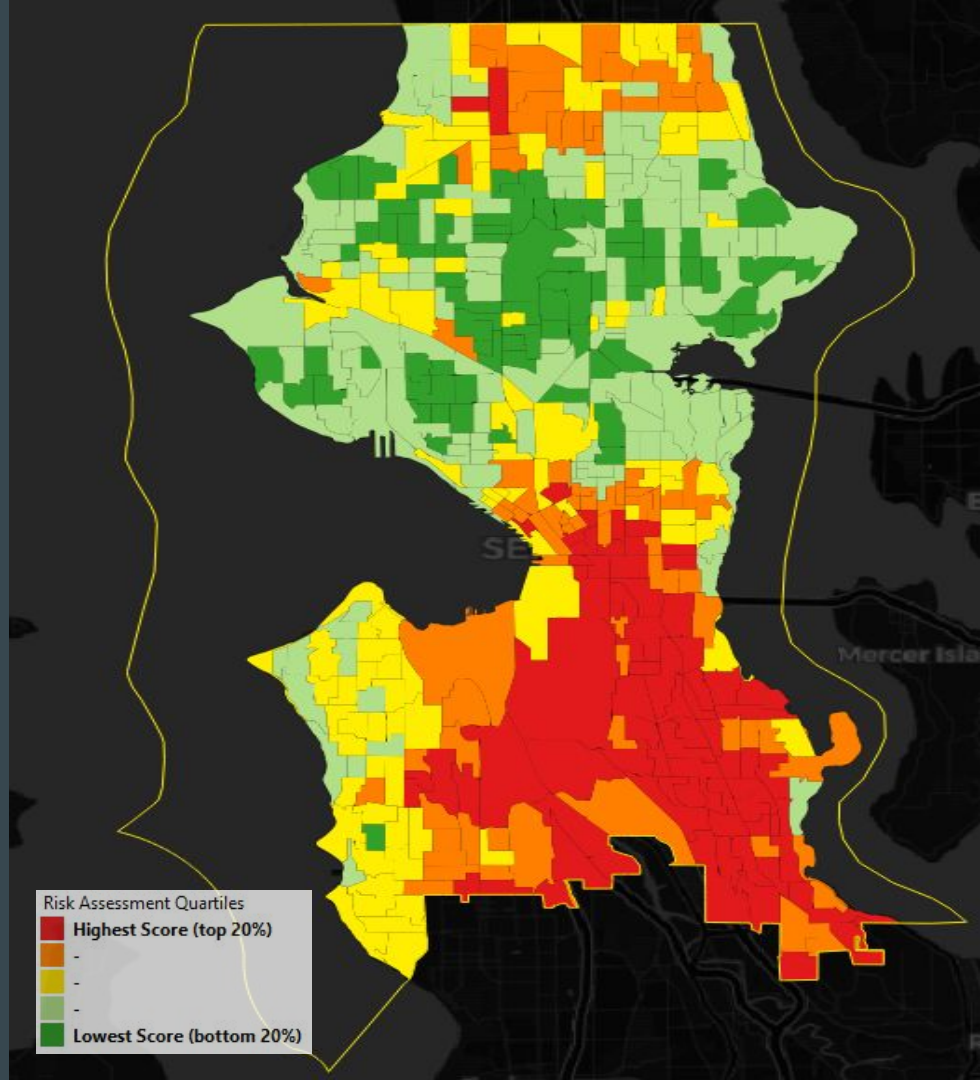
# Highly Impacted Communities

2014-2020 PSCAA's Strategic Plan



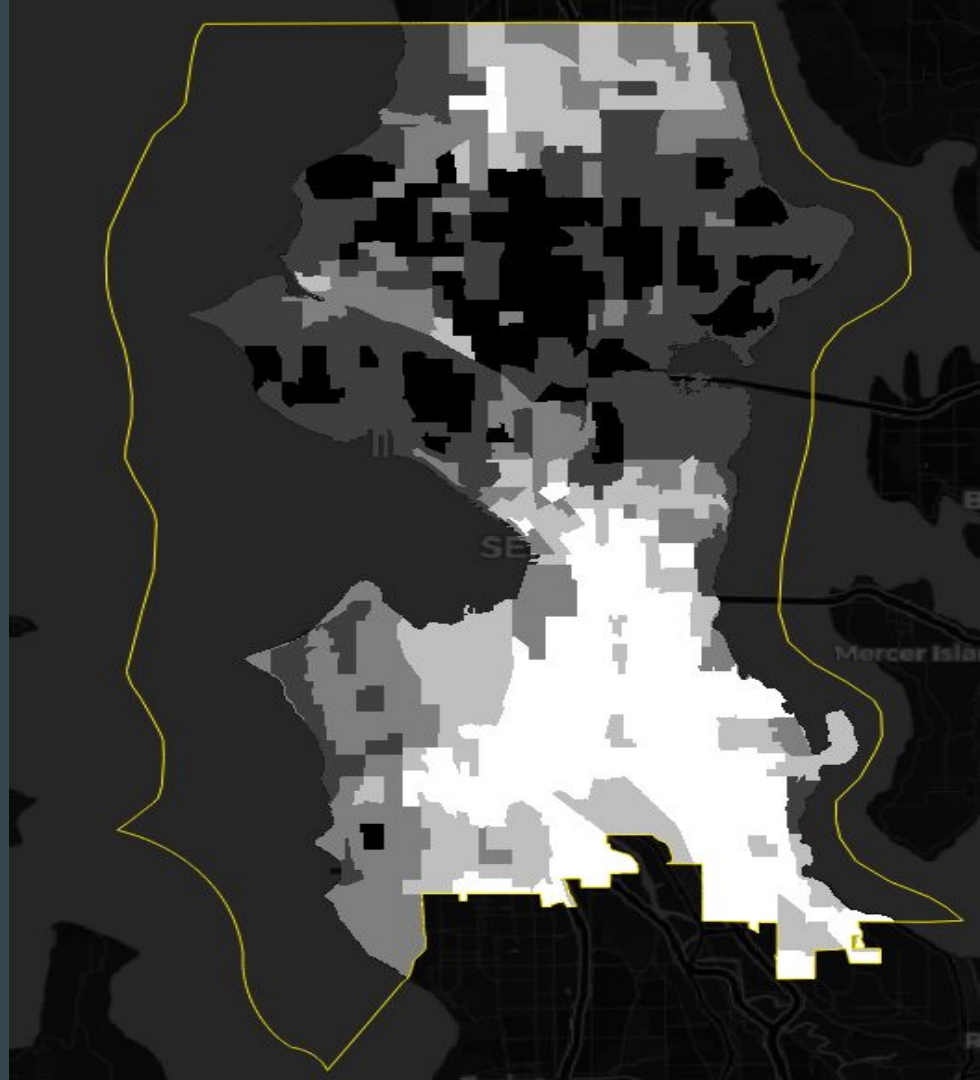
# Highly Impacted Communities

City of Seattle only



# Weight Assignment

Top Quintile = 100 (white)
Second Quintile = 80
Third Quintile = 60
Fourth Quintile = 40
Lowest Quintile = 20 (black)



# Office of Planning & Community Development
# Seattle GeoData

# Racial and Social Equity Composite Index

Foreign born

English language learner

Persons of color

**Race, English Language Learners, and Origins Index**

Low life expectancy at birth

Asthma

Disability

No leisure-time physical activity

Mental health not good

Diagnosed diabetes

Obesity

**Health Disadvantage Index**

Educational attainment less than a bachelor's degree

Income below 200% of poverty level

**Socioeconomic Disadvantage Index**

# Racial and Social Equity Composite Index

Foreign born

English language learner

Persons of color

**Race, English Language Learners, and Origins Index**

Low life expectancy at birth

Asthma

Disability

No leisure-time physical activity

Mental health not good

Diagnosed diabetes

Obesity

**Health Disadvantage Index**

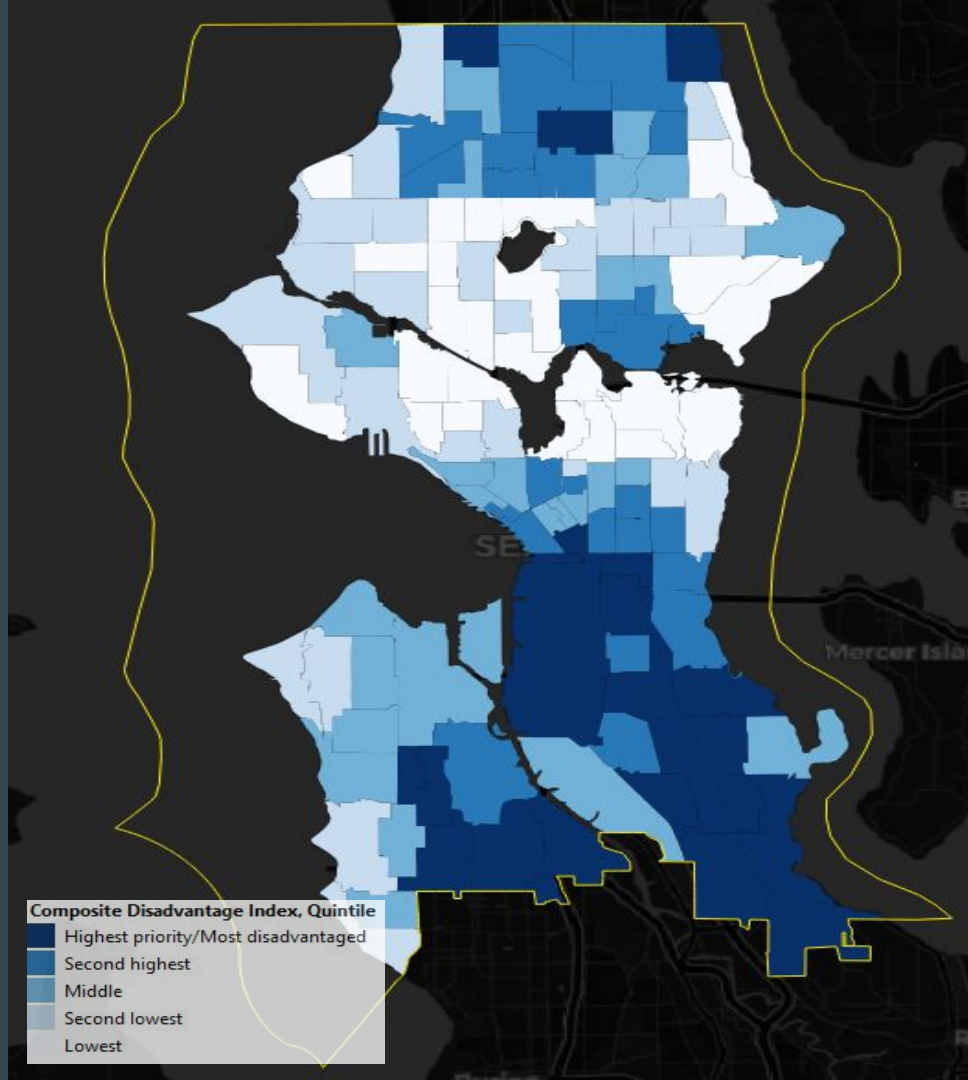
Educational attainment less than a bachelor's degree

Income below 200% of poverty level

**Socioeconomic Disadvantage Index**

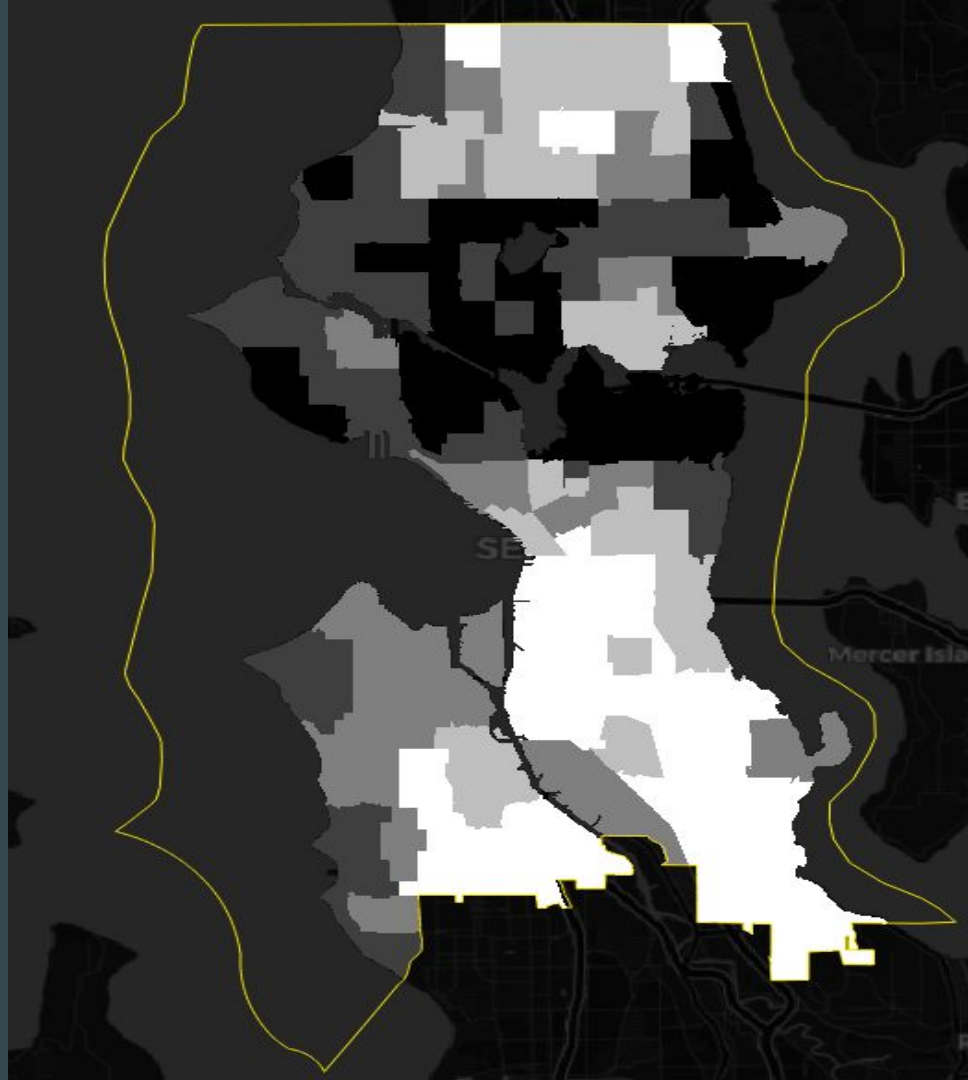
# Composite Disadvantage Index

2020 Racial and Social Equity Composite Index, City of Seattle Office of Planning & Community Development



# Weight Assignment

Top Quintile = 100 (white)
Second Quintile = 80
Third Quintile = 60
Fourth Quintile = 40
Lowest Quintile = 20 (black)



PurpleAir

# Weight Assignment

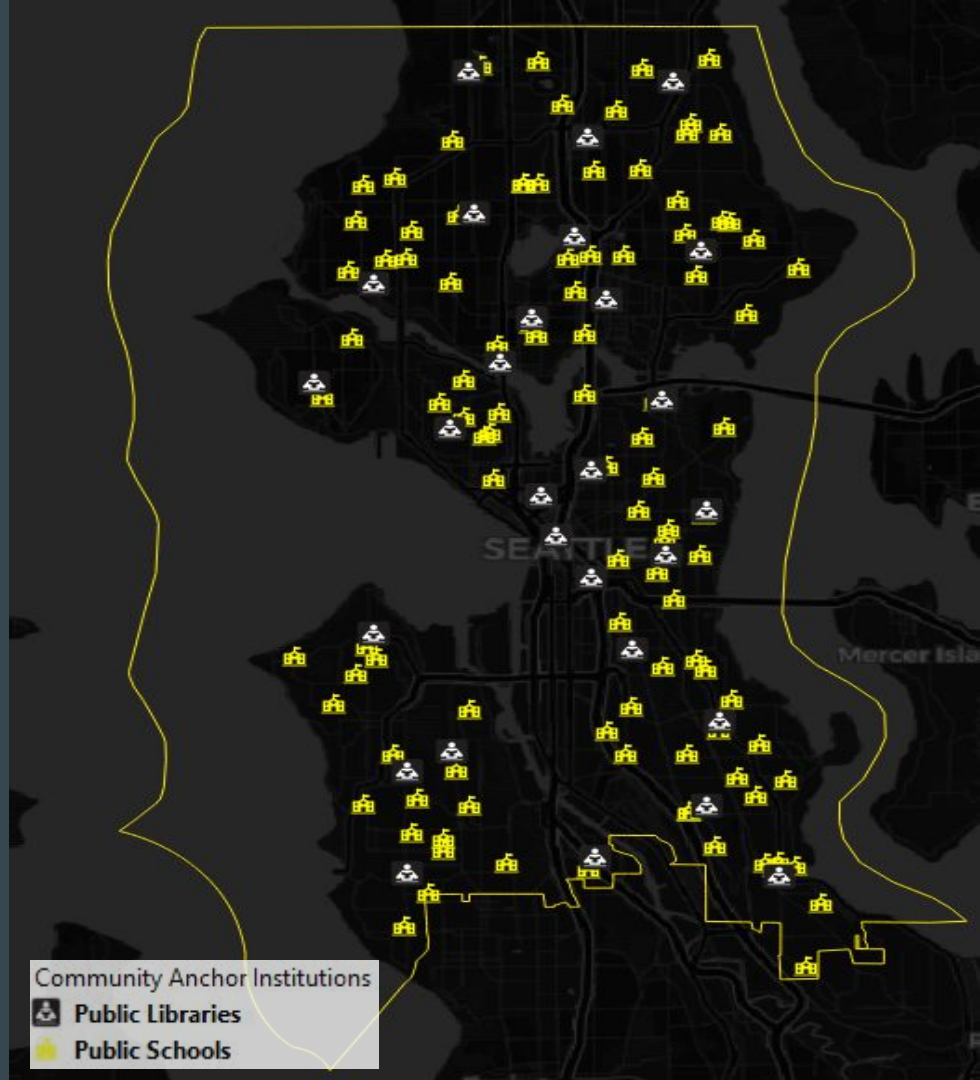
Proximity =< 1,000 m; = 25 (black)
Proximity =< 3,000 m; = 50
Proximity =< 6,000 m; = 75
Proximity > 6,000 m; = 100 (white)

4

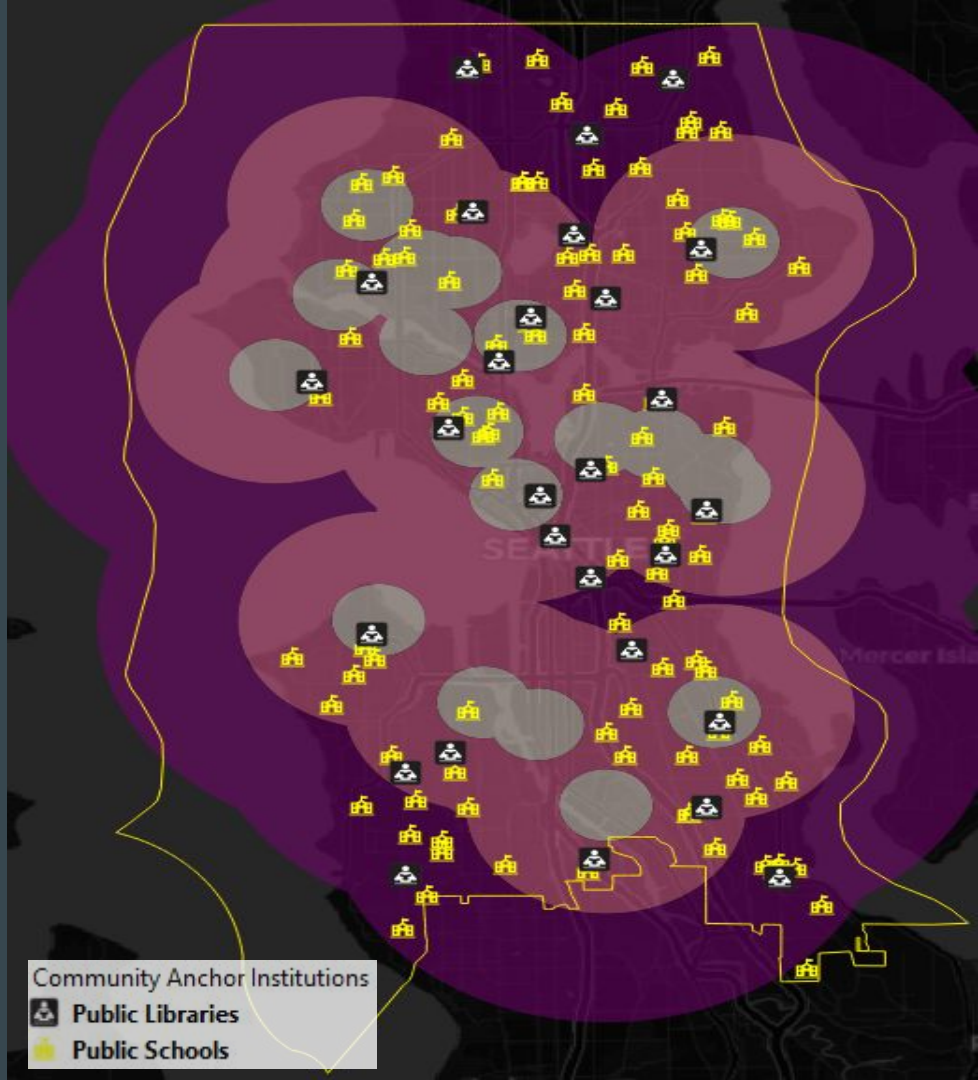
# Anchor Community Institutions: Public Schools & Libraries

Seattle GeoData

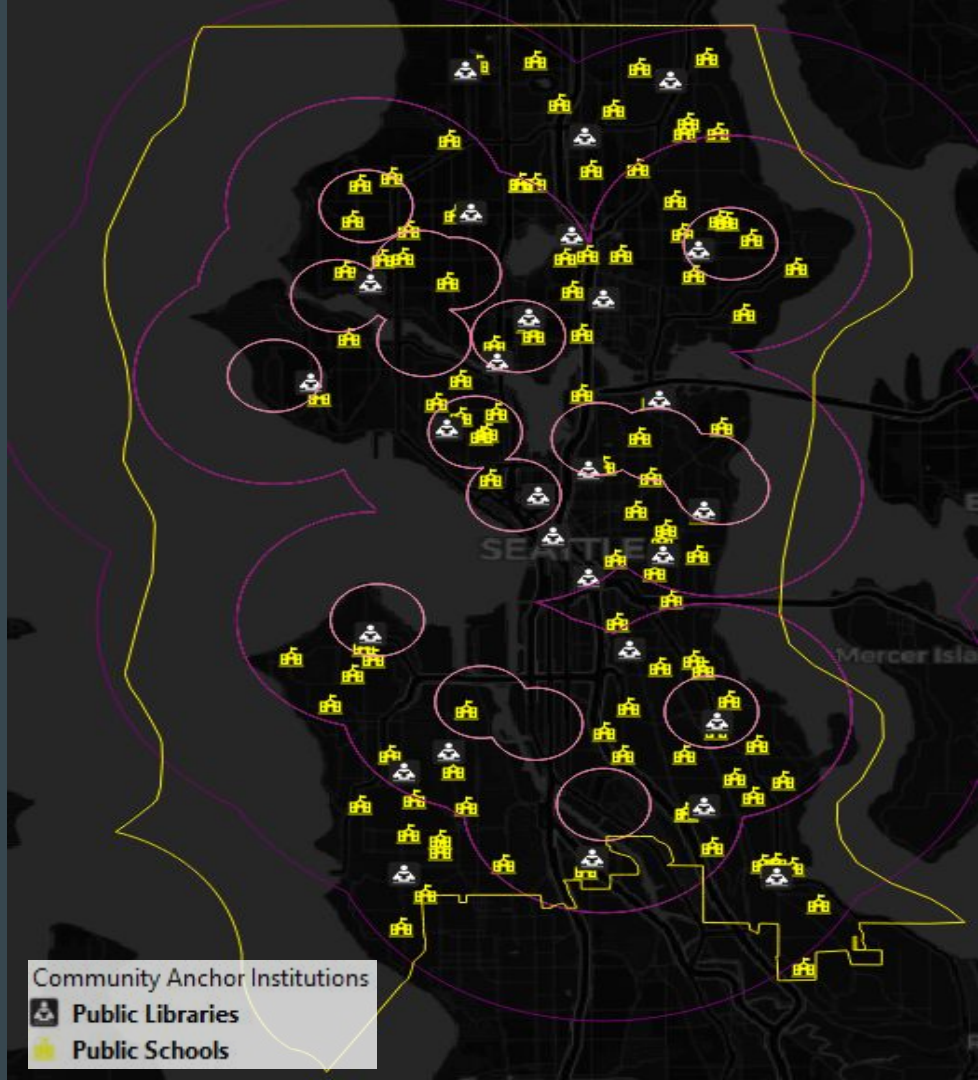
# Community Anchor Institutions as candidate sites to host low-cost sensors



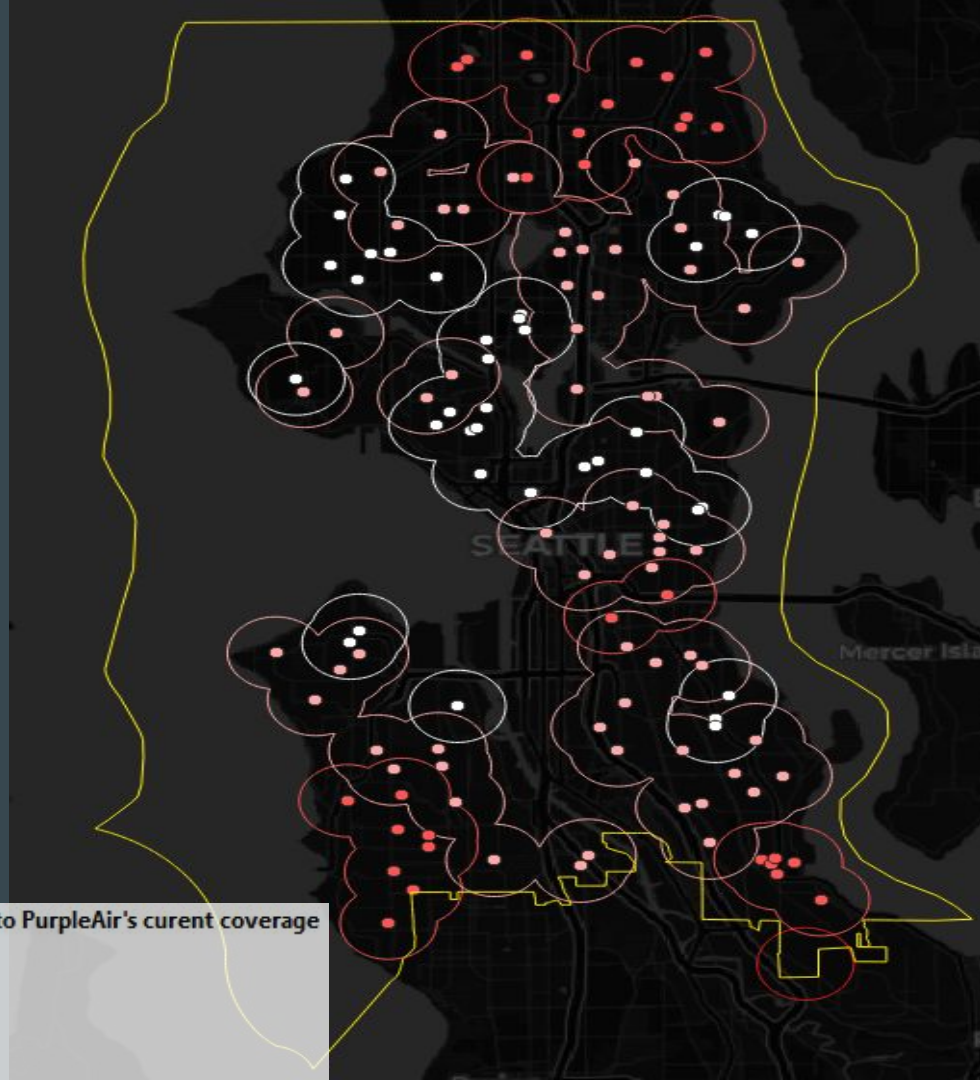
# Avoiding possible redundancies with existing PurpleAir's zone of coverage



# Intersecting known coverage with anchors' location

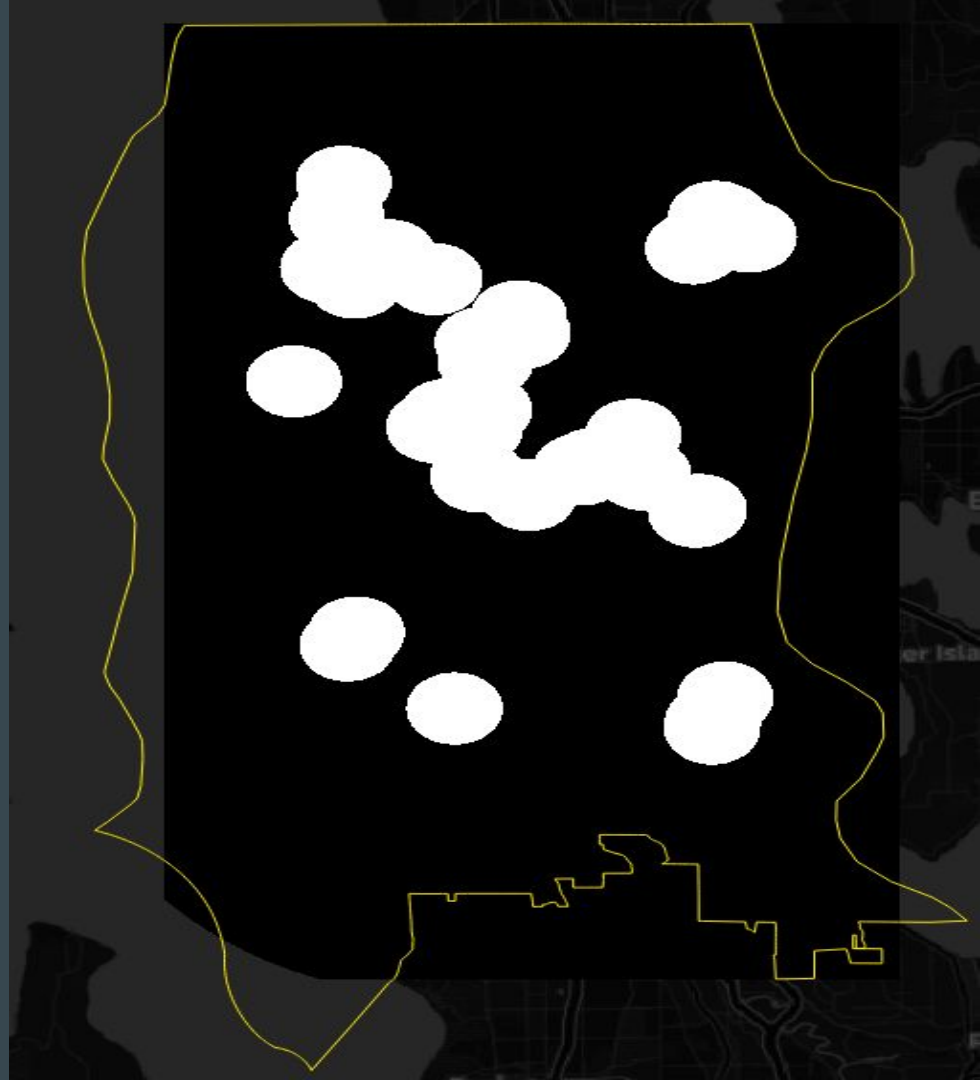


# Assigning a weight within 1,000 m of an anchor institution, based on proximity to PurpleAir's current coverage.



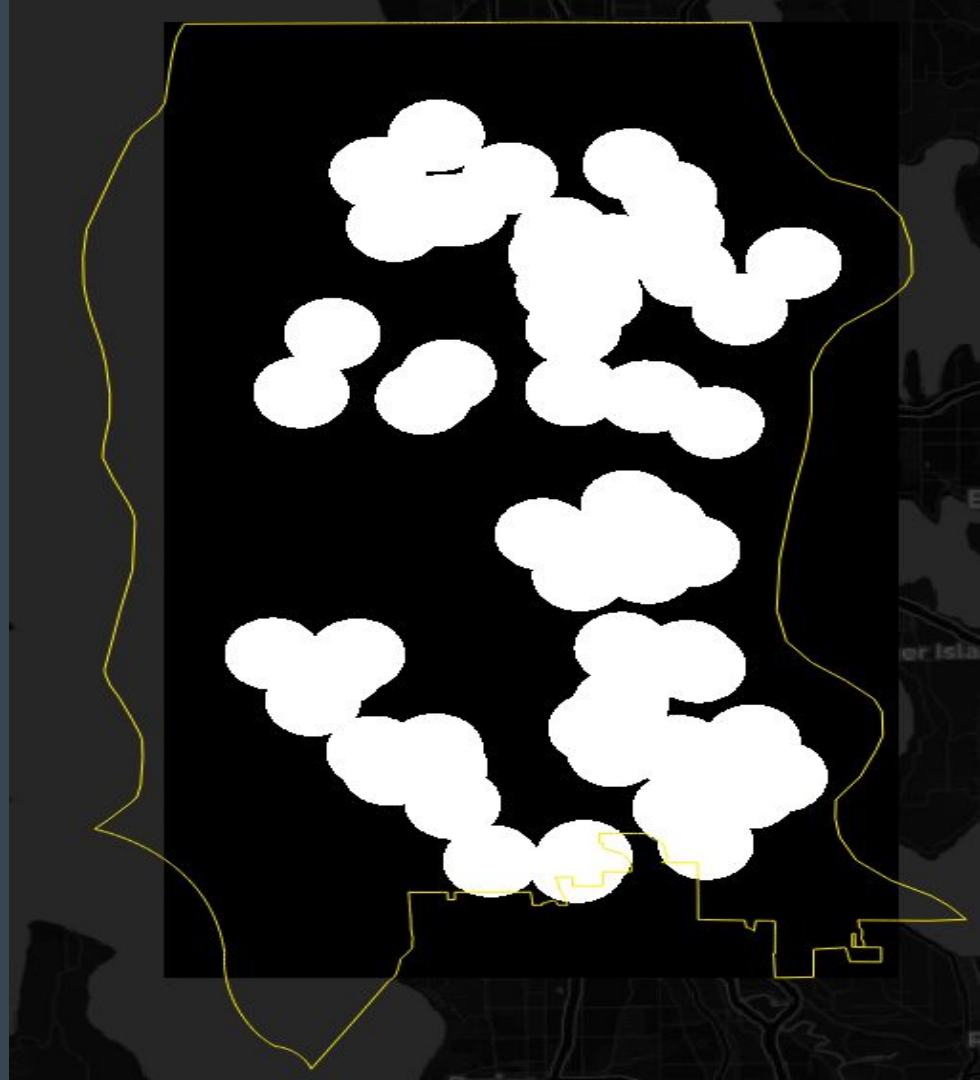
# Weight Assignment

Within 1,000 m of PurpleAir = 20



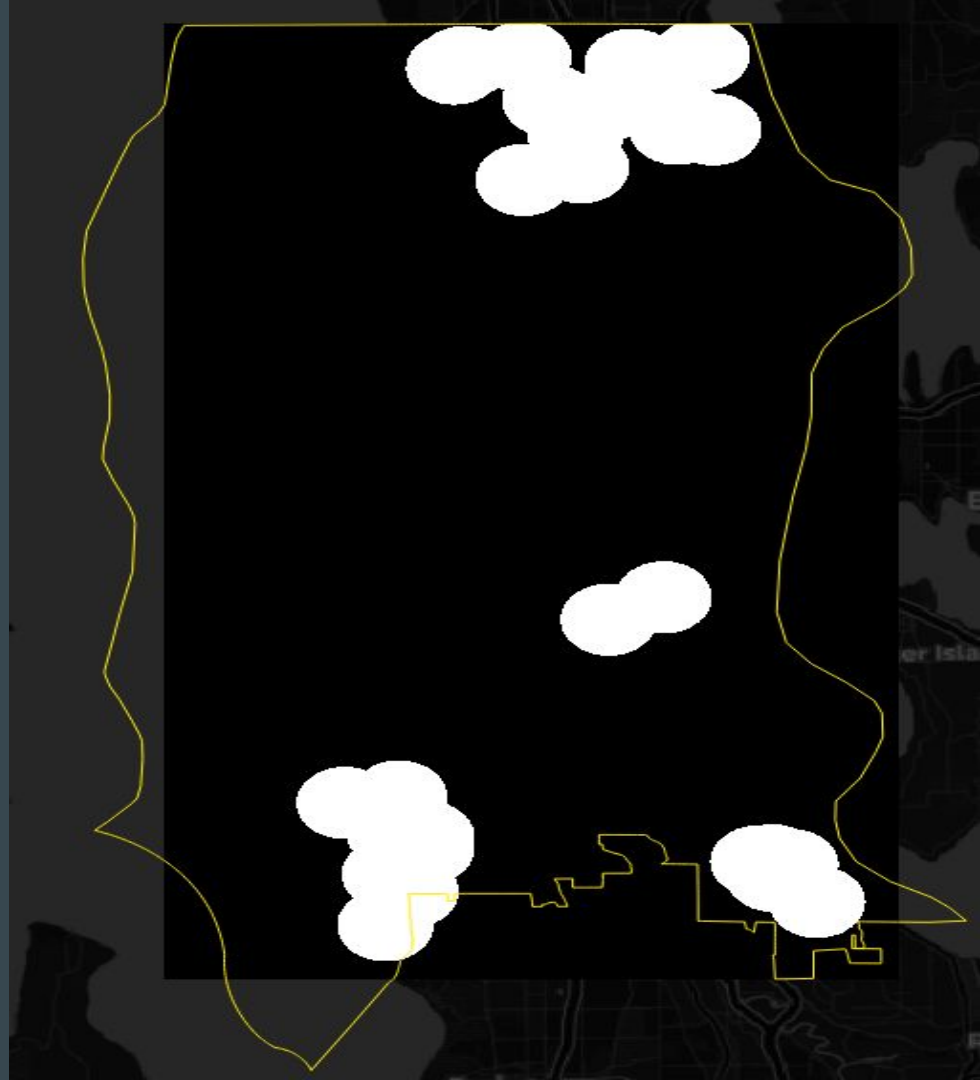
# Weight Assignment

Within 1,000 m of PurpleAir = 20
Within 3,000 m of PurpleAir = 60



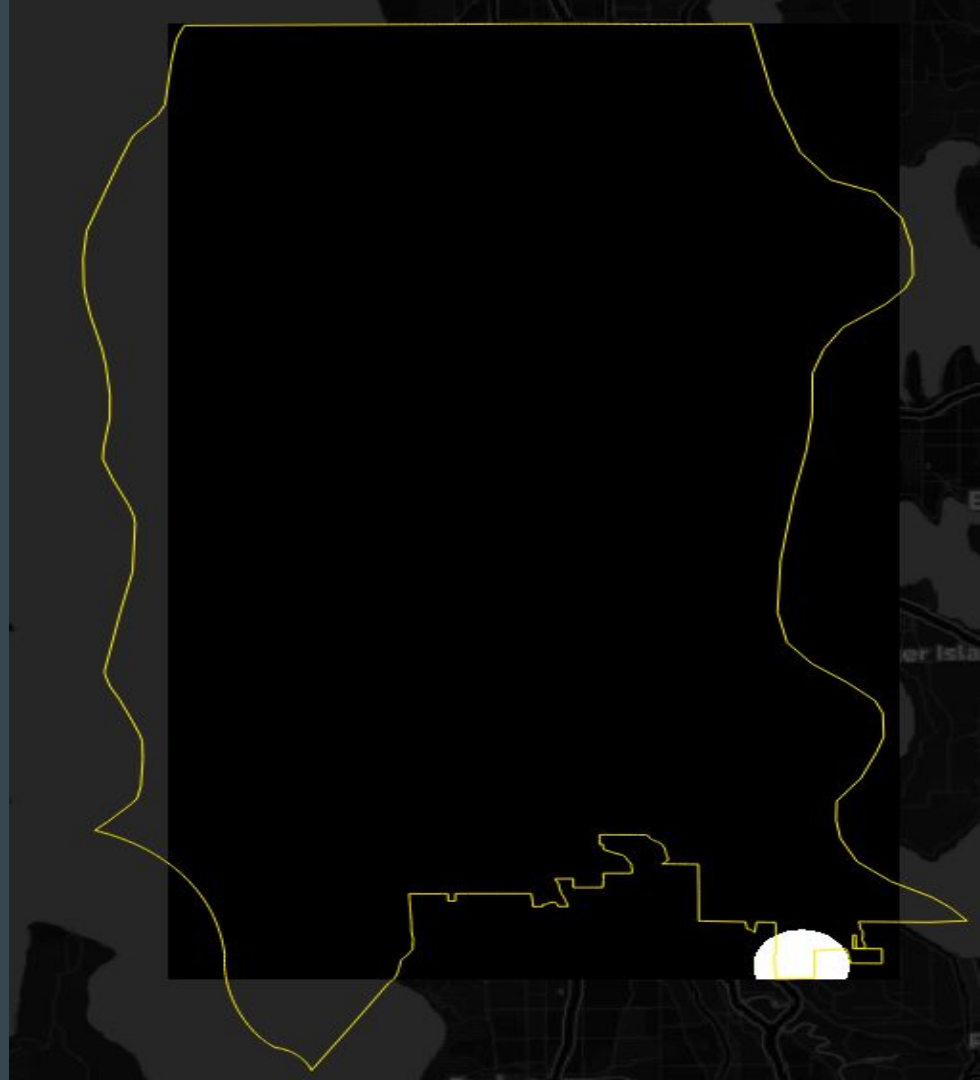
# Weight Assignment

Within 1,000 m of PurpleAir = 20
Within 3,000 m of PurpleAir = 60
Within 6,000 m of PurpleAir = 100



# Weight Assignment

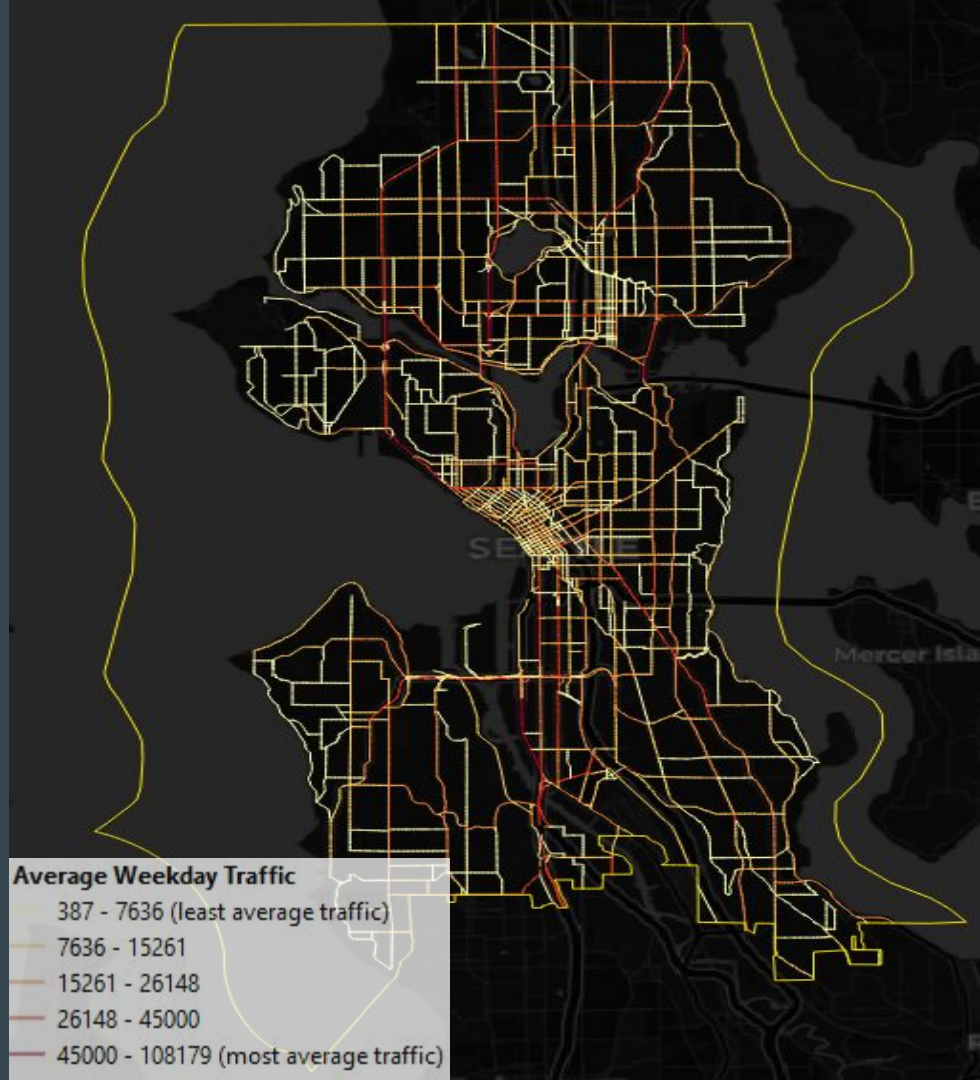
Within 1,000 m of PurpleAir = 20
Within 3,000 m of PurpleAir = 60
Within 6,000 m of PurpleAir = 100
Beyond 6,000 m of PurpleAir = 150



# Traffic Flow

## Seattle GeoData

# 2018 Traffic Flow Counts



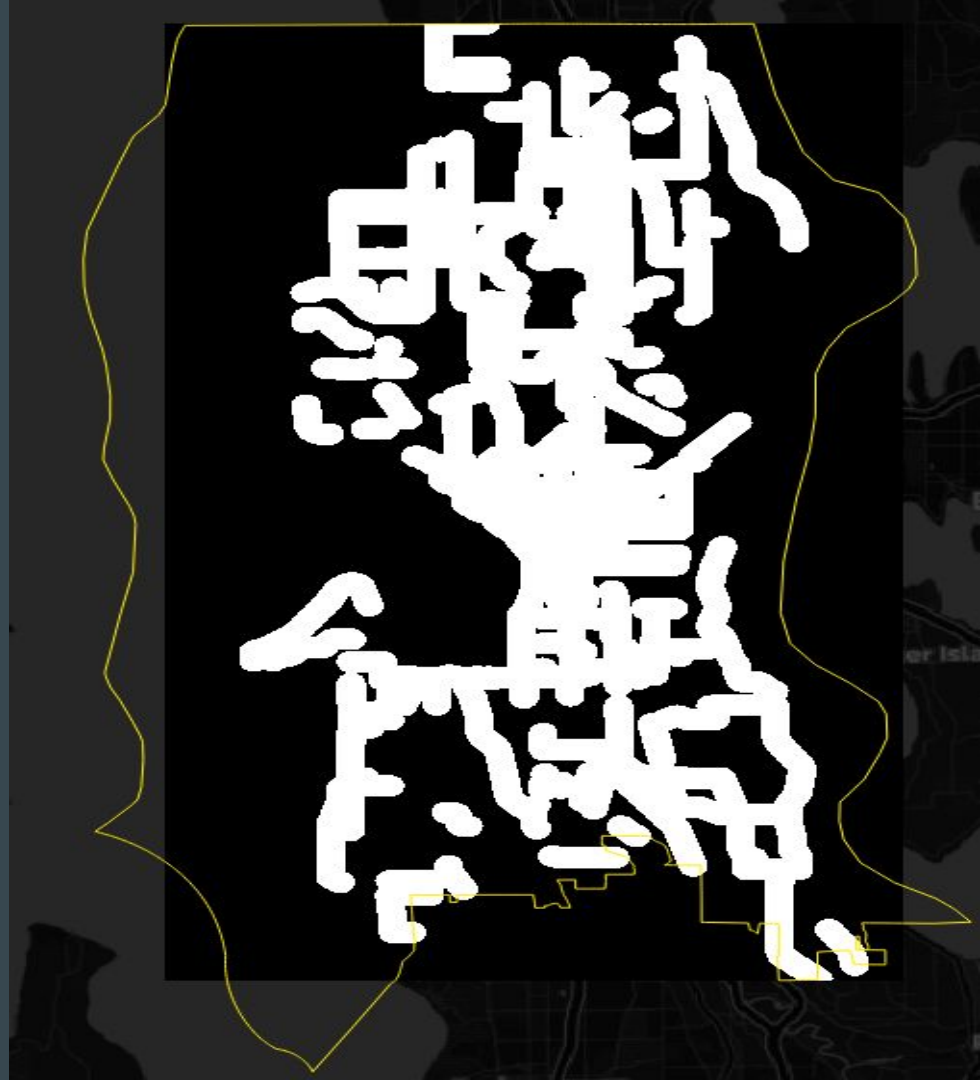
# Weight Assignment

Least Average Traffic = 20

# Weight Assignment

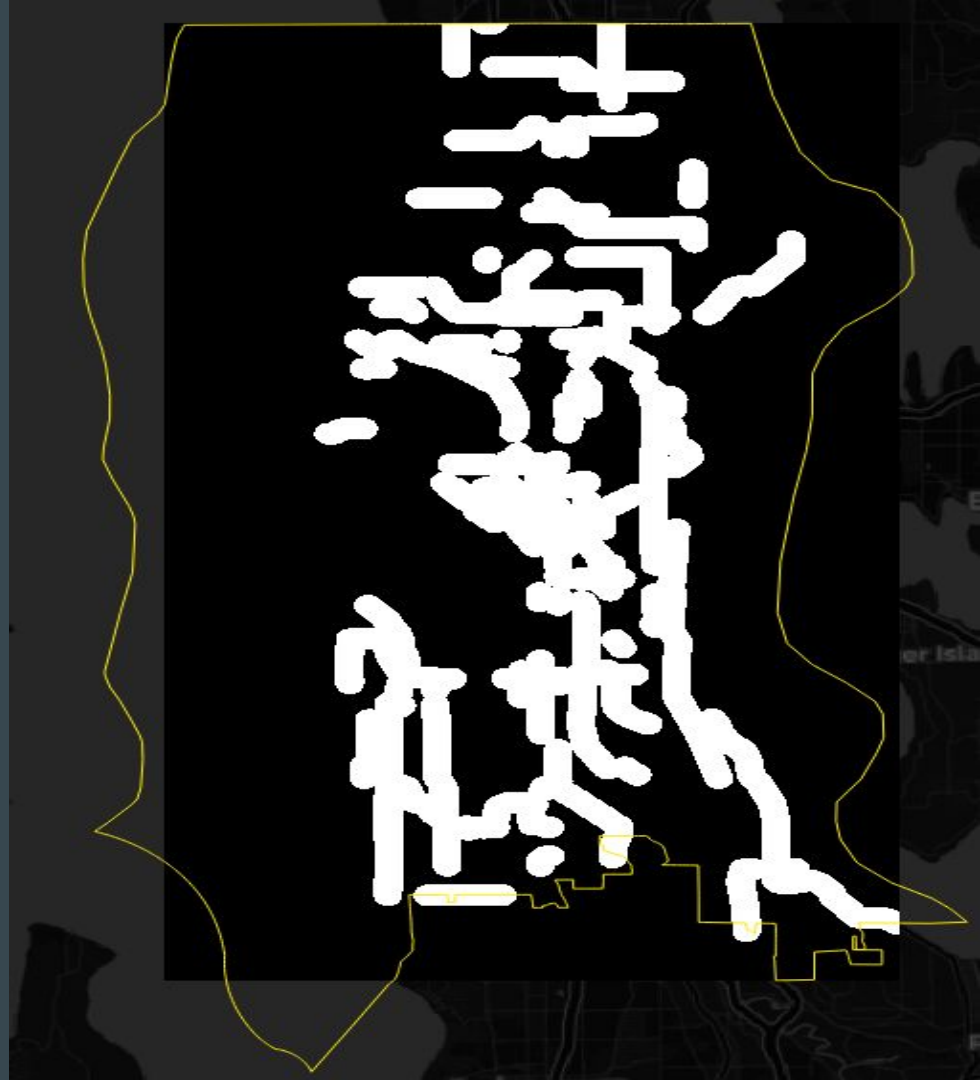
Least Average Traffic = 20

= 40



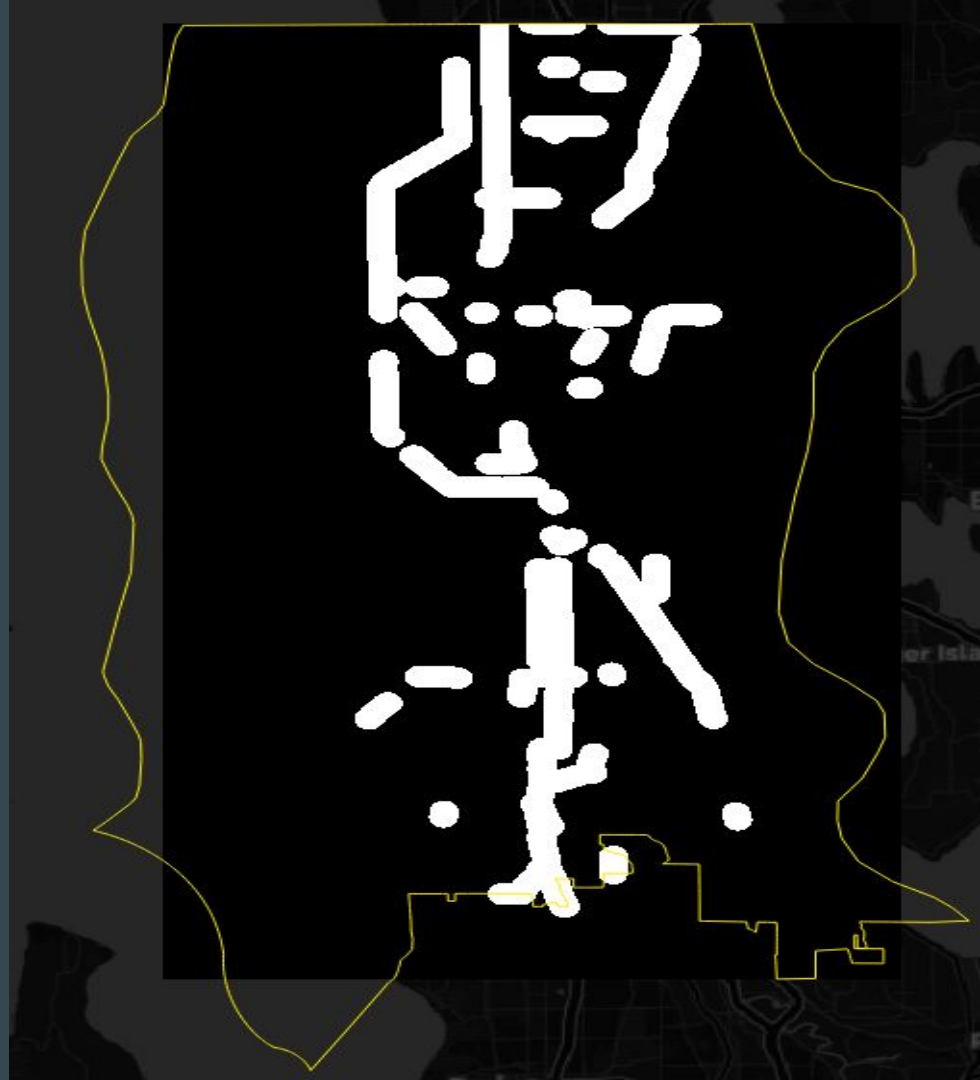
# Weight Assignment

Least Average Traffic = 20
= 40
= 60



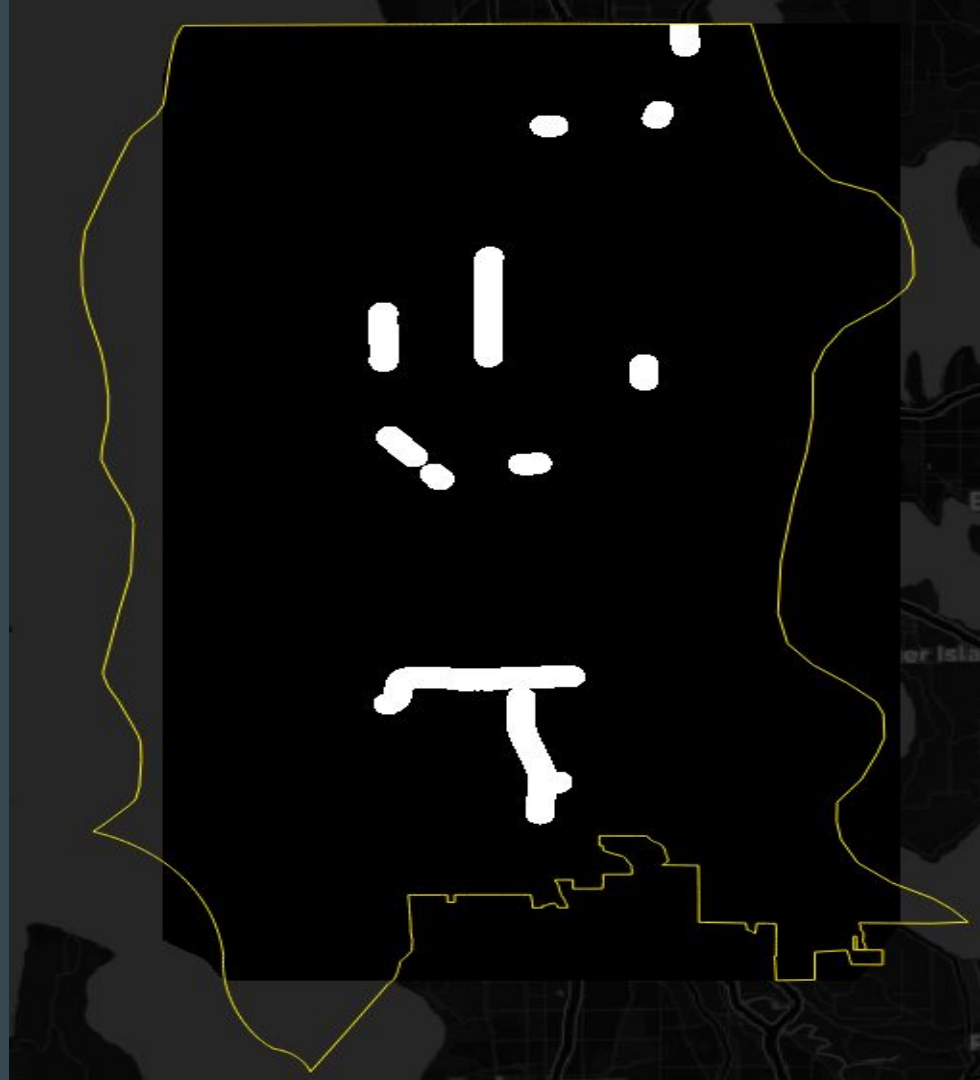
# Weight Assignment

Least Average Traffic = 20
= 40
= 60
= 80



# Weight Assignment

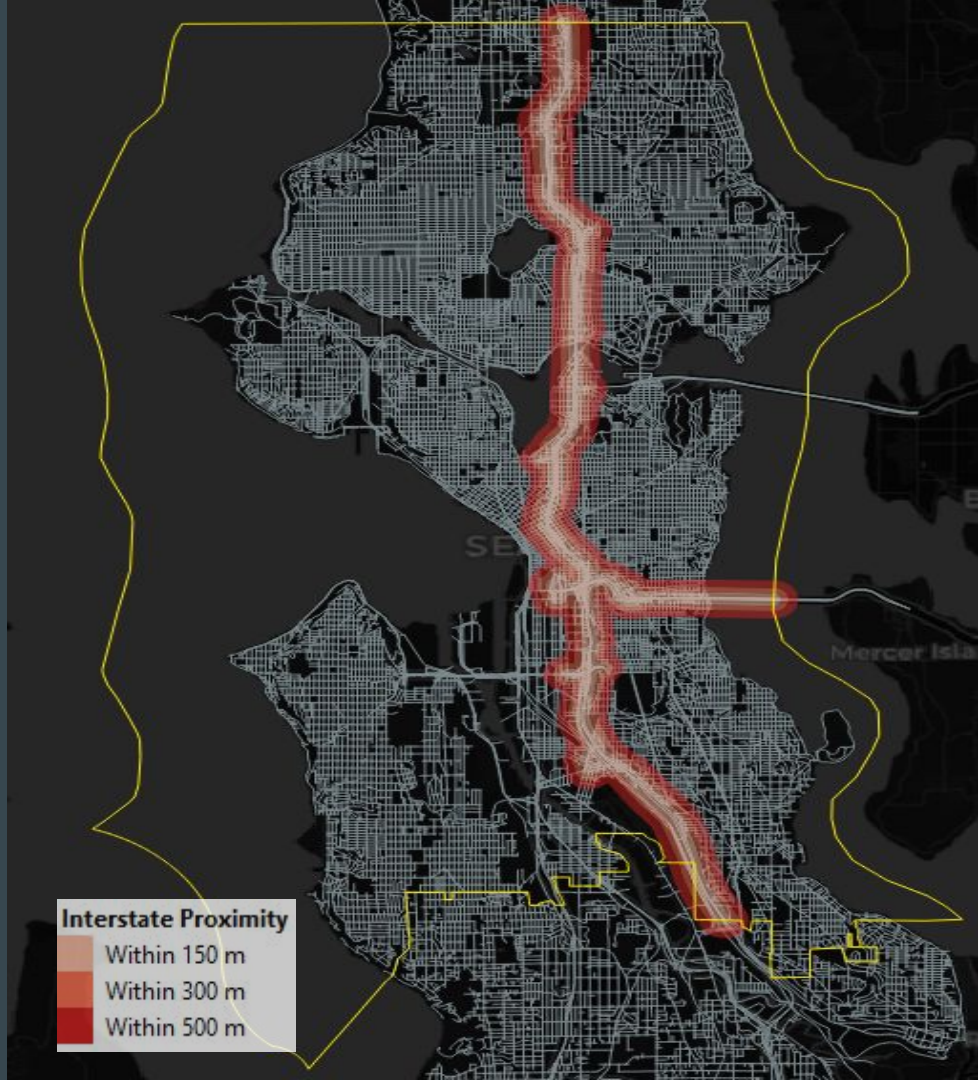
Least Average Traffic = 20
= 40
= 60
= 80
Most Average Traffic = 100



# Proximity to Major Traffic Arteries

Seattle GeoData

# Proximity to Interstates I-5 and I-90



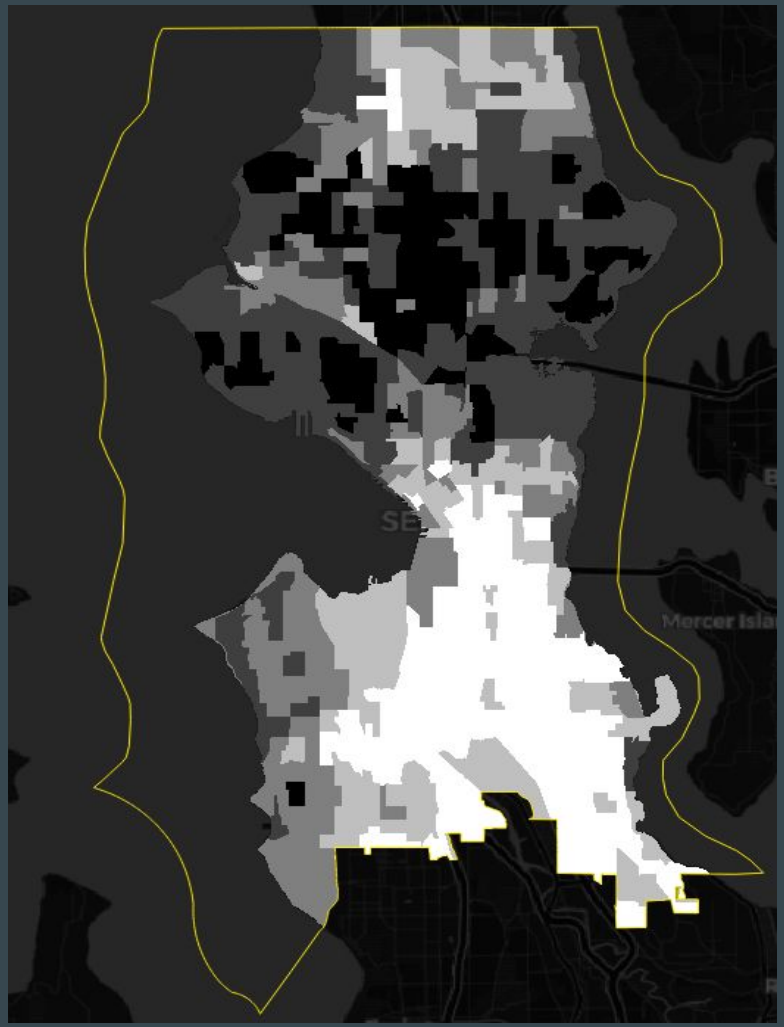
# Weight Assignment

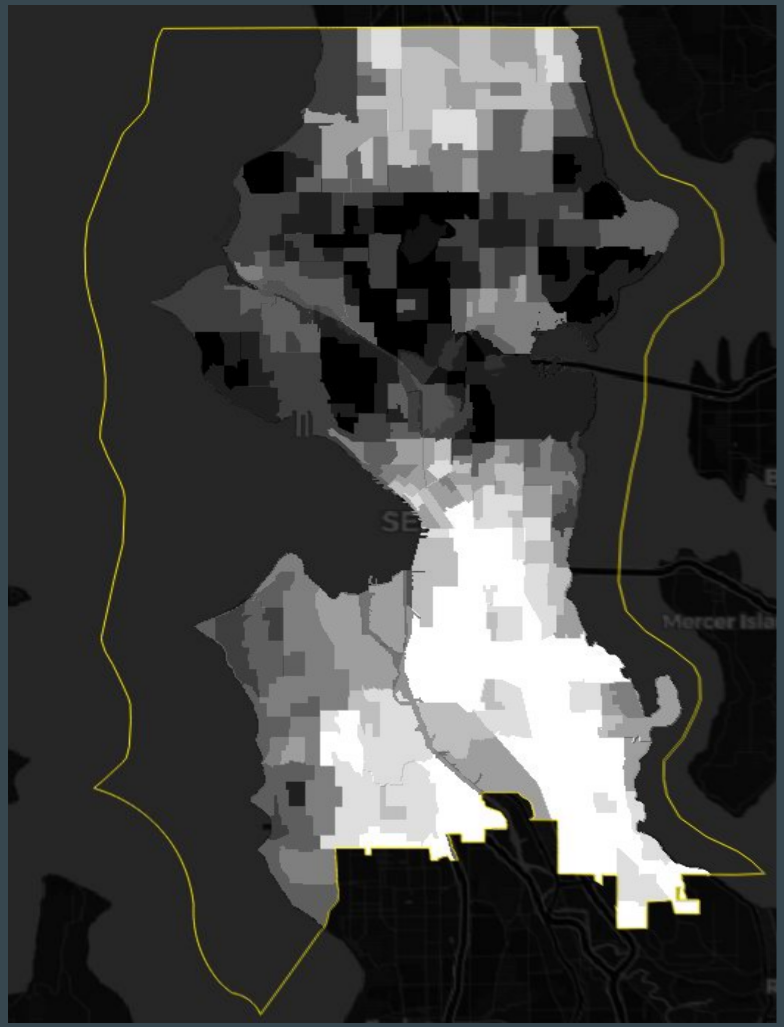
Within 150 m = 100 (white)
Within 300 m = 60
Within 500 m = 30
Beyond 500 m = 1 (black)

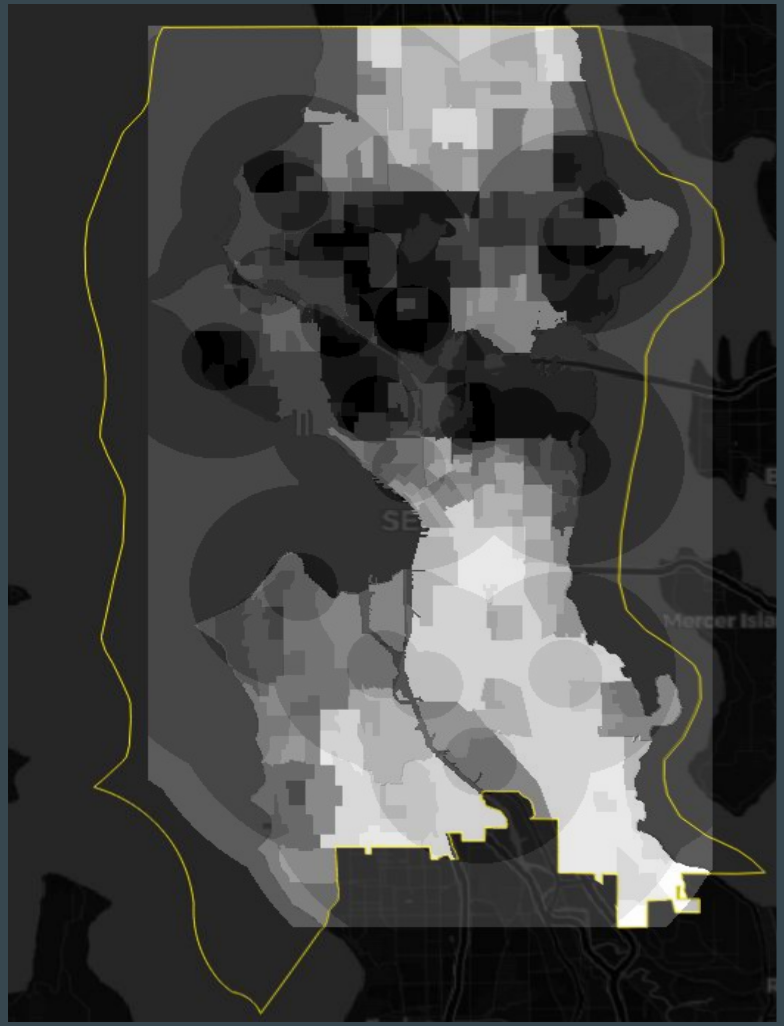
**Raster Calculator Expression**

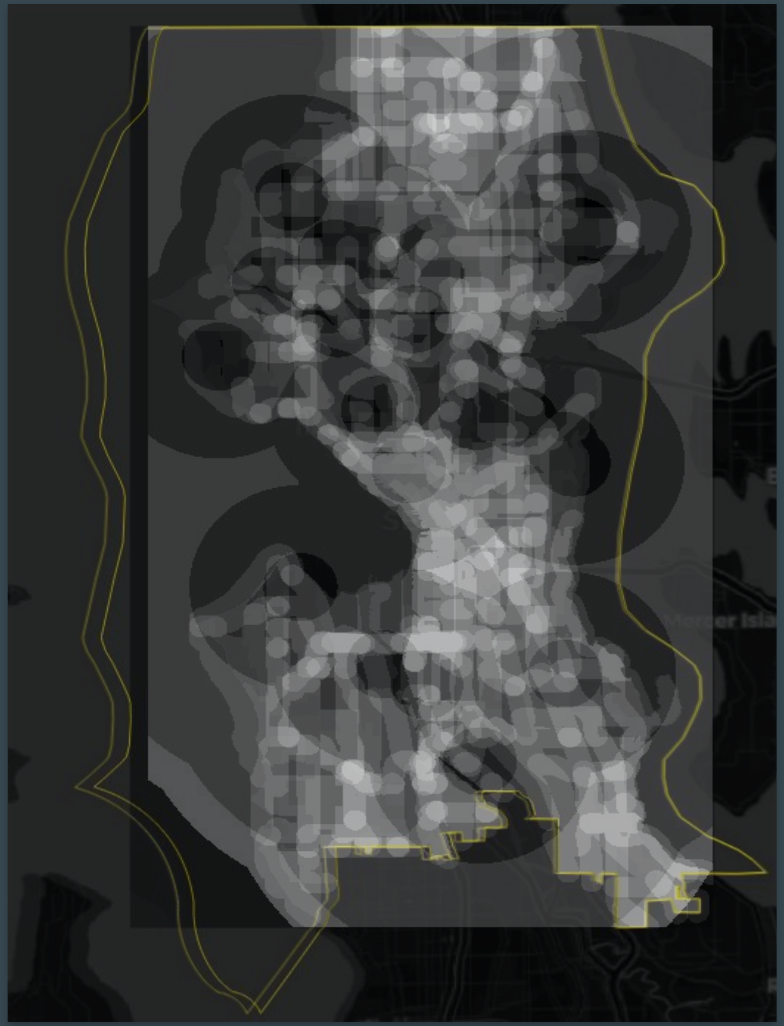
```
"CommIns100@1" + "CommIns150@1" + "CommIns20@1" + "CommIns60@1" + "Community Air Tool@1" +
"compositeIndex_all@1" + "interstateSeattle@1" + "purpleAir_monitoringRange2@1" +
"trafficCount_high2@1" + "trafficCount_high@1" + "trafficCount_low2@1" + "trafficCount_low@1" +
"trafficCount_medium@1"
```

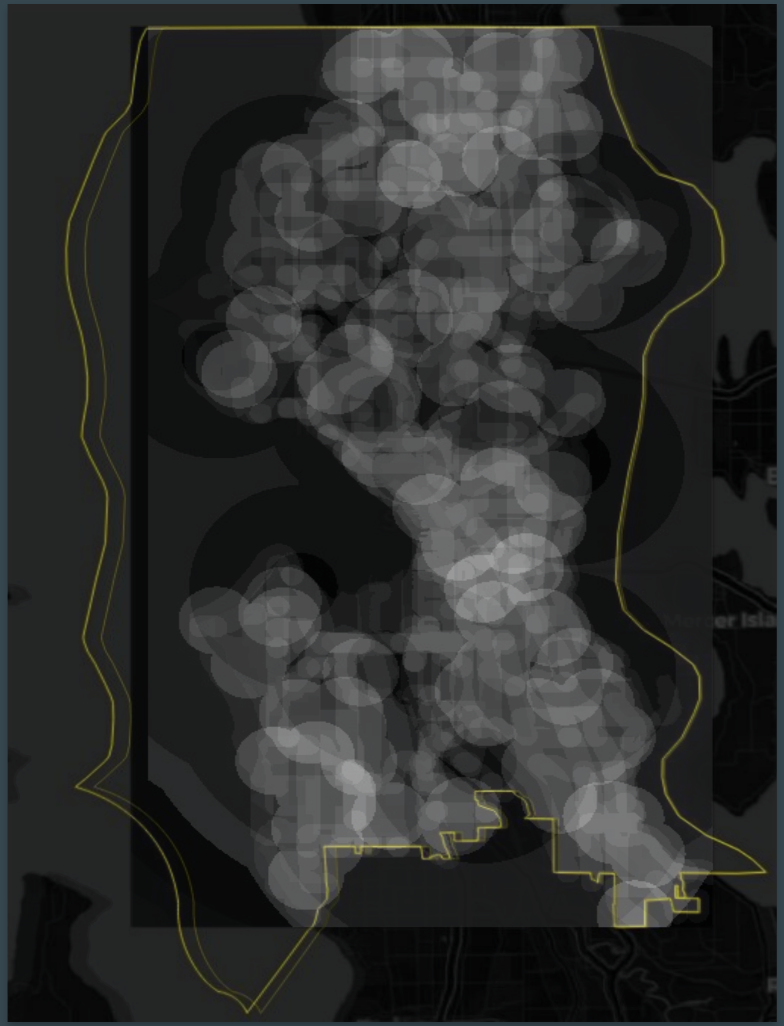
Expression valid

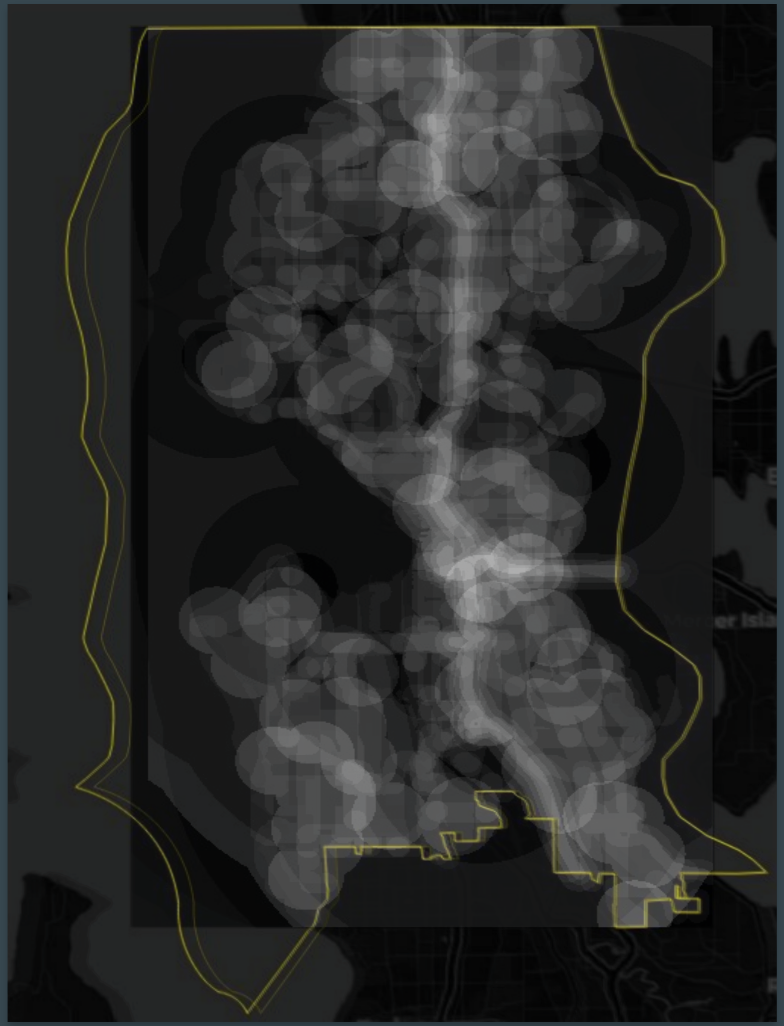

Mercer Isla

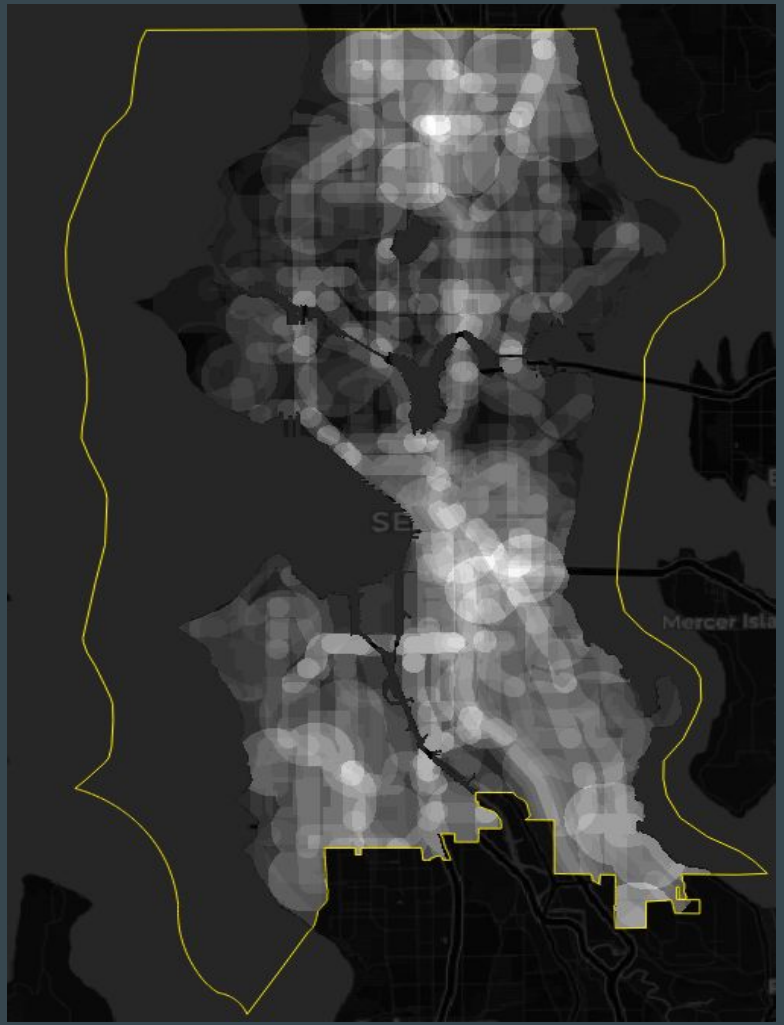

Mercer Isla


Mercer Isla








Mercer Isla

# Reservations

"Happy families are all alike; every unhappy family is unhappy in its own way."

Modelling with Community/Local Knowledge

Impact of COVID-19

Looking beyond Fine Particulate Matter Pollution

# Recommendations

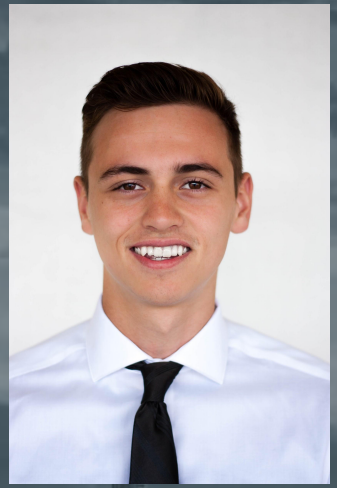
Incorporate historical context of local communities to strategically scope Environmental Justice Communities

Involve public participation in the Criteria Selection process

Make research openly available, accessible, and legible

Open-data is the future

Thank You!



Johnathan Padilla

Johnathan.d.padilla@gmail.com

San Jose State University, Physics B.S. 2020

Hadrien N Picq

hadrien.picq@mail.concordia.ca

Concordia University, Environmental Assessment MEnv 2020