



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

AGENDA: 3A

Update on the Development of Amendments to Rule 6-5

**Stationary Source Committee Meeting
July 29, 2020**

**David Joe, PE
Assistant Manager
Rule Development**

Outline



- Overview and Background
- Draft Amendments
- Other Potential Control Options
- Potential Impacts
- Next Steps

Overview and Background



- Fluidized catalytic cracking units (FCCUs) convert heavy components of crude oil into gasoline and high-octane products
- Large source of particulate matter (PM) emissions
- Four of the five Bay Area refineries operate FCCUs
- Approximately 40% of overall PM emissions at these refineries

Overview and Background (cont.)



- Rule 6-5 originally adopted in 2015
 - Requirements to reduce ammonia to limit formation of PM
- Assembly Bill (AB) 617 Expedited Best Available Retrofit Control Technology (BARCT) Implementation Schedule –
 - Identified potential rule development efforts to evaluate and implement BARCT at FCCUs
- Further address PM emissions
- Achieve public health benefits and continue progress towards attainment of ambient air quality standards

Draft Amendments to Rule 6-5



- New and modified limits on particulate matter components
 - Modified requirements for ammonia limit of 10 parts per million (ppm)
 - New limits on sulfur dioxide:
 - 25 ppm on a 365-day rolling average basis
 - 50 ppm on a 7-day rolling average basis
- New limit on total PM₁₀ of 0.020 gr/dscf
- Additional monitoring and testing requirements

Other Potential Control Options



- Staff evaluating potential control options for more stringent limits
- Lower levels of total PM₁₀ have been observed, mainly at facilities with wet gas scrubbing
- FCCUs with wet gas scrubbing may achieve total PM₁₀ levels of 0.010 gr/dscf or below
- Potential control option of a more stringent total PM₁₀ limit would likely require installation of wet gas scrubbing

Potential Impacts



- Preliminary estimates of potential impacts of draft amendments and more stringent control option
 - Emissions reductions
 - Compliance costs
 - Socioeconomic impacts
 - Environmental impacts
- Continue to develop and refine these estimates

Potential Impacts – Emissions and Costs (Draft Amendments)



- Preliminary estimates of potential emission reductions and cost impacts for limits in **Draft Amendments**

Facility	PM ₁₀ Emissions (tpy)	PM ₁₀ Reductions (tpy)	Capital Costs (\$MM)	Total Annualized Costs (\$MM)	Cost Effectiveness (\$/ton)
Chevron Richmond	245	80	\$7.5 - \$30	\$1.6 - \$4.5	\$20K/ton - \$56K/ton
Marathon Martinez	190	0	–	–	–
PBF Martinez	309	170	\$10 - \$40	\$3.5 - \$7.4	\$21K/ton - \$43K/ton
Valero Benicia	83	0	–	–	–
Total	827	250	\$18 - \$70	\$5.1 - \$12	\$20K/ton - \$47K/ton

Potential Impacts – Emissions and Costs (More Stringent Control Option)



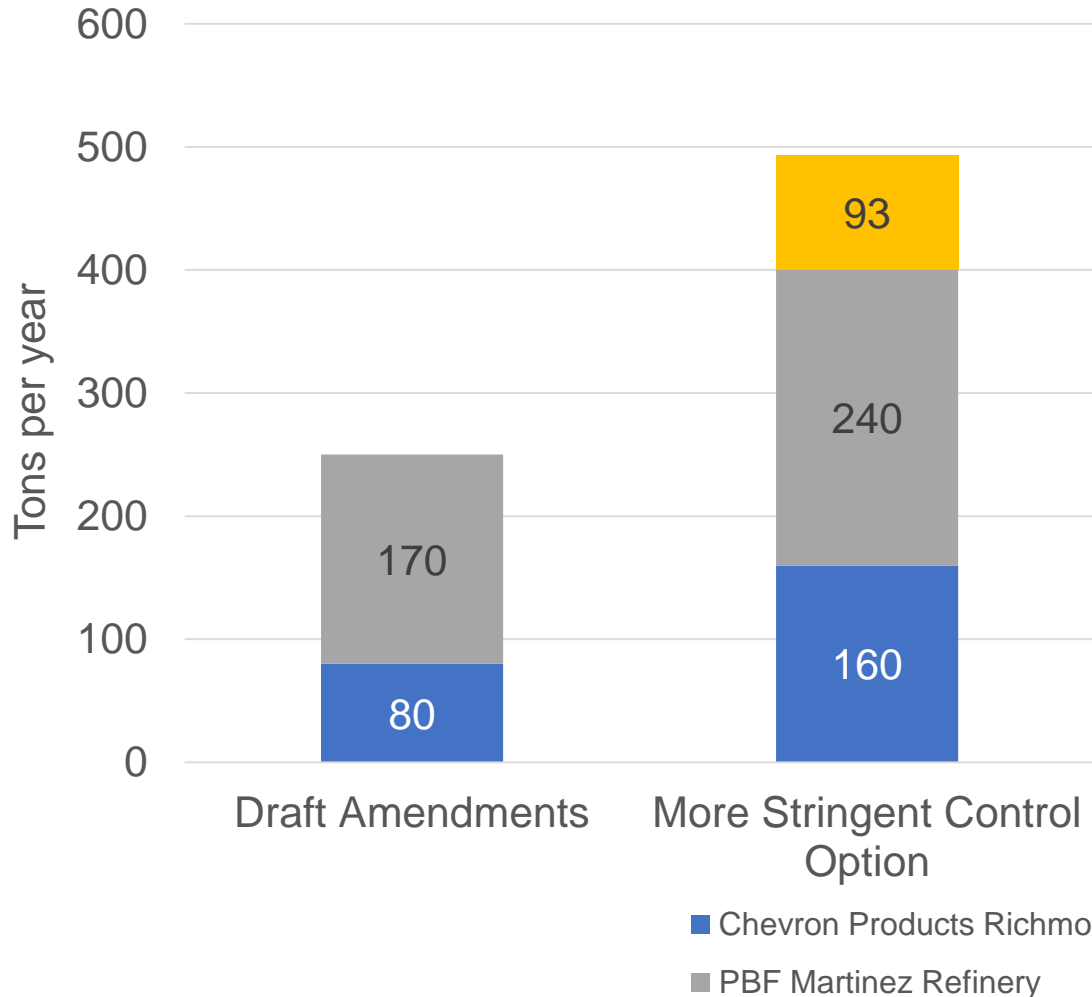
- Preliminary estimates of potential emission reductions and cost impacts for **more stringent control option**

Facility	PM ₁₀ Emissions (tpy)	PM ₁₀ Reductions (tpy)	Capital Costs (\$MM)	Total Annualized Costs (\$MM)	Cost Effectiveness (\$/ton)
Chevron Richmond	245	160	\$104 - \$263	\$18 - \$47	\$115K/ton - \$291K/ton
Marathon Martinez	190	93	\$104 - \$258	\$18 - \$46	\$198K/ton - \$492K/ton
PBF Martinez	309	240	\$137 - \$260	\$24 - \$46	\$101K/ton - \$192K/ton
Valero Benicia	83	0	–	–	–
Total	827	493	\$345 - \$781	\$61 - \$138	\$124K/ton - \$281K/ton

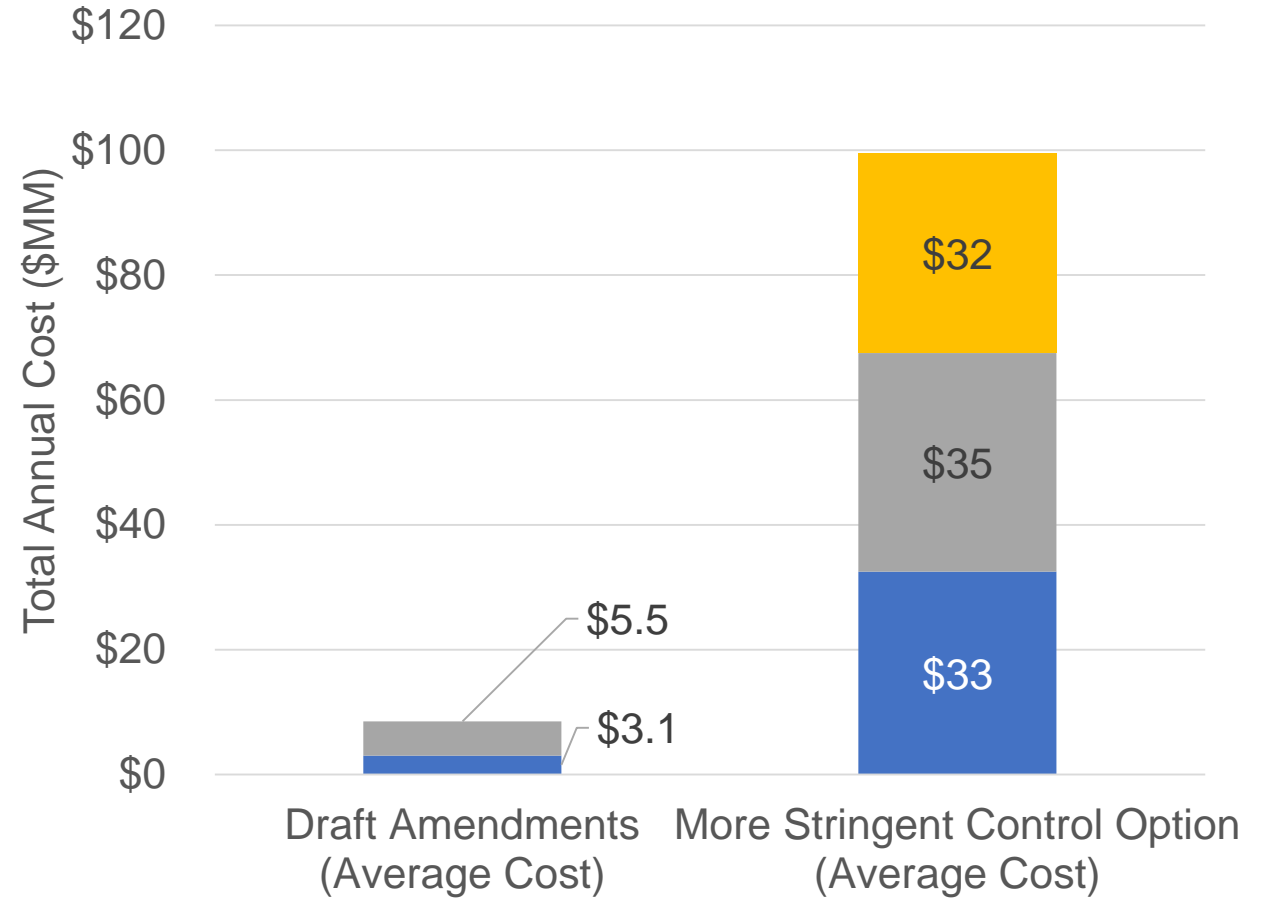
Potential Impacts – Emissions and Costs



Estimated PM₁₀ Reductions



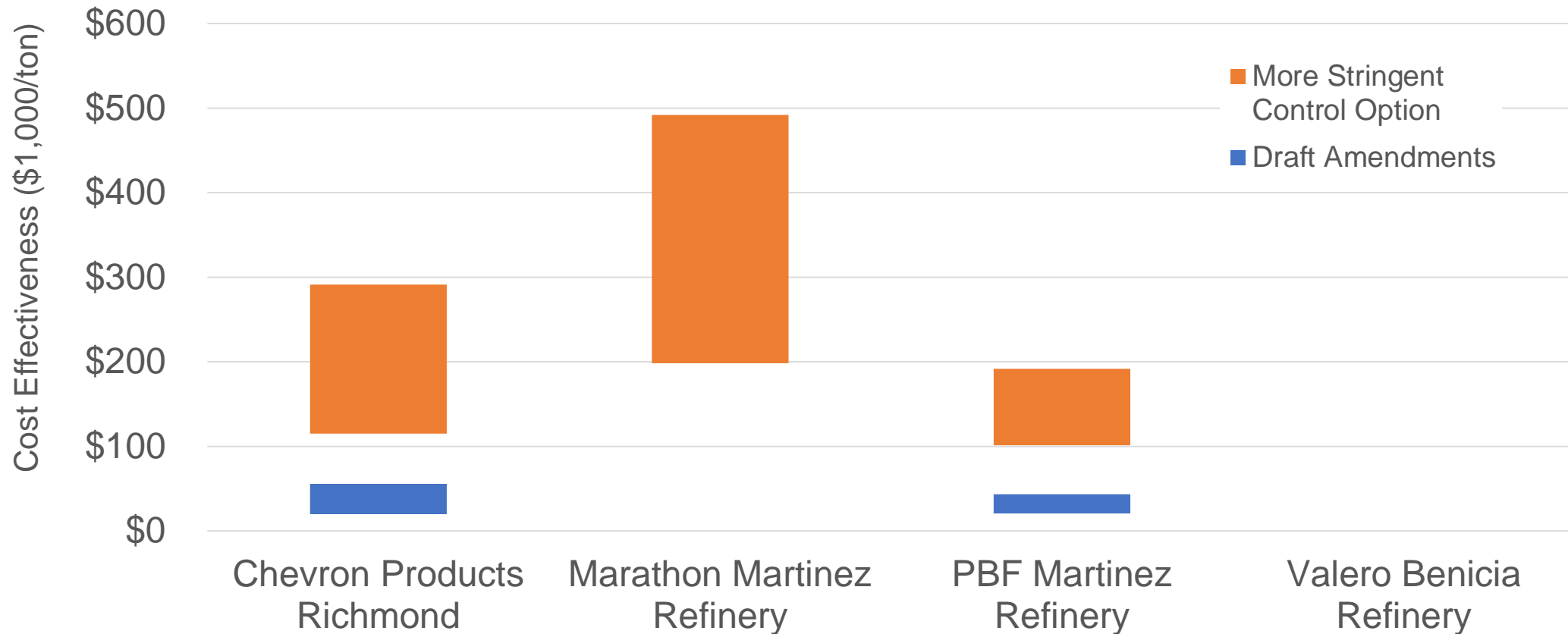
Estimated Annualized Costs (Average)



Potential Impacts – Cost Effectiveness



Estimated Cost Effectiveness



Potential Impacts – Socioeconomic



- Preliminary estimates of compliance costs as a proportion of profits (based on previous profit estimates)
- May not be reflective of recent economic circumstances and events

Facility	Annual Cost as % of Annual Net Profit (Draft Amendments)	Annual Cost as % of Annual Net Profit (More Stringent Control Option)
Chevron Richmond	0.2% - 0.7%	2.8% - 7.1%
Marathon Martinez	–	4.2% - 10.3%
PBF Martinez	0.8% - 1.8%	5.8% - 11.1%
Valero Benicia	–	–

Potential Impacts – Environmental



- 2018 Final EIR for the AB 617 Expedited BARCT Implementation Schedule identified significant water usage impacts for use of WGS
- Estimated water usage from three additional WGS systems is 1.3 million gallons per day
- Equivalent to daily water usage of approximately 4,400 single family homes

Next Steps



- Public comment period on draft amendments ended July 2020
- Continued stakeholder engagement
- Refining estimates of emissions, costs, socioeconomic, and environmental impacts
- Anticipated consideration by the Air District's Board of Directors in November/December 2020



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AGENDA: 3B

Fine Particulate Matter (PM_{2.5}) Concentration Impacts from a Bay Area Petroleum Refinery

Stationary Source Committee Meeting
July 29, 2020

Phil Martien, PhD
Director
Assessment, Inventory, & Modeling Division

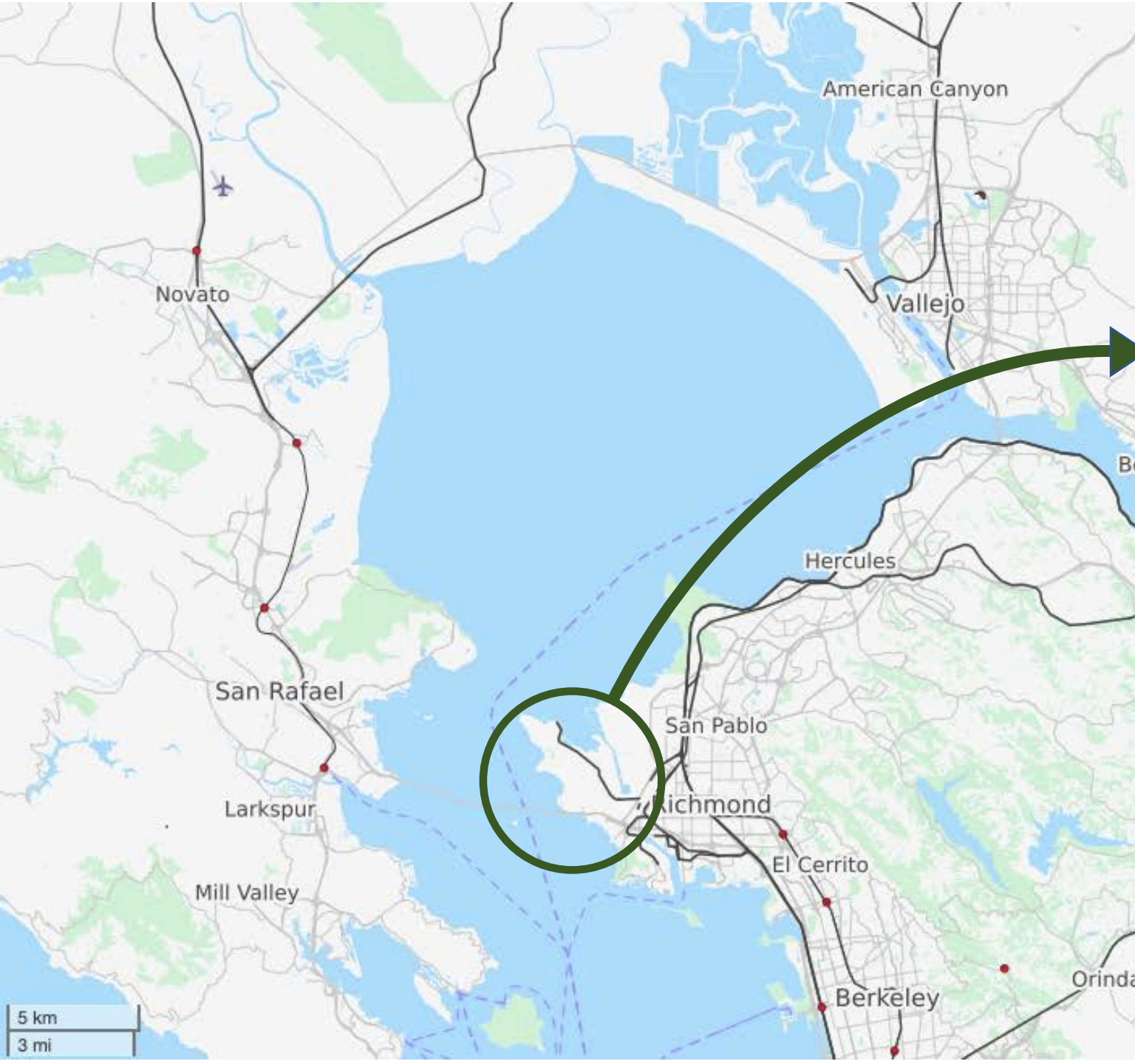
Overview



- Study underway to assess impacts of major industrial sources of fine particulate matter (PM_{2.5})
 - First facility assessed: Chevron Richmond Refinery
- What areas are impacted by PM_{2.5} emissions?
- Who is exposed, and how equitable are the exposures?
- What are the benefits of additional emission limits?
- Next steps



First Facility Assessed: Chevron Richmond Refinery



- Chevron**
- TOP 20 sources
 - All sources
 - Facility Boundary

5 km
3 mi

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
© OpenStreetMap contributors. Tiles courtesy of Andy Allan. Website at

Modeling Study: Scope



- Tracking directly emitted (primary) PM_{2.5}
- From all permitted sources at Chevron
 - 473 tons/year PM_{2.5} from 119 sources
- From FCCU only
 - About half (48%) of total PM_{2.5} emissions

Modeling Study: Two Emissions Scenarios



- Baseline scenario = existing emissions
- Additional FCCU emission reductions scenario (0.02 grains/dry standard cubic feet limit)
 - This limit reduces FCCU PM_{2.5} emissions by about 33%
 - And total facility PM_{2.5} emissions by about 16%

Modeling Study: Approach



- Track plumes with the CALPUFF air quality model to map concentrations
- Three years of modeling (2016-2018)
- Emissions estimates representative of 2018 for all three years

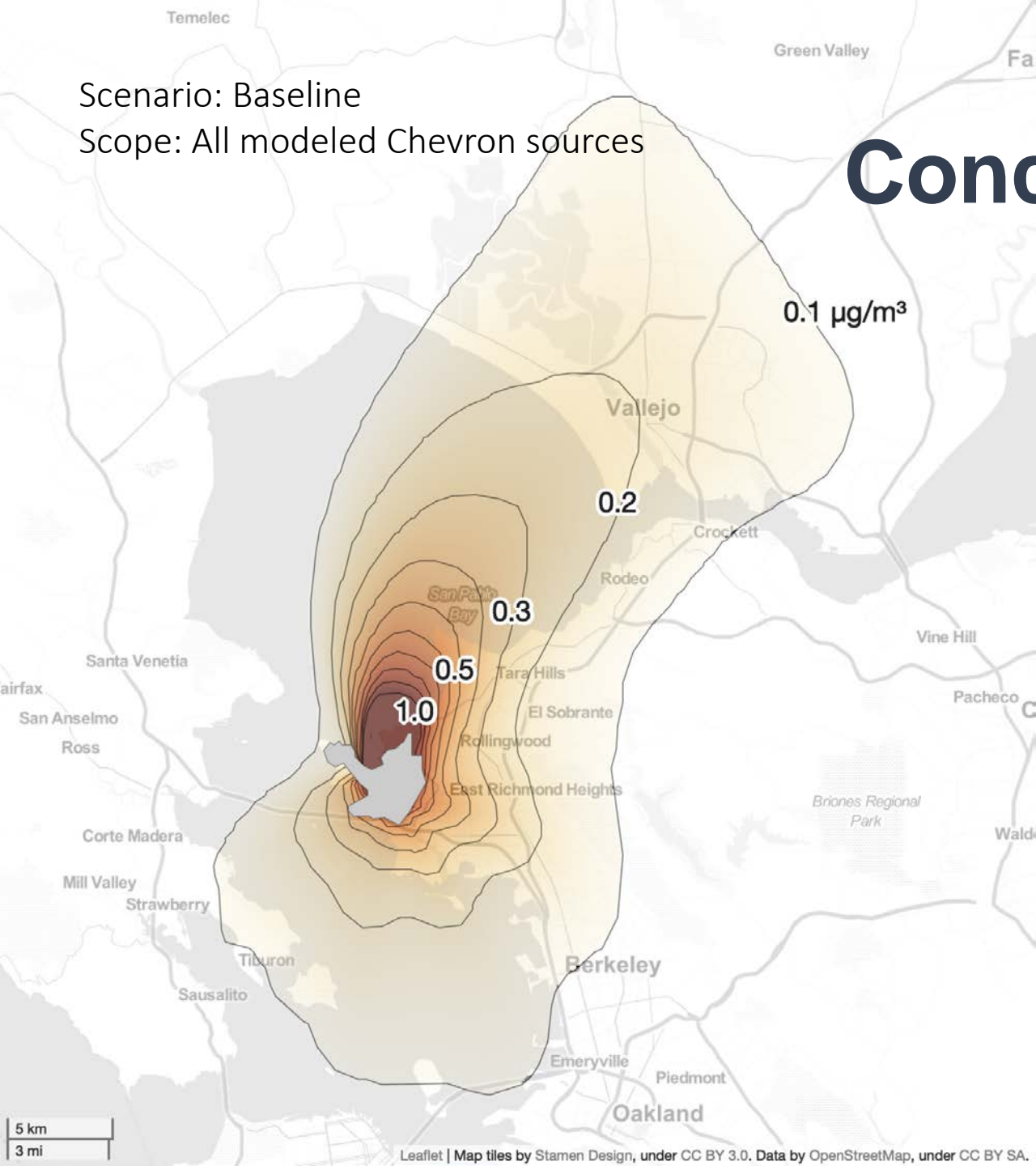
Modeling Study: Key Inputs



- Emissions estimates from Rule 12-15: (Petroleum Refining Emissions Tracking)
- Stack information from Rule 11-18: (Reduction of Risk from Air Toxic Emissions at Existing Facilities)
- Census information on residential population

Scenario: Baseline
Scope: All modeled Chevron sources

Chevron PM_{2.5} Concentration Impacts by Area



- Modeled annual-average, primary PM_{2.5} concentrations from all sources at Chevron
- Baseline scenario
- Measured annual-average PM_{2.5} at nearby San Pablo site: about 8-10 µg/m³*

* Excluding 2017-2018 wildfire days; about 8-13 µg/m³ including wildfire days

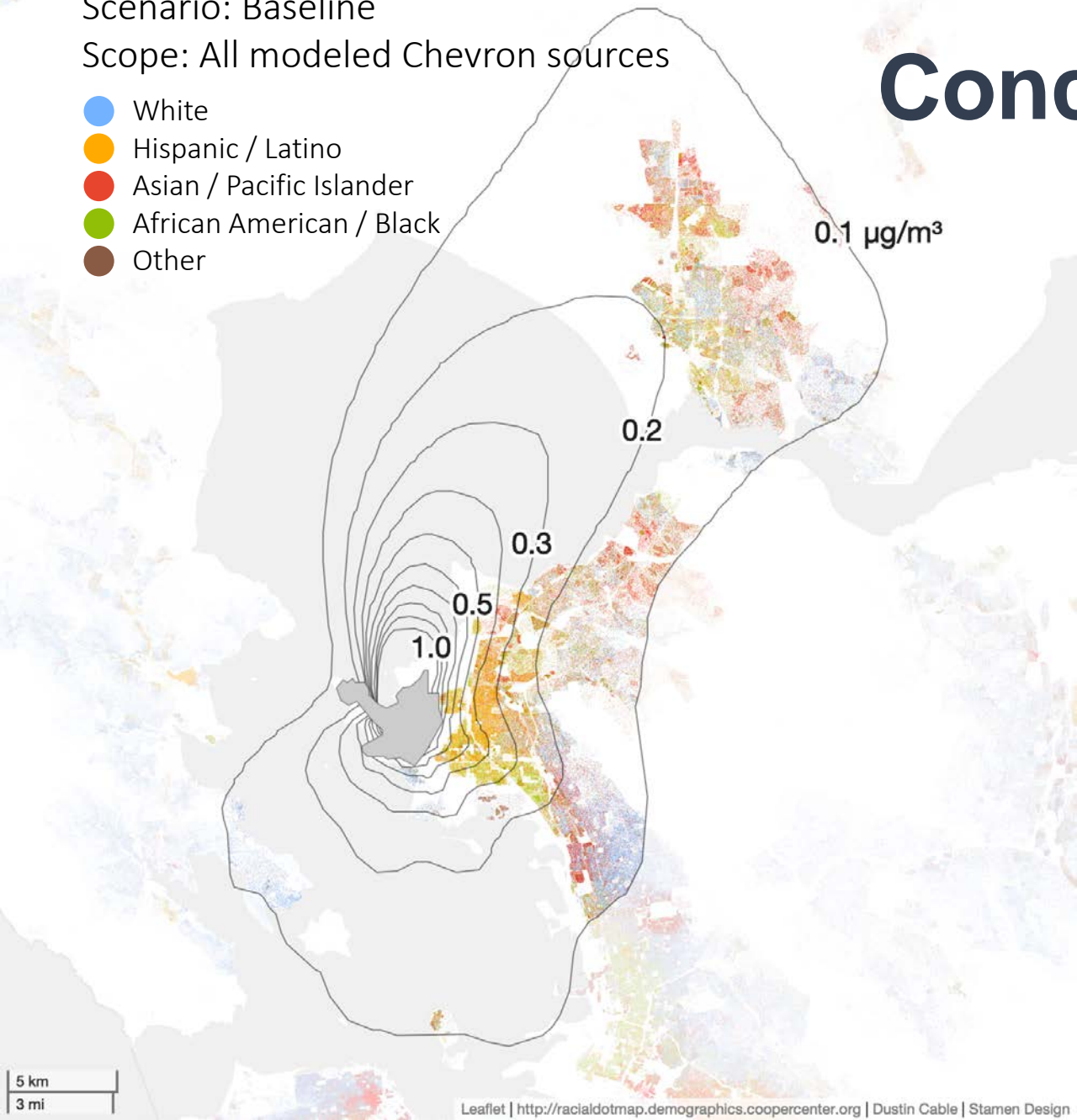


Chevron PM_{2.5} Concentration Impacts by Residents Exposed

Scenario: Baseline

Scope: All modeled Chevron sources

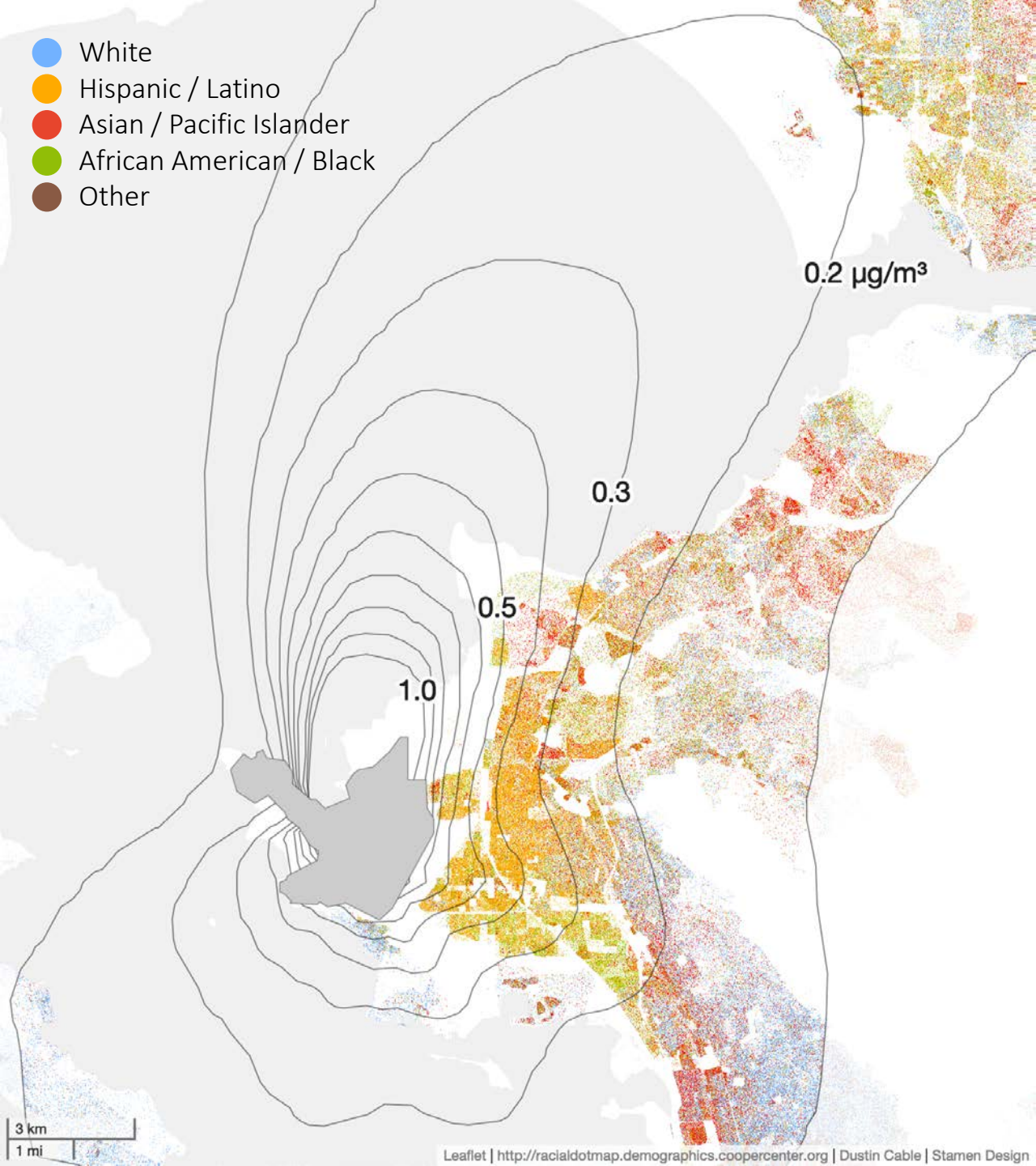
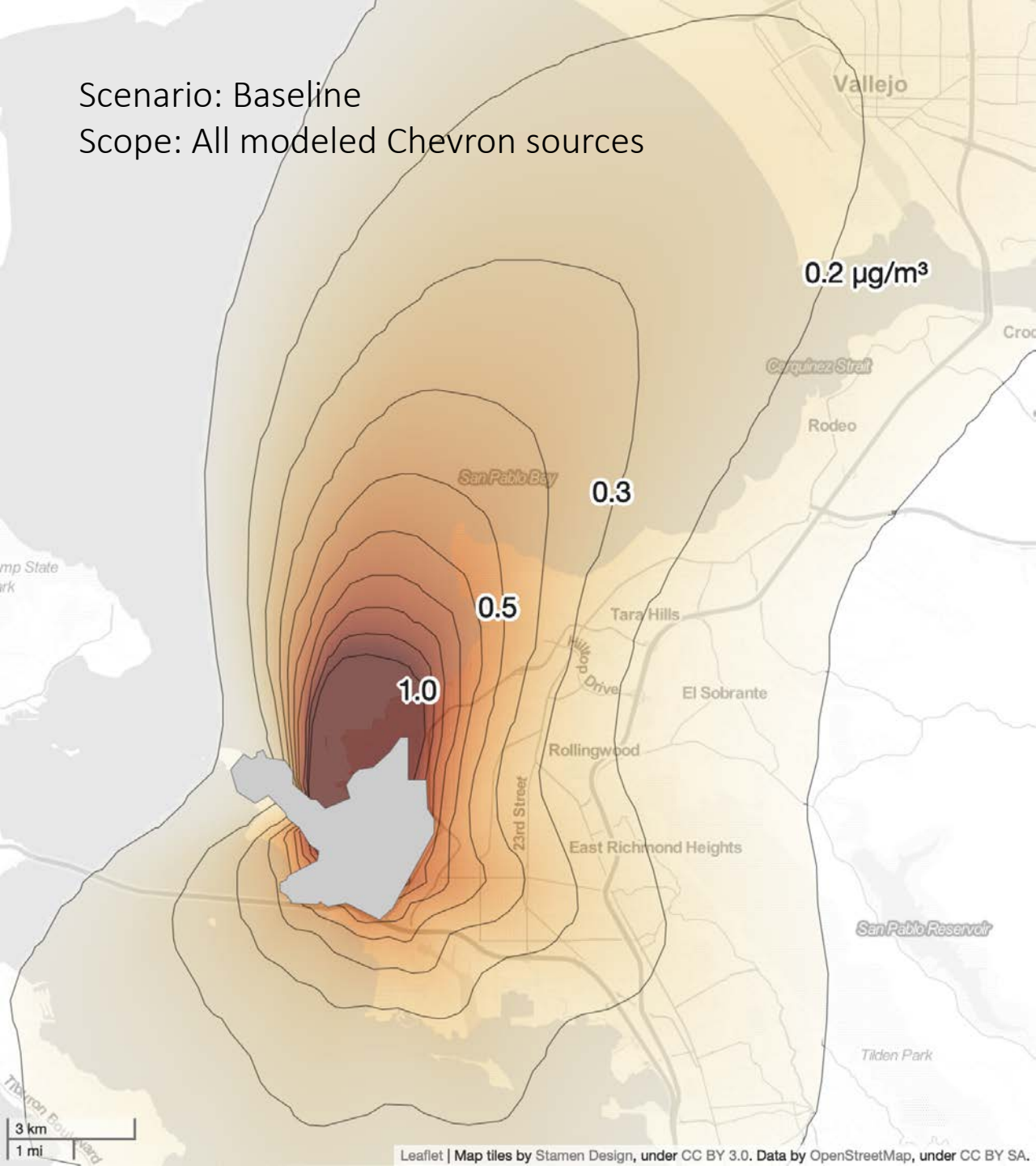
- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



- Each color dot represents one person
- Colors are muted outside the 0.1 $\mu\text{g}/\text{m}^3$ contour, “the plume”
- Almost half a million people (~449,000) in the plume

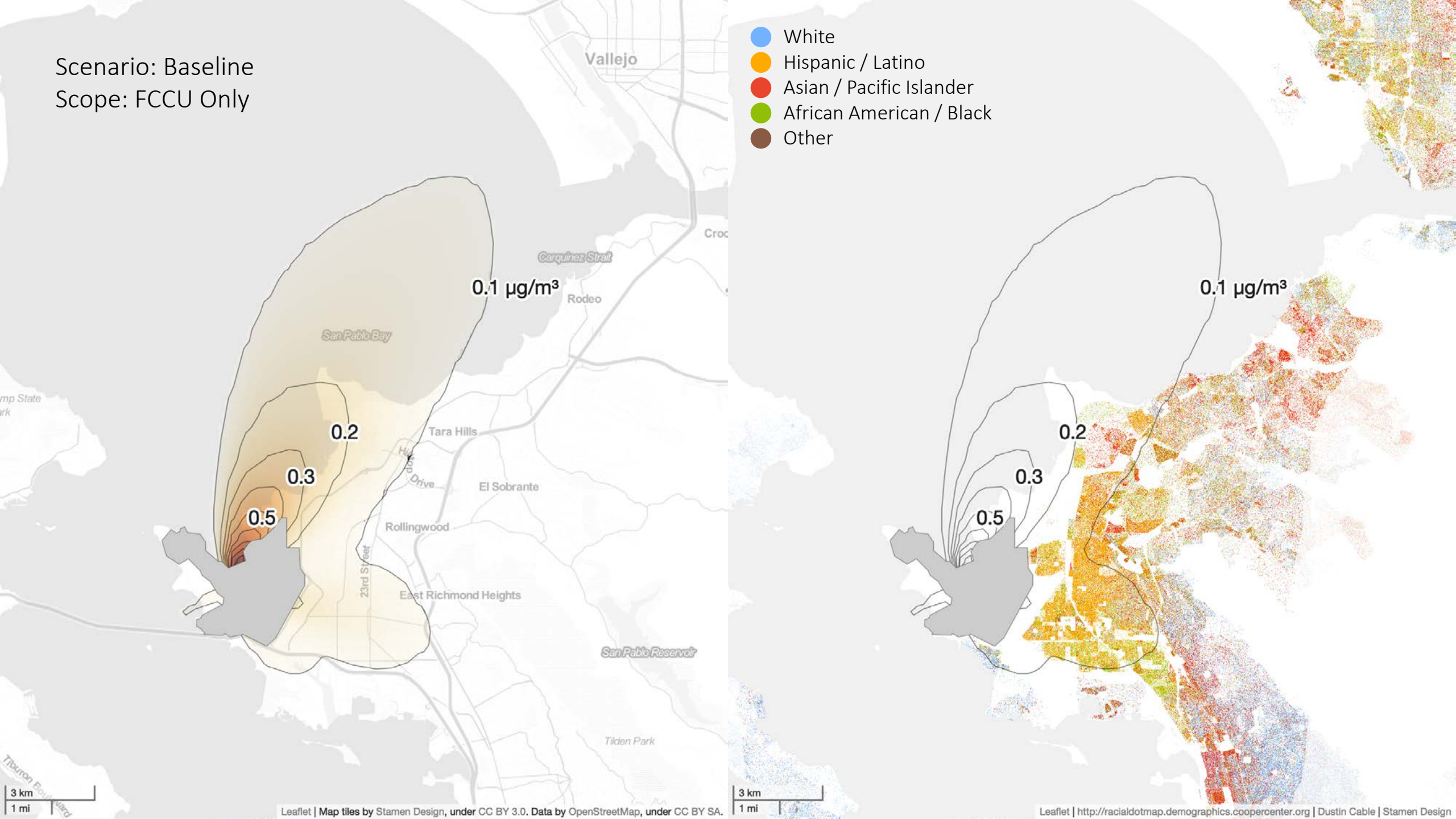
Scenario: Baseline
Scope: All modeled Chevron sources

- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



Scenario: Baseline
Scope: FCCU Only

- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other

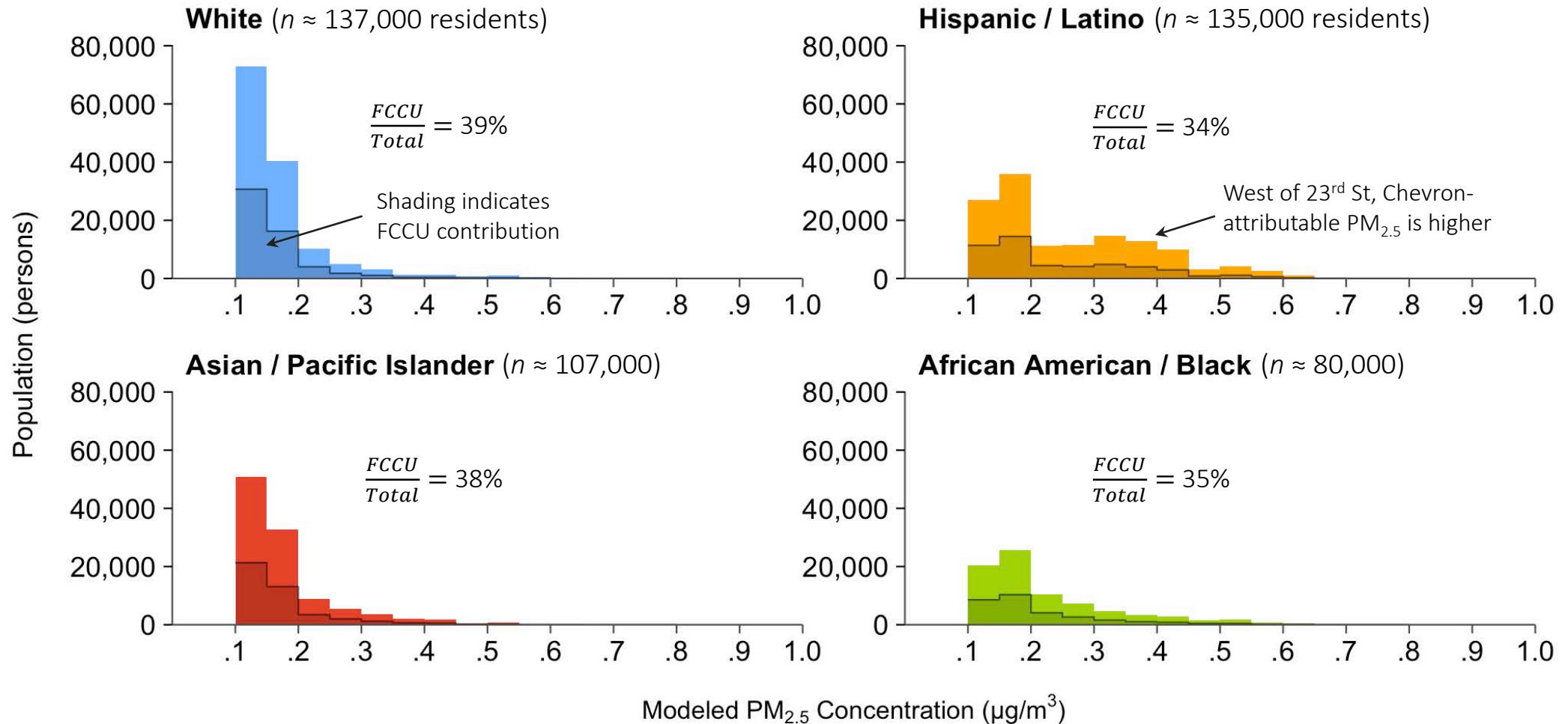


PM_{2.5} Exposures by Race/Ethnicity



Scenario: Baseline

Scope: Census blocks with 0.1 µg/m³ PM_{2.5} or more from Chevron



PM_{2.5} Exposures by Race/Ethnicity



Scenario: Baseline

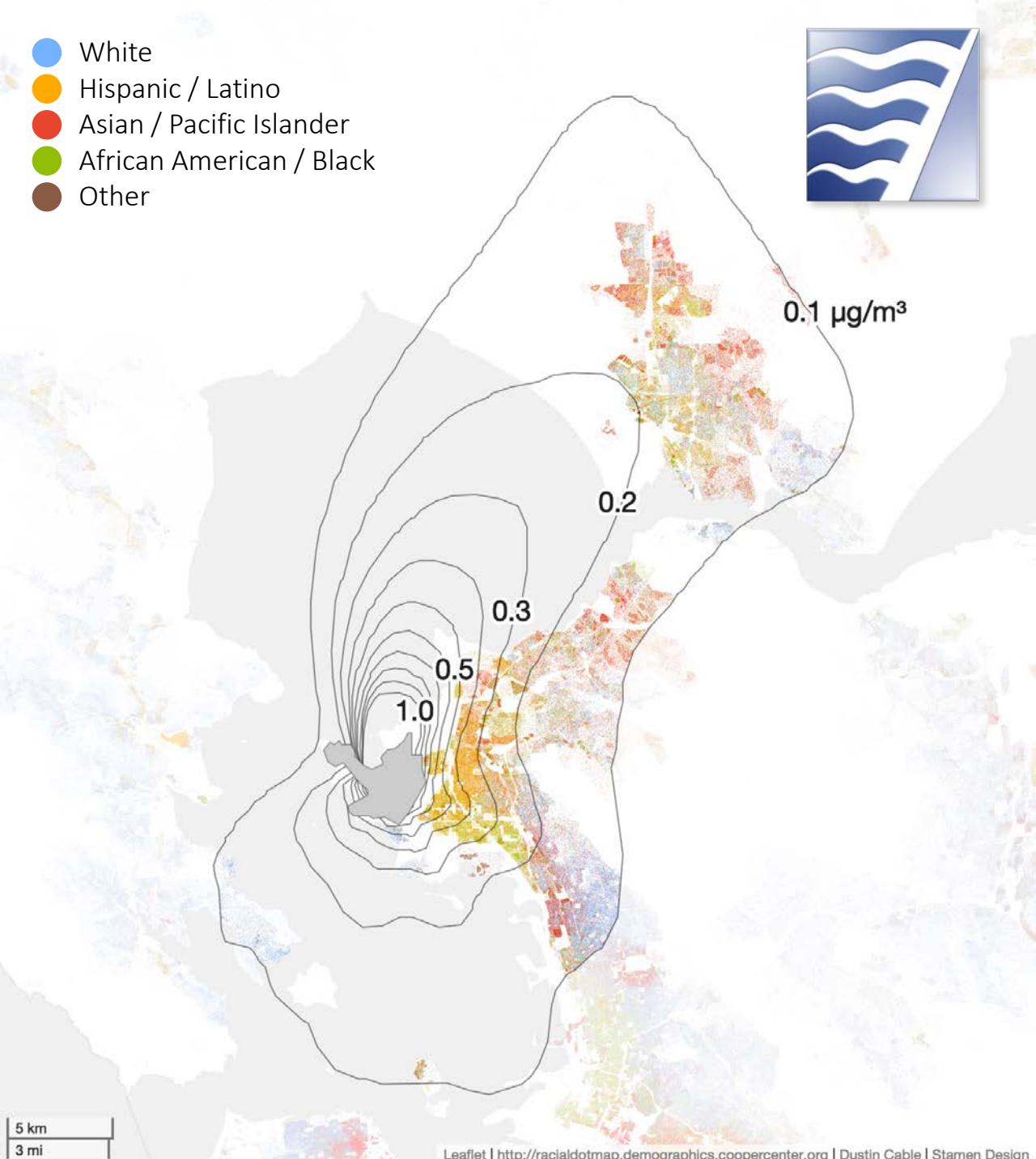
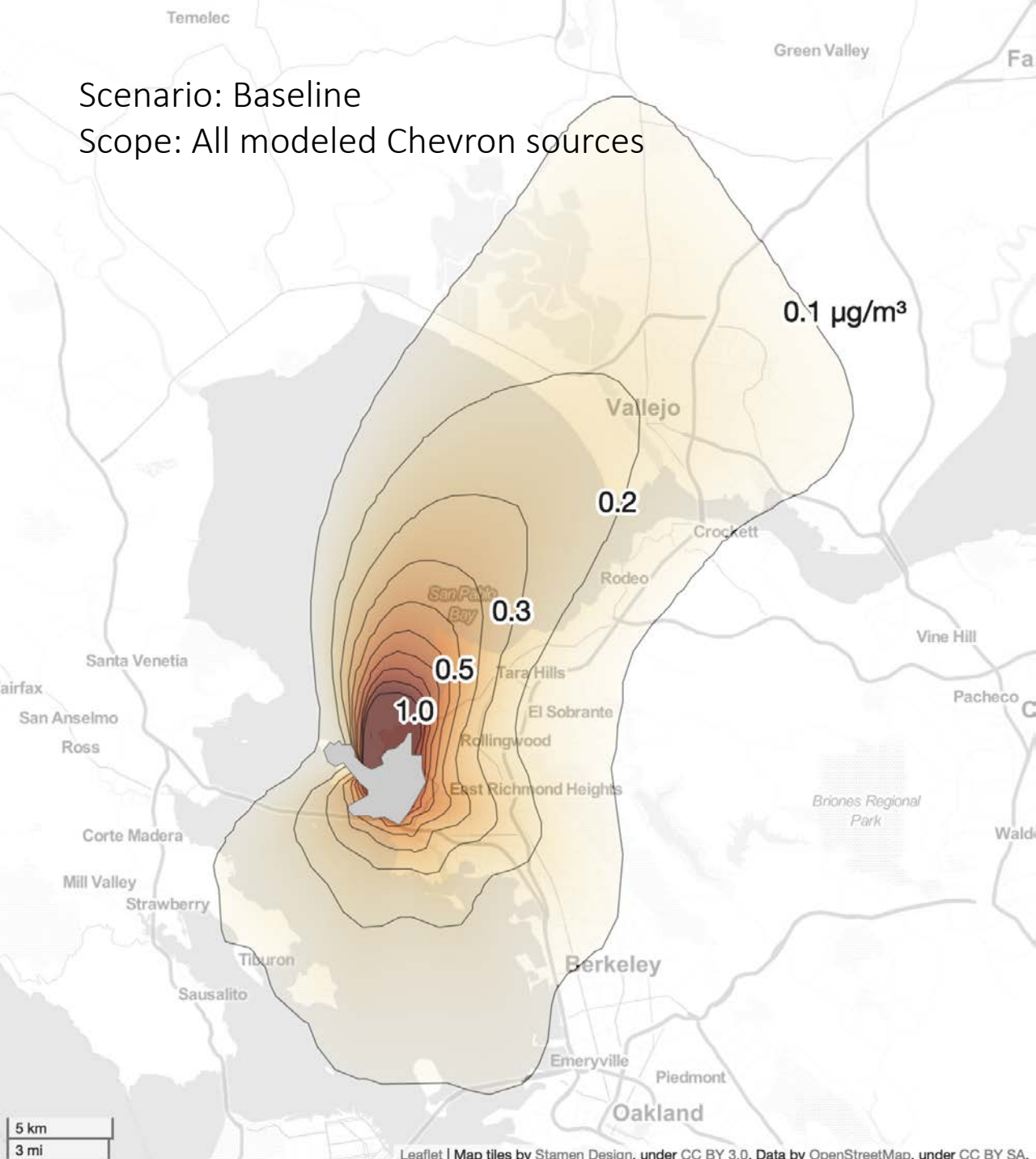
Scope: Census blocks with 0.1 µg/m³ PM_{2.5} or more from Chevron

	Residential Population		Average Exposure to Modeled PM_{2.5} from All Chevron Sources
White	136,801	30.5%	0.17 µg/m ³
Hispanic / Latino	134,932	30.0%	0.26 µg/m ³
Asian / Pacific Islander	107,052	23.8%	0.18 µg/m ³
African American / Black	80,230	17.9%	0.23 µg/m ³
Other	1,482	0.3%	0.20 µg/m ³
All	449,221	100.0%	0.21 µg/m ³

Scenario: Baseline

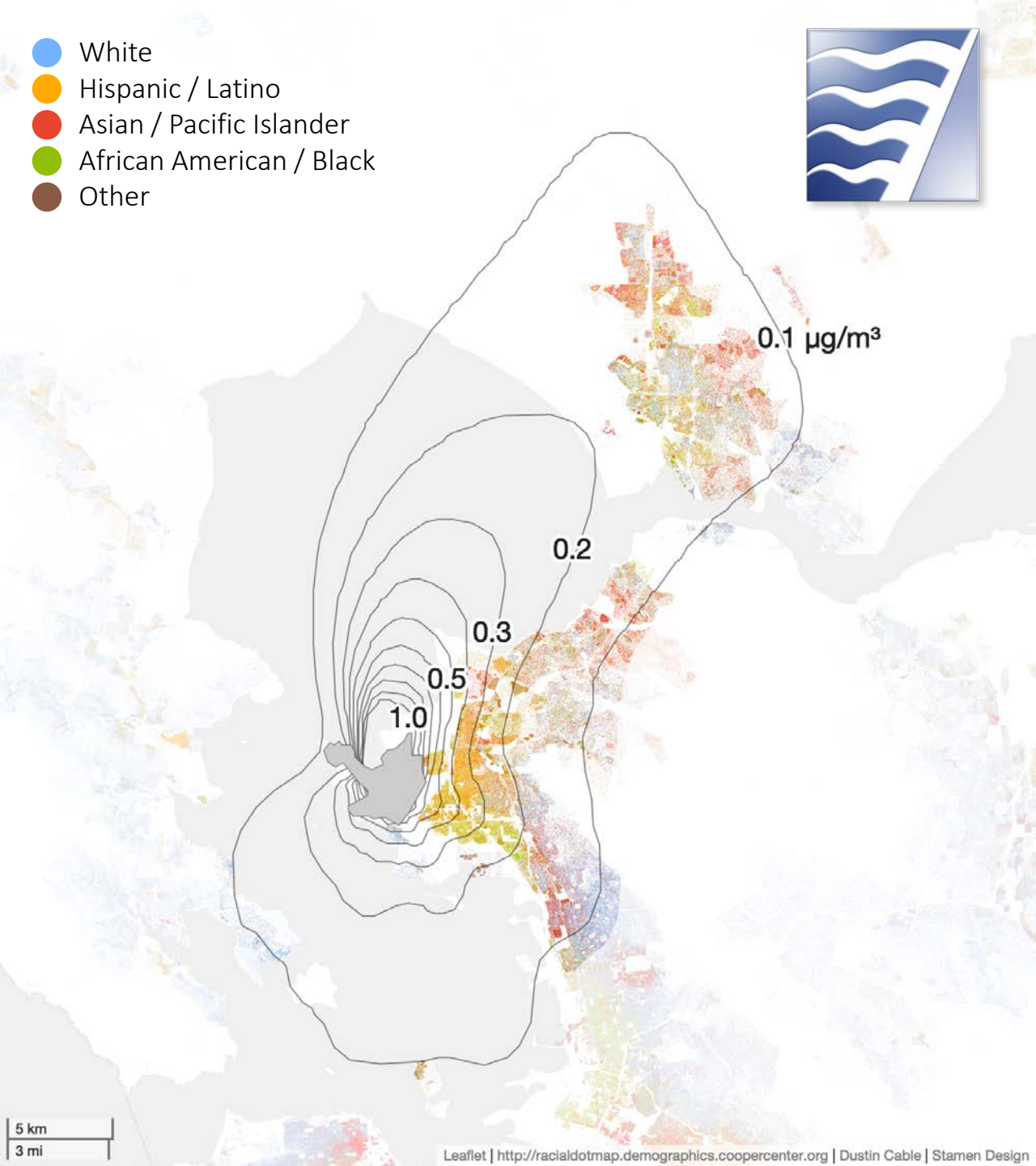
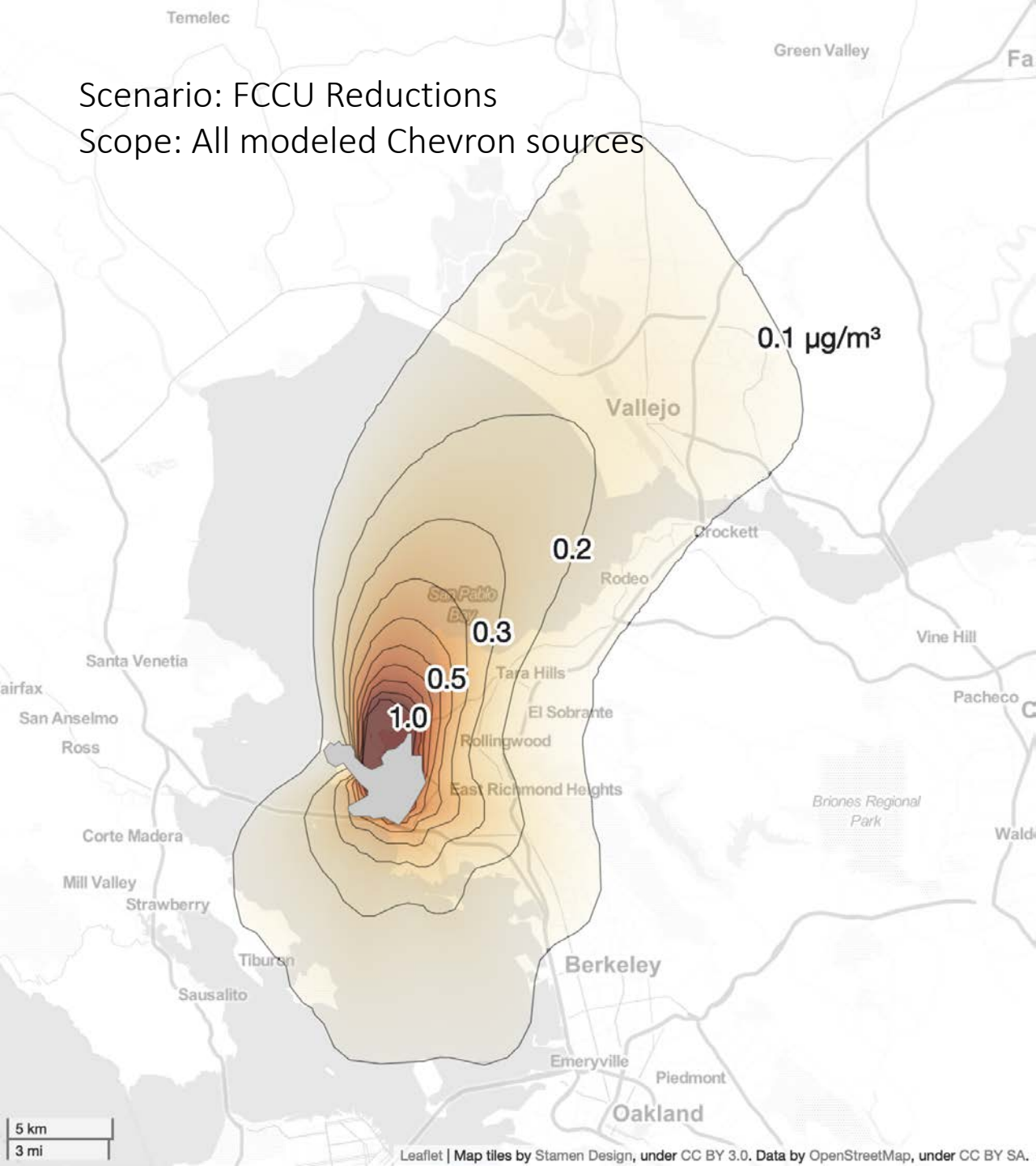
Scope: All modeled Chevron sources

- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



Scenario: FCCU Reductions
Scope: All modeled Chevron sources

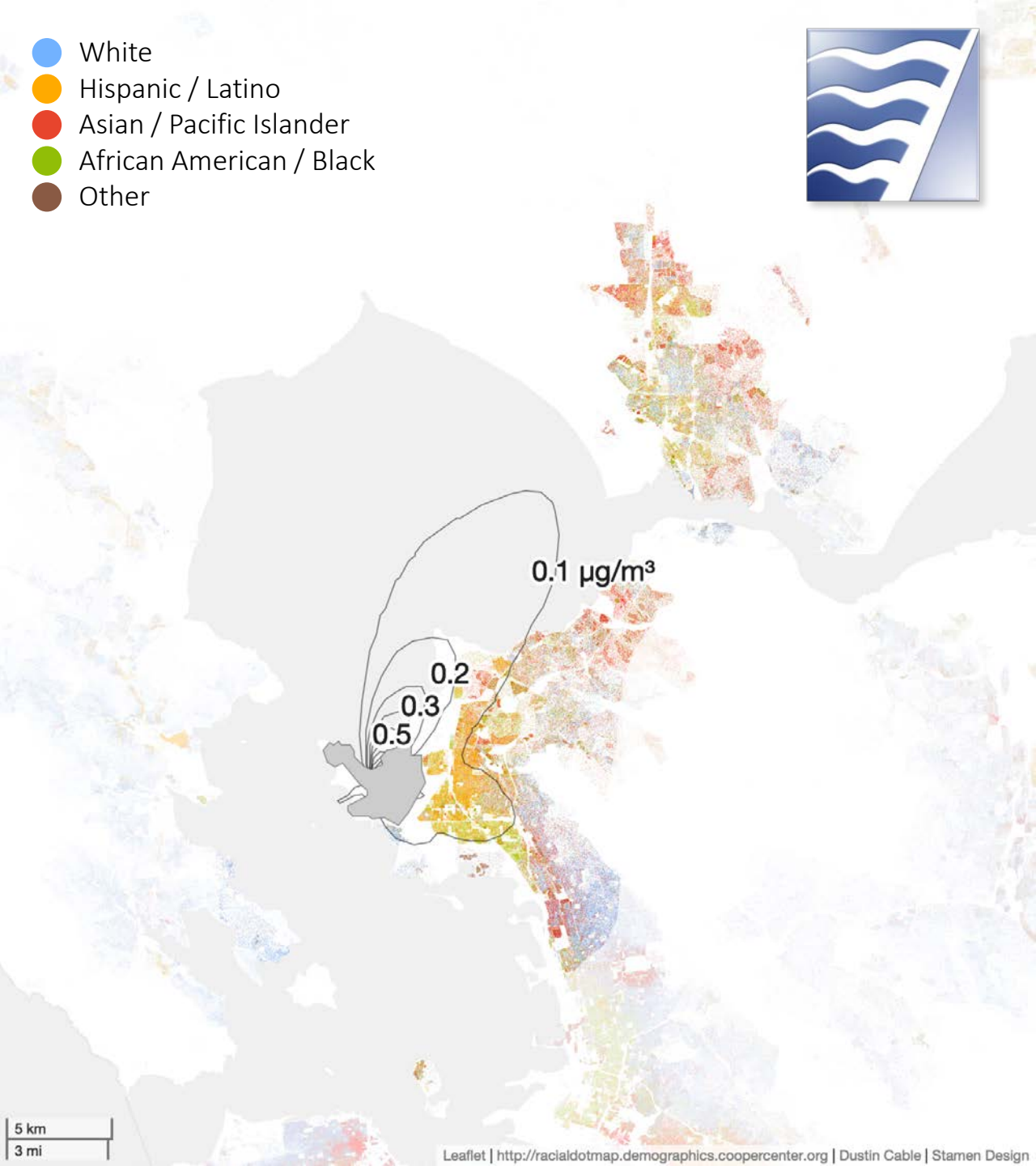
- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



Scenario: Baseline
Scope: FCCU Only

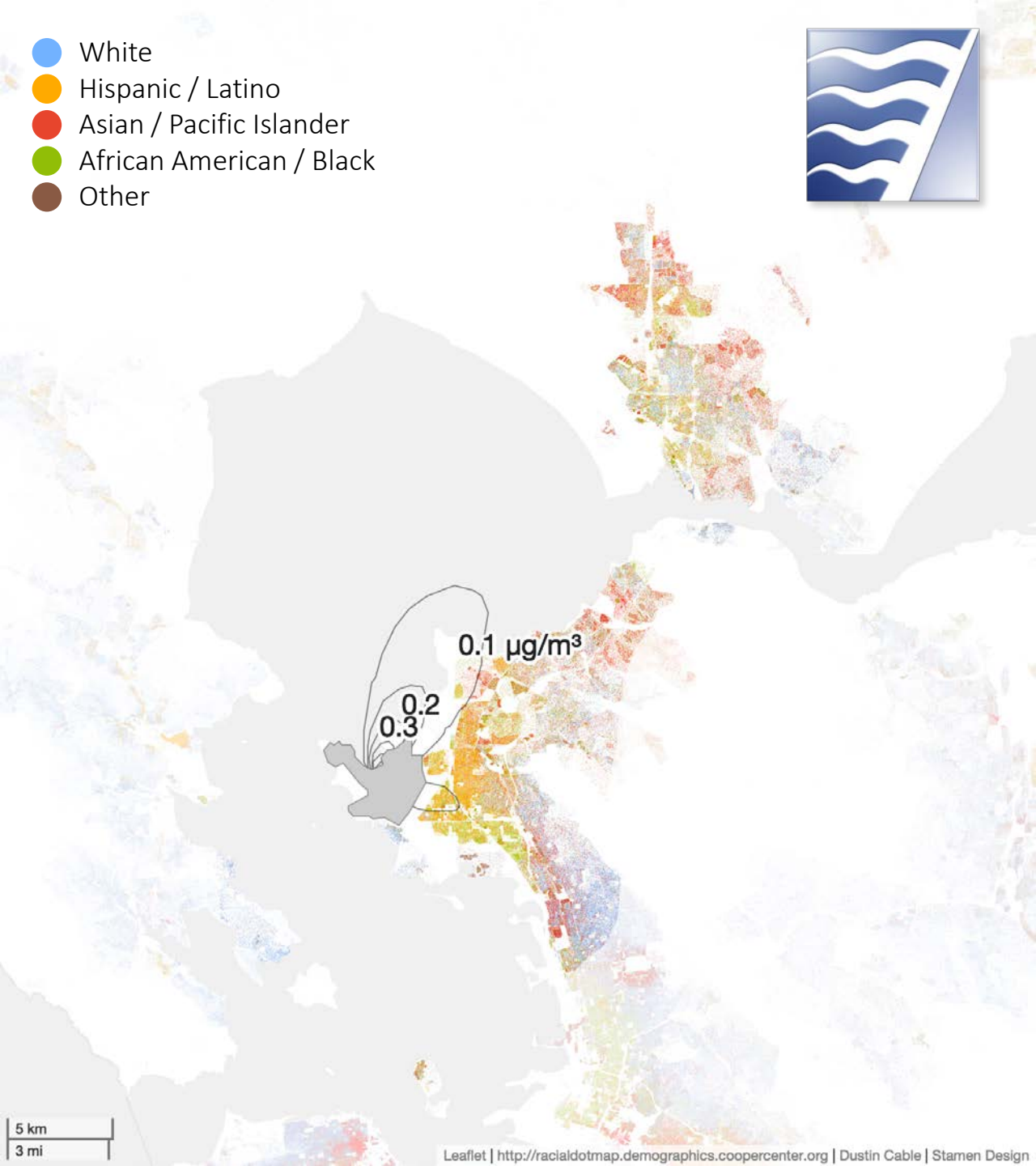
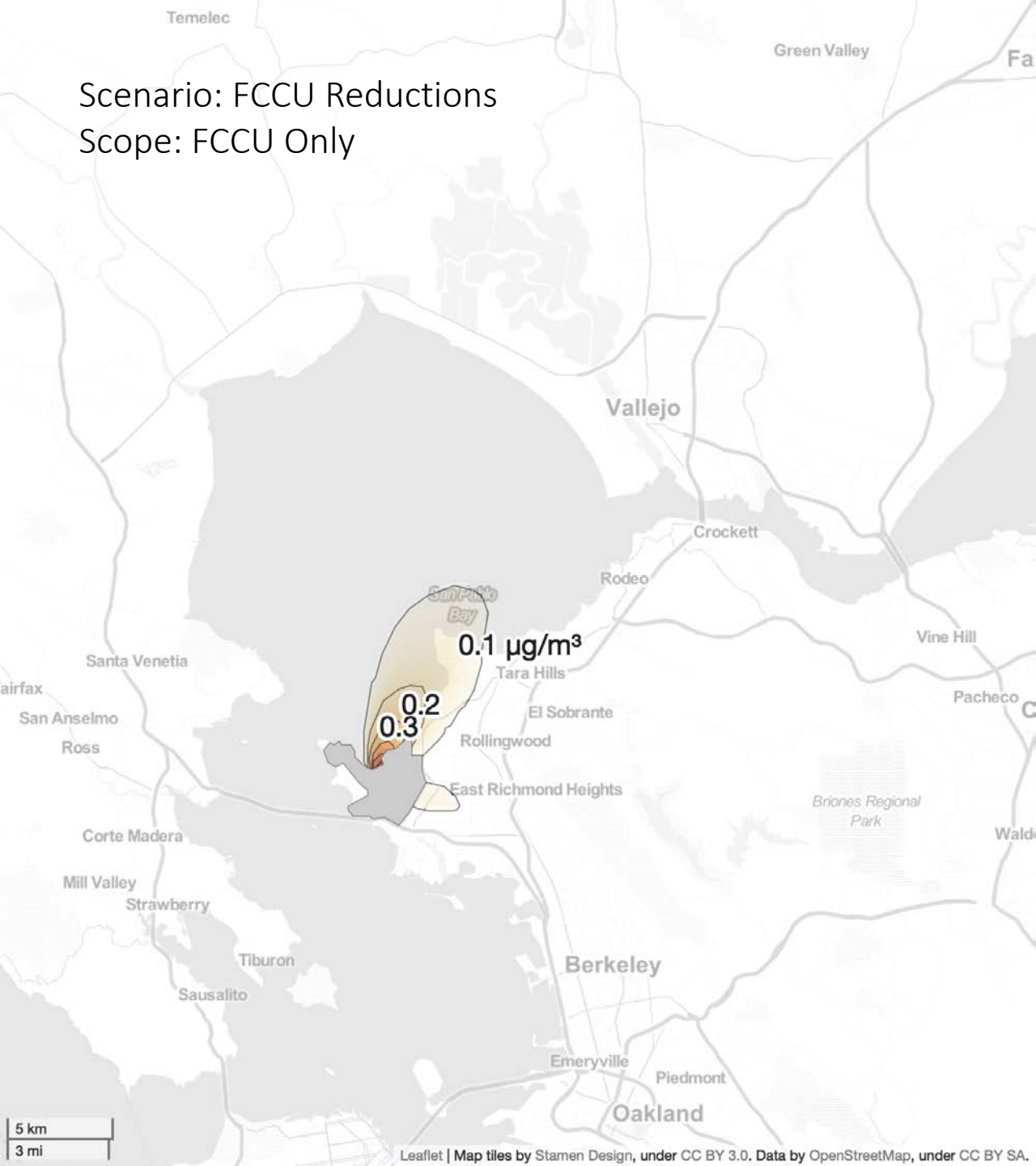


- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



Scenario: FCCU Reductions
Scope: FCCU Only

- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



Key Findings: Baseline Scenario



- **The FCCU adds about half (48%) the PM_{2.5} emissions and about a third (36%) of the exposures**
- In populated areas, the highest primary, annual PM_{2.5} concentrations from the Chevron Richmond Refinery are between 1 and 0.5 µg/m³
- The modeled PM_{2.5} plume extends for many miles before its concentration falls below 0.1 µg/m³
- Almost half a million people reside in that area

Key Findings: Equity



- **Exposures are not distributed equally**
- Within the plume (PM_{2.5} concentrations higher than 0.1 µg/m³) Hispanic/Latino and African American/Black residents are exposed to higher concentrations

Key Findings: FCCU Reductions



- Additional controls limiting FCCU emissions (0.02 grains/dry standard cubic feet limit) would
 - **reduce PM_{2.5} exposures from the Chevron Richmond Refinery by about 12%**
 - reduce FCCU PM_{2.5} emissions by 33%
 - reduce total refinery PM_{2.5} emissions by 16%
- Modeling maps shows that this scenario reduces the extent of the plume from the refinery and the concentrations within the plume

Next Steps



- Complete documentation of methods and modeling results
- Conduct a similar modeling assessment for the PBF (formerly Shell) Refinery
- Estimate the added risk of adult mortality from $PM_{2.5}$ emitted from the Chevron and PBF refineries and the reduced risk from amendments to Rule 6-5