Modeling Sources of Air Pollution

West Oakland Action Plan

West Oakland Steering Committee Meeting
March 6, 2019

Overview

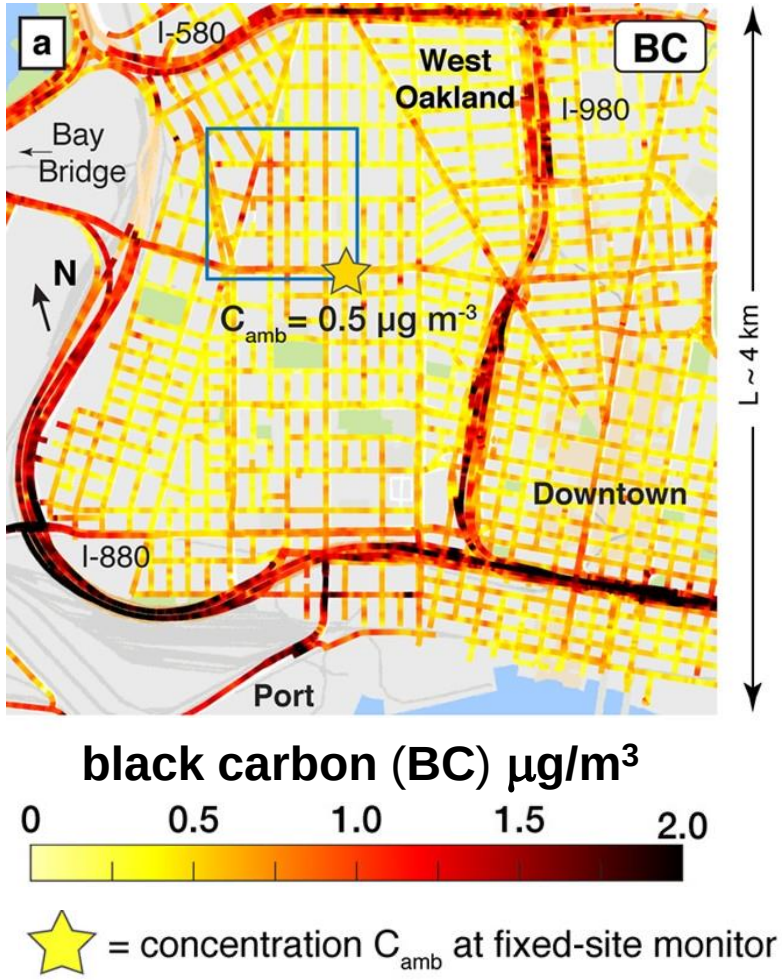
1. Goals of the technical assessment
2. Brief review of the modeling approach
3. Findings—what sources contribute to air pollution:
   - Residential impacts across West Oakland
   - Specific locations, including sensitive locations (schools, senior center, parks)
4. Summary

Goals of the Technical Assessment

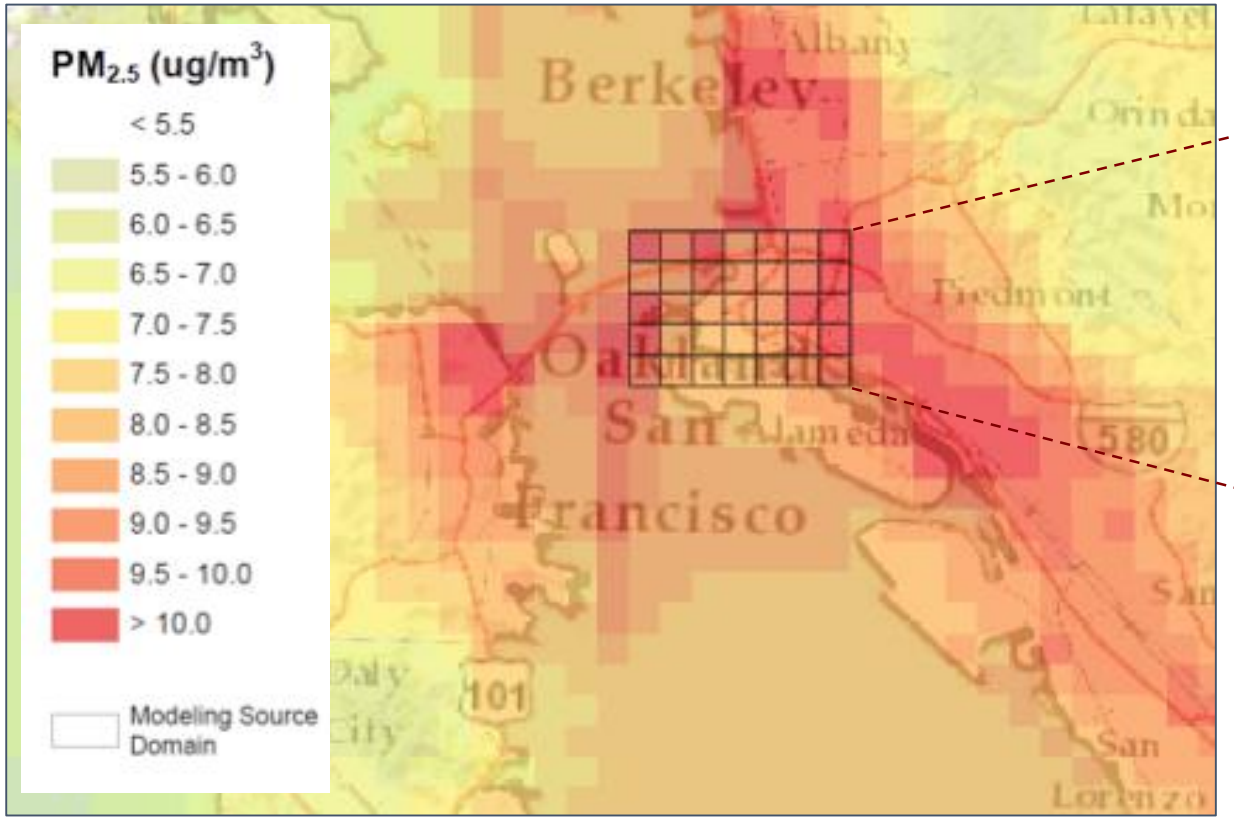
- Help identify strategies for the action plan
- Help prioritize measures
- Gain insight into how different sources of air pollution impact different locations in West Oakland
- Spur action by attributing impacts to specific sources

Why Model When We Can Measure?

- With instrument-based **measurements**, we can *quantify* and *compare*
  - Example: Street View study. How much black carbon do we find on each street? Where is it highest?
- With computer-based **models**, we can *diagnose, explain,* and *drill down*
  - Where does the black carbon, or diesel PM, come from? What sources are responsible and contribute the most?



Air Quality Modeling Approach



Regional-scale modeling: covers the Bay Area

Local-scale modeling: covers West Oakland, including impacts in receptor area (white) from sources in source area (red)

Pollutants Modeled

Fine Particulate Matter

The greatest health burden from air pollution is from particulate matter (PM).

Diesel PM

Diesel PM is highly toxic and poses the health burdens associated with fine PM.

Toxic Air Contaminants

Diesel PM and benzene, formaldehyde, acetaldehyde, hexavalent chromium, perchloroethylene, polycyclic aromatic hydrocarbons (PAHs), arsenic, dioxins, etc.

Why Discuss Cancer Risk?
What is Cancer Risk?

- Combine the impacts of toxic air contaminants and emphasize the most toxic contaminants
- Health professionals have developed useful methods to address cancer risk
- Cancer risk is a rough indication of other kinds of health issues
- Cancer risk: for one million people exposed over a 30-year period, the expected number of cancer cases

West Oakland Modeled Sources

Port of Oakland

Trucks, ships, harbor craft, locomotives, cargo-handling equipment, and other off-road equipment

Trains

Passenger and freight

Permitted stationary sources

Metal melters, scrap handlers, diesel engines, backup generators, boilers, and gas stations

Cars and trucks

Freeways and surface streets

Truck-related businesses

Distribution centers, parking, recyclers, scrap handlers

Ships, ferries, harbor craft

Sources Not Included

Construction equipment

Construction and demolition for buildings, roads, etc.

Wood burning

Fireplaces, wood stoves, backyard cooking and fire pits

Restaurants

Grilling and meat cooking

Household sources

Lawn and garden equipment, paints, and household products

Miscellaneous activity

Amtrak maintenance yard, small truck businesses, some parking

Studio industries

Small artisans, business without Air District permits

Focusing on the Local

How Much is Local?

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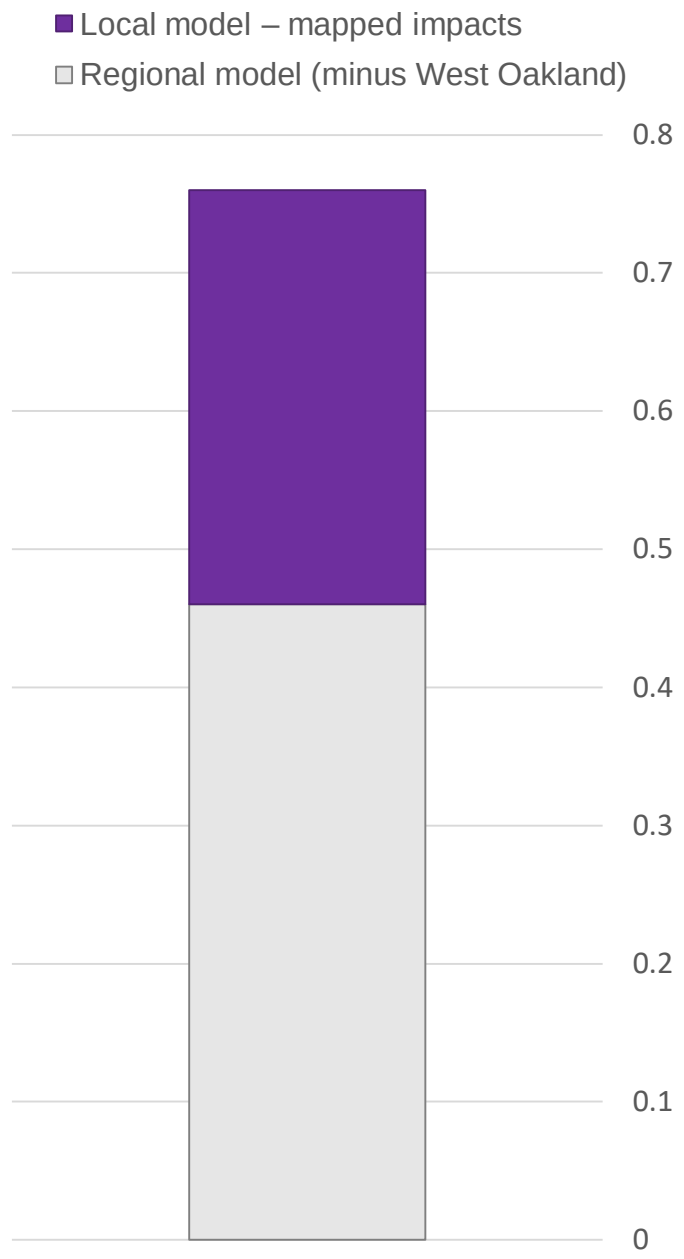
Modeled Impact of Local Sources on Residential

Top Contributors*:

- Trucks (49%)
- Marine vessels (28%)
- Rail (17%)

Diesel PM

+0.3 µg/m^3



*Diesel PM from construction was not modeled

How Much is Local?

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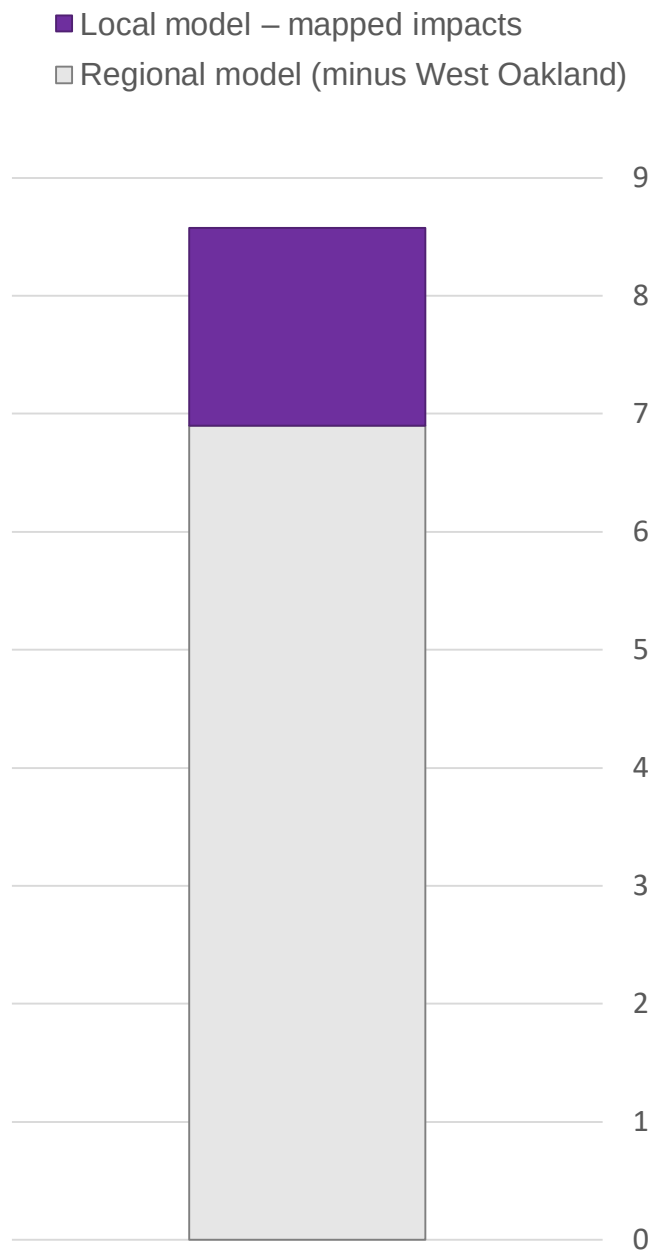
Modeled Impact of Local Sources on Residential

Top Contributors*:

- Road dust (36%)
- Passenger vehicles (27%)
- Permitted facilities (15%)
- Trucks (12%)

$PM_{2.5}$

+1.7 µg/m^3



*$PM_{2.5}$ from construction, wood burning, cooking was not modeled

How Much is Local?

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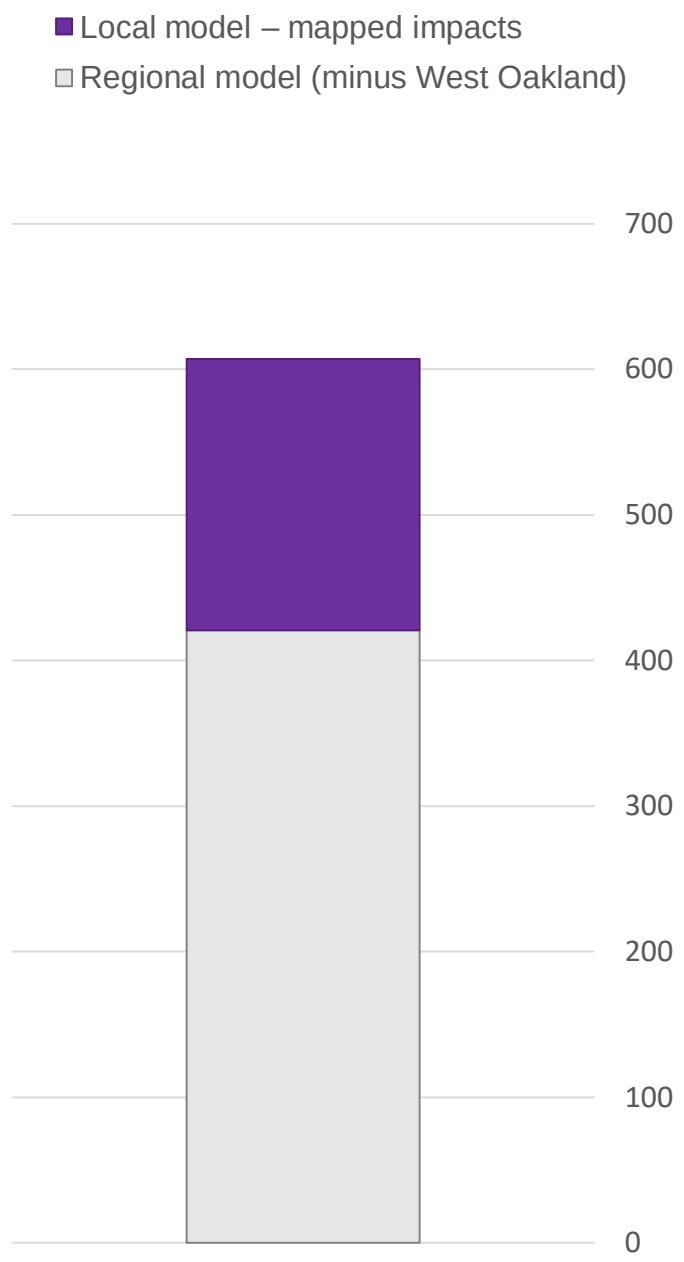
Modeled Impact of Local Sources on Residential

Top Contributors*:

- Trucks (33%)
- Marine vessels (31%)
- Permitted facilities (10%)

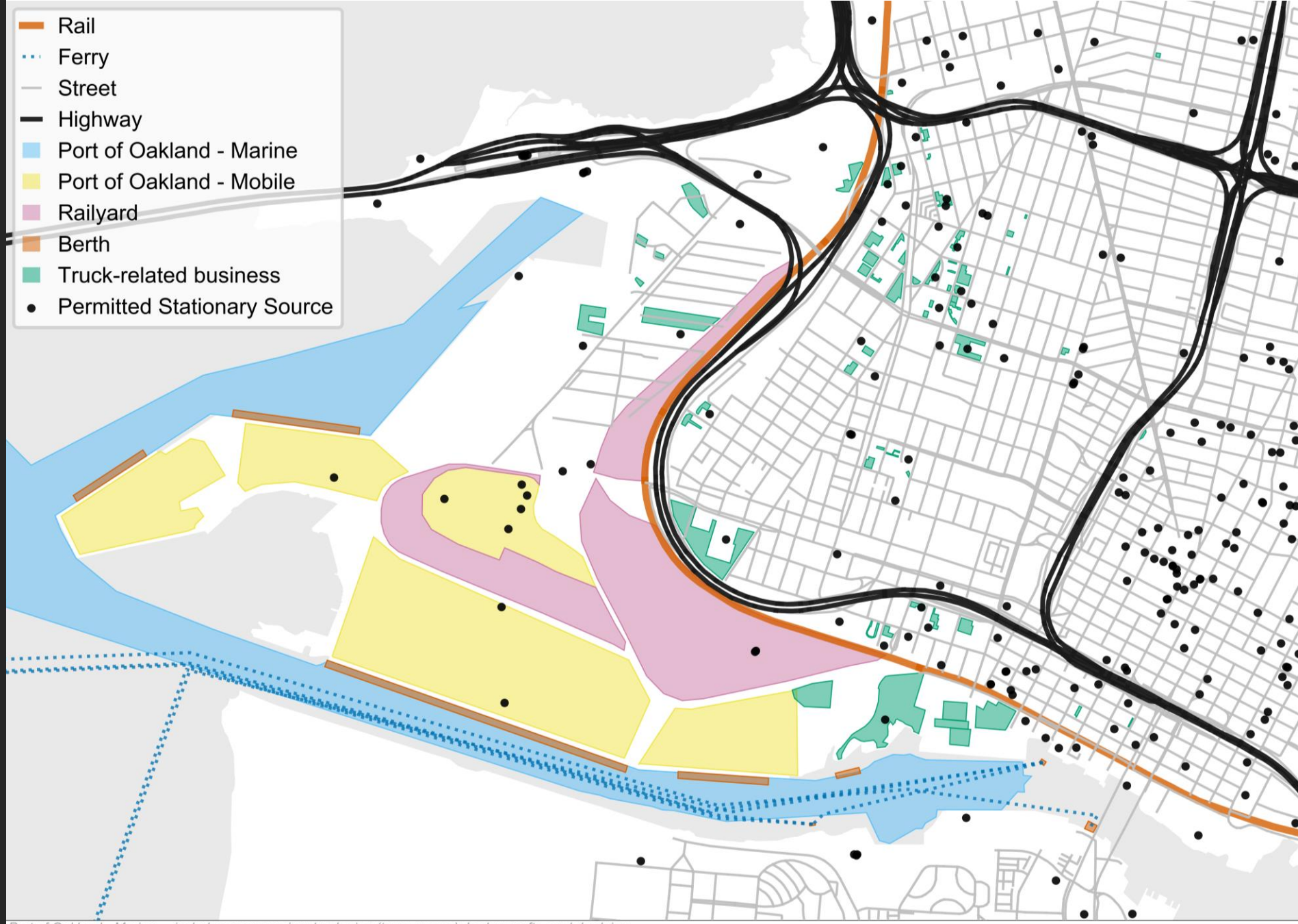
Cancer Risk

+186
per million



*Cancer risk from construction was not modeled

Local Sources that were Modeled



Port of Oakland - Marine – includes maneuvering, bunkering (tugs, pumps), harbor crafts, and dredging.
Port of Oakland - Mobile – includes Port Truck activity (idling, driving in-terminal and to highway) and cargo handling equipment.
Streets – includes on- and off-ramps.

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Average Impacts

from Local Sources

Modeled Impact of Local Sources on Residential

Diesel PM

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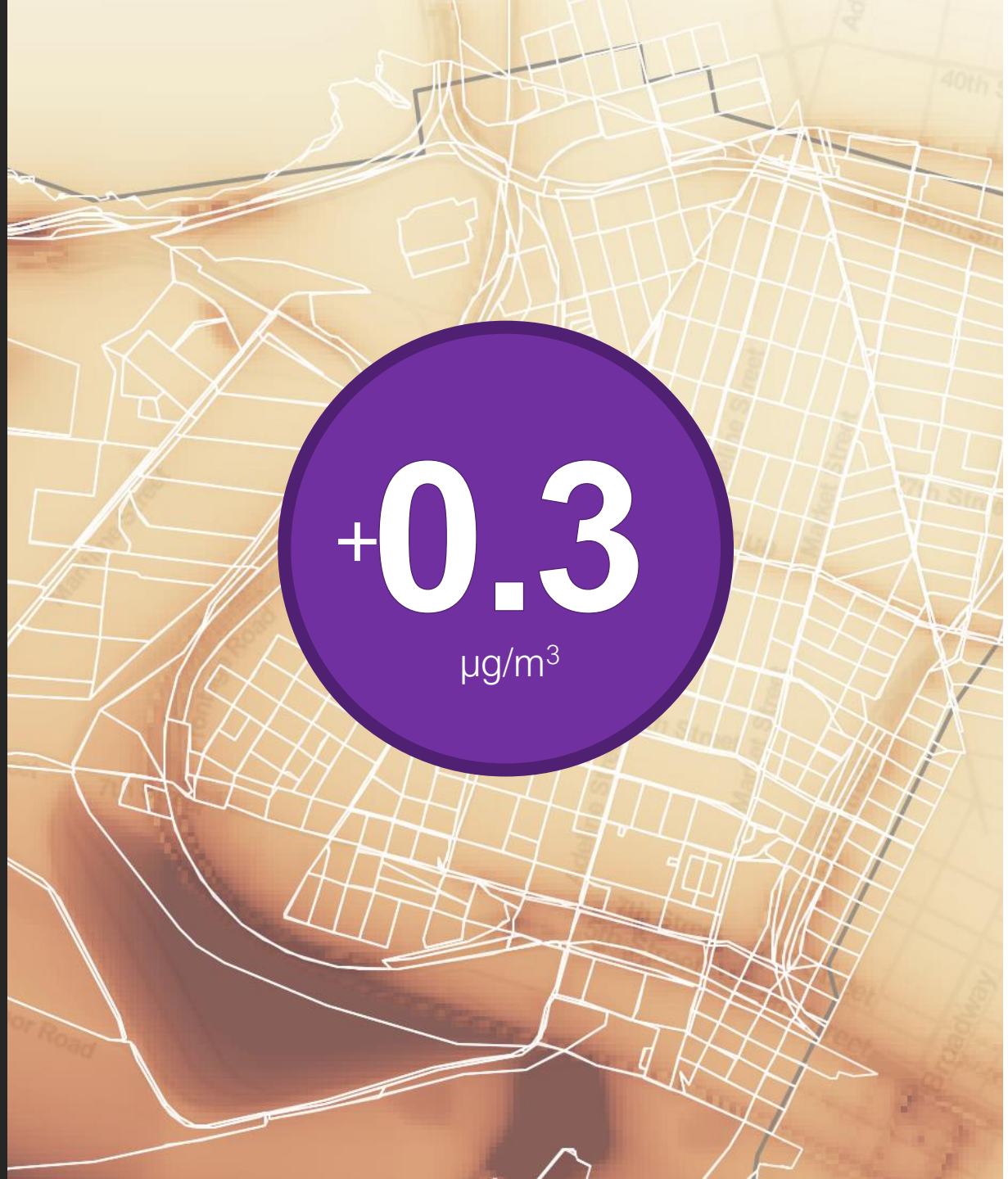
1.0 µg/m^3
0.8
0.6
0.4
0.2
0



Top Contributors:

- Trucks (49%)
- Marine vessels (28%)
- Rail (17%)

Highway		
Heavy/Medium HD trucks	0.056	19%
Passenger vehicles	0.005	2%
Light HD trucks	0.002	1%
Street		
Heavy/Medium HD trucks	0.068	23%
Passenger vehicles	0.005	2%
Light HD trucks	0.002	1%
Port		
Harbor craft	0.030	10%
OGV (berthing)	0.022	8%
OGV (maneuvering)	0.014	5%
Cargo handling	0.005	2%
Drayage trucks‡	0.005	2%
Dredging	0.003	1%
Railyard (OGRE)	0.003	1%
Railyard (BNSF)	0.002	1%
Bunkering (tugs + pumps)	0.001	0%
Rail		
Railyard (UP)	0.024	8%
Rail lines	0.020	7%
Permitted		
EBMUD	0.002	1%
Other facilities	0.001	0%
Other		
Schnitzer (trucks)	0.010	3%
Ferries	0.008	3%
Schnitzer (ships at berth)	0.003	1%
Truck-related businesses	0.001	0%

Modeled Impact of Local Sources on Residential

$PM_{2.5}$

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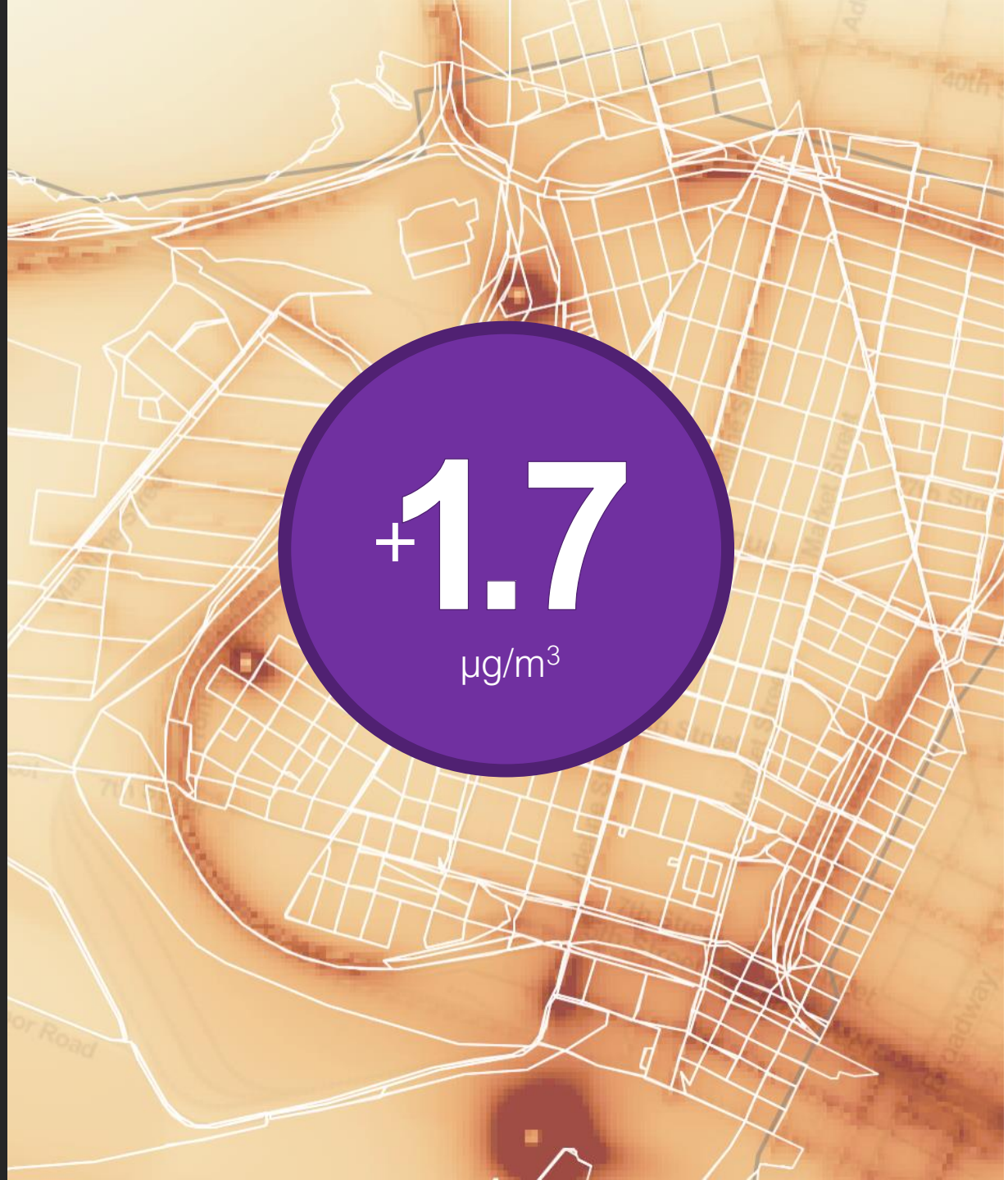
- 4.0 µg/m³
- 3.0
- 2.0
- 1.0
- 0



Top Contributors:

- Road dust (36%)
- Passenger vehicles (27%)
- Permitted facilities (15%)
- Trucks (12%)

Highway		
Passenger vehicles	0.264	16%
Road dust	0.108	6%
Heavy/Medium HD trucks	0.069	4%
Light HD trucks	0.010	1%
Street		
Road dust	0.508	30%
Passenger vehicles	0.191	11%
Heavy/Medium HD trucks	0.082	5%
Light HD trucks	0.009	1%
Port		
OGV (berthing)	0.031	2%
Harbor craft	0.029	2%
Road dust	0.021	1%
Drayage trucks‡	0.015	1%
OGV (maneuvering)	0.014	1%
Cargo handling	0.005	0%
Railyard (OGRE)	0.003	0%
Dredging	0.002	0%
Railyard (BNSF)	0.002	0%
Bunkering (tugs + pumps)	0.001	0%
Passenger vehicles	0.001	0%
Rail		
Railyard (UP)	0.023	1%
Rail lines	0.019	1%
Permitted		
Schnitzer (stationary)	0.045	3%
California Cereal	0.044	3%
EBMUD	0.043	3%
Sierra Pacific	0.039	2%
CA Waste (10th St)	0.038	2%
Other facilities	0.029	2%
CASS	0.006	0%
Other		
Schnitzer (trucks)	0.010	1%
Ferries	0.007	0%
Schnitzer (ships at berth)	0.003	0%
Truck-related businesses	0.001	0%

Modeled Impact of Local Sources on Residential

Cancer Risk

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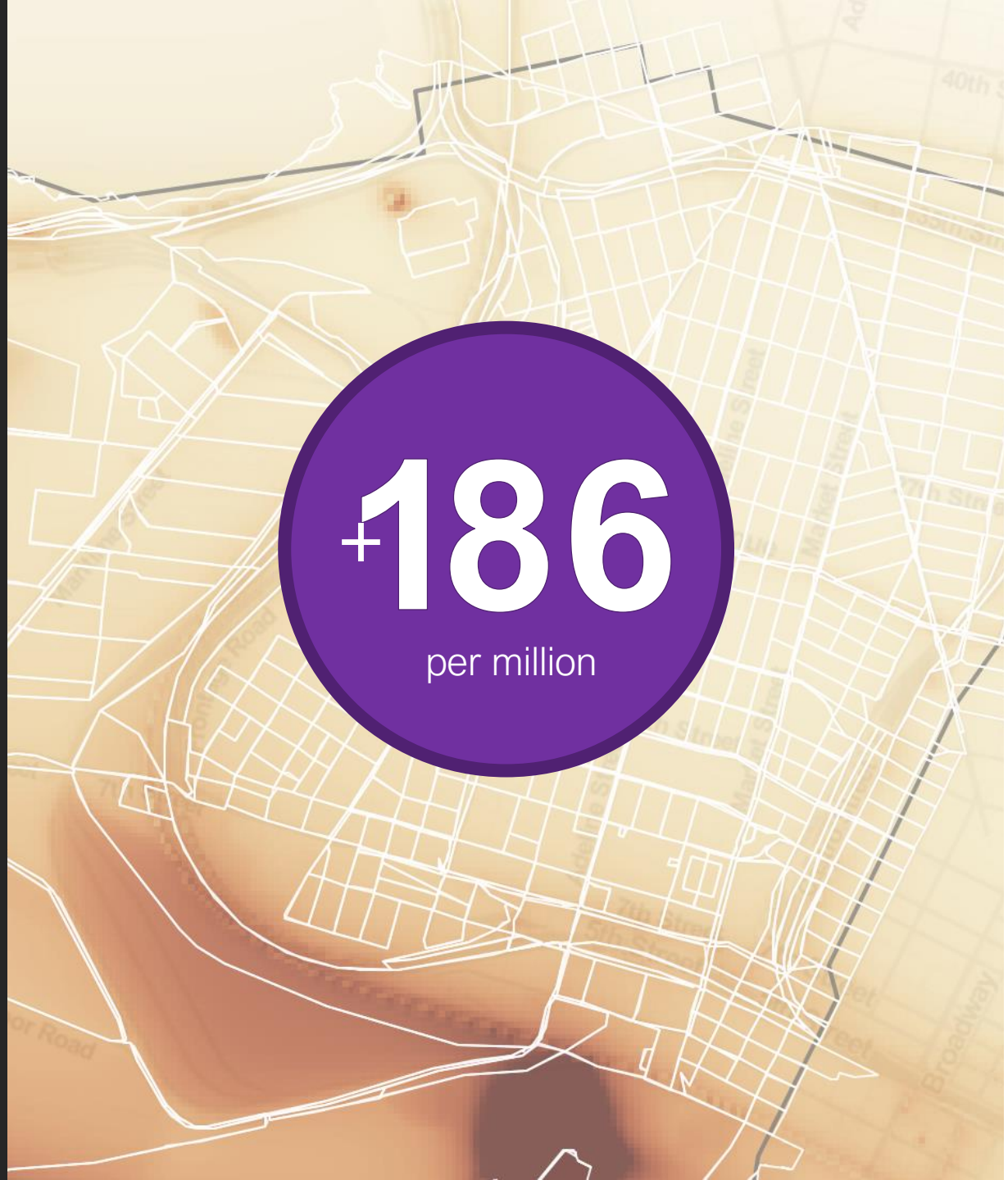
1000 per million
800
600
400
200
0



Top Contributors:

- Trucks (33%)
- Marine vessels (31%)
- Permitted facilities (10%)

Highway		
Heavy/Medium HD trucks	20.3	11%
Passenger vehicles	5.3	3%
Light HD trucks	1.3	1%
Street		
Heavy/Medium HD trucks	23.1	12%
Passenger vehicles	5.3	3%
Light HD trucks	1.5	1%
Port		
Harbor craft	22.6	12%
OGV (berthing)	16.6	9%
OGV (maneuvering)	10.5	6%
Cargo handling	3.4	2%
Drayage trucks‡	3.1	2%
Railyard (OGRE)	2.2	1%
Dredging	1.9	1%
Railyard (BNSF)	1.6	1%
Bunkering (tugs + pumps)	1.0	1%
Rail		
Railyard (UP)	18.2	10%
Rail lines	14.9	8%
Permitted		
Schnitzer (stationary)	13.4	7%
EBMUD	2.1	1%
Other facilities	1.3	1%
Other		
Schnitzer (trucks)	7.4	4%
Ferries	5.7	3%
Schnitzer (ships at berth)	2.3	1%
Truck-related businesses	1.0	1%

Sensitive Locations

Schools, daycares, senior centers, parks, etc.

Cancer Risk from local Sources at Sensitive Locations

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Cancer Risk from local Sources at Sensitive Locations

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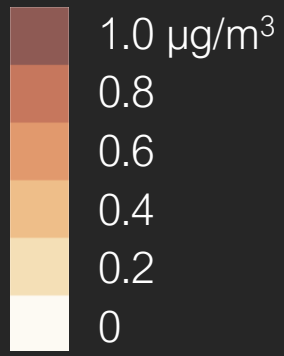
Bunkering (tugs + pumps)	1.9	1%
Rail		
Railyard (UP)	49.5	13%
Rail lines	24.7	7%
Permitted		
Schnitzer (stationary)	42.6	11%
EBMUD	1.2	0%
Other facilities	0.9	0%
Other		
Schnitzer (trucks)	24.7	7%
Ferries	11.1	3%
Schnitzer (ships at berth)	4.6	1%
Truck-related businesses	1.1	0%
	371.4	**100%**

Specific Impacts

at Selected Locations

Diesel PM from local Sources at Specific Locations



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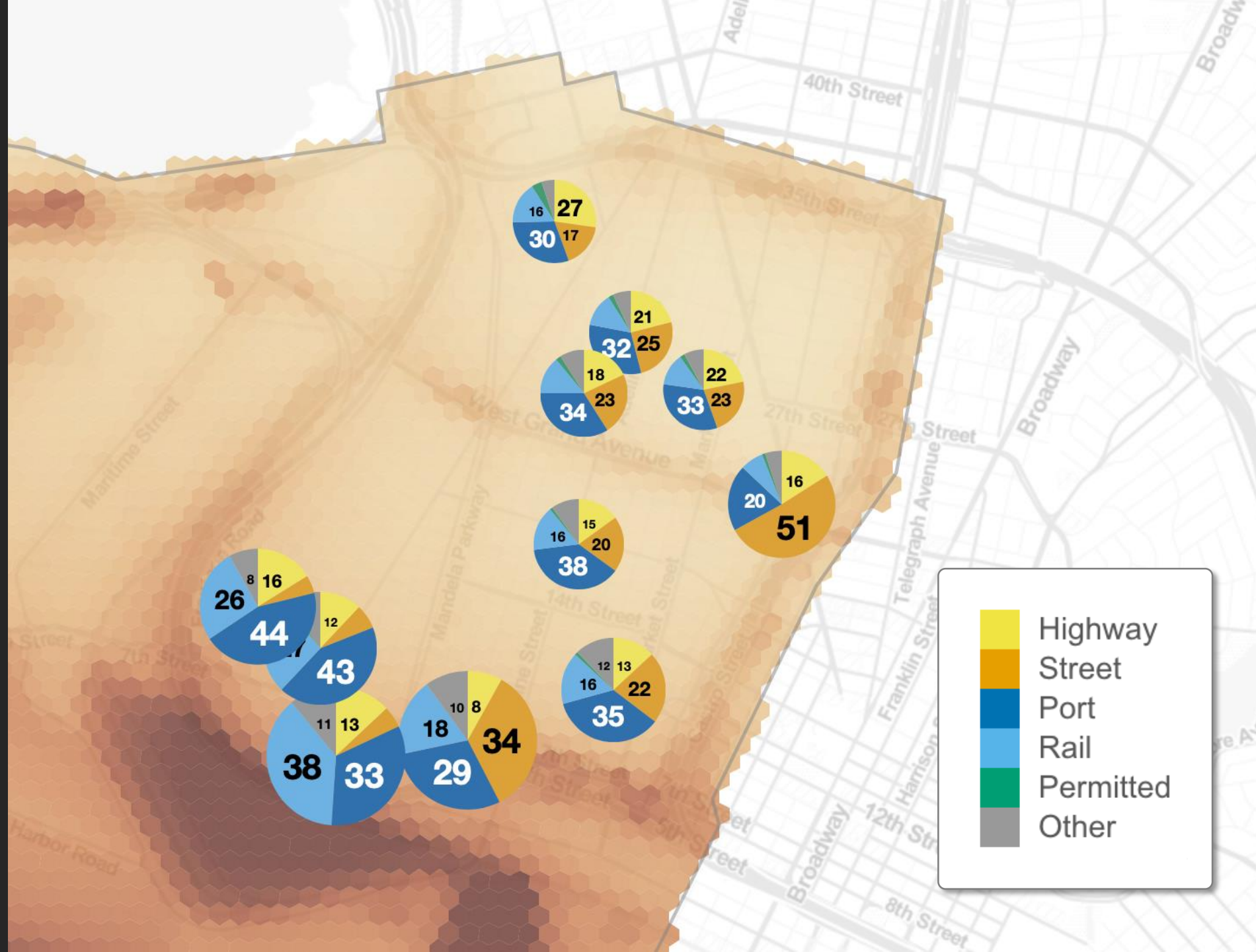

$PM_{2.5}$ from local Sources at Specific Locations

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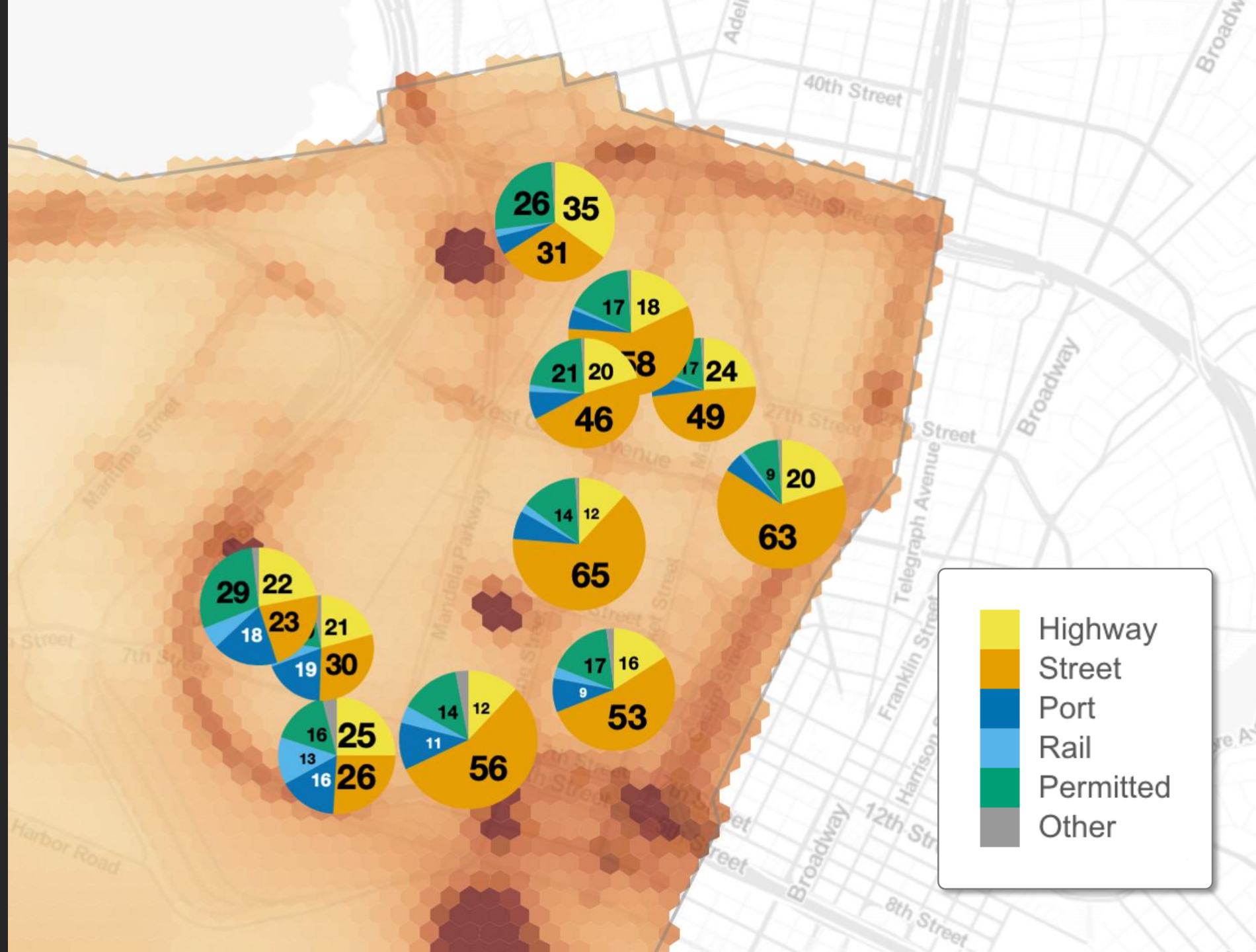
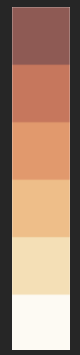


Cancer Risk from local Sources at Specific Locations



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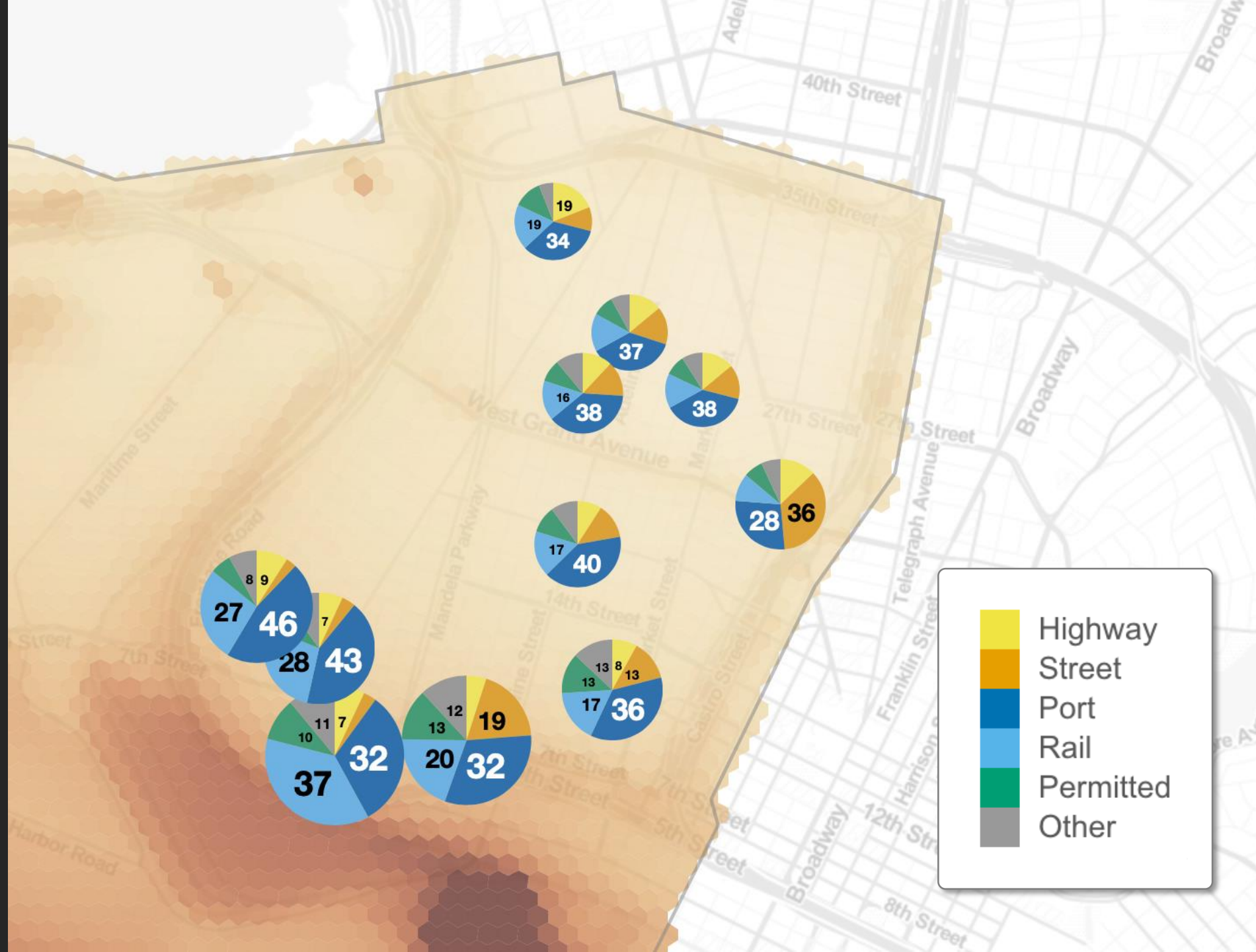

Summary

- Impacts vary with location and kind of pollutant
- Diesel PM and cancer risk are greatest in southern West Oakland, near Port, rail, and highway sources
- $PM_{2.5}$ impacts are more spread out, with highest impacts near highways, busy streets, and some industries
- This study shows *block-by-block* what sources contribute most

Extra Slides

Block by Block

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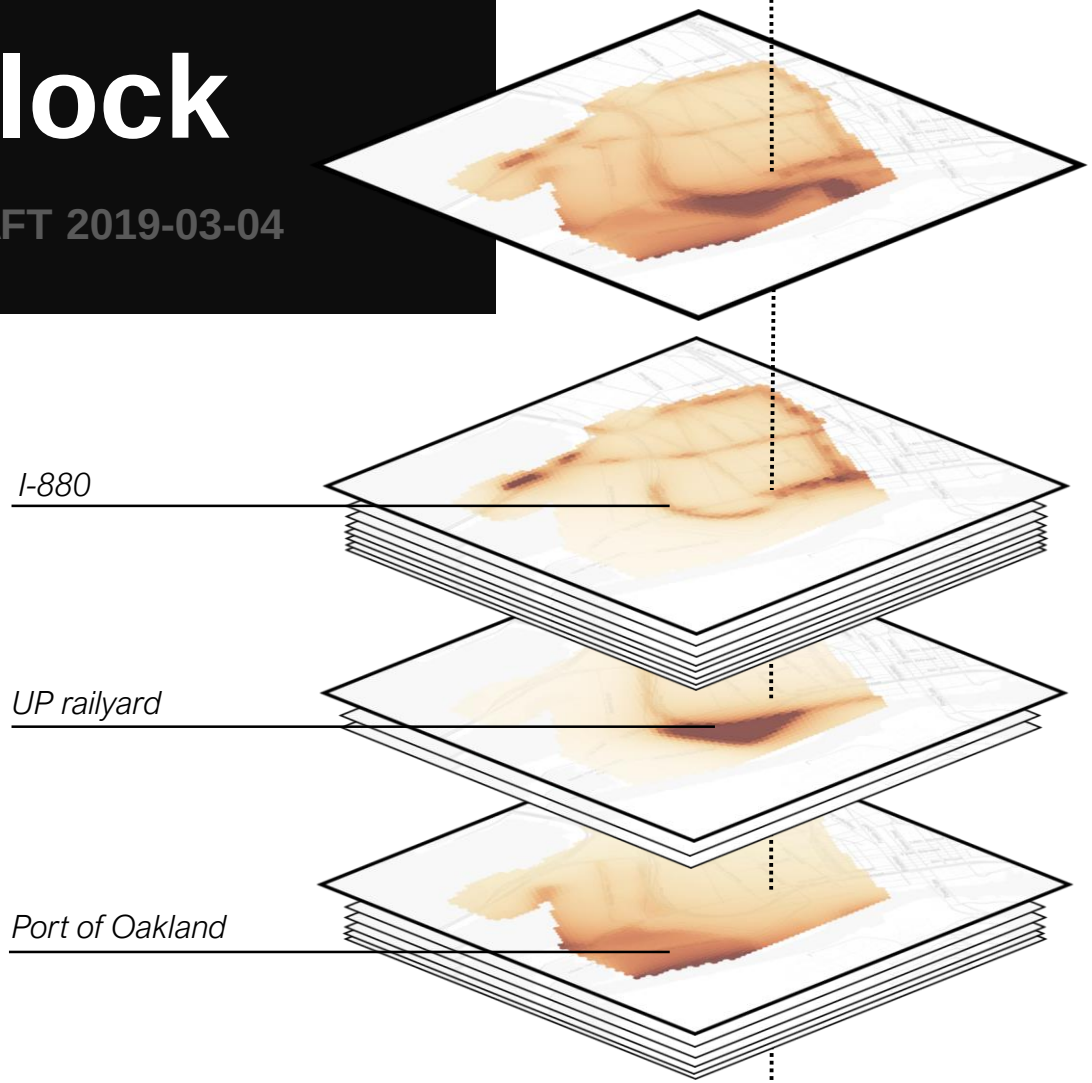
Impact of Local Sources on **Diesel PM**

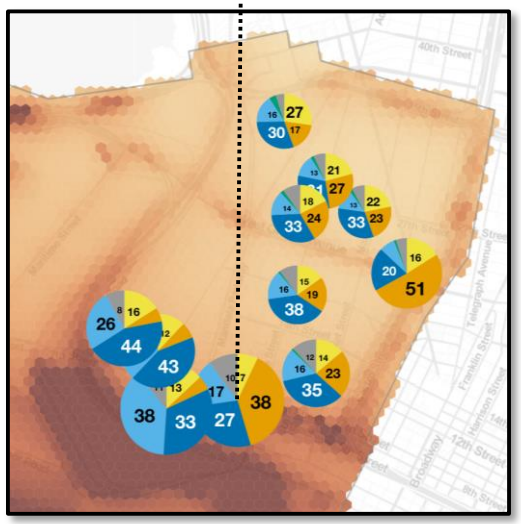


Grand total of modeled impacts from local sources

Sub-total from trucks, cars, and other vehicles on streets and highways

Sub-total from locomotive engines and railyards

Sub-total from harbor craft, ocean-going vessels, drayage, cargo handling, etc.



For any location, we can use the sub-totals to draw piecharts showing the relative impacts of sources A, B, C, etc.