COVID-19 and Air Pollution
A spatial assessment of land use in the Portland Metro

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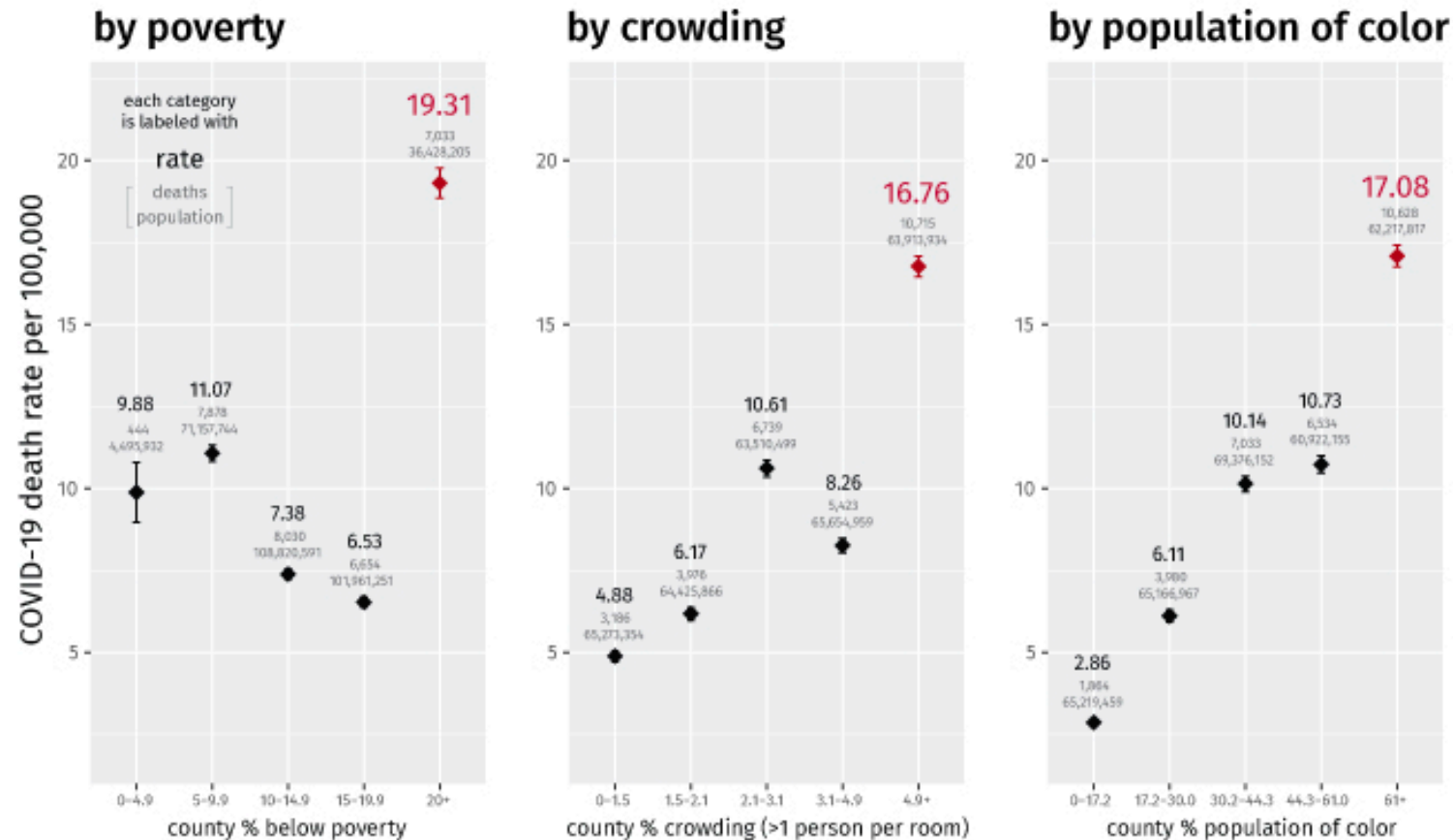*Chair, Urban Forestry Commission, City of Portland*

Portland State
UNIVERSITY

Inequities in US COVID-19 Deaths

(as of April 16, 2020)

The Harvard Center for Population and Development Studies

by poverty

each category is labeled with

rate

[deaths / population]

19.31
7,033
36,428,205

9.88
444
4,695,932

11.07
7,878
71,157,764

7.38
8,030
108,820,591

6.53
6,654
103,961,251

COVID-19 death rate per 100,000

x-axis: 0-4.9, 5-9.9, 10-14.9, 15-19.9, 20+

county % below poverty

by crowding

16.76
10,715
63,913,934

10.61
6,739
63,510,499

8.26
5,423
65,654,959

6.17
3,976
64,425,866

4.88
3,186
65,273,354

x-axis: 0-1.5, 1.5-2.1, 2.1-3.1, 3.1-4.9, 4.9+

county % crowding (>1 person per room)

by population of color

17.08
10,628
62,217,817

10.14
7,033
69,376,152

10.73
6,534
60,922,155

6.11
3,980
65,166,967

2.86
1,864
65,219,459

x-axis: 0-17.2, 17.2-30.0, 30.2-44.3, 44.3-61.0, 61+

county % population of color

people living in the most disadvantaged counties have the highest COVID-19 death rates

COVID-19 not affecting all races equally in King County

In King County, some communities of color have been infected with the novel coronavirus at higher rates than white people, according to a new analysis of public health data.
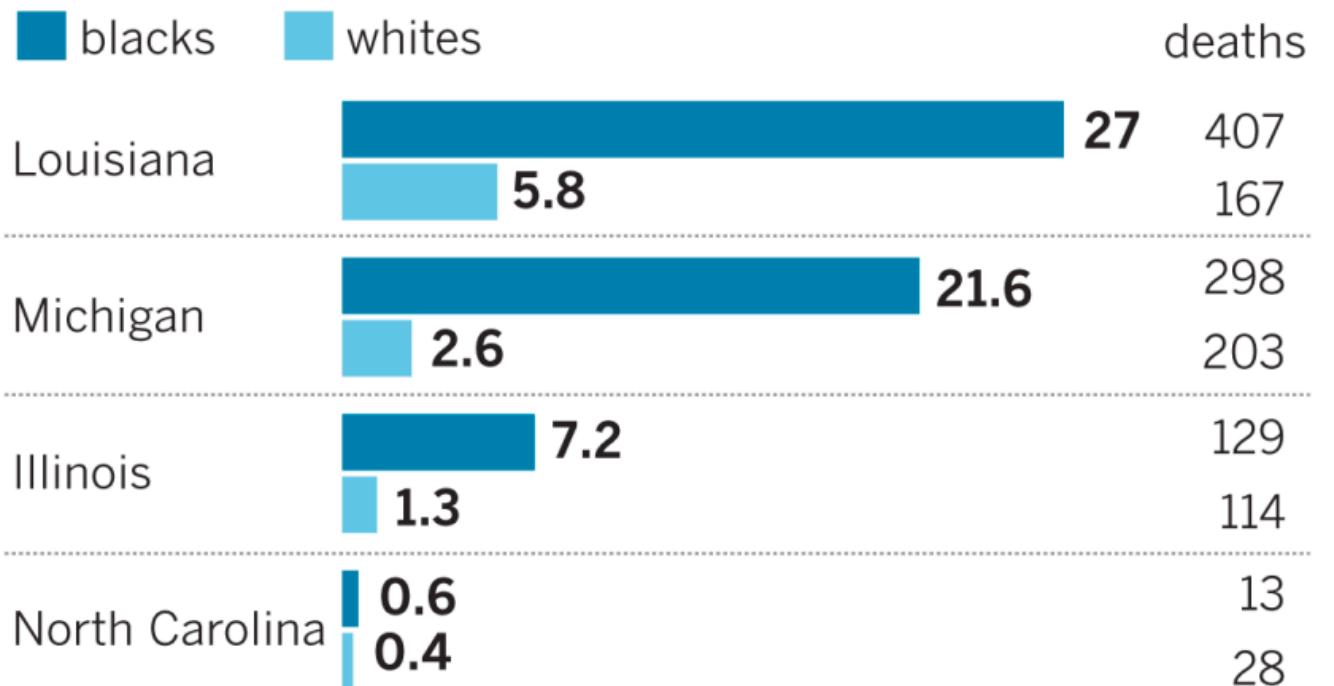
■ **Percent of King County COVID-19 cases**
■ *Percent of King County population (2019)*

CONFIRMED CASES BY RACE/ETHNICITY

Race/Ethnicity	Percent of cases	Percent of population
White	**50.2%**	58.7%
Black	**10.2%**	6.4%
Hispanic/Latino	**23%**	10%
Asian	**13.2%**	17.2%
Native Hawaiian/ Pacific Islander	**2.2%**	0.8%
American Indian/	**0.7%**	

CASES PER 100,000 RESIDENTS

Race/Ethnicity	Cases per 100,000
White	148.6
Black	327.6
Hispanic/Latino	627.6
Asian	154.5
Native Hawaiian/ Pacific Islander	666
American Indian/	216.9

National Statistics about COVID-19 and Race

Coronavirus deaths and race

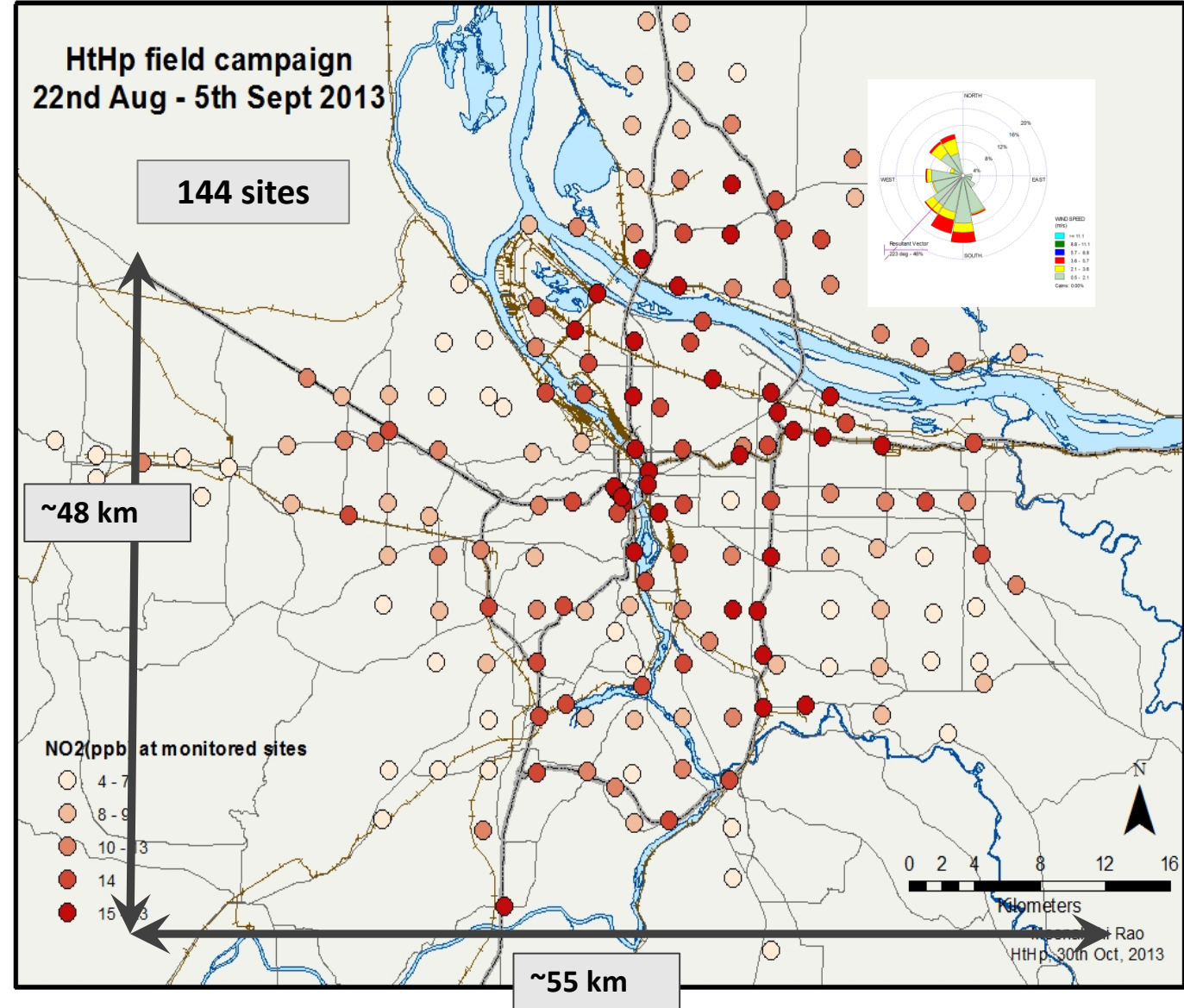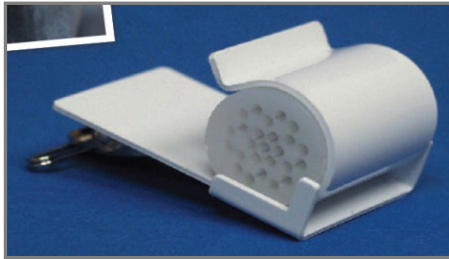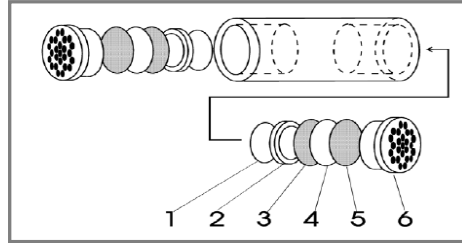COVID-19 is disproportionately killing black Americans, according to data released by several states.
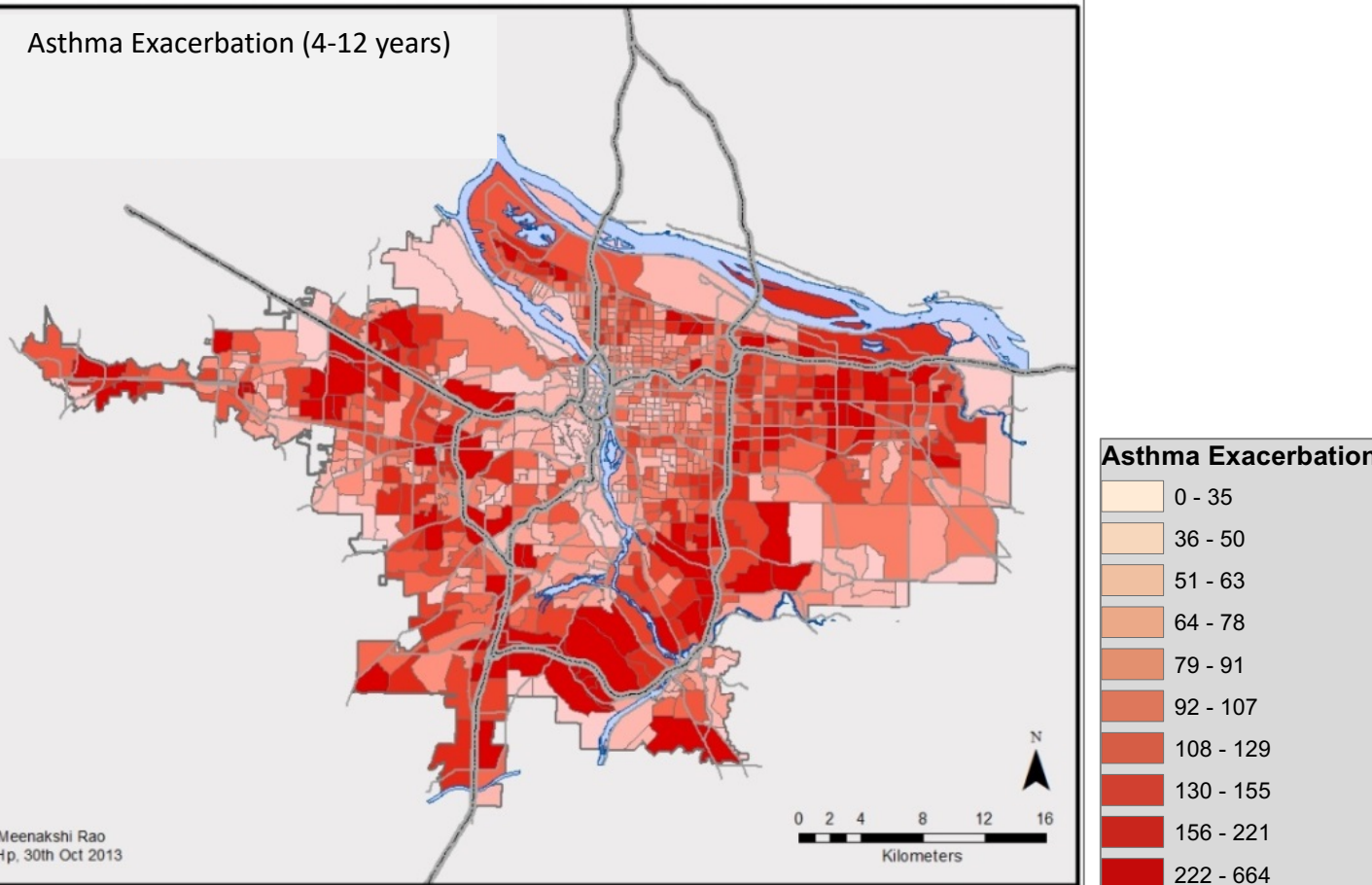
Deaths per 100,000

	blacks	whites		Total deaths
Louisiana	27			407
		5.8		167
Michigan	21.6			298
		2.6		203
Illinois	7.2			129
		1.3		114
North Carolina	0.6			13
		0.4		28

State governments, U.S. Census Bureau

Lorena Elebee / Los Angeles Times

Regional Assessments of Air Quality

Rao et al., 2014

Asthma Exacerbation (4-12 years)

Asthma Exacerbation
	0 - 35
	36 - 50
	51 - 63
	64 - 78
	79 - 91
	92 - 107
	108 - 129
	130 - 155
	156 - 221
	222 - 664

Meenakshi Rao
HtHp, 30th Oct 2013

0   2   4   8   12   16
Kilometers

Health Cost of Pollution (NO_2)

Rao et al., 2014

Health Impact	Incidence Estimate (LUR)	Economic Valuation (in $1,000,000)
Asthma Exacerbation, Missed school days (4-12 years)	32,003	2.74
Asthma Exacerbation, One or More Symptoms (4-12 years)	93,480	14.60
Emergency Room Visits, Asthma (all ages)	258	0.08
HA, All Respiratory (65 and older)	289	5.35
HA, Chronic Lung Disease (less Asthma) (65 and older)	135	1.85
		$24.62

Emergence of Cleaner Air Oregon

1. Spring 2103: US Forest Services researchers find higher levels of cadmium and arsenic in moss around glass manufacturers in Portland.

2. Corroborates findings from earlier studies showing high spatial variability of air pollutants, including nickel and chromium, cobalt, lead, and particulate matter, all of which emerge from land use.

3. The subsequent public outrage compelled Oregon Governor Kate Brown to launch Cleaner Air Oregon rulemaking process, April 2016.

4. Existing rules, based on Federal law, allow industrial facilities to release potentially harmful air toxics within legal requirements.

5. Oregon Environmental Quality Commission adopts CAO rules (Nov 2018) becoming the State's health risk-based air toxics regulatory program

6. As part of the CAO program, industries disclose air pollutants information by year and total lbs per year
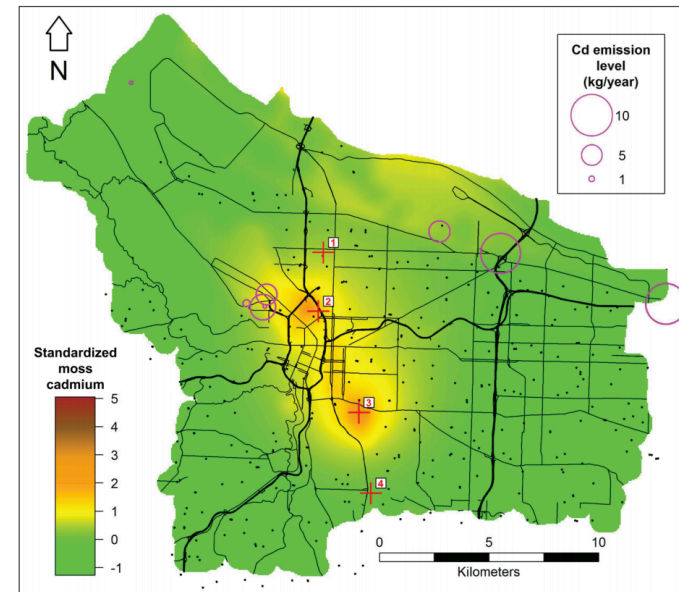
Of Moss and Men: Using Moss as a Bioindicator of Toxic Heavy Metals at the City Scale

Source: Donovan, G.H., et al. 2016

Cd emission level (kg/year)
10
5
1

Standardized moss cadmium
5
4
3
2
1
0
-1

0   5   10
Kilometers

This map is based on moss data from Portland, Oregon, and model output that predicts the presence of cadmium in moss on a 50-meter grid. The North Roselawn air-quality monitoring station (1) was the city's one permanent air-quality monitoring station in 2013. Data from this study helped pinpoint previously unidentified sources of cadmium emissions: (2) a smaller glass manufacturer, (3) a larger manufacturer, and (4) an electroplating business that uses cadmium. Black dots denote moss sampling points.

IN SUMMARY

Air quality is a critical issue affecting the health of billions of people worldwide, yet often little is known about what is in the air we breathe. To reduce air pollution's health impacts, pollution sources must first be reliably identified. Otherwise, it is impossible to design and effectively enforce environmental standards. However, urban networks of air quality monitors are often too widely spaced to identify the sources of air pollutants, especially for pollutants that do not disperse far from their sources. Developing high-resolution pollution maps with data from these widely spaced monitors is problematic.

In a recent study, scientists with the U.S. Forest Service Pacific Northwest Research Station tested a common tree moss for the presence of heavy metals at 346 locations in Portland, Oregon. The study yielded fine-scale maps showing air pollution distribution across the city at a level of spatial detail that had never been seen. The maps revealed two sources of cadmium that were emitting

Cleaner Air Oregon

Background and Overview

- Cleaner Air Oregon fact sheets
- Cleaner Air Oregon Rules
- CAO Rules Tables 📄
- CAO Regulatory Overhaul
- Ask a Question

CAO Hazard Index Rulemaking

- CAO Hazard Index Rulemaking 2019
- Overview of Proposed Hazard Index Rules 📄
- Infographic of Hazard Index Rulemaking 📄
- How Do Agencies Determine What

For Community

- Facilities Conducting CAO Health Risk Assessments
- How Risk Action Levels Work 📄
- Plan for Community Engagement Protocols 📄
- Map of DEQ Permitted Facilities

For Facilities

- CAO Permitting Requirements
- Risk Assessment Resources
- Facility Call-in Prioritization Report 📄
- CAO Call-in Prioritization Details
- Emissions Inventory

Cleaner Air Oregon Facilities by Location (2016)

Portland Industrial Facilites by Location
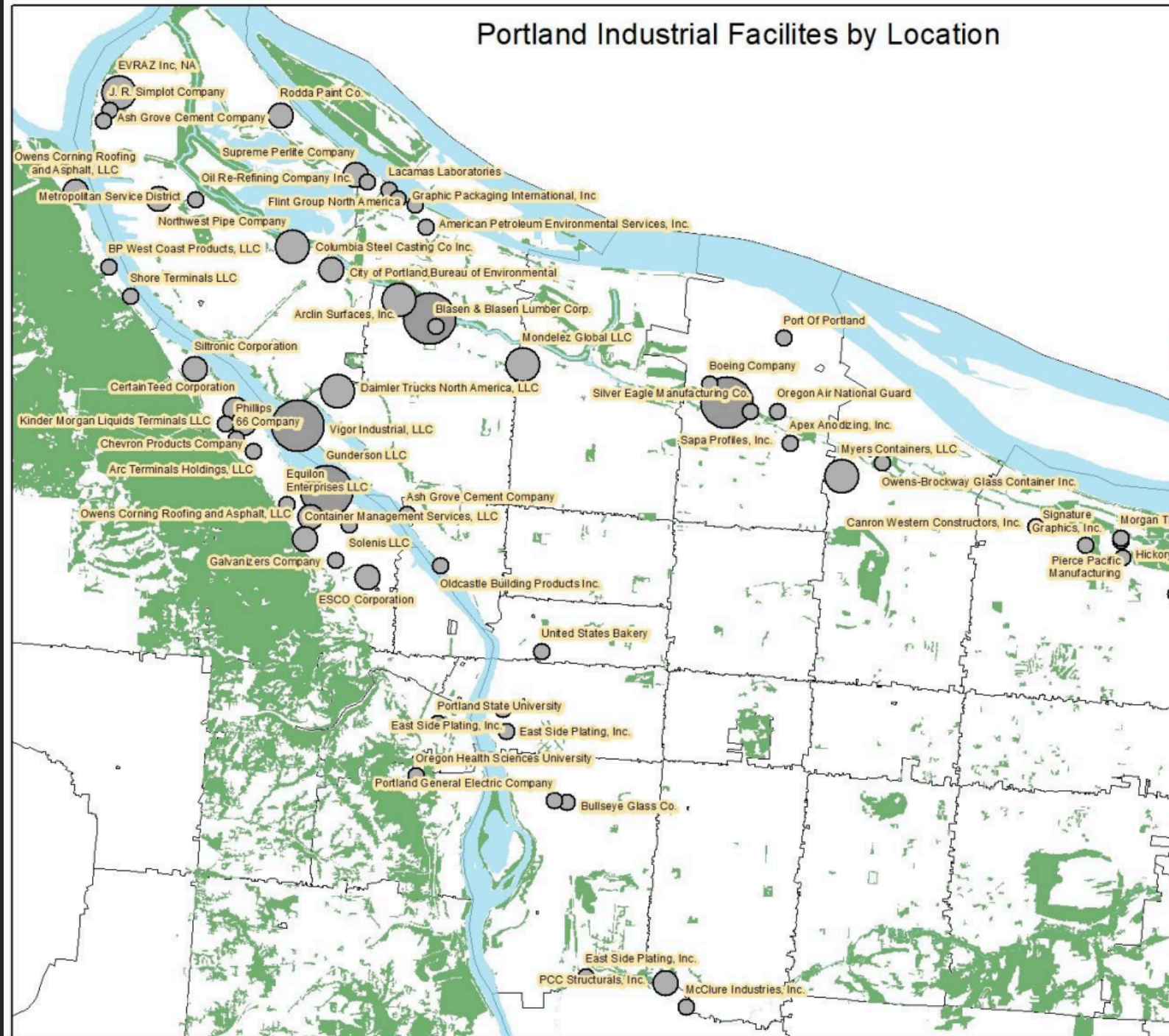
Top 10 Facilities and People of Color (POC) by Population Share

Legend

Top Ten Facilities

○ Facilities

Buffer by Meters
100
250
500
750
1000

% POC Census Block Groups
6.889764 - 10.000000
10.000001 - 20.000000
20.000001 - 29.836382
29.836383 - 37.491089
37.491090 - 46.451916
46.451917 - 56.338799
56.338800 - 69.723953
69.723954 - 80.000000
80.000001 - 95.000000

0   2,375   4,750   9,500 Meters
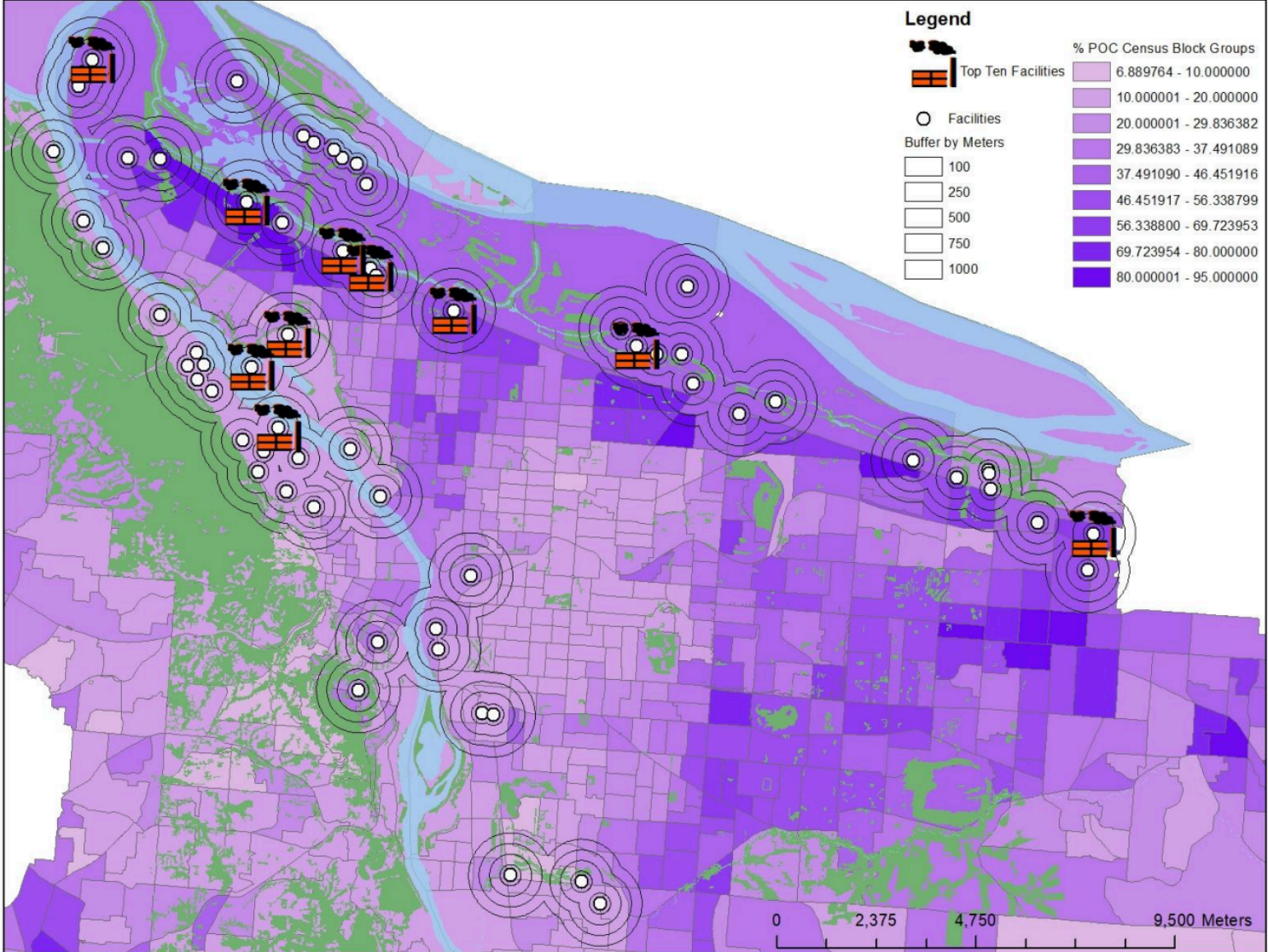
Cleaner Air Oregon.2020."CAO Emissions By Source". Oregon Department of Environmental Quality.
RLIS Discovery: Home - Census Block Groups 2010. 2010. Available at: http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=2589

Top 10 Industrial Facilities and Communities of Color
(Portland, 2016)

Historic Echoes of Injustice
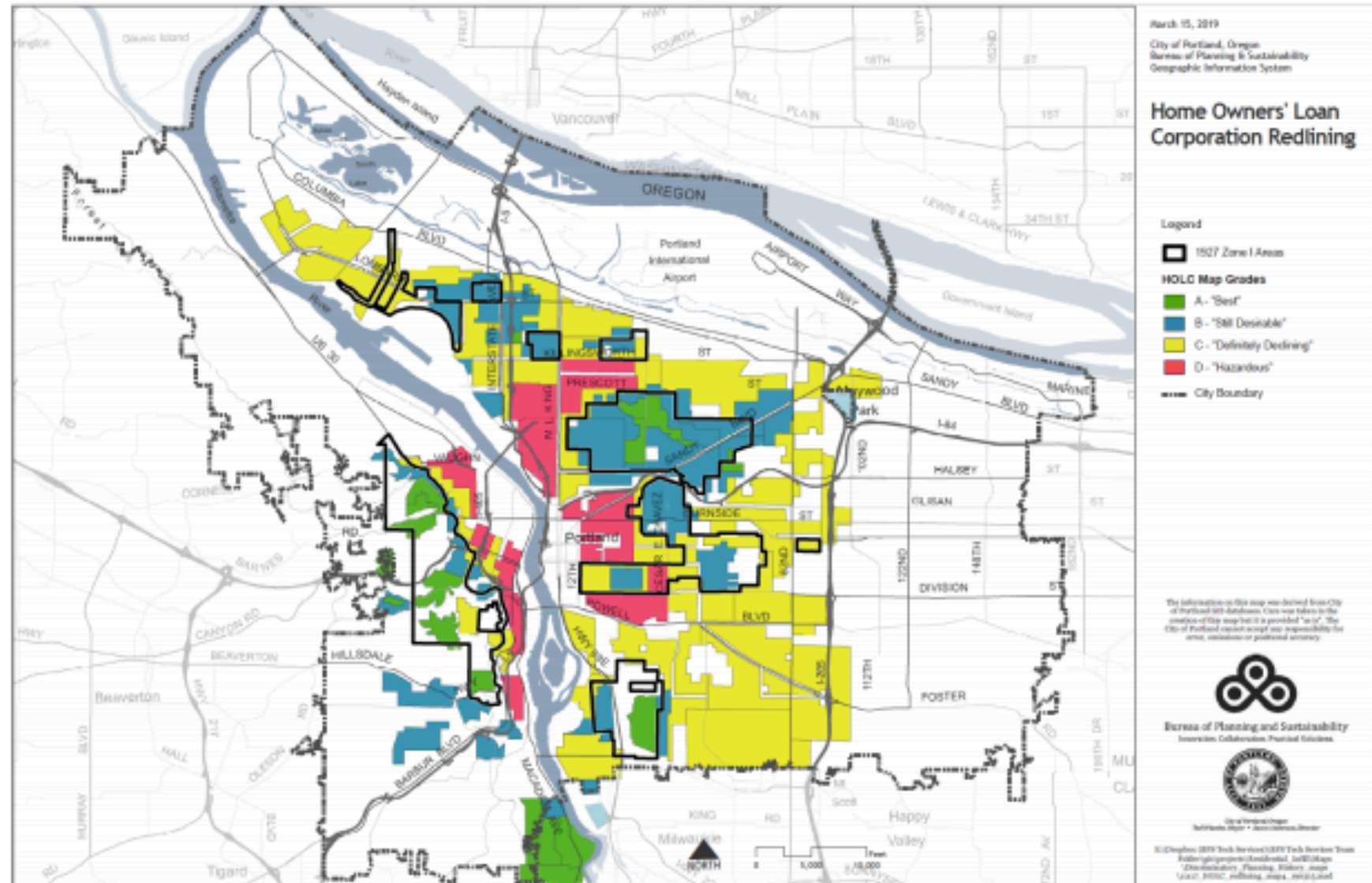
Portland's 1937 Redlined Areas by HOLC Grade

Legend

HOLC Grades

- A (dark green)
- B (light green)
- C (orange)
- D (red)
- Rivers (light blue)
- Nature (medium green)
- Neighborhood_Boundaries (white)

| 0 | 1,900 | 3,800 | | 7,600 Meters |

RLIS Discovery: Home - Neighborhood Boundaries 2010. 2010. Available at: http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=2589

Nelson, Robert K. ., LaDale Winling, Richard Marciano, and Nathan Connolly. 2020. "Mapping Inequality". American Panorama, ed. https://dsl.richmond.edu/panorama/redlining/#loc=5/39.1/-94.58&text=downloads.

Number of redlined census block groups within 2km of the top ten industrial air polluters
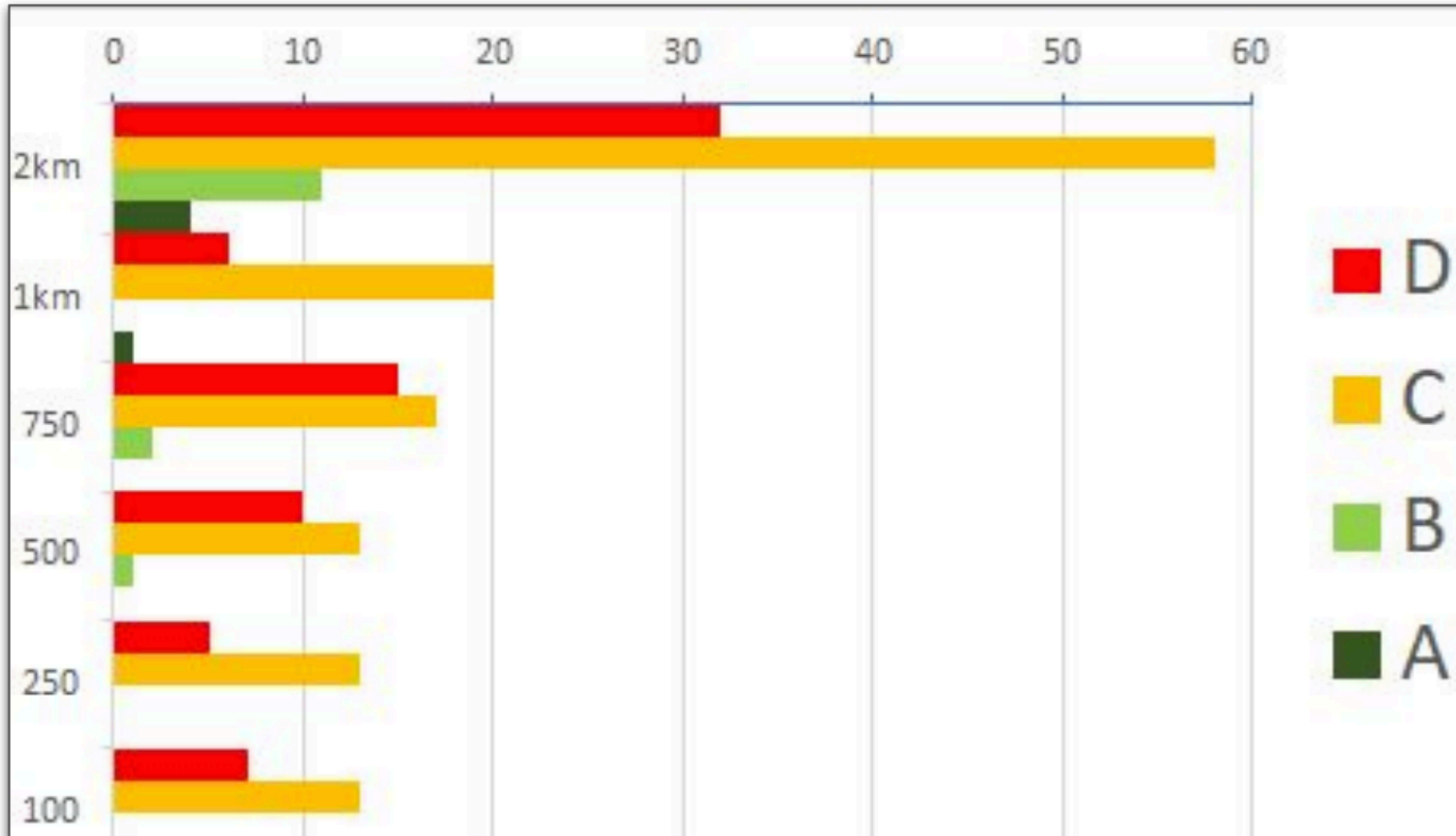
38% of POC in Portland are living within 2km of the top 10 industrial air polluters

42% of all C/D redlined grades are within 1 km of the top 10 facilities

35% of total emissions in Portland are produced by the top 10 facilities

Hottest: Pockets of high heat dot industrial areas and major roads in east Portland. Interstate Avenue, which runs through the Overlook neighborhood reached **93°F** on a hot summer afternoon.

Smith Lake
Columbia River
ST. JOHNS
AIRPORT
Forest Park
OVERLOOK
Willamette River
Rocky Butte Natural Area
DOWN TOWN
S.W. HILLS
PORTLAND
Mt. Tabor Park
LENTS
Powell Butte Natural Area
Tryon Creek Natural Area

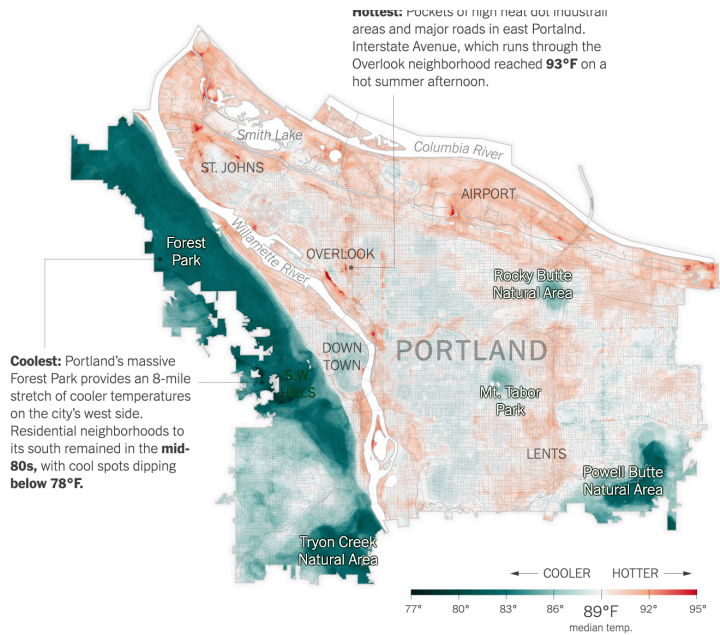**Coolest:** Portland's massive Forest Park provides an 8-mile stretch of cooler temperatures on the city's west side. Residential neighborhoods to its south remained in the **mid-80s,** with cool spots dipping **below 78°F.**

← COOLER   HOTTER →
77° 80° 83° 86° 89°F 92° 95°
median temp.

A Case Study of Urban Heat in Portland*

Communities living in the **hottest parts** of Portland include those with Less Formal Education **덥다!** Limited English Proficiency and in neighbor-hoods that contain High Racial Diversity Extreme Poverty
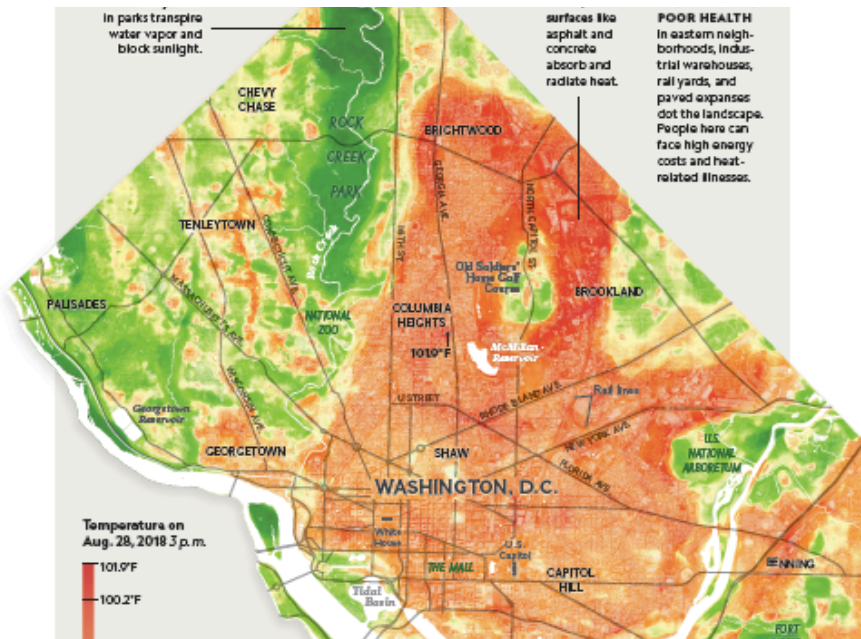
White communities are **more** likely to have Central Air Conditioning, while communities

Asian and Elderly Communities are less likely to have access to heat refuges

In parks transpire water vapor and block sunlight.

surfaces like asphalt and concrete absorb and radiate heat.

POOR HEALTH In eastern neigh-borhoods, indus-trial warehouses, rail yards, and paved expanses dot the landscape. People here can face high energy costs and heat-related illnesses.

CHEVY CHASE
ROCK CREEK PARK
BRIGHTWOOD
TENLEYTOWN
Old Soldiers' Home Golf Course
BROOKLAND
PALISADES
NATIONAL ZOO
COLUMBIA HEIGHTS
101.9°F
McMillan Reservoir
Georgetown Reservoir
U STREET
GEORGETOWN
SHAW
U.S. NATIONAL ARBORETUM
WASHINGTON, D.C.
THE MALL
U.S. Capitol
CAPITOL HILL
Tidal Basin

Temperature on Aug. 28, 2018 3 p.m.
101.9°F
100.2°F

As Summer Approaches....Heat + Air Quality
National Geographic and NYTimes Edition

HOLC 'Redlining' & Current Temperatures

State	City	A	B	C	D	D - A
GA	Atlanta	-2.9	-1.5	0.1	2.0	4.9
NY	Rochester	-2.7	-0.2	0.8	2.2	4.9
MD	Baltimore	-2.0	-1.5	0.7	3.2	5.1
KY	Louisville	-3.1	-0.7	0.5	2.1	5.2
PA	Philadelphia	-3.6	-0.9	1.1	1.6	5.2
VA	Roanoke	-4.5	0.2	0.6	0.7	5.3
IN	Indianapolis	-4.4	-0.9	0.5	0.9	5.3
TN	Chattanooga	-2.1	-2.3	0.3	3.3	5.3
CT	East Hartford	-2.7	-0.2	1.4	2.7	5.4
FL	Jacksonville	-3.1	-0.4	1.1	2.4	5.5
GA	Columbus	-3.5	-1.4	1.5	2.2	5.7
MN	Minneapolis	-3.1	-0.8	1.0	2.9	6.0
CO	Denver	-4.1	-2.1	0.4	2.6	6.7
OR	Portland	-4.4	0.5	0.7	2.7	7.1

Hoffman and Shandas (2020)

What is Needed?

- Higher resolution monitoring of air quality – neighborhood scale
- Integration of air quality data with heat vulnerability
- Decision support tools that provide real-time monitoring of air pollutants and extreme heat (street level)
- Acceleration of renewable energy efficiency programs that centering historically underserved communities

Contact

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Website: suprlab.org