

# METR/ENVS 113

## Lecture 11: Local-Scale Air Pollution & Air Toxics

SJSU Spring Semester 2020

Module 5: Local & Indoor Air Pollution

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# Module 5: Local & Indoor Air Pollution

**Lecture 11:** Local-Scale Air Pollution & Air Toxics

**Lecture 12:** Indoor Air Pollution

## **Motivation ...**

*To learn about aspects of air pollution that affect more at the individual rather than population level.*

# Lecture 11: Outline

- **Local vs. Ambient Air Pollution**
- **Air Toxics**

## *Local vs. Ambient Air Pollution*

# Ambient Air Pollution

- Outdoor air pollution that spans broad areas.
- Outdoor air, general population exposure
- Concentrations can change very gradually from place to place (over 10s - 100 of kilometer)
- Due to combined contributions of many emission sources

*Summer smog layer over San Jose*

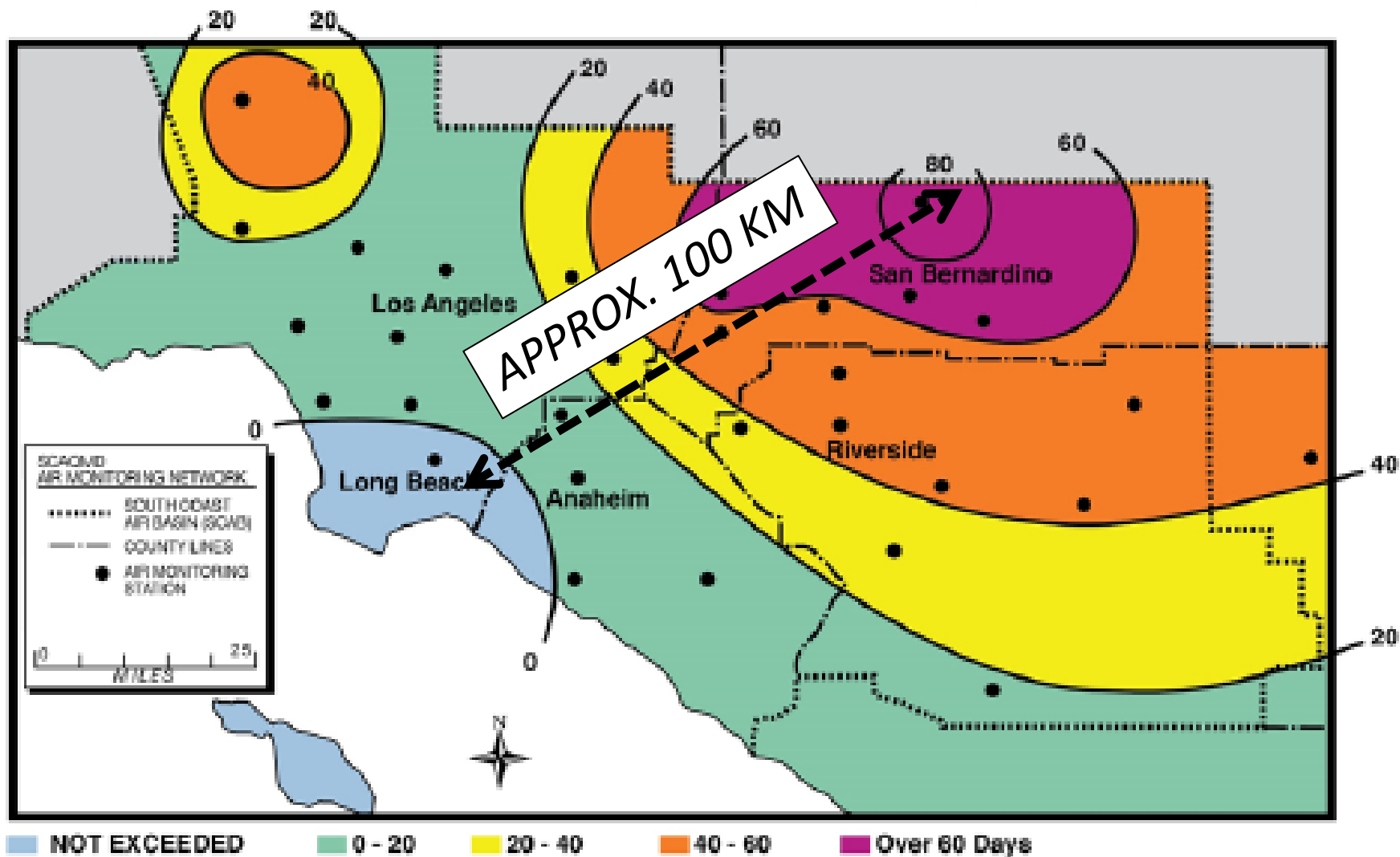


*Photochemical smog: Los Angeles*



# Example: Ambient Air Ozone Pattern across LA Basin

(Number of Days per Year Exceeding 8-hour ozone standard)



# Local Air Pollution

- Concerns exposure to individuals residing near specific source(s)
- Concentration decreases strongly with distance from source (over 100s of meters – 10 km)
- Examples of sources
  - Industrial complexes, oil refineries, ports, railways, major roadways

*Geneva Steel Mill (Utah)*

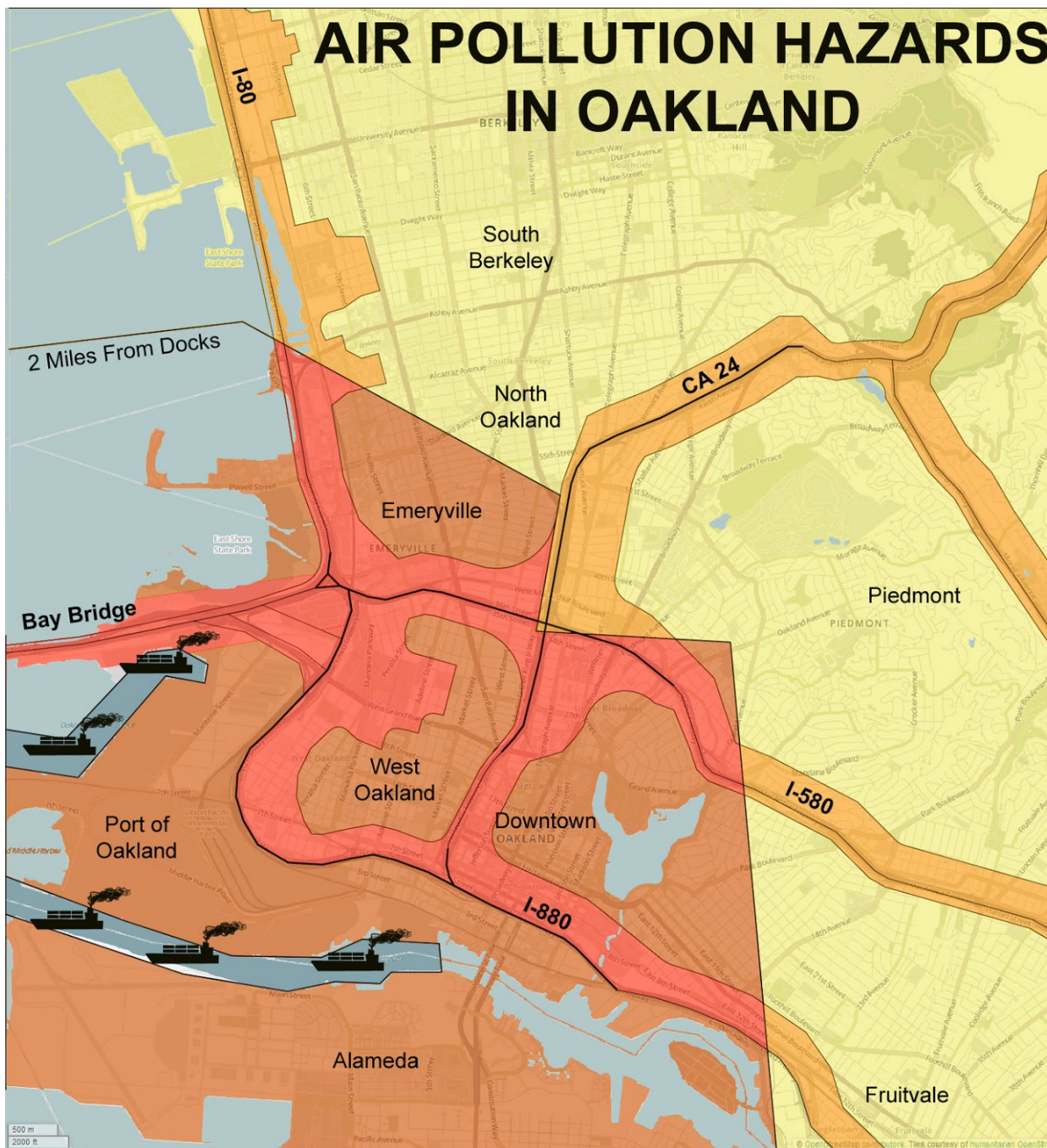


*Port of Oakland*

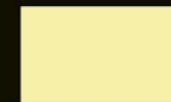




**APPROX. 8 KM  
(5 MILES)**



**Within  
2 Miles of  
Docks**



**Within  
5 Miles of  
Docks**



**Within  
2 Miles of  
Docks &  
Downwind  
of Freeway  
or Industry**

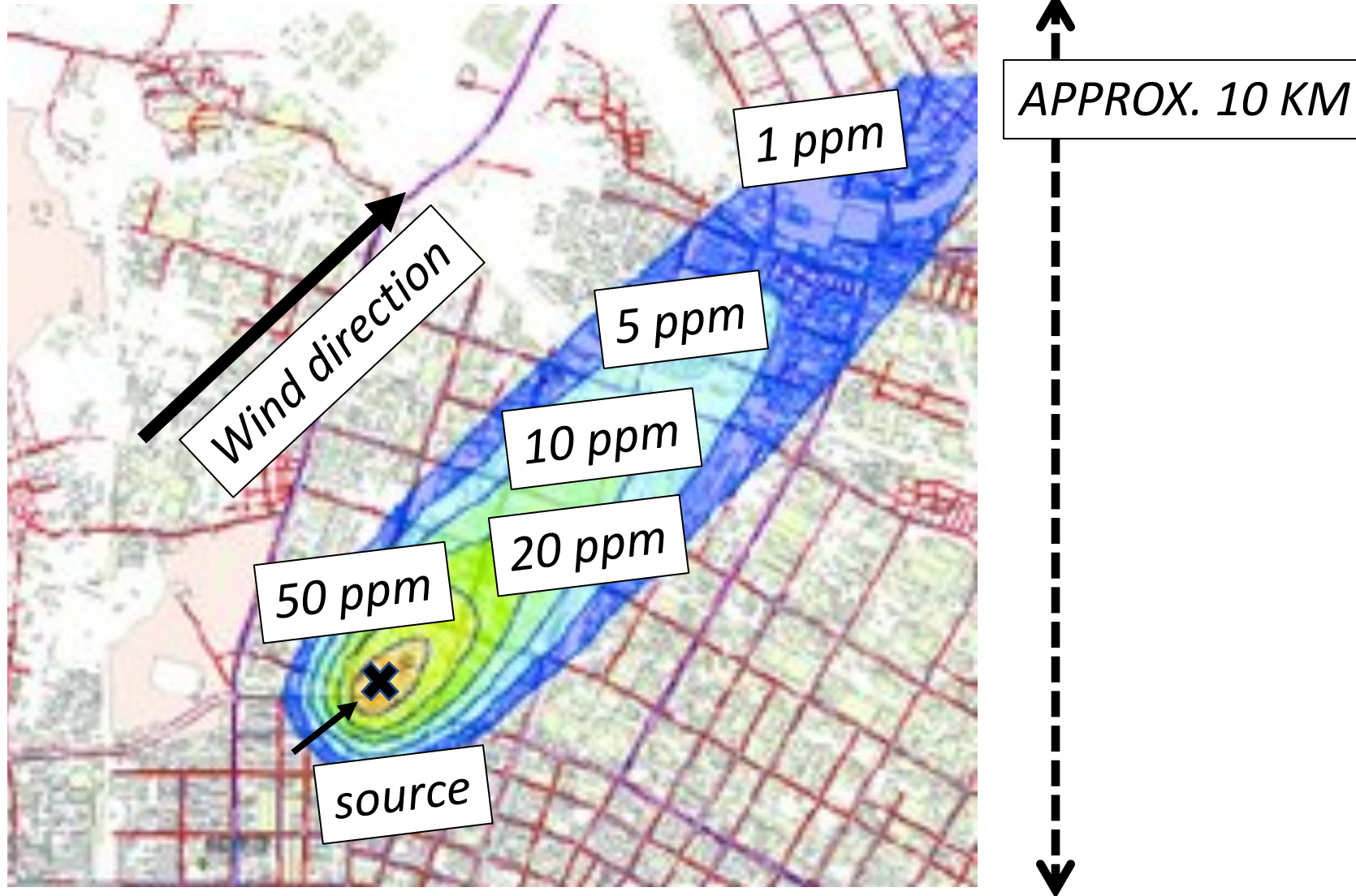


**Downwind  
of Freeway  
or Heavy  
Industry**



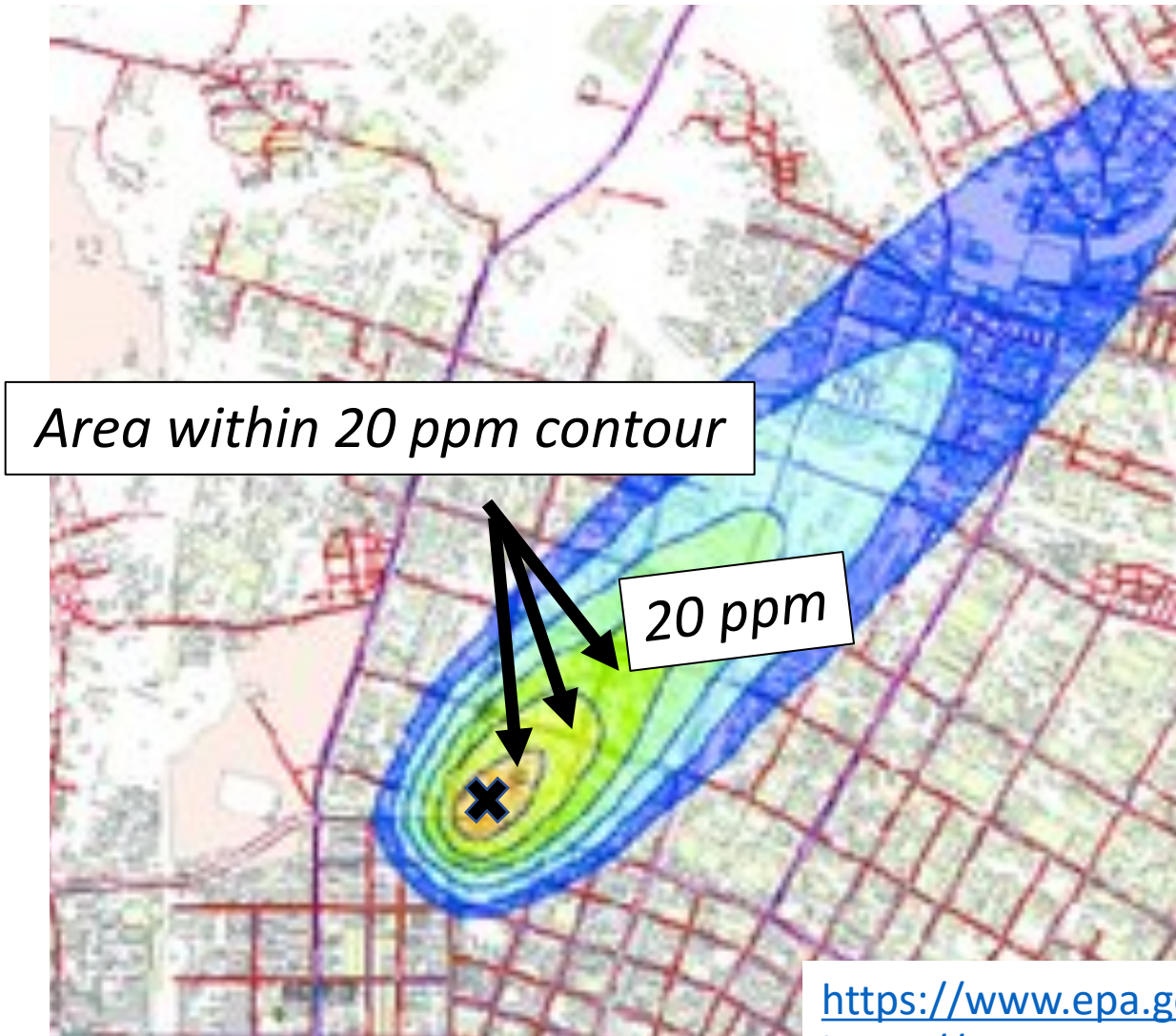
# Local Air Pollution

(Air Pollution Concentration Contour Map **for a single hour** of emission from a single source)



# Local Air Pollution

(Air Pollution Concentration Contour Map **for a single hour** of emission from a single source)



- Assume contours indicate concentrations of hydrogen chloride due to an accident.
- Level of concern for 1-hour exposure to HCl is around 20 ppm for lasting adverse health effects (see links below).
- Area within 20 ppm contour is therefore where concentrations are greater than level-of-concern & serious adverse health effects may be anticipated due to emission.

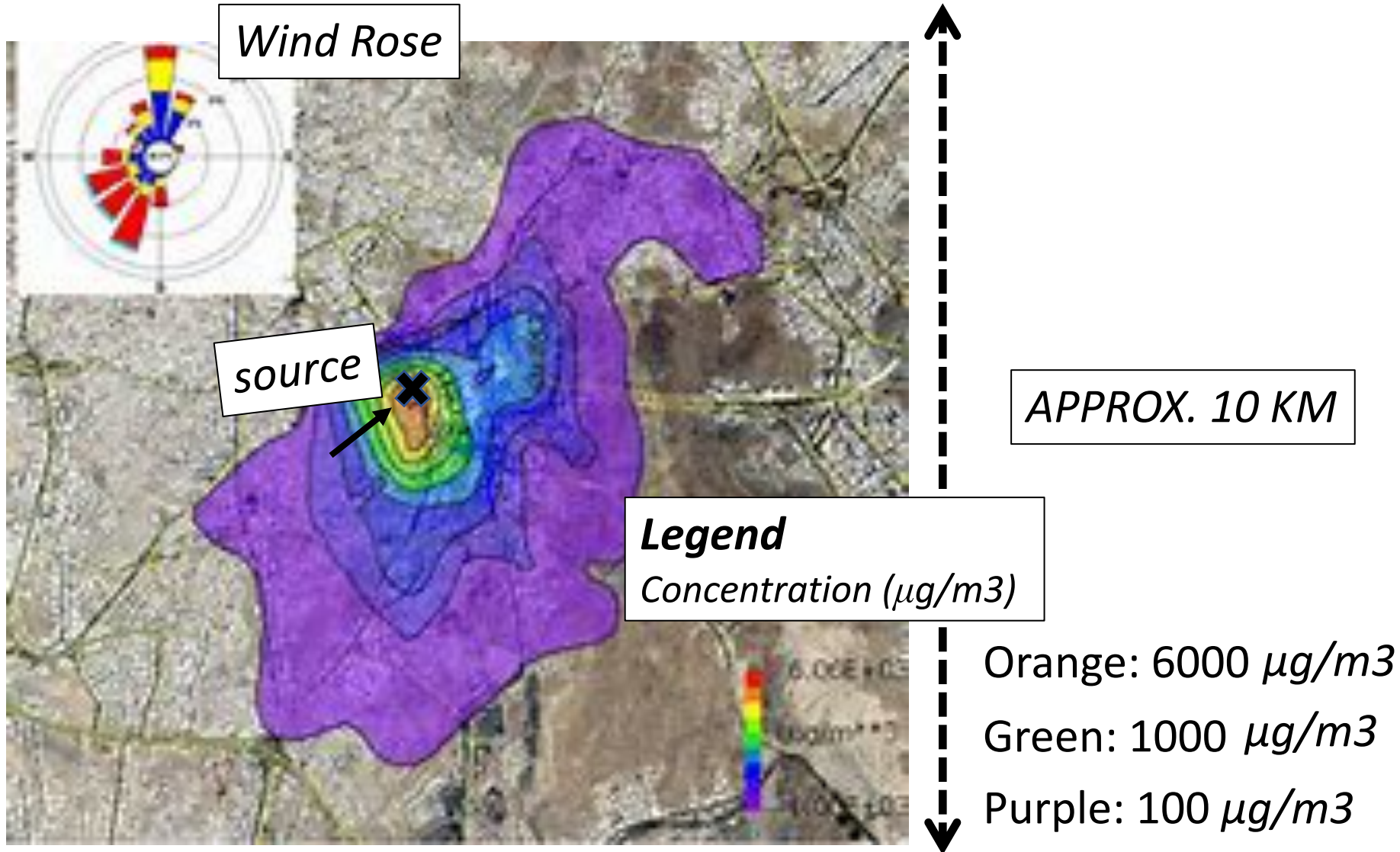
<https://www.epa.gov/aegl/hydrogen-chloride-results-aegl-program>

<https://www.epa.gov/aegl/about-acute-exposure-guideline-levels-aegls#assigned>



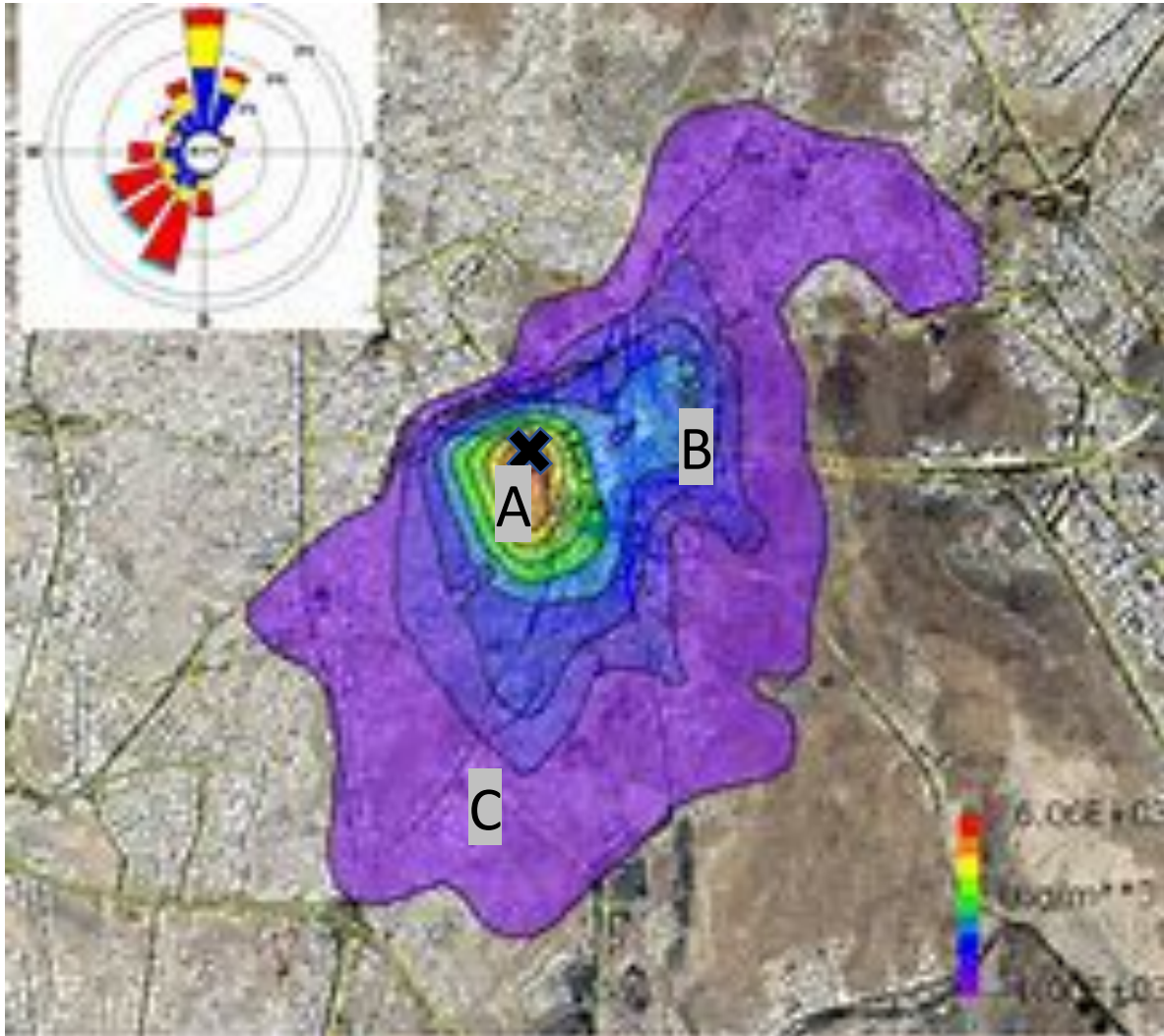
# Local Air Pollution

(Air Pollution Concentration Contour Map **for a year** of emission from a single source)



# Local Air Pollution

(Air Pollution Concentration Contour Map **for a year** of emission from a single source)



## ***Legend***

*Concentration ( $\mu\text{g}/\text{m}^3$ )*

Orange: 50

Yellow: 20

Green: 10

Blue: 5

Purple: 1

## *Air Toxics*



# Air Toxics

- Separate from criteria air pollutants
- Long list of species (next slide ...)
- Increased risk of cancer (most important inhalation risk)
- Synonyms ...
  - “Hazardous Air Pollutants” (HAPS)
  - “Toxic Air Contaminants” (TACS)

<https://ww3.arb.ca.gov/toxics/toxics.htm>

<https://www.epa.gov/urban-air-toxics/about-urban-air-toxics>

<https://www.epa.gov/haps/what-are-hazardous-air-pollutants>

# Air Toxics

(Main Species ... many others)

- Acetaldehyde
- Asbestos
- Benzene
- Benzo[a]pyrene
- 1,3-Butadiene
- Cadmium
- Carbon Tetrachloride
- Chlorinated Dioxins
- Chloroform
- Diesel Exhaust<sup>a</sup>
- Ethylene Dibromide
- Ethylene Dichloride
- Ethylene Oxide
- Formaldehyde
- Hexavalent Chromium
- Inorganic Arsenic
- Inorganic Lead<sup>b</sup>
- Methylene Chloride
- Methyl Tertiary Butyl Ether<sup>c</sup>
- Naphthalene<sup>d</sup>
- Nickel
- Perchloroethylene
- Trichloroethylene
- Vinyl Chloride

# Air Toxics

(Main Species ... many others)

- Acetaldehyde VOC
- Asbestos
- Benzene VOC
- Benzo[a]pyrene
- 1,3-Butadiene VOC
- Cadmium
- Carbon Tetrachloride
- Chlorinated Dioxins
- Chloroform
- Diesel Exhaust<sup>a</sup>
- Ethylene Dibromide
- Ethylene Dichloride
- Ethylene Oxide
- Formaldehyde VOC
- Hexavalent Chromium
- Inorganic Arsenic
- Inorganic Lead<sup>b</sup>
- Methylene Chloride
- Methyl Tertiary Butyl Ether<sup>c</sup> VOC
- Naphthalene<sup>d</sup>
- Nickel
- Perchloroethylene
- Trichloroethylene
- Vinyl Chloride VOC

# Air Toxics

(Main Species ... many others)

- Acetaldehyde
- Asbestos
- Benzene
- Benzo[a]pyrene
- 1,3-Butadiene
- Cadmium **Metal**
- Carbon Tetrachloride
- Chlorinated Dioxins
- Chloroform
- Diesel Exhaust<sup>a</sup>
- Ethylene Dibromide
- Ethylene Dichloride
- Ethylene Oxide
- Formaldehyde
- Hexavalent Chromium **Metal**
- Inorganic Arsenic **Metal**
- Inorganic Lead<sup>b</sup> **Metal**
- Methylene Chloride
- Methyl Tertiary Butyl Ether<sup>c</sup>
- Naphthalene<sup>d</sup>
- Nickel **Metal**
- Perchloroethylene
- Trichloroethylene
- Vinyl Chloride

# Air Toxics

(Main Species ... many others)

- Acetaldehyde
- Asbestos
- Benzene
- Benzo[a]pyrene    **Particulate**
- 1,3-Butadiene
- Cadmium
- Carbon Tetrachloride
- Chlorinated Dioxins    **Particulate**
- Chloroform
- Diesel Exhaust<sup>a</sup>    **Particulate**
- Ethylene Dibromide
- Ethylene Dichloride
- Ethylene Oxide
- Formaldehyde
- Hexavalent Chromium
- Inorganic Arsenic
- Inorganic Lead<sup>b</sup>
- Methylene Chloride
- Methyl Tertiary Butyl Ether<sup>c</sup>
- Naphthalene<sup>d</sup>    **Particulate**
- Nickel
- Perchloroethylene
- Trichloroethylene
- Vinyl Chloride



# **Air Toxics**

## **(Main Species Classifications)**

- **VOCs**

- “BTEX” complex: Benzene, Toluene, Ethylene, Xylene
- Aldehydes (Formaldehyde, Acetaldehydes)
- Various chlorinated species (e.g. Vinyl Chloride)

- **Fine Particulate**

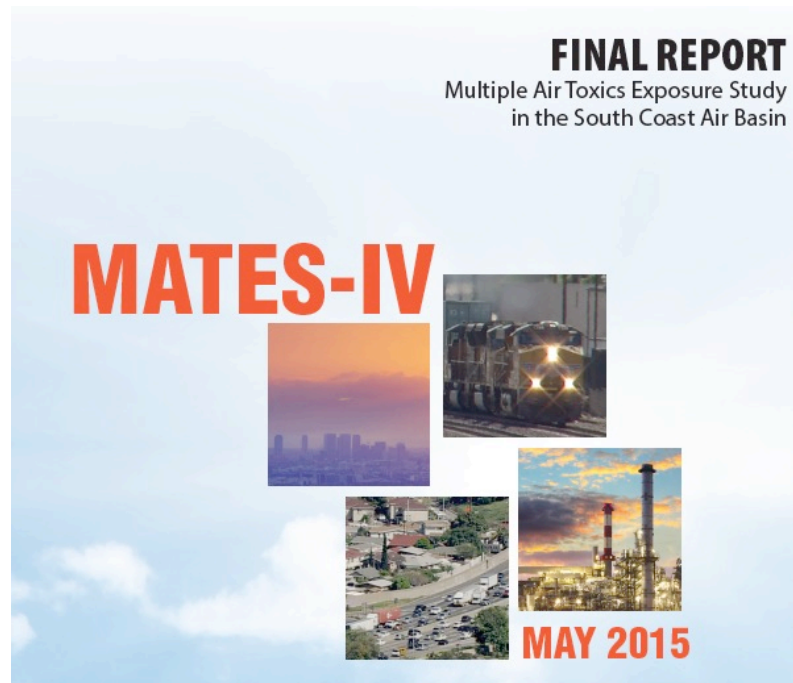
- Diesel Exhaust / Diesel Particulate Matter (DPM)
- Benzopyrenes
- Dioxins (PCBs, PCDs)

- **Metals**

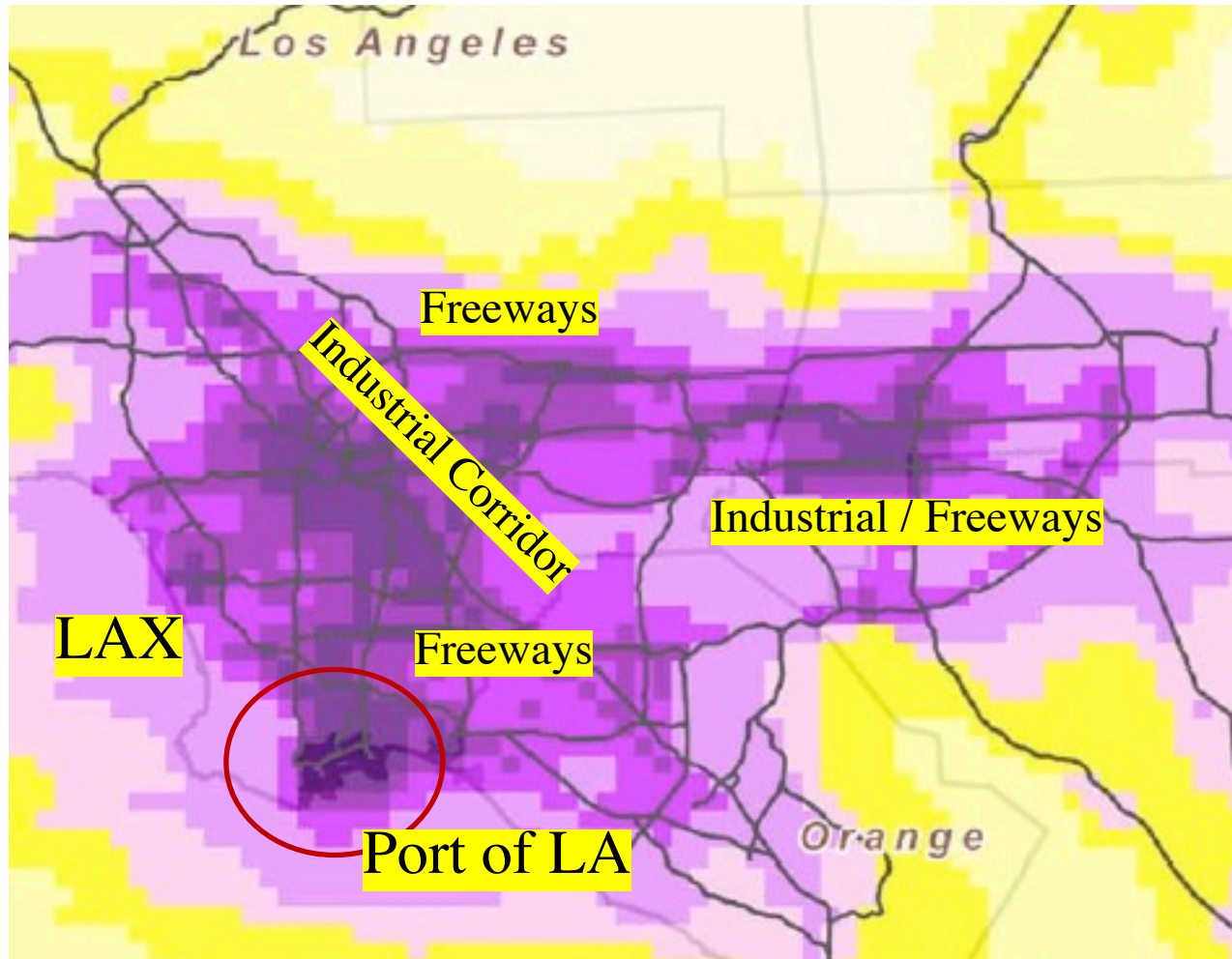
- Hexavalent Chromium especially
- Others: Nickel, Cadmium, Lead

# MATES-IV

(Multiple Air Toxics Exposure Study)  
(Metro Los Angeles, July 2012 – June 2013)



# Cancer Risk: Toxic Air Contaminants (TACs) in LA Basin (MATES-IV)



*Increased cancer risk relative to baseline  
(per million)*

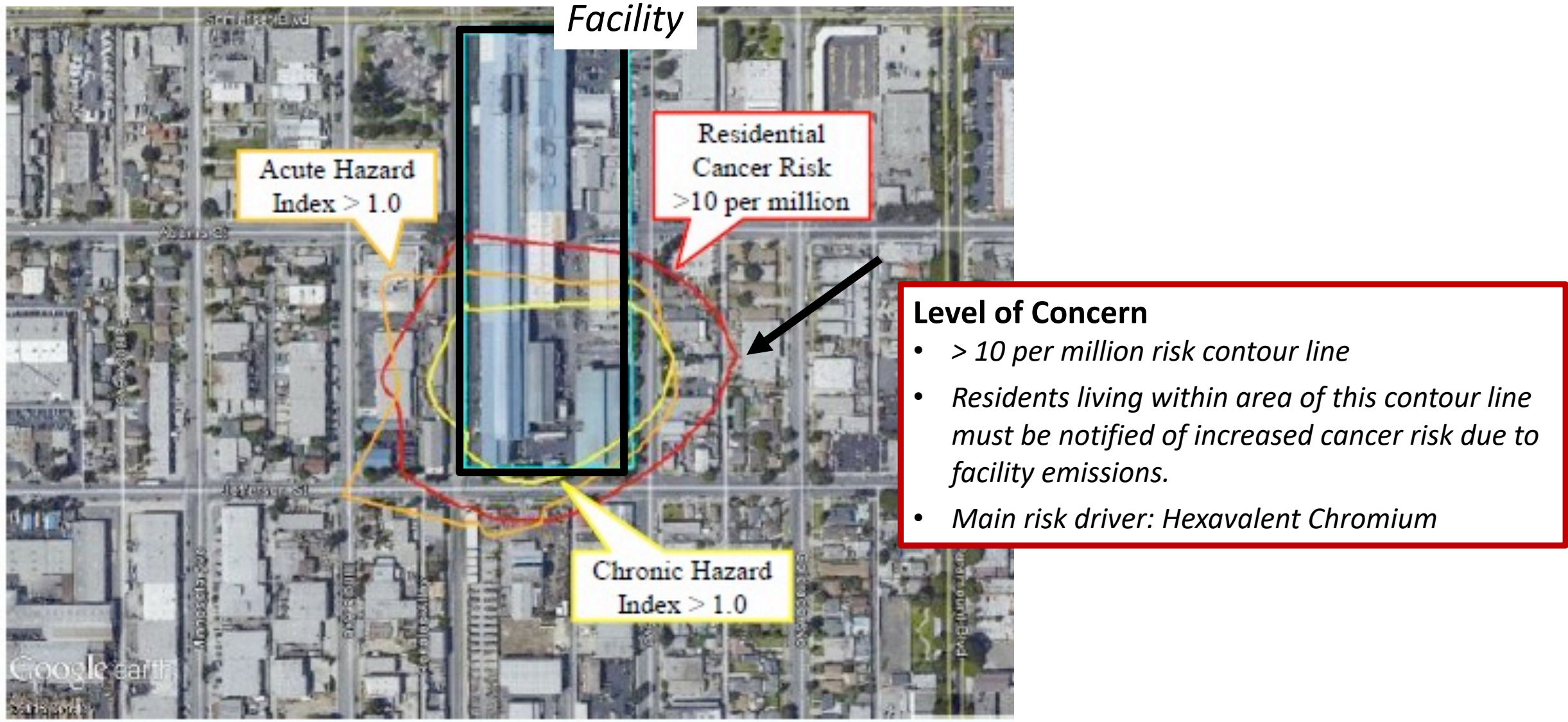
MATES IV OEHHA Revised Risk (per million)	
<100	400-500
100-200	500-800
200-300	800-1000
300-400	1000-1200
	>1200

- Based on hypothetical 70-year exposure to all TACs based on year 2012 LA Basin Emissions
- Computer model estimation



# Toxic Air Contaminant Health Risk Assessment

(required by California AB2588 “Toxics Hot Spots” Legislation)



*Estimated based on hypothetical 70-year exposure to current-day emission levels from facility*